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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON RADIATION PROTECTION

AND NUCLEAR MATERIALS

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WEDNESDAY,

APRIL 21, 2010

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. Michael T. Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman

J. SAM ARMIJO, Member

DANA A. POWERS, Member

JOHN D. SIEBER, Member

NRC STAFF PRESENT:

CHRISTOPHER BROWN, Cognizant Staff Engineer
and Designated Federal Official

RAY LORSON

ELIZABETH THOMPSON

RON PARKHILL

ROBERT EINZIGER

JORGE SOLIS

LUIS CRUZ

DENNIS DAMON

MICHEL CALL

JIM PEARSON

DAVID TANG

ZHIAN LI

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Adjourn

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

(8:28 a.m.)

CHAIRMAN RYAN: All right. It is the appointed hour, so we will come to order, please.

This is the meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Radiation Protection and Nuclear Materials.

I am Dr. Michael Ryan, Chairman of the Subcommittee. Subcommittee members in attendance are Dr. Sam Armijo, Dr. Dana Powers, Mr. Jack Sieber, and perhaps Harold Ray, but he is not here yet, so we will see him when he gets here.

The purpose of this meeting is to receive a follow-up briefing from the staff in the Division of Spent Fuel Storage and Transportation on the SRP for spent fuel dry storage at a general licensed facility, NUREG document 1536.

The Subcommittee was briefed on February 17, 2010, in which the staff discussed cask operations and vendor designs, and highlighted some of the pertinent changes made to the standard review plan. Today we will hear more details about the SRP revisions, in particular concerns raised about the risk prioritization approach in radiation protection. Also, fuel cladding integrity and ISG-25 will be discussed.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

Christopher Brown is the Designated Federal Official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting published in the Federal Register on April 2, 2010.

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.

We ask at this time that you silence your cell phone or Blackberry.

We have not received any requests from members of the public to make oral statements or written comments.

The full Committee is scheduled for SFST on May 6th at 8:30 a.m. in this room.

We will now proceed with the meeting, and I will call upon Mr. Ray Lorson, Deputy Director in

NMSS's Division of Spent Fuel Storage and Transportation, to begin.

MR. LORSON: Okay.

CHAIRMAN RYAN: Good morning, sir.

MR. LORSON: Good morning. Good morning, Dr. Ryan, and members of the Subcommittee. I just want to thank you for this follow-up meeting to our informational briefing that we had on February 17th.

At that meeting, there was a lot of good discussion in our view, and we heard a lot of messages and questions that we went back, looked at, reflected upon, and I think that we were able to take that input to make the document better. And the purpose of today's meeting in our view is to basically kind of take up where we left off from the last meeting, go through and provide back to you the responses from some of the issues and questions that were raised in preparation for the next briefing of the full ACRS meeting.

There were a couple of other things I want to point out. You had mentioned ISG-25. That was an ISG that we had had under development for a period of time, and we are going to discuss that briefly here today. That is something that is a natural fit into our standard review plan, and so that works out well from the perspective of efficiency in terms of handling multiple documents in this format.

The other thing you had mentioned was the issue with the fuel cladding integrity question, and I think that was something that was specifically requested at the last meeting. It wasn't necessarily an integral part of our SRP, but it was something that, you know, we are prepared to discuss with you today --

CHAIRMAN RYAN: Great.

MR. LORSON: -- based on your request. So we will cover that.

CHAIRMAN RYAN: Thank you.

MR. LORSON: Also, if you notice the gentleman to my left, Meraj Rahimi, is different than the fellow that was here on February 17th. That was Mike Waters. I don't know if anybody picked up on that difference.

(Laughter.)

Mike has been off tasked with a separate task. We received direction from the Commission in the form of a Staff Requirements Memorandum to relook at all of our regulations associated with spent fuel storage and transportation, to include a number of activities including our inspection process, oversight process, licensing process, and so this is actually kind of an early step in that direction we received from the Commission.

But Mike has been assigned full-time to kind of develop our plan for how we are going to respond to the Commission. So as a result, Mike is gone and now Meraj here is backfilling behind Mike as the Chief of the Thermal Containment Branch. So he stepped in at an opportune time to lead us through the discussion here today.

So with that, I will turn it over to Meraj.

MR. RAHIMI: Thank you. Thank you, Ray. My name is Meraj Rahimi. I am the Acting Branch Chief for Thermal Containment.

Go to the next slide.

CHAIRMAN RYAN: Could you not wrestle your microphone there? That is the recorder.

MR. RAHIMI: Ron control --

MR. BROWN: I thought Ron was going to be put there to operate that.

MR. RAHIMI: Yes, he just stepped out.

MR. BROWN: Okay. So you're going to have to --

MR. RAHIMI: Okay. Okay. I guess we

went through this slide.

As Dr. Ryan mentioned, we met last time February 17th. And what we did during that meeting, we presented the revision to the SRP, an overview of the revision to the SRP NUREG-1536, which is the SRP for spent fuel dry storage system. And this SRP has been in use by the staff for more than a decade, about 13 years, so I just wanted to mention that.

And what we did in this round of updating, including all of the ISGs and also risk -- or what I would say, you know, work prioritization, that -- we will go over that.

And last time at the meeting we gave some background on the dry cask storage system. We showed a typical operation from, you know, receiving, loading, transferring, placing a dry cask storage system on the pad, and we provided the regulatory basis and design basis.

In the Standard Review Plan update project, we also gave the overall project approach, and we also went over the -- sort of a risk-informed approach and -- but with your, you know, insightful comments. We went back and we call it now, you know, prioritization methods.

And we had the technical staff to present a, you know, key revision to each chapter, technical chapters. We went over that last time. And also, the key stakeholder comments, you know, per chapter, which was mainly from the industry.

And since the last meeting what we did, we went back and we revised the SRP based on the Committee comments. And some of them -- for example, we replaced the risk-informed terminology with the prioritization. That is one of the changes that we did throughout the document. And also, the Committee, you know, identified polymeric neutron shielding materials as important to safety, and, you know, we changed that. We included that as that item being important to safety.

So today -- the purpose of today's meeting is to continue the briefing on the update to the SRP. And we are going to discuss the carryover items from the last meeting, as Dr. Ryan mentioned, you know, a couple of them, ISG-25, cladding integrity, and there are a number of other items which in the next slide I will cover it.

And also, we are going to talk about some of the significant public comments and staff response to those comments. We want to talk about those today.

And so you are more than welcome to

identify any more areas of interest that the Committee would like to hear, especially for the next meeting, which is May 6th for the full Committee meeting.

CHAIRMAN RYAN: Great.

MR. RAHIMI: So today's presentation, that is the order. And, first, I think Ron -- since Dennis Damon is not here right now, so we are going to cover the item I guess as the second item. So we are going to go, first talk about the radiation protection. Ms. Thompson will lead that, and --

CHAIRMAN RYAN: Somebody is rubbing a microphone. Ron, is that you?

MR. PARKHILL: No, I don't --

CHAIRMAN RYAN: Yes, that black thing.

MR. PARKHILL: Oh.

CHAIRMAN RYAN: Don't rub that.

(Laughter.)

MR. PARKHILL: Sorry.

MR. RAHIMI: Bob Einziger is going to be here later on. Yes, Bob Einziger, he is going to cover, you know, two subject areas, spent fuel oxidation and damaged fuel. And Luis Cruz, he is going to briefly go over the ISG-25. That has been incorporated in the SRP. I think we already forwarded to the Committee the -- even the public comment and response to the public comment on that ISG.

And then, Ron will cover any other issues. And at the end we will go over the -- some of the public comments. And what we have done, we have picked the significant comments in each discipline areas, and we will go over those public comments and the staff responses to those comments.

CHAIRMAN RYAN: Okay.

MR. RAHIMI: So with that, I guess I will turn it over to Liz to go over the radiation protection.

CHAIRMAN RYAN: Liz, why don't you come up to the front, if you don't mind.

MS. THOMPSON: I kind of liked it back here, Mike.

CHAIRMAN RYAN: Well --

(Laughter.)

-- we know you did.

MEMBER POWERS: We're trying to get you out of your comfort zone here.

MS. THOMPSON: Okay. As many of you have guessed, I am Elizabeth Thompson. I'm a Certified Health Physicist and a Senior Health Physicist in SFST. I am going to talk to you about radiation protection and dry storage system licensing and operations.

I would like to start out by mentioning that the NRC regulations for spent fuel storage are structured to put the emphasis for radiation protection into operation, so this standard review plan reflects that emphasis. And this aspect of the standard review plan has not changed in this revision.

I would also like to note that Part 72 does not specify how specific operations are completed. It just ensures that the safety analysis report that is submitted to NRC has an overview of the operations that will be used with a system.

Another general thing to note is that for NRC licensees 10 CFR Part 20 governs radiological operations. All of these casks are used at facilities with Part 50 licenses. So all of these licensees have active and inspected 10 CFR Part 20 radiation protection programs.

Also, there were several questions about radiation limits last time, and it is not only the limits in the regulations that come into play, but also licensees have typically administrative limits that are lower than the regulatory limits that help in controlling the radiological activities at a site.

CHAIRMAN RYAN: Is there any typical value where they're set? Is it 80 percent, 75 percent, of the regulatory limits, or --

MS. THOMPSON: I don't know that there is a typical value. I would guess that there probably is, but I'm not familiar with what it is.

CHAIRMAN RYAN: Okay.

MR. LORSON: I think INPO establishes guidelines in the -- you know, where they distribute information to the industry. And then the industry tries to, you know, achieve a certain quartile status, and so they all want to try to, you know, do what they can to minimize dose compared to their industry peers.

CHAIRMAN RYAN: Okay.

MS. THOMPSON: All right. I am going to -- I am going to talk to you about the storage system and the radiation protection issues kind of together. So questions on either one I will -- if you have those, I will try to field them.

The key radiation protection of the -- the key radiation protection aspects of the design are reviewed during the review of an application for a dry storage system. We look at the shielding features, we look at the source terms of what is going to be placed in the design, or what is allowed to be placed in the design.

We look at the generic procedures that the applicant proposes. We look at the dose assessments that the applicant provides, and we look at the accident evaluations. Those are all reviewed during the licensing process.

Next one, Ron, please.

Oh. I should have mentioned on the previous slide the picture was of a welded canister system. In this slide it just shows some different systems on the right, and it's a system that has a bolted-closure canister. Both this and the previous system are generally -- are systems that are stored upright when they are taken to the ISFSI pad.

The upper left picture is of a horizontal storage system, and the lower left picture is actually a photo of a horizontal system located at a site.

The licensing review ensures that appropriate system characteristics and parameters are placed in the Certificate of Compliance and the technical specifications to control the design and ensure that we can develop effective inspection criteria for our inspectors to look at when they go out to inspect the systems.

Next, Ron, please.

Now, in the way of procedures, in the

safety analysis report, there are just high-level generic procedures. We look at these to see that they are consistent with ALARA principles, and these are reviewed by the staff in SFST during the licensing process.

Specific operating procedures are developed at each site. These have to be consistent with the procedures in the SAR, consistent with the Certificate of Compliance and the technical specifications, and also with 10 CFR 20 and the site's radiological protection program. And these are inspected by NRC's regional inspectors.

CHAIRMAN RYAN: Are the inspection staff from NRC the same staff that does the reactor work, or is it a separate --

MS. THOMPSON: There are separate inspectors that do the ISFSI operation inspections.

MR. LORSON: Actually, to give you a more complete answer, it is actually some combination of both. It depends on -- it varies slightly from region to region, because the regional makeups are slightly different. For example, Region 2 does not have a materials inspection program, whereas Regions 1, 3, and 4 do have a materials inspection program.

In Regions 1, 3, and 4, the inspections

are conducted separately out of their materials inspection group. However, they do get assistance from some of the folks that inspect the reactors programs.

Some areas, like, for example, heavy loads controls, is -- we rely upon the Part 50 heavy loads program for handling of these materials during the loading campaigns. And so the inspection is likely a hybrid of both a materials inspector who is very familiar with this, plus supplemented with some Part 50 inspectors if there is specific expertise that is required.

And from the headquarters office, we also support a number of the inspections around the country, mainly in the form of providing additional resources where the regions may not have folks available.

CHAIRMAN RYAN: Got you. Thank you.

MEMBER SIEBER: I have a quick question. You talked about heavy loads. When you actually -- this shows a picture here, this slide, of loading a cask and taking it out of the pool. The concrete and all of that is always with the liner, is that correct?

MR. LORSON: No. The concrete storage overpack --

MEMBER SIEBER: Right.

MR. LORSON: -- what you see here is you see the loading of -- this is a Holtec system design, and the outer white portion of the can that you are looking at, that is called a -- basically a transfer overpack. It is called the Hi-Trac.

MEMBER SIEBER: Okay.

MR. LORSON: And what happens is the actual mesh that you see on the picture, you know, the actual --

MEMBER SIEBER: Right.

MR. LORSON: See there? That is the actual multipurpose canister that the fuel is loaded into. And so what happens is the fuel is loaded into a honeycombed assembly --

MEMBER SIEBER: Right.

MR. LORSON: -- inside the multipurpose canister. That is processed and welded shut. Okay? And what happens is that overpack -- and we will see it here in a minute. If you go two slides down -- there we go. What you see on the left here is a picture of that overpack. That has been removed from the -- excuse me, not the overpack, that is the transfer, the high-track transfer.

MEMBER SIEBER: Okay. Is it the one on

the left or the right?

MR. LORSON: It is on the left.

MEMBER SIEBER: Okay. Got you.

MR. LORSON: Okay. The multipurpose canister sits in there, and that overtrack -- or, excuse me, that overpack there provides shielding while the cask is being processed. And then, what happens is later it is placed into a stack-up condition where it is actually landed on top of the concrete storage overpack that you see in this particular picture. Okay?

And then, what happens is the actual multipurpose canister is removed from the transfer overpack and then lowered into the concrete overpack, and then a separate crawler will take that concrete overpack to the pad.

MEMBER SIEBER: My question --

MR. LORSON: Oh, okay.

MEMBER SIEBER: -- involves when the -- when the liner and the fuel is at its least shielded conditions, what kind of exposure rates are available to personnel at that point, you know? Because you are moving a lot of things around, and the overpack is sitting over here, and the transfer cask is here. But there are times when all you have is spent fuel in the liner, right?

MS. THOMPSON: No, not --

MR. LORSON: Well, you have spent fuel in the liner. It is always enclosed by this transfer overpack here.

MEMBER SIEBER: So that goes into the pool.

MR. LORSON: Correct.

MEMBER SIEBER: Okay.

MR. LORSON: So it is always shielded by that.

MEMBER SIEBER: So what are the radiation doses when that -- at a point where personnel could be exposed?

MS. THOMPSON: For a typical system, it ranges from about half a rem per hour up to four or five rem per hour, combined gamma and neutron, at the surface.

MEMBER SIEBER: It's pretty substantial.

MS. THOMPSON: We have --

MEMBER SIEBER: And I take it there is an exclusion area?

MS. THOMPSON: We have one system that is in the process of being certified that could potentially have a higher dose rate around it. But we are looking at -- the applicant has decided to decrease the heat load of the fuel in the source term that is placed in that, to limit the dose rate on the outside of that to 10 rem per hour.

MR. LORSON: But to answer your question, the -- you know, your question regarding the radiological exclusion area, this operation is very carefully controlled by the site radiation protection staff. And they have established, you know, stand-off areas and things, and they are continuously checking for dose rates, to provide the appropriate -- you know, the appropriate radiation protection controls, so that nobody receives a -- you know, an excessive dose.

MEMBER SIEBER: Okay.

MR. LORSON: So there is a very controlled evolution.

MEMBER SIEBER: Do you have any idea of what the highest rad worker would receive in a cask loading operation, roughly?

MS. THOMPSON: Unfortunately, I have that information but didn't have time to review it before the meeting this morning.

MEMBER SIEBER: Is it in --

MS. THOMPSON: I know the -- for loading a cask, for the whole operation, from starting the process to putting it out on the pad, you get on the order of a man-rem or less for the whole operation, for the whole crew.

MEMBER SIEBER: For the whole crew, yes.

MS. THOMPSON: Okay? So --

CHAIRMAN RYAN: Typical crew size is?

MR. LORSON: You are probably looking at a total of about 15 to 20 people when you count the entire operation. You know, when you are talking radiation protection folks --

CHAIRMAN RYAN: So it is 75 millirem per person average.

MR. LORSON: Approximately. Some of them get a little more, some get a little less. The key point to keep in mind is that typically -- in a typical loading campaign, if you look at the total dose for the job, the first canister that is loaded is typically the highest dose that is received cumulatively, and it is typically less than one man-rem, okay?

As folks load additional casks, you see a pretty steep learning curve as folks gain familiarity with the tasks, such that typically, you know, on the order of about half your dose that you get from the entire campaign might be on that first cask, and then the next four casks you get much less dose.

MEMBER SIEBER: It has been my experience that during this operation the person most exposed would be the crane operator. He is sort of trapped there, and particularly if something goes wrong there is no way for -- no way for that person to sort of get away.

MR. LORSON: It depends where the crane operator is located. I think if --

MEMBER SIEBER: If he's on the crane, yes.

MR. LORSON: Right, on the crane. Sometimes you -- the cranes now today are mostly being operated remotely.

MEMBER SIEBER: Yes.

MR. LORSON: Okay? From somebody who might be in the fuel pool building, but not actually sitting in the cab of the crane. Okay?

But I think if you actually look at all of the data -- and I haven't looked at it this morning either, but what I seem to recall was that the folks that do the welding and processing of the canister and set up the welding machine, they tend to get a lot of the dose, because they will be closest to the --

MEMBER SIEBER: Right on it, yes.

MR. LORSON: -- fuel.

MEMBER SIEBER: Yes.

MR. LORSON: Yes.

MS. THOMPSON: I think that --

CHAIRMAN RYAN: Maybe we could make a mark to add that to the agenda for the May meeting, just to have a summary of that radiation protection.

MEMBER SIEBER: Yes. I think through the years that operation has changed as people have learned about it. On the other hand, it is one of the most critical pieces of potential exposure to workers throughout the lifetime of the canister and the fuel.

MS. THOMPSON: Right.

MR. LORSON: Potentially, very significant doses.

MEMBER SIEBER: And things can go wrong. So I personally think it's important.

MEMBER ARMIJO: Roughly how long does it take to -- for this whole operation? Load the canister, weld it shut, put it in this transfer thing, bring it to the final overpack and out on -- is this a week process, one week, one day?

MR. LORSON: It depends on --

MEMBER SIEBER: Shifts.

MR. LORSON: It is typically, I would say, one to three days without complications. But if you have complications, then it could be up to a week. Some of the complications you can encounter, you could have a problem with the crane or some handling device perhaps, maybe you have some problems in your weld passing the initial quality to requires rework, okay?

There is another component of this operation, which is drying the fuel, because before we put the fuel into storage we require that it basically be dried. Okay? Sometimes that can take longer than what you might expect. Okay? Depending on how much moisture the fuel has absorbed over sitting in the fuel pool for a period of time.

MEMBER SIEBER: I have some questions about that, but I will ask them later. Thank you.

MR. LORSON: Thank you. Okay. Liz?

MS. THOMPSON: Okay. Ron, why don't you go back to 16, please.

All right. This is Liz Thompson again.

I just wanted to note that the picture here is in preparation of a cask for loading. It is a canister inside a transfer cask, as Ray mentioned. And they are -- the workers at the side are hosing down the parts that have not yet been submerged, and filling up the cask with water to decrease the rise in level of the pool.

Next, please?

This image is of actually loading a fuel assembly into the canister. I would like to reiterate that all of these operations are conducted under the site's radiation protection program. And before a site loads its first canister, there is a dry run where no spent fuel is used, and our regional inspectors go out and go through the operation with the licensee to ensure that they are actually ready to do the operations with spent fuel.

Next, please.

MEMBER SIEBER: And this is underwater there.

MS. THOMPSON: Yes.

If we could go back just a moment.

Questions have been asked about how things are shielded at various points. When you are loading the spent fuel into the canister, all sites to this point use an underwater process, where you put the canister into the spent fuel pool, you move the fuel into the canister, and all of that is done with still a significant level of water between the top of the spent fuel and the surface of the water.

MEMBER SIEBER: I'm going to -- you can

give me a short answer, but I did this at one time in my life, and it turned out that my -- the greatest part of my radiation dose was neutron exposure from the casks. How significant is -- and neutrons have a quality factor of 10. So how significant is the neutron dose? Do people wear neutron dosimetry? What kind of surveys occur?

MS. THOMPSON: Any good radiation protection program, the workers are monitored for the type of radiation they are expected to encounter. In a situation like this, I would expect to see workers monitored for both neutron and gamma. I would expect to see both neutron and gamma detectors used for surveys.

With the systems that we have licensed now, the majority of the dose rate is due to gamma as opposed to neutron, probably a factor of roughly 10 to 1, give or take a little bit.

MEMBER SIEBER: Okay. So that makes it equal from the --

MS. THOMPSON: No, I'm talking about dose, not --

CHAIRMAN RYAN: That is dose-equivalent. That is after you multiple.

MS. THOMPSON: That has got that factored in. So that is just --

MEMBER SIEBER: Is that written into tech specs or -- that is not in the rules any place. That is the expected practice for health physicists, right?

MS. THOMPSON: Well, I believe in Part 20.

MEMBER SIEBER: Yes, it says you should --

MS. THOMPSON: I would have to look at it.

MEMBER SIEBER: -- you should monitor the radiation type that you expect to occur.

MS. THOMPSON: And they would be --

MEMBER SIEBER: That is a general statement, though.

CHAIRMAN RYAN: Well, Jack, I think there are specific sections that require you to monitor for specific radiations that you generate. And there is an obligation to identify what you generate --

MEMBER SIEBER: Right.

CHAIRMAN RYAN: -- how it is going to be monitored, both in terms of, you know, the levels and sensitivities and equipment and radiation type, and all of that. It gets into -- and I think many of the reg guides cover this. It's in pretty specific detail. It would be -- you would be hard-pressed to have a program that would miss something if you did it right.

MEMBER SIEBER: Yes, it has happened in the past, however.

CHAIRMAN RYAN: Yes. My guess is that some of the updates have --

MEMBER SIEBER: Okay.

CHAIRMAN RYAN: -- plugged some of those holes.

MR. LORSON: But I think it is fair to say that the 10 CFR rules apply to dry storage operations, like they apply to any other radiological work that you do in the power block.

In my experience of observing several of these activities, I have always seen them monitor for neutron doses at the point where the cask is going to actually exit the spent fuel pool. And at that point, everybody is required to be in the neutron dosimetry and appropriately monitored for the situation.

CHAIRMAN RYAN: Maybe one question that addresses Jack's point, and it is I think a helpful one to answer, is: how is the Part 50 license -- how does it tie in the radiation protection program for the station, and elements of the reactor's licensed activities to make it all, you know, kind of work under one banner so to speak?

MEMBER SIEBER: Right.

CHAIRMAN RYAN: How does that work?

MS. THOMPSON: Would you like to take those?

(Laughter.)

MR. LORSON: Sure. You know, when you have a Part 50 operating license, right, you know, you have a license with a number of conditions on it. You are required to implement, you know, a number of aspects of the regulation. As part of that license, somewhere in there it is going to tie in to Part 20 for conduct of any -- control of any radiological work that you are doing on the site.

So this is something that is being done under the site's radiological program under Part 20 that ties back into the Part 50 license. Okay?

In terms of, how do we assure that anybody that is going to handle spent fuel has a Part 50 license, we have two licensing processes. We have a general licensing process, and we have a site-specific licensing process. As a matter of practicality, we haven't issued any of these licenses for dry storage systems to anybody that does not have a Part 50 license. Okay?

But in the general licensing process, the first requirement is that you have a Part 50 license.

So that covers the folks that are in the general license population.

For folks that are site-specific licenses, okay, that would be something that, you know, we would be giving a site-specific license to, and it has always been something that would be in the line of somebody that has a current Part 50 license, is applying for a site-specific license. We would have to consider that as part of the licensing process.

MEMBER SIEBER: So it is not -- it doesn't necessarily have to be that way. You could have an independent operator of a spent fuel storage --

MR. LORSON: Correct. I mean, and the one case that comes to mind is this -- I'm trying to think. We have licensed one private interim storage facility --

MEMBER SIEBER: Right.

MR. LORSON: -- where they don't -- you know, they didn't have a pre-existing Part 50 license.

MEMBER SIEBER: Right.

MR. LORSON: And I think I would have to go back to find out exactly how we tied that knot.

MEMBER SIEBER: You don't have to for me.

MR. LORSON: Okay.

MEMBER SIEBER: But there is one.

MS. THOMPSON: If they would have radioactive material, they would be required to have a Part 20 radiation protection program. So they would need to meet similar operating -- they would have similar operating expectations as what we have of a Part 50 licensee's radiation protection program.

MR. LORSON: And just as kind of a heads up, when it comes to site-specific licenses, we have updated our standard review plan now for the general licenses. We plan in the near future to update our standard review plan for site-specific licenses, and, you know, we will be bringing that through separately.

MEMBER SIEBER: Okay. Thank you.

MR. LORSON: Thank you.

MS. THOMPSON: Okay. And this picture is just showing raising the loaded cask out of the pool to move it to the decontamination area, so that it can be decontaminated.

MEMBER ARMIJO: It is still full of water, right, at this point?

MS. THOMPSON: Right. Still full of water.

CHAIRMAN RYAN: Okay. I was going to ask that question.

MS. THOMPSON: Still full of water.

Depending on the system, there may or may not be a lid on it at this point.

CHAIRMAN RYAN: Yes, okay.

MS. THOMPSON: But it is full of water.

Okay. Then, the operations that follow moving it out of the pool are that it is decontaminated. The main closure lid is placed on the canister, if it is not already there, and it is either welded or bolted closed, depending on the design.

It is drained and dried and --

MEMBER ARMIJO: You have to do some draining before you can do that welding procedure.

MS. THOMPSON: Yes. I believe you --

MR. LORSON: Typically, you drain a nominal amount of water out of the cask before you weld. I have seen values typically in the neighborhood of about 50 gallons of water. Just to give yourself a pocket there, you can establish a purge gas before you do the welding.

MEMBER ARMIJO: Okay.

MR. PARKHILL: And typically it's backfilled with helium. There is no air in --

MEMBER ARMIJO: Right, covered gas.

MR. PARKHILL: Right.

MEMBER ARMIJO: And it's helium. Would

you do the same thing with the bolted covers? So it is basically the same process -- drain it a little bit, either weld or bolt these covers on?

MR. PARKHILL: Well, for bolted, you don't have to weld anything. So --

MEMBER ARMIJO: Yes, I understand, but --

MR. PARKHILL: -- I don't think you have to lower the water level. Just thinking off the -- I've never seen a bolted one loaded, but I'm, you know, just --

MEMBER ARMIJO: All right.

MR. LORSON: I mean, it would make sense you'd have to take a little bit of the water out, so you don't have like -- you would be able to ensure that you have a clean seal -- sealing surface before you actually apply -- you know, before you bolt it up.

MEMBER SIEBER: Is there a high-point vent on the lid?

MR. LORSON: The lids have a vent line and a drain line.

MEMBER SIEBER: Okay.

MR. PARKHILL: You are typically draining and pressurizing it at the same time, so you are lowering the water level. You are not pushing --

MEMBER SIEBER: Yes. Okay.

MS. THOMPSON: Okay. Then, after it has fully dried, you seal the vent and drain port. And this is pictures of one of the welding machines welding a canister lid.

Next, please, Ron.

MEMBER ARMIJO: Are these vent and drain ports always on the top of the canister, or are they -- where they are?

MR. PARKHILL: As it is loaded, yes.

MEMBER ARMIJO: Okay.

MR. PARKHILL: Yes. And they have a quick-disconnect valve that is the first avenue of making the seal. But we don't rely on that, so we have typically two disks that go over top of that that are each seal-welded to provide the redundant sealing.

MEMBER ARMIJO: Okay.

MR. LORSON: I think the idea is you want to keep that vent drain hardware within the footprint of the multipurpose canister, so when you place it into the storage overpack you don't have any potential for --

MEMBER SIEBER: Breaking it off.

MR. LORSON: Right.

MS. THOMPSON: This slide, as Ray mentioned earlier, shows the -- on the left side the preparation of the Hi-Trac, and on the right side the Hi-Trac stacked on top of the Hi-Storm, which is the storage overpack. So that the fuel canister can be transferred from the transfer cask to the storage overpack.

Now, this slide shows the transfer of the overpack to the ISFSI pad. Again, it is just a large piece of equipment moving a heavy object.

This is a picture of a storage cask array on an ISFSI pad. This picture brought up a lot of questions last time, so I want to just take a moment to clarify a couple of points.

The fence in the picture here is -- let me start. There are several areas at any reactor ISFSI site that go by various names. An ISFSI might have a fence around it, just to delineate the bounds of the ISFSI. Okay? It might have a fence around it to designate a protected area, which is a security term and has certain security aspects that are associated with that boundary.

And an ISFSI may be in its own protected area, or it may be inside the reactor's protected area. But it will be inside a protected area.

The controlled area is another area that we talk about with ISFSIs. The controlled area is in some ways more conceptual in that there is no regulatory requirement for a physical boundary to mark the controlled area. But the controlled area has to be a minimum distance -- the controlled area boundary has to be a minimum distance of 100 meters from the ISFSI, and the licensee has to be able to control access to that area. It may have a roadway or waterway going through it, as long as the applicant can --

MEMBER SIEBER: Protect it.

MS. THOMPSON: -- can control that access if they need to.

In this picture --

MEMBER ARMIJO: Well, maybe you are going to cover it. You have cabling on the outside of that overpack. Now, that is for some instrumentation. Could you just tell us what that is for?

MR. LORSON: Right. That appears to be resistance temperature detectors on the outlet of the gas vents. You will notice that there is -- you know, you have the concrete and then you have an area here that looks a little darker, and you have a little area here that looks --

MEMBER ARMIJO: Right.

MR. LORSON: -- a little darker.

Basically, what you have, you have air inlet vents. Air can travel in and passively cool the external -- the multipurpose canister and then exit through the top, and what you have is basically a remote temperature detector on the top of the outlet vent that allows you to monitor a differential temperature and just gives you the added confidence that you are getting air flow through the system.

MEMBER ARMIJO: And that is for all of the -- all types of systems? They all monitor the -- for that temperature?

MR. LORSON: Most of them do. There are tech spec requirements to verify the vents are clear. That is typically the requirement, to verify your vents are clear on some periodic basis. A temperature system may be put in by some facilities where they may have periodic problems with weather, for example, where it may not be convenient to send an individual out to, you know, somewhere remotely to check vents for clearance, in which case there might be alternate monitoring methods available to verify temperature.

So this seems to be a system that -- they have installed that system. But the tech spec requirement is typically to verify your vents are clear.

MS. THOMPSON: Okay. The next couple of slides just show more pictures of the horizontal system. In the first one it shows lining up the transfer cask with the door of the horizontal storage module, so that the fuel canister can be placed into the horizontal storage module. They make those up.

And then, the next one --

CHAIRMAN RYAN: Just before you leave that, what is the typical workforce makeup for these sorts of operations? Is this a vendor-supplied service, or do the plant people typically handle these units? Or how is that done?

MR. LORSON: It is typically kind of a mix of both. It depends on the operation. For example, the radiation protection programs are typically controlled by a site radiological person. Folks that are doing like the heavy loads lifting, handling the cranes, and what not, are typically site personnel.

Folks that are involved with the processing of the multipurpose canister, the actual welding, typically those are contractors. Folks that are involved with the operation of the drying of the cask may be supplied by the vendor or could be site utility folks.

Somebody like this who is doing the

detailed fit-up and alignment, that is probably a vendor representative who does these at multiple locations and is experienced and very familiar with the equipment. So it is kind of a mixed bag, if you will.

CHAIRMAN RYAN: It sounds like a good-sense mix of those that are good at it, come and do it, and those that can do in-house cheaper and better and faster and are our own program, that sounds like the cut.

MR. LORSON: Right. And I think that is a licensee-specific decision based upon availability of personnel, experience level of personnel, a whole host of things that go into that.

CHAIRMAN RYAN: Thank you.

MEMBER SIEBER: I think in most places it is combinations.

MR. LORSON: I would think so.

MS. THOMPSON: If there are no other questions, that concludes my part of --

MEMBER ARMIJO: This particular system doesn't have one of those transfer overpacks like the vertical. So it looks like the canister is -- people are standing around the canister and it never happens with the vertical system.

MS. THOMPSON: No. People are standing around the transfer cask.

MEMBER ARMIJO: Okay. There is a canister inside that --

MS. THOMPSON: There is a canister inside that cask that you see on the transporter.

MEMBER ARMIJO: Okay.

MS. THOMPSON: Okay. This is moved in a horizontal alignment, but what you are looking at is actually the transfer cask. For this system it is a steel-lead-steel construction, and the canister is inside of that.

MEMBER ARMIJO: So the whole thing is put inside, and then the transfer cask is removed or --

MS. THOMPSON: No. Actually, there is a ram that you can't really see. It is fitting on the end.

MR. RAHIMI: Actually, this is the --

MEMBER ARMIJO: Okay. That just pushes it in.

MR. RAHIMI: The ram pushes the canister inside the -- into the hole.

MEMBER ARMIJO: Got it. All right. Thank you.

MS. THOMPSON: It's just a thick stainless steel.

(Laughter.)

MEMBER ARMIJO: I imagine it is.

MR. PARKHILL: Okay. Thank you, Liz.

CHAIRMAN RYAN: Thanks, Liz.

MS. THOMPSON: You're welcome.

MR. PARKHILL: Robert Einziger is going to make presentations that were requested by the Subcommittee on fuel oxidation and damaged fuel. He has a few slides to talk about, and then we will probably regress and get into the prioritization methodology.

Do you want to load something in there, Bob?

MR. BROWN: Bob, we've got some -- we can't do that.

MR. EINZIGER: Okay. I will wing it, then. I was going to show some pictures, but I won't, then.

The pictures came from some presentations that I had made before, just so that you have a place that you can go to get more information on this subject. It was a presentation made at the high-level waste meeting that was held in Las Vegas in 2005, international high-level waste meeting that Chris and myself gave on this same topic.

I want to start out with a few facts about oxidation, just so you have a background. Oxidation of UO_2 can occur at any temperature, and it does occur at any temperature. The only thing that changes as you go up the temperature is the rate that it occurs.

MEMBER SIEBER: Right.

MR. EINZIGER: So there is some -- even some studies that have been at room temperature for 15 years that have shown oxidation of the fuel. But you have to be very careful about these tests, because they may not be applicable to -- the conclusions of the tests may not be applicable to the systems that we are working with.

When fuel oxidizes, it goes through a series of different phases. The phases for spent fuel are not the same as the phases for just unirradiated UO_2, and that is sort of surprising because basically spent fuel is UO_2.

UO_2 will go oxidize to U-307, and then on to U-308. Spent fuel will go to U-409, not pass the -- through the U-307 state, and then on to U-308.

When it goes from UO_2 to U-409, you have about a four percent contraction of the lattice that opens the grain boundaries that allows oxygen to get into the fuel. As it proceeds to oxidize further from U-409 to U-308, you have about a 30 percent expansion of the lattice, which basically tears the fuel rod apart. So you want to prevent that second step from happening.

MEMBER SIEBER: Now, that can occur at high temperatures in a matter of hours.

MR. EINZIGER: Well, that was the picture I was going to show you.

MEMBER SIEBER: Okay.

CHAIRMAN RYAN: Bob, just for the full Committee briefing, if you could work with Chris and get those pictures integrated into your presentation, that would probably be a good idea.

MR. EINZIGER: That's fine.

CHAIRMAN RYAN: Yes, thanks.

MR. EINZIGER: This was one of the things that came to me at my usual getting up at 2:00 in the morning thinking --

CHAIRMAN RYAN: I understand, yes.

MR. EINZIGER: -- about the --

CHAIRMAN RYAN: And we appreciate you bringing them, but we'll see them in May.

MEMBER SIEBER: The numbers that I remember is like four or five hours to where you get clad rupture, and U-308 is actually particles. It's powder at that point, right?

MR. EINZIGER: That's right. Well, you know, it -- at 150 C, you might have a number of years before you get anything. At 350 C, you split the cladding apart in about 30 to 40 hours. You get up near 400 degrees C, you are going to split it in a matter of an hour or so.

MEMBER SIEBER: Right.

MR. EINZIGER: And basically what happens is that the fuel oxidizes, and then it sits -- it goes up to U-409 fairly rapidly, it sits at a plateau for a while. Then, it continues to oxidize more to U-308. Depending upon the particular cladding, you can have anywhere from two to six percent strain on the cladding before you will start splitting it.

And then the split will either run down the cladding as a split, or it will spiral around the cladding, or will go partially down the cladding and then take a right turn and just wrap right around it and open the whole thing. So it is unpredictable what is going to happen.

The other interesting thing about the oxidation is that you take a pellet or fragments of a pellet that are fairly good size, and now you reduce it to a grain size powder.

MEMBER SIEBER: Powder.

MR. EINZIGER: And that is fairly easy to just fall out of the cladding. That has implications as a source term. It is particularly a concern in high burn-up fuel where you've got an outer rim structure that has got very fine grain particles in the sub-micron size. As the health physicists will know, that is already in the respirable range, and so now you are breaking it up and having a much higher distribution of respirable particles.

On the positive side, all indications we have is that high burn-up fuel oxidizes much slower than low burn-up fuel, primarily because of the presence of the actinides.

CHAIRMAN RYAN: Just so we get a marker down, what are you calling high and low burn-up in your example?

MR. EINZIGER: We have done studies up into the 48 gigawatt-day per metric ton range, and we started to see at that range that the oxidation rate was slowing down considerably.

The normal cutoff we use in spent fuel is 45 gigawatt-days between high and low burn-up, nothing -- not that it is a magic number, that at 46 you're high and at 44 you're low. But there seems to be a knee in many properties, and that is about where the knee occurs, at about 45.

At high burn-up you have competing effects. On one hand, the oxidation rate is decreasing. On the other hand, because it is a grain boundary-driven effect, and because in the rim region you've got so much more grain boundary, things can be happening faster. So to date there is really no good way of knowing which of those effects are going to dominate.

Now, about three years ago, I guess it was about three years ago, and during one of the dry runs for one of the utilities, they found out that they were draining about 75 percent of the cask empty before they were welding. And, in fact, they were letting it air-backfill it.

MEMBER SIEBER: Right.

MR. EINZIGER: And the question came up, is this okay? Well, remember you are up in the neighborhood of above 350 degrees C. We allow damaged fuel to have pinholes and tight cracks in them, so there is a way for air to get into the cladding and interact with the fuel. And so we put together an ISG-22, and basically it says, "We don't want you to allow the fuel to oxidize during the loading -- during any of the parts of the procedure."

There is a number of ways to prevent this. One is to assure that there are no breaches in the fuel column that are above the level where the water drains. Another one is to immediately backfill with helium or some other inert gas. A third way is to show that you have a temperature profile.

It is going to be such that during the time it is uncovered and in an air atmosphere that you won't have the oxidation occur. You won't get up to this plateau step. And there was a number of recommendations for places they could get data to go ahead and make these calculations.

There has recently been some more work done in that in France to try to put a model together to take some of the data and extrapolate it. I'm not particularly happy with that particular information. They are using uranium carbide fuel and extrapolating to UO_2, and there are some other things happening.

But the bottom line was, while I disagree with their methodology, they basically came out with the same conclusion in terms of a time-temperature relationship that we came up with 15 years ago.

That is basically what I had to say about oxidation.

MEMBER SIEBER: Yes. Let me ask a quick question. From the time that the fuel is discharged or the reactor is shutdown, discharged into the spent fuel, until you get into this operation is typically at least five years. Decay heat levels are -- have come down to fairly low levels.

Is there a time where you could keep the fuel in the spent fuel pool long enough so that it could not get up to the rapid oxidation point? I presume it is more than five years.

And a corollary to that question would be, if you kept it at five years, which is typically the storage time, and then exposed it to oxidation, how rapidly would you get up to the temperature which is the knee in the curve where this damage would occur? Is that at like three hours, four hours?

MR. EINZIGER: Well, the second question --

MEMBER SIEBER: The first number is --

MR. EINZIGER: The second question I am going to defer to some of our thermal experts in the group. What we have to remember is that the cask vendors want to load the casks so that they can get the maximum thermal load in there and still stay below the temperature that we say that they -- the maximum temperatures that they can have on the pad, which is about 400 degrees.

MEMBER SIEBER: Okay.

MR. EINZIGER: And so if you have put the fuel in a cask that is going to go near 400 degrees on the pad, now you start draining it, it is even going to be higher. So the question of: how long can you lead it out there until you get to that low temperature -- in the pool, it is fairly cool.

MEMBER SIEBER: Yes, it is.

MR. EINZIGER: And it is down into the -- anywhere between 60 and 85 C.

MEMBER SIEBER: C, right.

MR. EINZIGER: And -- but as soon as you put it into the cask, and you start draining it, the temperature starts going up. So I really don't have a good answer for your question, other than it is going to be significantly longer than five years. And that also is going to be dependent on the burn-up of the fuel. The higher the burn-up is, the longer it is going to have to wait.

MEMBER SIEBER: Okay. On the other hand, it is not unreasonable to assume that five-year old fuel, if you drain it, expose it to oxygen, the temperature will get up there in a matter of hours to where the damage would occur.

MR. EINZIGER: I can't say one way or another on that. That would have to be a question that is answered by our thermal expert.

MR. LORSON: Well, I mean, I think the heat uprates can be a function of what is decay heat load, right? And then, what is the external environment that you are in? What was your initial starting temperature, for example?

But, you know, I think the real issue is that we sidestep it operationally -- that concern -- by limiting events and trying to provide appropriate controls, so you don't get into a situation where you expose the fuel during the drying --

MEMBER SIEBER: Yes. But I am just thinking of what kind of accident can you have when somebody makes a mistake?

MR. LORSON: Right.

MR. PARKHILL: Well, there is also a practicality issue with the -- what we are limited with is the, you know, capacity of the spent fuel pool that drives, you know, when we load the fuel. So if they had -- you know, if we had our druthers, yes, we would build a lot of spent fuel pools, but nobody wants to do that. So they are trying to unload these pools.

And it is my understanding that some of the fuel is being loaded sooner than five years, too. Yes, three years.

MEMBER SIEBER: Wow.

MR. LORSON: Yes, we have had applications for three years. But what we could do is we could take a question back. I don't know if Jorge would be able to -- if there is anything you could pull off a model that would give us an idea of heat uprates.

MEMBER SIEBER: From a regulatory standpoint, if you can do the calculation, I guess it is not important. It is more for me just to fill in the background of what I expect would happen. So I would not want to require you to do a lot of extra work to answer that question.

MR. LORSON: Okay.

MEMBER SIEBER: You can decide for yourself.

MR. LORSON: Okay. Well, Jorge Solis is a thermal expert. Do you have anything you care to add regarding that?

MR. SOLIS: Jorge Solis. Typically, the heating rate would depend on the initial total heat load in the canister. And that is controlled through calculations for time to boil. Typically, the vendors perform those calculations, and they have those time limits in the technical specifications. For a typical, let's say, 30 kilowatts, with water inside, you are talking about 15 to 20 hours to reach the time to boil.

MEMBER SIEBER: Okay. Thank you.

MR. EINZIGER: And I just want to add a note on oxidation. We are saying this was the phenomena that drove the Yucca Mountain project to have an above-ground facility where all the repackaging was going to have to be done under water.

MR. PARKHILL: Just one footnote, because I might have misheard this. But undamaged fuel can have pinhole leaks and hairline cracks in it, so --

MEMBER ARMIJO: By your definition.

MR. PARKHILL: By our definition. So it could be loaded and classified as undamaged, and have hairline cracks and pinhole leaks, which leads right into Bob's --

MEMBER ARMIJO: But the utilities know when they have got leakers.

MR. EINZIGER: They should.

MEMBER ARMIJO: It is pretty easy to tell when you've got leakers. It is a rare case that you have a pinhole that somehow is plugged and it is not leaking. I have seen --

MR. EINZIGER: Right.

MEMBER ARMIJO: -- one example in my career. But it is really rare, so -- my question was, since this issue is really only relevant to breached fuel, fuel that -- where the air could get in there --

MR. EINZIGER: That's right.

MEMBER ARMIJO: -- do you have any requirements where you kind of segregate beyond damage, where you know you've got a leaker, you've definitely got leaking assemblies, that you say, "Okay. For these particular assemblies, your procedure for loading is going to be more conservative, or we are going to assure that it is" -- or do you just say, "Hey, if it fits in that cask, and you use these procedures, you will be safe, whether or not it has got a pinhole"?

MR. PARKHILL: Well, our initial guidance when we first started, the initial revision to the standard review plan, you know, 13 years ago --

MEMBER ARMIJO: Yes.

MR. PARKHILL: -- there were studies by PNNL that made recommendations that the fuel be kept in an inert environment. And that was always our presumption. And then, we'd come along and find out, well, there is a deviation from it in the operations. So the ISG was written to make -- you know, to fix that problem.

MEMBER ARMIJO: I agree with you. If you do the inerting properly, and you keep your temperature below 400 --

MR. EINZIGER: There is three classes of --

MEMBER ARMIJO: -- it doesn't really matter.

MR. EINZIGER: There is three classes of elements, Sam. There is the rods and the assemblies that have no breaches in them. They are good to go. This isn't an issue with those.

MEMBER ARMIJO: Right.

MR. EINZIGER: Then, there is the class of assemblies where they have large breaches in the cladding, which we call gross breaches. And if it's a gross breach, the fuel is damaged, and then it has to be treated in damaged fuel cans, which are not necessarily sealed.

And then, you have an intermediate group, which is considered undamaged fuel but has -- could have pinholes and tight cracks in it. Both of the latter two groups, where there is penetration of the cladding that allows the oxygen in the air to contact with the fuel, has to be treated -- considered under these conditions where either the temperature is kept low enough, the gas is inerted, or they show that those breaches are not above the water level or -- right, not above the water level.

MEMBER ARMIJO: Yes. Which is hard to do if there are just tiny pinholes.

MR. EINZIGER: That's right.

MEMBER ARMIJO: So, but there is a category of fuel that is so badly damaged, broke, it splits, that requires canning?

MR. EINZIGER: I will get to that in a minute.

MEMBER ARMIJO: Okay.

MEMBER POWERS: Bob, you have not discussed the issue of metallic nodules in the fuel.

MR. EINZIGER: Excuse me?

MEMBER POWERS: You have not discussed the issue of metallic nodules in the fuel and the problem of ruthenium tetroxide formation.

MR. EINZIGER: If you do get ruthenium tetroxide formation, you've got a very volatile substance that is readily dislodgeable and can escape the fuel. We have never monitored for that when we have done the oxidation experiments. But it is a concern as a release constituent and a source term constituent.

MEMBER POWERS: When I look at the dose consequences for ruthenium release, I see a radionuclide that is equivalent to iodine for short-term doses and equivalent to cesium for long-term doses.

MR. EINZIGER: We know the rate that spent fuel oxidizes. So we know the volume of the fuel that is oxidizing. If you -- when you get to the U-308, and you are opening up the lattice, then you can release the ruthenium. And the amount of ruthenium that you can -- is available there is proportional to the amount of fuel that has been oxidized, which is proportional to the time at whatever particular temperature. So it can be calculated, knowing the inventory of the ruthenium.

MEMBER POWERS: I suspect, without actually knowing, that what you observe when you see the change in fuel oxidation as a function of burn-up is that you are seeing a transition from oxidizing fuel to oxidizing the molybdenum and ruthenium nodules.

MR. EINZIGER: Yes. You are getting oxidation of the other -- the actinides, oxidation of the other products in there.

MEMBER POWERS: I suspect --

MR. EINZIGER: That is what is slowing it down.

MEMBER POWERS: I suspect it is not so much the actinides as it is the metallic inclusions.

MR. EINZIGER: It may well be. It is not a very well-studied phenomena. The only thing that was really studied was the fact that it -- the rate was slowing down. Unfortunately, most of the work on the oxidation of fuel was done by the Yucca Mountain project, and at the time that they were starting to get into high burn-up fuel the oxidation program was already starting to ramp down.

MEMBER POWERS: We usually see that oxidation of -- the nodules or alloys of molybdenum, ruthenium, rhenium, palladium, technetium, zirconium --

MR. EINZIGER: Five metal particles.

MEMBER POWERS: -- and they would usually see that actually buffers out the hyperstoichiometry of the fuel during operation. And so there is going to be a point where air oxidation starts oxidizing those in preference to the lattice material. So you are going to see less fuel oxidation.

But, unfortunately, that is not a good thing, because now you are forming both molybdenum trioxide, which is not an indifferent radionuclide, but you will also see the ruthenium tetroxide, which at these temperatures is gas, and has correspondingly high transport characteristics.

MR. EINZIGER: The most recent and probably the best work on high burn-up fuel oxidation is work that was put out by Brady Hanson at PNNL. I guess it was in 1998. If there was any mention of the ruthenium -- and I would have to go back and look at that again -- it would be in that report.

Damaged fuel -- this is an issue that is addressed in ISG-1, Rev 3. Up until a number of years ago, there was a very stringent rule for damaged fuel, and that was basically if it had any defects in the cladding that were bigger than pinholes, or tight cracks, it was damaged. If it couldn't be handled by normal means, it was damaged, and you have put it in the damaged fuel can. That was pretty much what it said.

About 19 -- excuse me, about 2005, we

started thinking about this subject, and why was this considered damaged? Is it the only way fuel could be damaged? And we basically took a different approach to it.

It said it is only damaged if it can't do what it is supposed to do. If it can meet all of the requirements of the system, it is not damaged. Damage could have different meanings under different circumstances.

When I gave a presentation at the IAEA meeting in 2006, the example I gave was my old beat-up Datsun. If I wanted to use that car to go woo a mistress, you probably wouldn't do very well it was so beat up, and it would be -- could be considered damaged. But for getting me back and forth to work it did just a great job, and for that purpose it was not damaged. So damage depends -- whether it's damaged depends on what you want to use it for.

And so there could be different definitions for damage in the reactor, damage in the spent fuel pool, damage in the storage, damage in transportation, depending upon what the requirements are on the fuel.

We also looked -- said, "Okay. What are the requirements on the fuel?" And, actually, there are very few requirements in either Part 71 or Part 72 on the fuel itself. Basically, it can't interact with anything.

But there is a number of other requirements that could be put on the fuel by the applicant in order to meet other requirements. There could be a requirement on the fuel to stay in its configuration, so it is retrievable. You don't want it to break all apart.

It could be that you want to maintain a configuration so that you could do your criticality calculations. So there are certain functional requirements. There is regulatory requirements, which is basically don't interact, and there is functional requirements, and these are ones that are basically put on the system by the applicant.

And so we sort of changed the definition of "damaged fuel" and the way it's handled. Damaged fuel is anything that can't meet its functional and regulatory requirements. Or, conversely, if it can meet the functional and regulatory requirements, it is not damaged. And there is a number of ways to approach this.

One way is, if it's damaged, fix it. We see that in the case where there is corrosion of the top-end nozzles, and they are putting bracing in there to hold the system together. If it is damaged because there is a rod in there that has got a large breach, take the rod out and put a replacement rod in or put a dummy rod in. If you don't want to do any of this, and it is still damaged, put it in a can.

Or you can show that with a particular amount of defects in the fuel, elements in fuel assemblies, that you can still meet all of the functional requirements, assume that these defects are in there and show that it's still structurally sound, still subcritical, still maintains its shielding aspects, etcetera.

And so we changed the definition of damaged fuel. A lot of the work on this definition and the way to handle it was done in an IAEA consultancy, which resulted in an IAEA document that is listed in this viewgraph that has an extensive discussion of the issue of damaged fuel.

But basically what we require now that is -- is that when an applicant comes in, if he wants to load damaged fuel, he'd define it. We gave him a default definition, which was basically the old definition, no pinholes, it can be handled. But if they want to have assemblies go into the cask that has more defects in it, and they can show under this definition that it can still meet all of the requirements of criticality, retrievability, if that's a case, shielding, containment, etcetera, we don't consider it damage, then.

MEMBER ARMIJO: Well, there could be some practical problems in drying out. Let's say you've got something with a one-inch axial crack, and it -- the rod has gotten full of water. And so when you go through your drying process you might have a -- take a long time to get that done or --

MR. EINZIGER: That's correct.

MEMBER ARMIJO: So there could be practical issues. But I was just more concerned about fuel that is really in bad shape. I mean, it is literally broken, big splits.

Now, maybe I -- I usually call -- people call that degraded.

MR. EINZIGER: We call that damaged.

MEMBER ARMIJO: You call that damaged, but you have a big spectrum of what damage would be. But there is no requirements that fuel that is in that bad a shape, there is no regulatory requirement that that be canned separately and treated separately than --

MR. EINZIGER: We are not like most of the foreign countries who require that any damaged fuel be put in a can, a quiver, or whatever they want to call it. But we do require that it be placed in a condition where it can meet all of the requirements.

And usually fuel that is badly degraded, can't meet a retrievability requirement, if it's in storage, or it can't meet a criticality calculation if it's free to move this stuff all over the cask --

MEMBER ARMIJO: Well, I'll give you, Bob -- there is examples, you know. People have had -- have been -- utilities have been afraid to remove the fuel rod, because it might break up. And so they leave it in the assembly, and so it is pretty badly damaged.

Now, fortunately, that is pretty rare, but it does happen. I'm just wondering, let's say you have an assembly with a pretty badly damaged fuel rod, can that go into your system? And as long as they can eventually dry it out, pump it out, and inert it, I agree that that is the end of the line, it's okay. But you don't have any special requirement other than, really, practicality and --

MR. EINZIGER: That's right. I mean, almost all the time, if they get into that situation, they will put it in a damaged fuel can. That seems to be --

MEMBER ARMIJO: Yes, I get --

MR. EINZIGER: That is the practice, because it is the easiest thing to do. But a place where this definition really came into vogue is recently we had a situation at Humboldt Bay where they --

MEMBER ARMIJO: That's really old fuel.

MR. EINZIGER: Excuse me?

MEMBER ARMIJO: That's really old fuel.

MR. EINZIGER: Yes, it is very old fuel, but they couldn't determine that -- whether there were leakers and in how many fuel assemblies. And they had already procured the system, and their system only allowed damaged fuel in half the slots. They didn't have enough -- if they had to declare all of the fuel damaged, then they did not have enough slots in their canisters to put all of the fuel.

And so working with the criticality people, we said, "Okay. If the fuel in the middle has defects in it, rods that are defected, but we know that the ones on the outside" -- say the rows on the outside were damaged, they are in damaged fuel cans, but the ones in the middle are of an unknown configuration, they may have breaches in them, can they do all the calculations to show that it is going to hold up and meet the criticality requirements and the shielding requirements, and all, and it did, then even though there was sort of an unknown condition in the middle, we declared those as undamaged fuel rods.

MR. LORSON: See, I think, you know, one thing it's important to consider is in the Certificate of Compliance, the applicant, or in this case the end user, needs to confirm that they are operating the system in accordance with the constraints of the Certificate of Compliance, which, you know, specifies what you are authorized to load.

And so they need to evaluate a condition such as you have mentioned that, you know, indicates some degradation or adverse-to-quality type condition, and make their own assessment and confirm that they are either in compliance with the certificate or not in compliance.

They may be able to get in compliance through the use of a damaged fuel can. That may be a simpler, more pragmatic route, or, alternatively, they could do some type of analysis. If they conclude they are still within the certificate, they could load it as is. Or if they do the analysis and conclude that they are not in compliance with the certificate, they can come in for some type of amendment or exemption to the certificate.

So those would be the avenues that folks would approach.

MEMBER ARMIJO: Okay.

MR. PARKHILL: Just to make sure you are not getting a wrong perception here, I think most -- it would be fair to say most of the damaged fuel that is out there is canned, and I would say 90 percent.

MR. EINZIGER: I am not willing to say any particular number. But most of the applications that I have seen -- and it is only a fraction of them -- have indicated they are going to put it into a damaged fuel can.

But, for instance, another example is there are a number of assemblies out there where they pull on the nozzle, which is connected to the control rod tubes, to remove the assembly from the pool or from the reactor. And there is some question about whether there is stress corrosion cracking at the joints of the nozzle with the control rod tubes, which could -- if there was, it could mean that when they pull on the nozzle that they -- that it comes loose.

One way of handling it is everything that has this corrosion is declared damaged fuel, and put in damaged fuel cans, let's say. Another way to approach it is that, okay, we are not going to pull on the nozzle; we are going to put some sort of device that gets into the tubes themselves and pulls on the tubes themselves. Therefore, we still meet the retrievability function. Therefore, that fuel is now declared not damaged.

So there are a lot of ways around the issue. If you look in this IAEA document, which by the way is on the IAEA website, it has lots of pictures of things that were damaged and are no longer damaged, ways various countries handle damaged fuel, and a way that the damaged fuel definition can be exercised in a number of cases.

MEMBER ARMIJO: Okay.

MR. LORSON: Okay. If there are no other questions in this area, I think we ought to probably move it along.

MEMBER ARMIJO: Thanks, Bob.

MR. PARKHILL: Why don't we go to ISG-25, and maybe a break after that, depending on what --

CHAIRMAN RYAN: Yes.

MR. LORSON: We are scheduled to have the break at 10:15, so --

CHAIRMAN RYAN: That works.

MR. PARKHILL: And then, we will regress back to the methodology.

CHAIRMAN RYAN: Sounds good.

MR. CRUZ: Let me change my name from Bob to Luis.

CHAIRMAN RYAN: Sure.

(Laughter.)

MR. CRUZ: Good morning to all. My name is Luis Cruz. I am a mechanical engineer in SFST. I will be highlighting the main aspects of ISG-25 and its pressure on helium leakage testing and the confinement boundary of the spent fuel dry storage systems.

This ISG has been mainly developed to support the SRP in terms of the required ASME pressure testings and the helium leak rate testings that have to be done to ensure that these systems have been fabricated according to the design criteria, and also that these systems comply with the regulatory requirements established for operation.

This guidance basically divides in two parts, generally in terms of pressure testings and helium leak rate testing. For the ASME pressure testings, these are basically split into two categories. One is for the pressure testings for welded canisters, and the pressure testings for bolted casks.

For the welded canisters, there are some pressures -- some pressures tested and -- some pressure tests performed in the fabrication shop and out in the field. In terms of the fabrication shop, at this point the canister shell should be pressure tested. In case the canister shell is not pressure tested in the fabrication shop, then an alternative for acceptance will be helium leak rate testings later, since at this point most of the welds in the system will not be accessible.

Also, in the field the closure welds have to be also pressure tested. In terms of bolted casks, there has to be a pressure test, but this one shall be performed in fabrication shop, and this doesn't have any other closure welding, since it is just the bolted cask itself.

For these ASME pressure testings, well, they are referring in the guidance from the ASME boiler pressure and vessel code, specifically from Section 3, Revision 1, which is rules for inspection and rules for construction of nuclear facility components. And it is basically referred in this guidance.

MEMBER ARMIJO: What pressure levels? How high in pressure do --

MR. CRUZ: Well, for these testings, the -- what it specifies in the guidance, there are the design pressure -- the pressure test is I think between 110 and 125, the design pressure. And then, there are other testings that require other -- or a percentage of the design pressure to be tested. I think initially it is 110 to 125 percent for 10 minutes, what it is tested.

MR. PARKHILL: If it is pneumatic, it is 10 percent above. And if it's water, it's 25 percent above.

MR. CRUZ: Right.

MR. PARKHILL: Depending on what they defined the applicable confinement boundary being, either in NB or NC.

MR. CRUZ: Yes.

MR. LORSON: But the testing requirements follow the ASME code relative to --

MR. CRUZ: Yes, yes.

MR. LORSON: -- hydrostatic testing.

MR. CRUZ: Yes. Basically, the details of this are provided in Section 3, Revision 1, subsections NB or NC, specifically in the 6,000 --

MR. PARKHILL: While we're on pressure, just -- some of these canisters get up to like seven atmospheres. You know, so they are pressurized mainly for thermal reasons, to remove the heat, but they have a good amount of pressure in them.

MEMBER ARMIJO: Okay.

MR. CRUZ: In terms of helium leak rate test, both systems have to be leak rate tested. The leak rate test has to be performed in the complete confinement boundary. There may be some exceptions, but they have to be considered on a case-by-case basis in terms of ISG-18. And these subsections are in terms of final closure welds.

These helium leak rate testings are to be performed in the -- are typically performed in the fabrication shop for the entire confinement boundary. And then, in the field there has to be a leak rate test for the vent and drain port covers.

The guidance referred -- the standard referred in this guidance for this leak rate testing is ANSI N-14.5. That is basically the aspects of the -- as far as the pressure testing and the helium leak rate testing.

This ISG was up for public comments in October last year. We received the public comments, and the staff evaluated these and incorporated these accordingly, in the current version of the ISG.

MEMBER ARMIJO: Now, there is no requirement for periodic monitoring of the helium in these canisters. I mean, if somehow, let's say, a weld in one of these vent or drain port covers developed a leak, some stress corrosion, crack, or inclusion in the weld that finally dissolved out, and it starts leaking very, very slowly, but these things are going to be out there for years and years and years, is there any way in which you monitor or assure yourself that the helium pressure is still there in that --

MR. PARKHILL: For welded closures, the answer is no, it is all sealed. But for bolted closures, we have a seal monitoring system on it, which is basically a pressurized can with alarms on it that goes between the two seals and the bolted closures. So if you get any loss of pressure, either into or out of the can, you get an alarm and --

MEMBER ARMIJO: But my question -- and, yes, I think that's good for the bolted. But the question I have is, the assumption is made that once it is all welded, it is -- you know, it is inerted and it is --

MR. PARKHILL: Right.

MEMBER ARMIJO: -- welded, it is leak tested, that it -- everything is going to stay that way for 20 years or more sitting out there in the open.

MR. PARKHILL: For its design life. Now, there is another SRP that comes along for license renewal, and that is a separate area. But for our SRP that talks about the initial design life, there is no other criteria. There is the presumption that it is going to be --

MEMBER ARMIJO: There is no analysis that says, hey, you know, we know this thing is still full of helium, it is keeping the fuel temperatures below the 400 C, and all of that? There is no way on a welded canister that is in the -- that you require to assure that that's the case?

MR. LORSON: That's correct. We do not require monitoring of the canister to detect loss of helium after it has been seal-welded and placed on the pad. However, if you were to have a loss of helium, there is two potential concerns you might run into. One is it could provide some type of dose concern, because of the leakage of potentially particles getting picked up inside the cask.

MEMBER SIEBER: Redistribution of --

MEMBER ARMIJO: I am talking about a slow leak. I know you guys can make a really good initial weld and everything else, and your leak test is pretty tough.

MR. LORSON: Right.

MEMBER ARMIJO: but I'm talking about, for some reason or another, that a weld cracks, or some non-metallic inclusion dissolves out, and now you have a little pinhole, and over time you lose your pressure --

MR. LORSON: Right.

MEMBER ARMIJO: -- and so the fuel gets hotter.

MR. LORSON: Right.

MEMBER ARMIJO: And how -- isn't there any way in which you can -- you know, it shouldn't get hot or somebody should notice it.

MR. LORSON: Right. And to answer --

MEMBER SIEBER: It's the differential pressure, so you aren't going to get a lot of movement.

MEMBER ARMIJO: You don't have a pressure gauge on it, Jack.

MR. LORSON: You don't have a pressure

gauge, but you do have -- again, as I mentioned, you have two concerns, one being the radiological release. And there are requirements for monitoring for radiological parameters around the cask.

So maybe if you had a significant enough leak that resulted in some type of contamination external to the cask, you would hope that a site radiological monitoring program might pick that up.

The second point, which I think you are really leading to, is the issue associated with thermal performance. Okay? And what we have done, and Jorge can speak to this directly, is we have modeled various postulated leak sizes. For example, a leak in the neighborhood of 10^{-3} cubic centimeters per second is typically what could be detected through hydrostatic testing if you look at the information that is contained in ANSI 14.5.

Now, as you have a leak through some postulated flaw, say you were to have a leak of that size, as a function of time the leak rate is going to drop, because you are going to lose your driving pressure. Okay? And what is going to happen is you have two effects. One is your pressure and your leak rate are decaying as a function of time due to the continued loss of pressure from the canister. The second effect is that the fuel is continuing to decay. Okay?

And Jorge can talk a little bit about the calculation he did. It gives us kind of a framework for how long it takes you to deplete the overpressure from a particular, you know, system based upon some initial assumptions relative to what the thermal performance might be.

MR. SOLIS: Yes. For some of the pressurized cans it serves like Hi-Storm 100. We did calculations assuming an initial pressure of six atmospheres. And for a leak rate of -- constant leak rate at about E to the minus three, it would take about 400 years to completely leak the entire helium to get to --

MEMBER ARMIJO: Does that include the fact that the -- that as you lose helium pressure the cooling of the fuel is less efficient, and you start heating it up, so it may not depressurize as fast as you think.

MR. SOLIS: Right.

MEMBER ARMIJO: But you have taken all of that into account in your analysis?

MR. SOLIS: Yes. Yes.

MR. RAHIMI: Yes. I would like to add to

what Jorge -- we just -- that is a very interesting question. We just did this calculation recently that Jorge determined if we have a leak rate, let's say as large as hydrostatic test, 10^{-3}, you know, that is what was our starting assumption, as he said, you know, it would take about 3- to 400 years to lose all of the helium overpressure, meaning going from 5.5 psig to -- all the way to one atmospheric pressure.

And then, we had our decay specialist do the decay calculation during that time, and we looked at decay. By then, we will be below 12 kilowatts, and 14 kilowatts is the number that the -- below which you do not rely on helium overpressure to transfer your heat through convection.

So we showed that the -- if you lose all of the helium overpressure, that by then you will get below 14 kilowatts, that you are fine, your peak clad temperature -- you are below the peak clad temperature.

MEMBER ARMIJO: And unless you had leaks that are much bigger than this 10^{-3}, you have no concern. It seemed to me that somehow it would be easy to put a thermocouple on the outside of a container. And if the temperature was not going down with time the way it should, then you probably have a leak, you know.

I am just saying that there is some -- seem to be some pretty simple ways to just eyeball these things. One of your pictures you showed a bunch of these canisters out in the field, and all of the snow is melted all around these things, because it is warmer there. And I just think it would be something that would -- if I were a utility, I would think about monitoring it in some way, simple --

CHAIRMAN RYAN: Or at least a sample of some --

MEMBER ARMIJO: Yes, once in a while, just to -- because these things -- leaks can happen in these steel -- I imagine these are all stainless steel and good materials, and all of that, but there is -- there is contamination. They can fail. And if they leak too fast, you would lose the helium that you are counting on. I would expect it would be very rare, but it's something that should be -- periodically, I would monitor it, if it was me.

MR. LORSON: And I think, you know, it is kind of a multi-part, you know, response. One is, if it were a slow leak that was coming over a period of time, we would expect there would be some sort of accompanying contamination external to the canister that would be detectable.

MEMBER ARMIJO: That is one indication, yes.

MR. LORSON: If it were something that were of slower -- that it didn't result in a contamination event, and it were, you know, in the neighborhood of 10^{-3}, okay, or lower, then what we've shown is through, you know, some analysis at least from one container that we are comfortable that the leak rate is such that you are not going to likely exceed a thermal concern before the heat load has substantially decayed away to the point where you don't require helium overpressure.

And I think, as a matter of point, I don't believe that all of the vendors rely upon the helium overpressure. I think it is just the one vendor that we have -- Hi-Trac -- that relies on the helium overpressure, and that is the vendor that we did, you know, the calculation for.

And then, if you had a more significant upset type event, you know -- you know, you could postulate maybe somebody drives a forklift into someway. I mean, I don't think that would be sufficient to damage the concrete overpack and cause damage to the liner. But if you postulate some type of upset event that would be apparent, then you would expect that the licensee's corrective action program would go in and evaluate the adequacy of the system and make a determination whether they are still in compliance or not.

MEMBER ARMIJO: Okay.

MR. PARKHILL: One point, because I am a little sensitive to the scope of the standard review plan here, is that we are limited by what we have before you to a 40-year time period based on new rulemaking. It was 20 years.

And then, after that 40-year time period, we are going to have a new standard review plan that is in public comments right -- it has already gone out for public comments and it is being resolved -- that is going to talk about the license renewal, you know, issues and aging issues associated with a canister.

And it sounds like, if we're talking about periods longer than that, that would fall under the scope of that document. I just wanted to --

MEMBER ARMIJO: No. I'm not talking about period of time. I'm just talking about things that go wrong that are hard to detect.

MR. PARKHILL: Right.

MEMBER ARMIJO: And that could lead to consequences that are far worse than need to be.

MR. LORSON: It's a very good question. We had the same concern. That is partially why we did some of the calculations, and what it showed us is that we are comfortable that for various postulated leak sizes that we believe to be credible, we are comfortable that for a 40-year license period that, you know, we can demonstrate safety.

When you get beyond that, into the license renewal space, okay, then yes, it would require the applicant or the licensee to have an aging management program. So, you know, as part of that they would have to assess the condition of the exterior boundary, and have an appropriate method for, you know, examining those systems. And that is something that we would be looking at, you know, in the longer term.

MEMBER ARMIJO: Okay. Thank you.

MEMBER SIEBER: Maybe I could just ask one question. If the backfilled gas was at atmospheric pressure, is there enough heat transfer to maintain the fuel cool enough, so that you don't have this rapid --

MR. SOLIS: No, you are not. You need the pressure. You need to have that six atmospheres.

MEMBER SIEBER: How many atmospheres? Do you know or --

MR. SOLIS: Well --

MEMBER SIEBER: -- do you just know you need some?

MR. SOLIS: Now, so far for -- for like the highest pressurized canisters we have licensed, they are required to have seven atmospheres of helium. And that is -- they are not far from the limit. So that's the same.

MR. RAHIMI: Yes. And I also would add that depends on the heat load. You know, if you are at the high heat load, you need that overpressure. But if you are loading the, you know, no burn-up, low-cool decay, below 14 kilowatts, you do not need helium overpressures. You can rely on the conduction and radiation heat transfer.

MR. SOLIS: And, remember, we did calculations for 400 years, but actually, depending on the initial decay heat, it would decay pretty fast. I think your calculations show that it would take like 30 to 40 years?

MR. RAHIMI: That's right. Yes, we did the decay calculations, and really, you know, we said if we were off by a factor of 10, you know, within 40 years we will be below 14 kilowatts, that we do not rely on the helium overpressure.

MR. SOLIS: Right.

MR. RAHIMI: So at atmospheric pressure below 14 kilowatt, you are fine.

MEMBER SIEBER: Good. Thank you.

MR. LORSON: By the way, one of the public comments that we addressed in response to the ISG is there was a push-back from industry not to do any of this helium leak testing at all. And we didn't think that was appropriate, because of, you know -- and their argument is that these welds have been examined through dye penetrant testing, through radiography, and so, you know, there are multi-test welds, and it is impossible to have a leak.

We just didn't accept that argument. And so we require that leak testing be performed, so --

MEMBER SIEBER: Okay.

MR. LORSON: Thank you, Jorge.

CHAIRMAN RYAN: Are there any other questions?

(No response.)

Anything else, Jack? Sam?

(No response.)

Okay. Why don't we take our scheduled

break, and we'll come back at the appointed hour of 10:30 and start there. Okay?

Thank you.

(Whereupon, the proceedings in the foregoing matter went off the record at 10:05 a.m. and went back on the record at 10:28 a.m.)

CHAIRMAN RYAN: Okay. I guess I'd like to call the meeting back to order please.

I think now Dennis are you up? Dennis Damon will be presenting. So please, sir.

MR. DAMON: Well --

CHAIRMAN RYAN: Oh, I'm sorry, Ron, go ahead. Excuse me.

MR. PARKHILL: That's okay.

CHAIRMAN RYAN: I went by the name on the screen.

MR. PARKHILL: Well, there's two.

CHAIRMAN RYAN: Well, yes.

MR. PARKHILL: Dennis gets top billing on this.

I just wanted to go real quickly over the prioritization methodology. As Meraj said, we went back at your recommendation and took out any references to risk-informing and replaced it with either prioritized or another version of that.

The purpose of the prioritization methodology is to classify the review procedures items into either high, medium, or low as to the level of effort that we think that the staff needs to devote to that item based on our subjective determination and primarily based on our experience.

That standard review plan is broken up into these objective areas of review, regulatory requirements, acceptance criteria, review procedures, and evaluation findings. And the only thing that we're really prioritizing is the review procedures.

A quick review of the methodology is we ask three questions for each item that we want to rate. The first question is the likelihood that that requirement will not be met by the applicant. The second question is the likelihood that the staff will find that discrepancy. And the third is the perceived risk if those requirements were not being met.

We assign a scoring system to the first two questions of zero to four and the third for risk is a one to three. We add up those collective scores and come up with a low, medium, or high ranking that we determine as the risk score.

Then we make a defense-in-depth determination. And the scoring for the defense-in-depth determination is the same as a risk. It's going to be a one, two, or three for a low, medium, or high. Then we decide whether or not which one controls, whether defense-in-depth or risk will control, and we assign the higher score in that case.

In no case do we use defense-in-depth to lower the score of an item. So the questions that came back that we have from the last meeting were -- the first one was, there was a concern that the uncertainties in the PRA were not addressed. Now in fairness to these questions, they were made as the introductory remarks from the Subcommittee without benefit to the entire presentation. But for completeness, we wanted to go through them.

PARTICIPANT: True.

MR. PARKHILL: The first one is we really haven't done a PRA. We don't have data for these determinations. It's the, you know, subjective judgment of experienced staff through a process that will allow us to be -- or guide our thought process.

PARTICIPANT: The point is still right, though, that uncertainties weren't formally analyzed.

MR. PARKHILL: Right.

PARTICIPANT: Yes, okay.

MR. RAHIMI: Dennis, were you going to say something?

MR. DAMON: What? Well, I could, if you want.

MR. RAHIMI: Okay.

MR. DAMON: I mean as Ron says, we didn't -- there wasn't really a quantitative risk assessment done. It certainly would have been -- we probably could have done better if we did have such a thing.

But if you go back to the first -- the Slide 8 -- or the one that has the methodology and the scoring stuff on it, we didn't adopt this structure lightly. There was considerable effort made up front to think about what we should be assessing here.

And so the factors, the factors really are aimed as if you did have a risk information. But the point is we don't have the risk information because basically we didn't have the time and resources to do it.

And nobody has ever done such a thing because the kind of risk study you would do in order to inform such a thing to make it more objective would be you want to assess each of these factors, like the likelihood the requirement would not be met, you would do a study, okay? How many times have we -- what kind of applications have we got? How many times has this thing been found to be not in compliance?

That kind of quantitative -- and the same with what is the risk if the requirement is not met. Well, also on the likelihood thing, what you are looking for is not the likelihood that once you build and deploy this thing that something goes wrong, it's what is the likelihood that they have already done something wrong in what they have submitted to you in the design, before they ever build the thing even, that they've actually made a mistake in the design or the analysis of the design.

So it is a kind of risk assessment I've never seen anybody do around here. So that's what we're missing, that kind of a risk assessment.

CHAIRMAN RYAN: Yes, no, I think after the discussion and particularly the follow up, we understand a little bit better. But you realize you're dealing with PRA folks.

MR. DAMON: Yes, I mean it would have been -- that was my reaction is --

MEMBER ARMIJO: These changes are going to changes are going to save you a lot of grief at the full Committee meeting.

(Laughter.)

MEMBER ARMIJO: And that's the whole

purpose of the recommendation.

MR. DAMON: Well, what we asked ourselves when we confronted this is okay, if we wanted to do this, what would it take? Well, I estimate this would take us another two years up front before we even started to apply it. And so it wasn't worth --

MEMBER ARMIJO: And even then would it be any better than what you've done?

MR. DAMON: It's hard to say.

MEMBER ARMIJO: I don't see how it could be. I don't see it would be even a practical use of your resources to try and do something like that.

CHAIRMAN RYAN: And I think I agree with that, too, Sam, from the standpoint that, you know, you just don't have the historical database of experience to pull on. I mean it's just not there.

So, I mean, the phrase you used was, you know, informed professional judgment and that's not a bad thing.

MR. DAMON: So that's what we did. And so when you talk about uncertainties in PRA, what is say is okay, yes, that's a valid question. The real uncertainty I would be concerned about is that these professionals made the wrong judgment, you know, that they just flat did it wrong.

And, of course, that's why we involve multiple people and we try to get the best people. But you are, in fact, vulnerable to that.

CHAIRMAN RYAN: And I think that is a fair assessment from your part of it that, you know, there is some uncertainty with what is a six or a nine or a four or a seven, you know, those aren't cast in stone. But I think we recognize that.

MR. DAMON: Okay. So that's my take on the first one.

MR. PARKHILL: Okay. The second bullet, an observation was made or felt that question number one, the values, the places where the applicant has made mistakes. Well, it tries to identify the areas where we have experience where applicants have made mistakes and passes that knowledge along so that hopefully the next person doing one of the similar reviews can have benefit of that.

Question number two is a more interesting question. We had to do some data analysis of the sheets that we had. This third bullet, question number two, when we get a low ranking for -- and this is the staff's assessment -- when we value our review as low, meaning that we either omitted finding the mistake or aren't looking for it, should we do something different?

And I think our answer is yes. So what we did, we went back and looked at all 143 items that were prioritized in the standard review plan. And of those, only seven of the 143 were identified as the staff having a low or very low component for question two.

One of those was already -- was an overall rated of a medium, so we didn't worry too much about that. But what we looked at was the risk evaluation associated with the remaining six. And of those six, four of them had a low risk rating. So I wasn't concerned about something where we would miss it and it had a low risk rating.

Two of those had a high and medium rating. And so those two items we took a harder look at. The first of those items had to do with -- it was in the thermal section and had to do with axial distribution data that is submitted for use in our thermal analysis. And initially that was rated as a risk component as high.

We reviewed that and we are kind of going to change our risk rating on that. Our review now is even if you change the axial profile to move it towards the center, down or up, it's just going to change the values of where your high values -- or your highest temperatures are along the axis. It's not like you're putting more decay heat into the package.

So we feel that we conservatively erred initially in our rating and improperly calculated -- or not calculated but identified that as a high. We now think that item is low because it has no real overall impact on the overall heat rating of the package or the high temperatures associated with the cladding.

The second item had to do was in the materials chapter. And it had to do with periodic inspections. And they are talking about period inspections associated with inaccessible areas where we may require a one-time look over the life to assure that things are still adequate.

The other periodic inspection that is mentioned in this paragraph is the possibility of radiation surveys to ensure that the neutron shield material is still, you know, functioning properly. And those were rated as an M. So we're going to keep that rating and increase the rating of this item for periodic inspections in the materials section up to a medium rating based on that.

So the point being is yes, we shouldn't --

anytime we leave -- or answer question two and we have a low rating for the value of our review, where we are guided by a standard review plan, and we rate our review as low or very low, then we're going to go back and take a look at that. And we are proposing to tweak the procedure, the prioritization method to reflect that in its guidance.

And if there are no further questions on that, we'll go on --

MEMBER ARMIJO: So you loop around to make sure --

MR. PARKHILL: Yes, we're going to take another look.

MEMBER ARMIJO: -- if the consequences are significant, you loop around to see if the answer is still right. And if the answer is still right, maybe you've got to do something else.

MR. PARKHILL: Right.

MEMBER ARMIJO: Okay.

MR. PARKHILL: In the two cases that we came up, one of them we're going to keep the rating and the other we're going to bump it up. But that was based on our assumptions.

CHAIRMAN RYAN: So you really made it based on the criteria tools that you set up, the initial rating. And then you went back -- and let me say it phenomenologically to see if that made good sense.

MR. PARKHILL: Right.

CHAIRMAN RYAN: And you've ended up changing a couple and leaving a couple alone.

MR. PARKHILL: Right. Yes, we're making a commitment to change the process to always go back and look at those.

CHAIRMAN RYAN: Right.

MR. PARKHILL: And then when you go back and look, you're going to either say well, that decision was right or wrong or we're going to change it. And in one case, we decided that our initial assessment was incorrect for the risk rating for that axial profile.

CHAIRMAN RYAN: Okay. Good.

MR. PARKHILL: And the third question was -- and that's the risk assessment. And there was a concern where the risk question wasn't weighted equally as the two previous questions. We didn't go back and try to give it the same weight but I guess our perspective is even if you increase the rating to a one to a five, the same as the other ones, it's not going to really impact the results hardly at all.

And, of course, we would change our criteria for being high, medium, and low in that they also would be expanded by those two points.

MEMBER ARMIJO: You know, one thing I should have asked earlier is why didn't you have a very high in question three?

MR. PARKHILL: Oh, okay, well, that's kind of what we're trying to answer here was all the other ones go from very low --

MEMBER ARMIJO: Yes, yes.

MR. PARKHILL: -- to very high. And this one just goes --

MEMBER ARMIJO: To high.

MR. PARKHILL: -- yes, low to high.

MR. DAMON: Yes, I think if -- given that we may have a little bit of time here between now and doing this again on something else, my recommendation would be not simply to like stretch this one so it has a broader range of scores but rather to do something to actually inform that judgment about the risk impacts by some more quantitative information about if this is done wrong, you know, what kind of accident can happen.

So do something more quantitative. And then take all of the scores and calibrate them so they are all on an equivalent basis, which would mean to go from these numerical scores that are just sort of arbitrary to taking the logarithms of the probabilities so they are negative numbers then but they are all on the same basis. They are all tied to the same reality so that they will address exactly that point. They will all be equivalent.

MEMBER ARMIJO: Yes, well, you know, when you use a term like catastrophic consequences, I don't know how much higher you can go from a catastrophe so --

MR. PARKHILL: Well, that's why.

MEMBER ARMIJO: -- H, in my terminology, means very high.

MR. PARKHILL: That's why we have the quantitative measure there also. Basically, I wouldn't get too hung up on the words. You are looking at an item and you have a perception as to what you think the risk associated with that is in your mind, an experienced review is, is this going to be bad news or is this not going to be so --

CHAIRMAN RYAN: Well, thinking about it the way you laid it out here, really -- and I have no problem with the three in number three and the five in number one, that's fine -- but if you take out the magic words of catastrophic and moderate and all that --

MEMBER ARMIJO: Yes, I think if you just use the numbers.

CHAIRMAN RYAN: -- the numerical values can really do the job for you.

MR. PARKHILL: Okay.

CHAIRMAN RYAN: You don't have to give me a qualitative interpretation of that. It's either in the dose range or the risk range or it's not. It's one of the three, you know, or above it. So why do we need to call it catastrophic or modestly unwell or whatever name we come up with.

MR. PARKHILL: The answer is we don't.

CHAIRMAN RYAN: Okay. So I mean that way no you've got a numerical scheme for one and two and three and four.

MEMBER ARMIJO: And it is your professional judgment of your experts that says we can make a judgment that is going to be greater than ten to the minus three or 25 rem. And we don't do it in a quantitative -- using a quantitative methodology.

CHAIRMAN RYAN: And you kind of --

MEMBER ARMIJO: Yes, because that's where the next question is going to come up at the full

Committee.

MR. PARKHILL: I participated, not as an active member, but I was there for all of these panels that Ray went through each and every chapter. And it depended on the reviewer, on his perspective.

Some people didn't have a problem going high, medium, and low. Some people looked for, you know, the quantitative guidance over there to help them make that decision. But it's still the subjective experienced judgment of the person making that determination.

And then there were three of them and then they kind of hashed it out. So you weren't limited to one person making a judgment. So it was three people. And then they talked it over and came up with a, you know, final high, medium, and low on it.

MR. DAMON: And like I say, my view was to prove this is to do some more thinking about what would actually happen because some of the things that could, quote, happen are a little bit subtle like, for example, if something is done wrong in the design and analysis and they produce a package that actually will need to be repackaged to ship or something, where they didn't anticipate doing that, then what they're incurring may be the occupational dose due to having to do a repackaging.

So you need to think it through as to what are the real consequences to people if a particular thing is done wrong. And that's why I say that would be -- that would get us more value for our money than worrying too much about how we're doing --

CHAIRMAN RYAN: Yes, and, again, that's an example where just the numerical values in three give you that ability to it's either a low, medium, or high.

MR. DAMON: Yes, that's really -- what Ron was saying is when we ask a question about, you know, is the methodology okay or not, we really want to look at what is our bottom line. And where did we come out on this? And did it accomplish what we were trying to do? And --

CHAIRMAN RYAN: Yes.

MR. DAMON: -- you know, we're trying to get things into high, medium, low to sort of give a starting point for the staff on what to focus on.

And like in some of these -- the other questions about like number -- the one on -- we might be devaluing something, are we looking at the right things, this is really just -- the scoring in this SRP is just the starting point.

And there's, I believe, words in the SRP that we would put in there that says this is a starting point. Once you start looking into the actual case you are looking at, and you find things, and then you start deviating from this and you start weighting the things that you find that might be a problem more importantly than other ones.

And so this is like a starting point. And then you go into the process.

MR. PARKHILL: Yes, the user of the Standard Review Plan, the reviewer, needs to make a judgment whether this collective experience is really applicable to the design they are now reviewing. And if it is new, something new and innovative coming in, then all bets are off. You know it is going to be a very detailed look.

So I think we've covered those three.

CHAIRMAN RYAN: Okay.

MR. PARKHILL: Questions? And the -- another question that came out of the last meeting was there weren't any high priority items in the radiation protection and accident analysis chapters.

First I'll start off by saying medium isn't bad news. Medium is normal staff review. And they get a pretty good thorough review with that.

The radiation protection, I'll just try to generalize what Liz says. But basically the staff assures that the design can be used in a manner consistent with the radiation regulations there.

I mean it is a review of the programmatic or process. And the real implementation of the radiation protection is done in the field. You know we set up the guidelines that you commit to making these programs. And the implementation is with the licensee. And it's monitored by the people at our regions.

And so we do the front end of it to make sure it's, you know, the process is okay. And so that's kind of an explanation why, you know, you don't see any items there because we're buying off on a process that we viewed has been adequately implemented previously.

So we don't have any hard data coming back that says hey, somebody doesn't know how to set up a radiation process. If we did, some items would be high.

Accident analysis, I can see where there is a certain perception. Our standard review plan doesn't talk about specific accidents explicitly. It's done through that ANSI guidance, which describes the specific events.

So what our standard review plan does, and it talks about in the review procedures, it asks them to describe the cause of the event, the means for detecting the event, summary and consequences, and, you know, a corrective action.

So, again, it's the programmatic end that we're buying off on in the standard review plan. Now based on our experience, when they come in with an application, in the accident analysis chapter, they will follow the ANSI guidance. And what they'll have, you know, the off-normal events and the accident events.

But from our perspective in rating the things that are in there, we have good -- relatively good feedback that, you know, they are good at identifying all of the events that they should. They're not missing any. And they're analyzing them.

So that kind of meets the -- you know, that's why, from a programmatic standpoint, we don't have any bad feedback where we would cause the item to be bumped up to more than our normal review. And our normal review ain't that bad.

MEMBER ARMIJO: Well, the big difference I saw from last meeting was that in your -- when it's high, you do independent confirmatory analysis but you don't necessarily do that when it's medium. I think that's different.

MR. PARKHILL: That's part of the definition. But, again, it depends on a lot of ifs. How close they are to margins, you know how much time is -- okay.

MEMBER ARMIJO: Okay.

MS. THOMPSON: Ron, this is Liz Thompson. I'd like to add something here.

The independent confirmatory analysis that you may be thinking would be done under radiation protection are probably actually the ones done under the shielding evaluation because there aren't a lot of calculations in the radiation protection where we would have the information to do an independent confirmatory analysis.

MEMBER ARMIJO: How about criticality?

MS. THOMPSON: Criticality has its own review. That's, again, not covered under radiation protection. I think Michael Call can speak briefly to that.

MR. RAHIMI: Yes. Let me add that. To answer the question, generally yes. For the criticality, we do the independent, you know, calculations.

MR. PARKHILL: Whether it is medium or high.

MR. RAHIMI: Whether it is medium or high.

MEMBER ARMIJO: Just about everything in criticality is high or medium.

CHAIRMAN RYAN: And we think the other big area, I mean just to kind of pick on these, is three, there's structural, there's criticality, and materials. Those are the three where the action is. And when you combine medium and high.

MR. RAHIMI: Yes.

MR. CALL: Mike, if I could add something real quick?

CHAIRMAN RYAN: Sure.

MR. CALL: This is Mike Call. With the criticality, a lot of times -- well, not a lot of times -- when we're looking at the criticality evaluations, and we do the modeling, that also will encompass anything that may be changes to the cask conditions as a result of the accidents.

So if there are certain things that are part of the accident, you know, accident scenarios, those things will be analyzed and considered as part of the criticality review. So that anything that comes out into the Chapter 12 discussions with accidents wouldn't have an impact on what analyses have been done in the criticality review because those conditions would have already been considered as part of that chapter and any modeling that would have been done for that.

CHAIRMAN RYAN: Thank you.

MR. PARKHILL: Okay. So here is the summary that we showed you before. It doesn't reflect the one item we told you in materials that we were going to bump to a medium. So those numbers will change accordingly.

And if we could, I'd like to fast forward to -- I'm not sure where the slide is -- this was originally intended to all be in order.

CHAIRMAN RYAN: No problem.

MR. PARKHILL: Okay. Other issues from the previous ACRS briefing. There was a question regarding the linkage between the chapters. In other words, what other things we are doing besides the Figure X.1, you know substitute chapter number for X, that provides the interrelationship between that specific chapter and the other chapters.

And that's fairly detailed and can be a little confusing to somebody that's not familiar with the process. But if you take the radiation protection -- I mean if you take the chapters that we have in the standard review plan, and they're listed there, and next to each one of them is responsibilities of the reviewer as they go about this.

This is basically in-bred -- any one of the people that are doing the reviews, so if you pick the shielding area, besides them doing that review, there's also the interfaces that play into it from the other diagrams.

So there are certain chapters where there's a specific lead, structural, thermal, confinement, shielding, criticality, materials, radiation protection, and quality assurance all have specific people assigned with the lead responsibility for that.

There's other chapters where all the disciplines, including the project manager, need to look at them. So pick on shielding, for example, besides doing a shielding review or she doing her shielding review, would also look at the general description, the principle design criteria, the operating procedures, the accident analysis, the tech specs. So that's generally how we do it.

We have a figure that talks about the

interfaces. And then we have a team setup that complements that figure.

CHAIRMAN RYAN: Okay.

MEMBER ARMIJO: The reviewers -- let's say if you are going to be reviewing the criticality chapter, do you have -- does the NRC staffer have to have some sort of qualification or requirement or training or --

MR. PARKHILL: Depending on your age, yes.

(Laughter.)

MR. PARKHILL: Yes, there is a program, a formal program for qualification for that. Some people have been grandfathered.

MEMBER ARMIJO: Okay.

MR. RAHIMI: Yes, we do have a formal qualification for all discipline and even project managers that they have to go through the qualification program.

MEMBER ARMIJO: Okay.

MR. PARKHILL: Okay. We had another question. How do we ensure that the regulations are met? There's a table, not to confused with the previous figure but per chapter that defines the regulations.

What we had previously in the standard

review plan was just the listing of the regulations there without the statement of them. So this has been expanded a little bit. We try to identify the topic or area that the regulation applies to in the table. And, you know, that aids the reviewer when identifying items what to cite to and also ensures to see what we need to comply with.

There is a regulation that defines the regulations that are specifically applicable to a general licensee or certification of compliance holder that are applicable to this standard review plan. It also identifies the regulations for a specific licensee. And that would be the subject of the next standard review plan that comes through.

But there is -- that regulation says hey, here's the regulations that apply to a general license and also a certificate holder.

CHAIRMAN RYAN: This is just a point of information, Ron, or anybody, at a power plant location where the ISFSI is kind of co-located or nearby, I'm guessing there's a lot of overlap with the personnel that take care of the ISFSI.

How do they handle the programmatic aspects? Is there a completely kind of separate program for the ISFSI? Or is it the same people and they have, you know, overlapping procedures? Or how is that done?

I know they get two separate licenses so --

MR. LORSON: Right. You know, it is two separate licenses. The licensee needs to be able to maintain them separately. But they use their own existing site procedures as the framework for how they would comply with -- you know, for example, is there is a surveillance requirement as, you know, we looked at the casks earlier, verify the vents are clear on a periodic basis, that requirement, while it is coming out of their Part 72 license, and there would be a copy of that Part 72 license in the control room along with their Part 50 license with all their requirements and the technical specifications so the control room operator has, you know, immediate access to what, you know, the information is but, you know, the requirement to go out and do that particular surveillance test would be molded into typically their normal maintenance procedures.

And so the licensee would have one set of maintenance procedures with, you know, and the requirement to go out and do that test would be integrated into their site work plans and, you know, planning process and stuff. So they don't have two separate site organizations.

It is one site organization. And the requirements from this program would get morphed into and molded into those requirements.

CHAIRMAN RYAN: And somewhere in the management chain there is a check to make sure that everybody is doing everything from both licenses. And it's not one of these deals where --

MR. LORSON: Right, right. That would be part of their licensing assurance or regulatory assurance function to make sure that --

CHAIRMAN RYAN: And it's part of the QA function to make sure things get done under both licenses and so forth.

MR. LORSON: Exactly.

CHAIRMAN RYAN: And, again, I wouldn't -- I'm not offering the question as any kind of a hint or a criticism but whenever you have multiple licenses at one site, there is a coordination issue on meeting requirements, you know. It sounds like that is fairly straightforward for --

MR. LORSON: Right.

CHAIRMAN RYAN: -- an ISFSI added on to a power plant.

MR. LORSON: No, absolutely. And, you

know, you start to talk about some of these power plants that have operating units, an ISFSI and a unit under construction.

CHAIRMAN RYAN: Yes, there you go.

MR. LORSON: Okay, now they are operating under Part 50, Part 72, and, you know --

CHAIRMAN RYAN: Several others.

MR. LORSON: Yes, several others. So, you know, how do you coordinate those all. But at the end of the day, they need to have an integrated approach to ensure that they meet all of the requirements --

CHAIRMAN RYAN: Right.

MR. LORSON: -- for each individual area.

MEMBER SIEBER: I think most utilities have a planning and scheduling outfit that does that integration. That's all they do is put schedules today for the next week, the next month, and so forth.

CHAIRMAN RYAN: Sure.

MEMBER SIEBER: And they are responsible that everything is complied with.

MR. LORSON: Correct.

CHAIRMAN RYAN: And is that something that you get involved in at this stage of reviewing an application for a Part 50? Or do you pull that string when you --

MR. LORSON: It is something that gets looked at as part of the inspection process.

CHAIRMAN RYAN: But not in terms of the licensing process.

MR. LORSON: Not in terms of the licensing process.

CHAIRMAN RYAN: They make a commitment we're going to do it this way and that's either okay or not. And then you have to go into the inspection space to verify it?

MR. LORSON: Correct.

CHAIRMAN RYAN: Okay.

MEMBER ARMIJO: What is the inspection frequency or cycle time for an ISFSI facility by an NRC inspector, whether it's I guess a site -- people at the site -- is it a year?

MR. LORSON: Right.

MEMBER ARMIJO: Or two years? Something --

MR. LORSON: We have Jim Pearson here. He is a senior inspector in our group. Maybe he can field the question. The question is what is the inspection process or program for inspection of ISFSI.

MEMBER ARMIJO: The frequency.

MR. PEARSON: The frequency?

MEMBER ARMIJO: Yes, how often.

MR. PEARSON: The frequency may vary some depending on what type of activities are occurring. We perform reactive inspections if there are problem issues that would put us in motion or the regions in motion. The regions typically handle most of the Part 72 inspections with our support.

If it is a fabricator or a vendor, those inspections occur periodically which, right now, that periodicity is a three-year period.

In regard to -- I'd like to also add while I'm speaking is the quality assurance criteria that Ray and you were speaking of in regard to -- and management control as well -- but the quality assurance criteria is the same for Part 50, Part 71, and Part 72. So that criteria rolls across all those different areas and keeps things, I think, more in line, so to speak, as opposed to maybe even management differences.

CHAIRMAN RYAN: Fair enough. Yes. Thanks.

MR. CALL: Thank you.

MR. PARKHILL: Okay. And if there isn't any more questions, we'll go on to the public comments.

You had benefit, I guess, finally of our disposition of all the comments in Appendix D to the standard review plan. We got comments, public comments were received only from industry. We got 192 from NEI and we got 30 from NAC. And NAC's were mostly duplicative of the NEI comments.

Like I said, they were all dispositioned in Appendix D, identification of their comment, our response to it, and any changes we made to the standard review plan. We agreed with over 60 percent of the comments. So the public comment helped with the improving of this document.

And in the previous briefing, we went through chapter by chapter and discussed what we considered to be the major comments on a chapter basis. And so now what we'd like to do is just give you our view of what we considered to be the more significant comments, not to belittle the ones that aren't addressed but we have only a finite amount of time.

The first comment I'd like to address is the technical specifications were viewed by NEI to be too arbitrary. We don't agree with that. We felt that based on the diversity of designs plus the applicants' suggested content of the technical specifications have led to technical specifications that are really geared to a specific applicant.

So -- and not to close the door on the issue, we've left this item open for discussion with the industry at the dry cask storage forum. It's just that right now we're not taking any action in the standard review plan based on the comment and our experience with the different designs.

Second comment is in the structural area. I'll read it off and Dave can jump in here. Replace Reg Guide 1.60 because it is too seismically conservative and replace it with a NUREG guidance. We didn't agree with that. And we felt that the Reg Guide 1.60 should be still utilized.

MR. TANG: This is David Tang, Senior Structural Engineer.

On this comment, we noted that Reg Guide 1.60 is a broad-based general guidance which takes precedence over NUREG contractor reports. Okay. This NUREG deals with technical basis for revision of regulatory guidance on design ground motions, which was the first NUREG.

The next NUREG deals with parametric evaluation of seismic behavior of freestanding dry cask storage systems, which was accomplished many years ago. And we thought the Reg Guide 1.60 still should govern. And that is the basis we said there shouldn't be any change about this based on these comments.

The next general comments we found of importance was the structural analysis, as noted, should have allowed the use of elastic-plastic and other non-linear analysis method as permitted by ASME Code Appendix F, so to speak. And, again, as noted, this is only part of the comment.

The second part of the comment, which is not captured in this particular bullet, deals with allowing the strain-based criteria to be used. Nevertheless, we agree that say the elastic-plastic and other analysis method, as captured in the code, of course has been considered already.

But the second part dealing with strain-based criteria, which hasn't been really recognized by the code. And for that purpose and like any other say method that we continue to have the position, if the applicant proposed to use strain-based criteria, we are going to consider it on a case-by-case basis. So those are the general --

MEMBER ARMIJO: Was that related to something like a drop analysis and deformation of a canister or something like that? Would that be the topic? Or was it related to the fuel itself?

MR. TANG: Correct in that sense. We talk about energy-based driving say function as versus say forced-based driving -- driving force or displacement driving force. For that matter, I think up to this point, the energy based say drop events dealing with handling of casks within the reactor buildings or on the ISFSI pad, generally the challenge has been rather mild relatively speaking.

I think what aroused the interest of the applicant or for us was, for instance, in the private fuel storage licensing part, it has been identified that say aircraft crash, which would cause the large deformation in say high strain activity demand for the canisters. So that was the starting point.

But, of course, in preparation for say Yucca Mountain licensing event, there could be some events which would still count on the -- say still count on the say strain-based criteria. Of course, it's not going to be the case any more because of say Yucca Mountain say current events.

MEMBER ARMIJO: Thank you.

MR. TANG: Okay.

MR. PARKHILL: Okay. The next public

comment was had concerned the level of detail, specifically time steps being sufficiently small in the models that we are looking at. And they felt that they were too detailed and recommended, I guess, not being included in the standard review plan as guidance.

We feel that we disagree with that respectively, feeling that the level of detail depends upon the specifics of the application.

And Jorge, do you want to add anything to that?

MR. CRUZ: No.

MR. LORSON: I think, in essence, the standard review plan is our guidance to our staff in terms of the things we want them to consider when they evaluate applications. So the better tools that we can give to the staff with the more detail regarding how to conduct the reviews and the types of questions they should be thinking about and asking, we think is within our interest.

That's not to say that we are imposing a requirement on the industry but we want to make sure our staff have the best tools available to do the review.

MR. PARKHILL: And the last comment we

chose to present here had to do with the industry's concern on the release fractions for damaged fuel. We have some data that is out there that gives specific numbers. And we don't -- they are requesting to use that data for damaged fuel.

We disagree with that. The data that we have that supports those release fractions is based on a single rod and a single failure, a split in that one rod and the release fractions associated for that.

For damaged fuel, we don't have any supporting data. And so we're erring to be conservative and recommend that they generally go to a leak-tight criteria for determining -- I mean for the design of the cask. So they have to test it up to ten to the minus seven standards there.

It's also noteworthy to point out that a lot of the canisters are now pressurized, which would provide a driving force. And accident fuel fractures could also contribute to the source term.

That's all we had to present here. We chose to present the ones we disagreed with. Last time we presented public comments where we both agreed and disagreed. And, again, we got a lot of comments that were incorporated and have added to the value of the -- oh, it's not all the public comments here.

CHAIRMAN RYAN: I think you accepted quite a large number of comments, too, if I recall. But we'll get to that in a minute. Go ahead.

MR. PARKHILL: Yes, well, it was 193, as we said, from NEI, and 30-some from NAC.

The next comment has to do with delete the dose rate limits from the technical specifications. We disagree with that because that's one of the few measurable items that we have to ensure that the cask is performing as designed and fabricated.

The next public comment, and I believe this is the last one, yes, delete measurements to confirm assembly burnup values. We are not recommending a change with that because that with burnup, we feel that it needs to be measured and not just calculated when it comes to giving them some relief.

MEMBER ARMIJO: What --

MR. LORSON: Sorry?

MEMBER ARMIJO: These are calculations, right, in both cases. I mean they don't have a --

MR. PARKHILL: Well, we're recommending measurements for burnup if they come in and they want to use burnup. But I'm going to let Michael Call field this question.

MEMBER ARMIJO: Yes, also tell me how these things would be measured.

MR. CALL: Well, my name is Mike Call. The comment here particularly deals with the incorporation of guidance that was in an ISG related to burnup credit. And for burnup credit, of course, as we have it right now, all the systems that we have that are licensed under Part 72 for storage do not relay on burnup credit.

They, for criticality purposes, assume that the fuel is fresh fuel or unirradiated fuel in which case there is no recommendation in the guidance for a confirmatory measurement of the burnup. However, if they need to burnup credit as far as there are certain limits in the guidance regarding the minimum burnup limit an assembly would need to have, and that's depending upon the analysis that's used for the burnup credit.

And as far as part of the loading operations, there would need to be a way to verify that the assembly itself meets those parameters. And for meeting the minimum burnup, there would be some type of verification measurement.

Now what that would entail, I'm not familiar with all the different methods but I do know of something along the lines of a fork detector where you have a signal that comes out and based off the signal which you would have that detector would be calibrated using measurements of assemblies with known burnups and from the signal that you measure for an assembly with a known burnup, you would use that calibration to pretty much do a check to see that what you've got is actually in the burnup range that your records say that it is.

So it is kind of like just a check to say this assembly is where it needs to be, yes. We've got the right one. We can go ahead and load it.

MEMBER ARMIJO: So this is a physical measurement. This is not an --

MEMBER SIEBER: Radiological --

MEMBER ARMIJO: -- independent calculation. It's not the utility's tracking of burnup. I mean they have a pretty sophisticated process for knowing the burnup of their assemblies.

MR. CALL: Yes.

CHAIRMAN RYAN: So really this is all based on making sure that the fuel element you think you have is the fuel element you actually allow.

MR. RAHIMI: That's correct.

MEMBER ARMIJO: Well, that's a loading

error kind of mistake. But, you know, I think --

MR. CALL: See one of the things that we --

MEMBER ARMIJO: -- it surprises me that you don't have -- if we permit the utilities to operate reactor cores based on their calculations of what the burnup is and what the power is, we would have some confidence that the burnup is what it is after it is out of the reactor. And you wouldn't require a separate measurement of some sort.

If it was easy to do, I'd say fine. That's a rational thing to do. But if it is very difficult --

MR. RAHIMI: Let me add something to that. Yes, you are absolutely right. Right now what -- they're loading based on the reactor records, you know, what their burnup has been signed through, you know, the fuel management code they have and the core power, that's how they are assigned.

MEMBER ARMIJO: All of our accidents and everything.

MR. RAHIMI: You are absolutely right. That's how each assembly burnup has been assigned. And they are using those records as part of their, you know, check confirmation to put into the cask.

But, you know, we have seen over the years some errors in terms of loading with respect, you know, to other parameters, you know, burnup and cooling time --

CHAIRMAN RYAN: Loading what? Loading these casks?

MR. RAHIMI: It has varied from misplacing the fuel rack but also included some, you know, loading into the cask. And we do have actually specifically, you know, in the Reactor Event Database, you know, those are reported, some of those mis-loads.

So what we have put in the SRP in case that they want to go -- they want to use burnup credit as a design basis, at this point, all the applications we have received and we have approved, they have not taken credit for burnup for storage because during loading, they rely on the borated water in the pool as part of one of the parameters for criticality control.

Once on the storage path, they assume sort of a moderate exclusion. The water does not get in.

MEMBER ARMIJO: The BWR guys don't put boron --

MR. RAHIMI: Right. In the BWR, the design is in such a way they neither need boron nor burnup credit because of small assembly in terms of criticality, less reactive.

So mainly on the PWR, so far, in all the applications we have been received and approved for storage, they haven't invoked burnup credit. But under transportation, it is a different story, you know, they do have burnup credit.

So what we have put in the storage SRP, in case they want to go after burnup credit, because on the transportation we have Interim Staff Guidance, and we have approved burnup credit design for transportation.

MEMBER ARMIJO: Have you approved a test methodology, short of a bundled gamma scan, that is acceptable to demonstrate burnup credit? Burnup is -- is there a way to do it? You know, that's what I'd like. I know how to do it the hard way but is there a practical way --

MEMBER SIEBER: Is there a radiological measurement using gamma?

MEMBER ARMIJO: Yes, well, you can do bundled gamma scans.

MEMBER SIEBER: It's a pretty simple thing.

MR. RAHIMI: Yes, as Michael pointed out, there are instruments, and he mentioned fork detector

--

CHAIRMAN RYAN: But wait a minute, you're making a gamma ray measurement on inventory of fission product gamma ray in the fuel and you're calculating what the burnup has to be to get that gamma ray profile, correct? You're not measuring burnup in any direct way at all.

MR. RAHIMI: We don't. You're right. We do not measure burnup. Yes.

CHAIRMAN RYAN: The next question I'll ask is what is the accuracy of this measurement and the accuracy of the back-calculation to burnup?

MR. LORSON: Well, and I think, you know, the answer to that -- and I'll let Zhian give you the accuracy if he knows it -- but that would be something you would do in addition to all of the reactor records and administrative controls you have.

CHAIRMAN RYAN: Yes, yes, yes, that's not my question. I want to stick with my question.

MR. LORSON: Okay.

CHAIRMAN RYAN: I'm asking what is the precision and accuracy of this measurement and calculation?

MR. LI: That's a really good question.

CHAIRMAN RYAN: Thank you.

(Laughter.)

MR. LI: As a matter of fact, it is a complicated process.

CHAIRMAN RYAN: That means it is probably not real accurate maybe.

MR. LI: I think the report, the AEI report says it is pretty accurate, five percent within.

CHAIRMAN RYAN: So I'm within five percent of the burnup, what's actually there if I make this measurement and calculation?

MR. RAHIMI: Basically -- go ahead, you finish.

MR. LI: Yes, they call it the fork detector. It's like a fork. It goes up, down, along the fuel assembly.

CHAIRMAN RYAN: Sure, sure, no, I appreciate that.

MR. LI: So I think based on the curium-244, the neutrons spectrum, that's the detector, the fundamental basis.

CHAIRMAN RYAN: Okay.

MR. LI: And then, of course, they have a kind of a calibrate the detector itself for a known burnup fuel.

MEMBER ARMIJO: So we have to have a standard of some sort.

CHAIRMAN RYAN: They have to have some fuel rod they've picked out and examined and said that's the reference check source.

MR. LI: Right. Yes, the reason I said it's complicated is it is based on a known burnup fuel. That's the complicated part.

MEMBER ARMIJO: And there is no methodology where you can take the calculated burnups from the reactor and put a margin on it? It's a well, maybe you're -- we'll put 50 percent margin or some big number and still allow burnup credit?

MR. LORSON: Yes, we have a separate activity we're working on with the Office of Research, okay, where we are basically taking a look at what have been the fuel mishandling or mis-load events that have occurred, you know, because now we have a population on our database so we're trying to assign kind of using a probabilistic type of argument to see whether or not we can make any adjustments to the need to do some type of independent measurement verification.

And I think there will be a number of factors. One is what is our historical mis-load data, okay. Two might be what is the licensee's population of fuel in terms of enrichment, predicted burnups, and things of that nature.

So the idea would be to come up with some type of, as we develop our ISG, which you'll see, you know, probably early next year, in working with Research to see if we can come up with some kind of definitive better way to do this absent a direct measurement. And I think that's one of the things that is ongoing.

With respect to the standard review plan, you know we write the guidance based upon kind of the rules and practices we have in place.

MEMBER ARMIJO: Yes.

MR. LORSON: It doesn't mean that it is, you know, that we're not continuing to, you know, try to push the envelope and expand into areas where we can make improvements and enhancements. So a lot of these comments speak to things that we are currently working on in the enhancement area. It's just not -- this is not the right time to put it into the SRP.

CHAIRMAN RYAN: But is it the right time to have the option in the SRP?

MR. LORSON: Well, once we complete the User Need from Research, it gives us the technical basis for why we --

CHAIRMAN RYAN: You know what I'm hearing is there is a measurement that is currently available to do burnup credit assessment. There's also a huge amount of records and all the rest dealing with the fuel that's in the fuel pool.

So the real question I'm wrestling with here is what does this added measurement give me in terms of controlling individual fuel elements that ultimately end up in a bundle? Because I could make the fuel loading mistake after I make all these measurements.

MR. DAMON: I mean my impression from having been involved in this research project is that the primary reason for the verification is not the accuracy or inaccuracy of the determination of burnup. It is mis-loading.

MEMBER ARMIJO: That is a different issue.

CHAIRMAN RYAN: That is a different issue. We're putting mis-loading and burnup in the same bucket. I don't understand that.

MR. DAMON: They are different. Burnup is mentioned because it all ties together. You have to know well if I do a mis-load, how much of a mis-load do I need before I get in trouble.

CHAIRMAN RYAN: But the root cause here is the mis-load.

MR. DAMON: Yes.

CHAIRMAN RYAN: So I think the focus should be on how do you prevent mis-loads. Not how do you measure burn-up.

MEMBER ARMIJO: And Jack wants to say something. We keep interrupting.

CHAIRMAN RYAN: All right. Go ahead, Jack. Sorry, Jack.

MEMBER SIEBER: I agree that 90 percent of the purpose is prevention of mis-loads. But if you take fresh fuel all the way to the spent fuel storage system, there are four opportunities to make a mistake as to where the fuel is located in the reactor, when it was discharged, was it placed in the right place in the spent fuel pool, and so on.

And really what this verification is is a verification that you have the right assembly and you know what it is.

MEMBER ARMIJO: But that could be done by --

MEMBER SIEBER: It is not as accurate as the burnup calculation that the physics guy would do. It's not as accurate.

MEMBER ARMIJO: But they're all numbered, Jack. They have readable numbers.

MEMBER SIEBER: I understand that. I also worked in a power plant and I know what goes on in power plants, okay.

MEMBER ARMIJO: Well, you've got to get guys with better eyesight.

MEMBER SIEBER: Yes. I like their way of doing it myself.

MR. LORSON: I like Jack's comment.

(Laughter.)

MEMBER ARMIJO: You know I don't think you should tie burnup credit with mis-loading errors. I think they are two separate issues. And burnup credit, it always made me wonder why we couldn't -- if we can credit that we know the burnup in an assembly to operate a nuclear power plant and to do all the accident analyses and everything else, why can't we have some confidence that a burned-up fuel was burned up partly and throw some margin on him and give him some partial burnup credit separate from the issue of mis-loading.

That's a different thing. They have to be able to verify that the right assembly is going into that canister. And that's not a physics problem.

That's mechanics.

MR. LORSON: Right. And I think that's, you know, what our ISG will attempt to address. And we're still doing the research relative to, you know, address that point.

CHAIRMAN RYAN: Well, why try and cast the rock into the wall here now doing this, you know?

MR. CALL: Well, the thing is, my understanding is that of course with the analysis, now we have certain parameters. And part of the tech specs are what are the parameters to verify that the contents that you actually put in meet the parameters that were designed for.

And that is where with burnup credit, we didn't have to worry about a minimum burnup because the assumption was fresh fuel. Now that we have a minimum burnup with various other reactor operations parameters --

CHAIRMAN RYAN: That's not the question now. The question is by what method do we make that burnup credit determination. And what you're hearing, I think, from Sam and me is that if you have the pedigree on where and how long it has been in the core and it is discharged, and you know you are matching up that fuel element with the records, you know that.

The added measurement doesn't give you anything extra except maybe some verification with some uncertainty band that yes, that number is okay or within some bounds.

MR. CALL: It proves with certainty that you haven't had a mis-load.

MEMBER SIEBER: You don't care whether you've got the right assembly or not if you don't take credit for the burnup.

MR. CALL: Right. Right.

MEMBER SIEBER: So you can make the mistake. So to me it is pure logic.

MEMBER ARMIJO: Well, you always are going to be wanting to know that the right assembly is loaded into the canister whether or not you have a burnup credit. I would think that the requirements wouldn't be so loosey-goosey. Throw anything in there you want because we're not giving you burnup credit. I can't believe that.

MR. RAHIMI: Yes, yes, we record the decay time, enrichment, you are absolutely right. You've got to make sure you pick out the right assembly.

But I do want to stress the fact, Dr. Ryan, you are absolutely right that the reactor record is the record that we rely on for burnup. And all these devices that we're talking about burnup measurement, it doesn't even measure the burnup.

It is a correlation of the neutron and gamma to the reactor record. What you do, you do a bunch of measurements. You say are the correlating? You do not measure burnup because you cannot measure the burnup.

CHAIRMAN RYAN: But, see, in the same way Jack's sees the hand-offs and the discharges of a fuel element as having some potential for, you know, mis-locating it and then getting confused on which one is which, I see this measurement thing as an opportunity where I'm running measurements up and down a fuel element underwater and, you know, there's lots of opportunities to have goof-ups there, too.

MEMBER SIEBER: That's okay.

CHAIRMAN RYAN: That's okay?

MEMBER SIEBER: Because you are going to get a result that is indicative of a burnup similar to the one you think you have, okay?

CHAIRMAN RYAN: Well, it is a proof-positive measurement for that fuel element. And, again, I'm skeptical about what proof-positive really means. But I mean what is the error uncertainty in it.

PARTICIPANT: It's interesting. You guys see three different views.

MEMBER ARMIJO: Okay, well, look, that's really Technical and Research and all that. But I see two issues. And I think it is clear that you do, too, and you're working on that. I just wanted to speak my piece on it.

CHAIRMAN RYAN: And, Sam, I agree with you. I think it's not clear in this document how it will end up because it is work in progress. It's going to come later in an ISG.

I guess what I'm reaching for is there any way to avoid another ISG and get it in this one?

PARTICIPANT: Well, probably not. It's not ready yet.

PARTICIPANT: We're not quite there yet.

MEMBER ARMIJO: Is that a fair conclusion on my part?

MR. RAHIMI: Yes.

MR. LORSON: The one thing I would like to address is, you know, the question regarding burnup in the reactor, we rely upon these burnup records for how we manage the core at-power. But there is a difference in that when you are operating a reactor, you have, you know, flux measurements typically within the reactor. It's being actively monitored. You are continuously computing and evaluating your thermal performance.

Once you put the fuel assembly into a storage container that may be later transported down the road, you really rely upon all the up-front quality controls to make sure that what you have in there, there's no further opportunity to do monitoring.

MEMBER ARMIJO: You know, I don't know how all the different PWR fuel designs are marked but in the BWR, it's very -- you know, we have material numbers. Yes, you know, to me that's how you know what assembly you are dealing with, whether it is in the core or whether it is in the fuel pool.

And if you make that verification, and you have all this reactor operating information, you know the burnup.

CHAIRMAN RYAN: One thing that would be helpful, I think --

MEMBER ARMIJO: And so to me they are two different kinds of problems.

MR. LORSON: If I could just address that point, you are right, the serial numbers, the bundles are serialized, okay, and, you know, maybe Jack has looked at a bunch of these and I certainly have. You can't always read the serial numbers all that well, okay.

MEMBER SIEBER: If they are under water.

MR. LORSON: Underwater, remember you're looking at it through a camera under 40 feet of water.

MEMBER ARMIJO: Then that is a mechanical problem to figure out how to read the serial numbers properly with high confidence. And that's a different problem than the physics problem of measuring some gammas coming off and comparing it to a standard and everything else.

CHAIRMAN RYAN: And I guess maybe the take-away message --

MEMBER SIEBER: That's just a quality control check.

MR. LORSON: It's a quality control check and you also have to rely upon your fidelity of your accurate records, right, and occasionally you can get, you know, serial numbers can, you know, be transposed perhaps in a database.

MEMBER ARMIJO: Well, with old fuel, really old, old, old fuel, I agree with you because there was a lot of things that went wrong. But I think with the more modern fuel, and I'm talking about the last 20 years, you should have really -- maybe you have more experience and you can tell me about all the mistakes.

MR. LORSON: Well, we just get the reports when the mis-loads occur. And so we say gee, you know, given that they have serial numbers on the handles and given that, you know, they have these databases and it's, you know, within the last 20 years, why do we have assemblies that are still not in their right location?

MEMBER ARMIJO: But that's what they've got to fix. Right? That part.

MR. LORSON: And this is just kind of an additional quality control check, if you will, to make sure that we don't put the wrong assembly in the cask.

CHAIRMAN RYAN: I think that it would be helpful to somehow describe this in the guide, that this is a combination of two things. It's not just verifying what fuel element goes into a storage unit. It's -- and we're doing that by this radioactive material measurement or gamma ray measurement, there is a fuel- handling question that you are also integrating into this. And mis-loads is part of what you are addressing and not just burnup.

So I think, at least for the user, it

would be very helpful to add some discussion that you are addressing the possibility of mis-loads getting to the fuel canister as well as a radiological condition in the burnup.

MEMBER ARMIJO: If there is a really big benefit, I would think that the utilities and the guys that are in this cask business would develop methods that give you confidence that they will load the right assembly into those casks. And so that they can get some credit, if not 100 percent burnup credit, but something based on high quality reactor data.

And so the guidance would help them focus their R&D efforts to say hey, we have these super-duper microscopes and jacks -- we can examine fuel in great detail in a pool. We ought to be able to read serial numbers on the handle of an assembly.

CHAIRMAN RYAN: And I can tell you that's --

MEMBER ARMIJO: If there is any question there at all, just having this conversation in the standard review plan might give people the heads up that if there is any chance whatsoever that you are reading a three as an eight, you'd better think again.

CHAIRMAN RYAN: Because, you know, then maybe something where there is some identification question, you can route it to the measurement. I don't know you could put it together in some way so it might work a little better.

MR. LORSON: So we'd only do it in the unusual cases or where you are not absolutely sure.

CHAIRMAN RYAN: Perhaps. I'm just throwing that out as an idea to kick around.

MR. LORSON: Right.

CHAIRMAN RYAN: But, you know, I think the take-away part for me is that there are two issues here. There's not just one. It's not just measuring and verifying burnup. It's making sure that you are actually measuring whatever you are going to measure, if you measure it at all, on the right fuel assembly that you are going to put into the storage unit. So there's a mis-load question as well as the burnup question.

MR. LORSON: Right.

CHAIRMAN RYAN: Okay.

MR. RAHIMI: So we might call it loading verification as opposed to burnup verification.

CHAIRMAN RYAN: Yes. Right. Or both. Loading and burnup verification. Why not?

MEMBER ARMIJO: I am getting the impression from the conversation that if you could be certain that you knew which assembly that you had the right assembly, you would have far less concern about getting -- allowing a burnup credit even if you threw some margin on it , you know, and say well, you think it is 60,000, we'll give you credit for 40,000 or something.

CHAIRMAN RYAN: Right.

MR. PEARSON: This is Jim Pearson. Could I add just a couple of things here?

CHAIRMAN RYAN: Sure.

MR. PEARSON: And maybe Dennis can speak to this if he needs to when I'm finished.

We started down this road some years ago with the cask-drop HRA. And I know that two issues creep into this. And one is fatigue of the handler and also the other one is complacency.

And those are two things that are really hard to eliminate because each of us is different for one particular reason. And I know that those two items would be -- would enter into this assurance area.

MEMBER ARMIJO: Well, you know, I think that's where you go to machines to do that instead of your eyeballs, you know. A character reader that compares what is supposed to be there with what is being seen under the periscope in the pool.

And if it doesn't match, you've got a potential error. And it isn't some guy straining his eyes at three o'clock in the morning to make sure that he knows that assembly he is moving.

But I think that is a technology problem that is really mechanical. And not physics.

MR. LORSON: And I think, you know, as we complete the research and develop the ISG, we'll be able to answer some of those questions a little better.

MEMBER ARMIJO: Well, the burden on the vendors to come up -- if they know that is the problem, to come up with a solution that the staff can have confidence is reliable.

CHAIRMAN RYAN: Okay. Thanks. That was a good discussion.

Anything else?

MR. PARKHILL: Well, I'm ready for a summary of why we're here.

MEMBER ARMIJO: Can I just raise one more question as long as I've got the experts here? There was somewhere in the commentary about the allowance of convection -- cooling by convection outside of the canister but not within. Is that -- did I misread that? Or misunderstand that you allow thermal convection once it is in the over-pack and sitting out? But you don't allow it within the canister? Or did I misunderstand that?

MR. SOLIS: Yes. Actually, yes, they take credit for both, internal and external.

MEMBER ARMIJO: Okay.

MR. SOLIS: But there was -- the SRP was confusing.

MEMBER ARMIJO: Okay. Okay. Because I was wondering how you can turn convection off inside a vertical --

MR. PARKHILL: Earlier designs did not design for it. So they didn't have enough, you know, space plenums to allow it to happen.

MEMBER ARMIJO: Oh, you're right.

MR. PARKHILL: Yes, so --

MR. SOLIS: But they were not using the correct tools, analytical tools.

MEMBER ARMIJO: Okay. But if they have the correct analytical tools, they can use that?

MR. SOLIS: Yes.

MEMBER ARMIJO: Okay.

MR. PARKHILL: So what have we been doing to this 13-year-old standard review plan that has been in use? We've incorporated roughly 25 ISGs. We've updated it to reflect the current practices that are in place. We've added a new materials chapter, which isn't really new. It's just consolidating the materials review in one place.

We've prioritized the review procedures sections of each chapter to aid in the specific reviewer's ease in looking at what is important or more important versus less important. And we've resolved a bunch of industry comments, a large percentage of which we agreed with.

And we think we improved the overall safety focus of our review process. And we're hoping that we'll still go forward here in the main Committee on May 6th. We looking for issuance of this guidance in June as Revision 1. And we're continuing to work on the sister document for storage facilities.

CHAIRMAN RYAN: Great. See you on May 6th.

MR. PARKHILL: Are you supposed to give us some feedback now?

CHAIRMAN RYAN: Well, I thought the last half hour covered that pretty well.

(Laughter.)

CHAIRMAN RYAN: Well, let me ask if there are any comments.

Jack?

MEMBER SIEBER: No, expect to say that I think the staff did a great job. And I think you have a good standard review plan now. And I have no comments that would require any significant change to the document.

MR. PARKHILL: Great. Thank you.

CHAIRMAN RYAN: Sam?

MEMBER ARMIJO: I agree with Jack. I think it is something that needed to be done for a long time. I think it puts everything that an applicant really needs to know, not just the staff but, you know, an applicant, of how to deal with these issues.

And I think it is a good job. You know I have some quibbles about -- I'd sure like to see some assurance like a surveillance that says that they're still reading those casks even though it's a low probability that a big leak hasn't occurred. But it would be so easy to assure it with periodic surveillance. But that's sort of a quibble.

CHAIRMAN RYAN: And, again, I want to thank you all for a great presentation today. It was very responsive to our earlier meeting. And you addressed the number of points we had raised previously in our first preliminary Subcommittee meeting. So I appreciate that.

And, you know, other than this one last little thing that you probably will think about between now and May 6th some more and at least articulate, you know, what the issues are that you are putting forward, maybe either address them in some way or lay them out clearly in this version of the SRP, that would be a welcome discussion for the May 6th meeting.

But I think we're -- I agree with my colleagues. It is a very thorough and well done standard review plan. So great update.

MR. PARKHILL: Now we're still scheduled for one hour, which means a half-an-hour presentation on our part, right?

CHAIRMAN RYAN: Yes.

MR. PARKHILL: Okay. So that will factor into what we can present.

CHAIRMAN RYAN: May is jam-packed.

MR. PARKHILL: Okay.

CHAIRMAN RYAN: I will take that as an appreciation for the fact we've worked over a lot of issues that you can cover in the full Committee meeting as having been addressed with the Subcommittee and so forth.

MEMBER SIEBER: And you can have confidence in our opinion because neither Sam nor I have ever made a mistake.

(Laughter.)

MEMBER ARMIJO: Jack has made several. I haven't. Just to correct the record.

CHAIRMAN RYAN: Anyway. Thank you very much. Any other comments, gentlemen?

MR. LORSON: Thank you. I think the comments and the discussion have been very productive. And we've taken them back and it has helped us make the product better, which I think is in our common interest. So we appreciate it.

CHAIRMAN RYAN: So with that summation of great work, if there's no objection, we'll adjourn the Subcommittee meeting.

(Whereupon, the above-entitled Subcommittee on Radiation Protection and Nuclear Materials was concluded at 11:43 a.m.)

Updating the Standard Review Plan for Dry Storage Systems (NUREG-1536)

Briefing for the ACRS Subcommittee of Radiation Protection & Nuclear Materials

Division of Spent Fuel Storage and Transportation
Office Of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

- April 21, 2010 -

Opening Remarks

Raymond Lorson, Deputy Director
Meraj Rahimi, Acting TCB Branch Chief
Technical Review Directorate
Division of Spent Fuel Storage and Transportation (SFST)

February 17, 2010 ACRS Briefing

- Revision to NUREG-1536, Jan 1997
- Dry Cask Storage Background
  - Division of Spent Fuel Storage and Transportation
  - Typical Dry Cask Storage Operations
  - Regulatory Basis and Design Basis
- Std. Review Plan (SRP) Update Project
  - Overall Project Approach
  - Prioritization Method
  - Key Revisions to SRP per Chapter
  - Key Stakeholder Comments per Chapter
- Changed SRP based on ACRS input
  - Replaced “Risk Informed” with Prioritized
  - Identified Polymeric Neutron Shielding Materials as Important-To-Safety

Purpose

- Continue briefing on the update to the standard review plan (SRP) for dry storage systems
  - Discuss carry over items from prior ACRS briefing (2-17-10)
  - Public Comments (only industry submitted)
- Identify areas of interest for future interactions with ACRS on the final SRP

Today's Presentation

- Items from Feb 17, 2010, Briefing
  - Prioritization Methodology (Dennis Damon/Ron Parkhill)
  - Radiation Protection (Elizabeth Thompson)
  - Spent Fuel Oxidation (Robert Einziger)
  - Damaged Fuel (Robert Einziger)
  - Interim Staff Guidance (ISG) 25 (Luis Cruz)
  - Other Issues (Ron Parkhill)
- Public Comments
  - Key Stakeholder Comments (SFST Staff)

Prioritization Methodology

Dennis Damon,
Sr. Level Advisor for Risk Assessment, FCSS
Ron Parkhill, Sr. Mechanical Engineer, SFST

Prioritization Methodology - focuses staff resources

- Focuses staff resources by assigning high, medium or low to items in the Review Procedures
- Standard Review Plan Chapter Structure
  - Review Objective
  - Areas of Review
  - Regulatory Requirements
  - Acceptance Criteria
  - Review Procedures (Prioritized)
  - Evaluation Findings

Prioritization Methodology

(1) Likelihood that requirement will not be met	**VH**=4, likely to occur, P>.5 **H**=3, Probably will occur, 0.1< P < 0.5 **M**=2, May occur, 0.03< P< 0.1 **L**=1, Unlikely to occur, 0.01<P< 0.03 **VL**=0, Occurrence improbable P< 0.01
(2) Likelihood that staff review will find the discrepancy	Same as (1)
(3) Risk if requirement not met	**H**=3, Likely to occur or catastrophic consequences, $>10^{-3}$/yr or 25 rem to worker or 1 rem to public **M**=2, may occur or moderate consequences, $<10^{-3}$/yr but $>10^{-5}$/yr or 5-25 rem to worker or 0.1-1 rem to public **L**=1, Occurrence improbable or marginal consequences, $< 10^{-5}$/yr or less than 10CFR 20 dose limits for workers & public
(4) Add scores from (1), (2) & (3) to get combined Risk score	**High** is 9 to 11 **Medium** is 6 to 8 **Low** is 1 to 5

Prioritization Methodology (Cont'd.)

(5) Determine Defense in Depth- a review procedure impacts DinD if it provides a back up to the first line of defense (e.g. confinement is back up to cladding integrity)	If failure to perform a review procedure could impact DinD (assuming front line safety measure has failed) and has -a low, medium or high likelihood and/or consequence, then the item should be a low, medium or high, respectively -Same as (3) for low, medium or high Note most SRP review procedure items don't have DinD
(6) Determine which controls (or is more important) DinD (Step 5) or Risk (Step 4)	Assign controlling rating from DInD or Risk

Related Subcommittee Comments from April 17th briefing

- Uncertainties in PRA not addressed
- Question #1 devalues places where the applicant has made mistakes
- Question #2 when low, should we look to see if we are reviewing the right things?
- Question #3 isn't weighted equally as two previous questions.

Why no High Priority Items in Chapters 11 & 12?

- Medium priority means normal staff Level of Effort
- Radiation Protection Chapter 11
  - Staff assures that the design can be used in a manner consistent with 10CFR Part 20
  - Licensee implements radiation protection program with regional inspection oversight
- Accident Analyses Chapter 12
  - ANSI/ANS 57.9-92 describes specific events
  - Review procedures address
    - Cause of event
    - Detection of event
    - Summary of event consequences & regulatory compliance
    - Corrective course of action

Summary of Prioritization Results

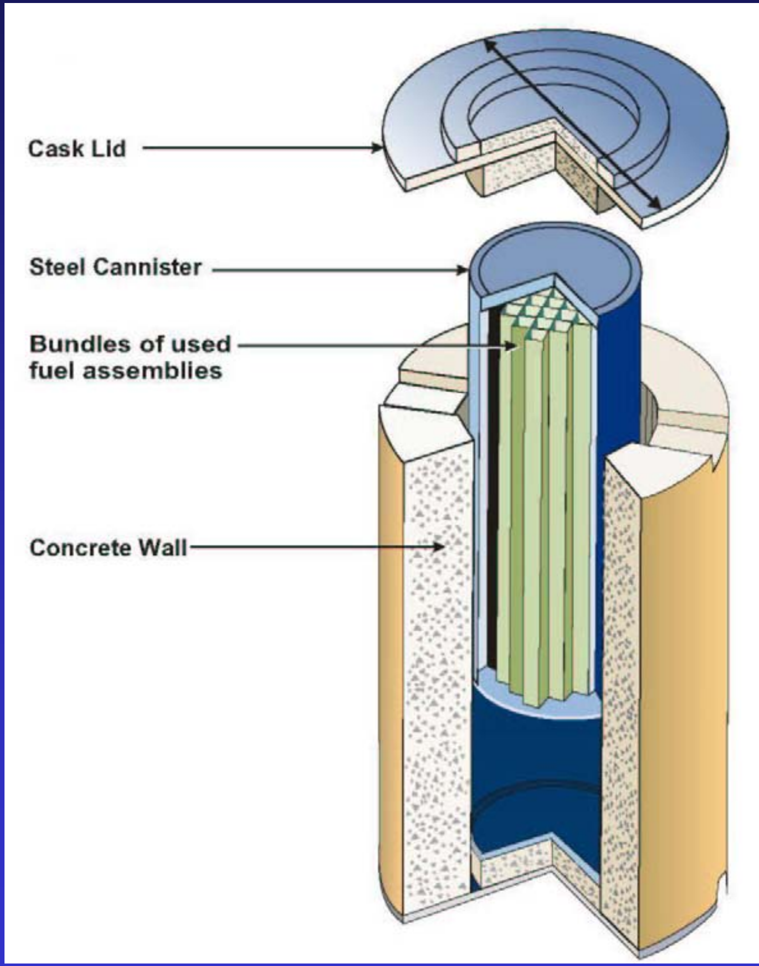
Chapter	HIGH	MEDIUM	LOW	Total
1) General Info	----	4	----	4
2) Principle Design Criteria	----	4	1	5
3) Structural	6	13	7	26
4) Thermal	6	7	5	18
5) Confinement	----	5	2	7
6) Shielding	5	3	----	8
7) Criticality	11	3	1	15
8) Materials	7	12	8	27
9) Operating Procedures	2	5	4	11
10) Acceptance tests and Maintenance Program	5	3	7	15
11) Radiation Protection	----	4	----	4
12) Accident Analyses	----	1	----	1
13) Technical Specifications and Operational Controls & Limits	1	----	----	1
14) Quality Assurance	1	----	----	1
TOTALS	**44**	**64**	**35**	**143**

Radiation Protection in Dry Storage System Licensing and Operations

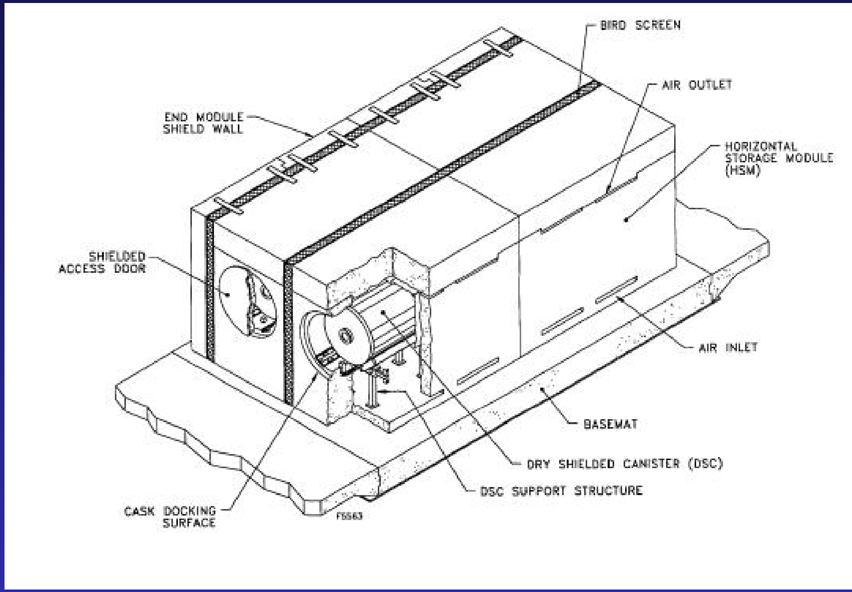
Elizabeth Thompson, CHP
Senior Health Physicist, SFST

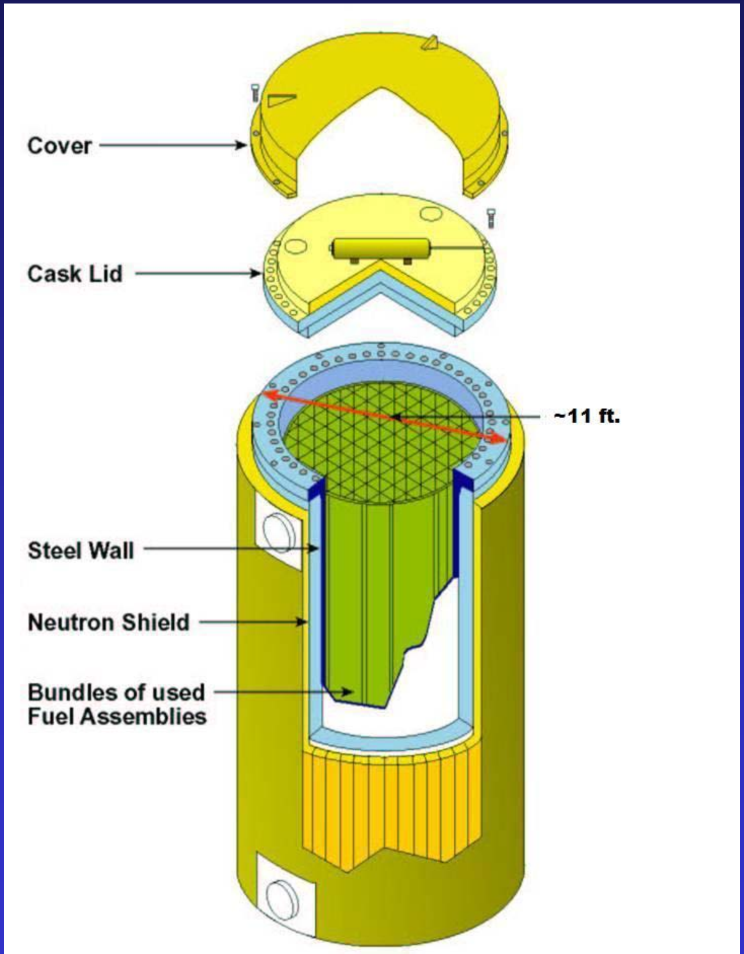
General License Storage System

- Key radiation protection aspects of the design are reviewed
  - Shielding features
  - Source terms
  - Generic procedures
  - Dose assessments
  - Accident evaluations



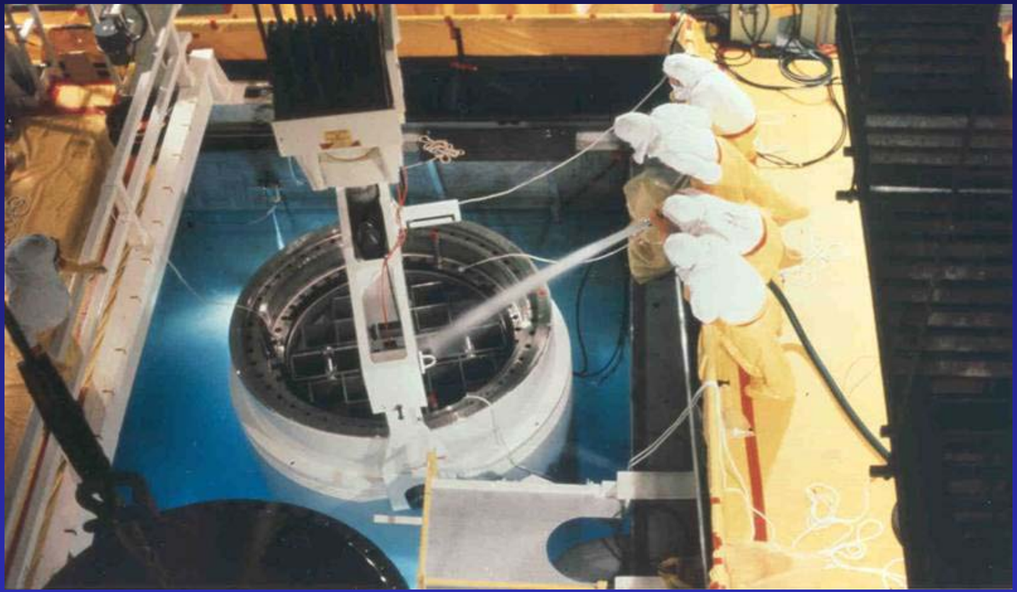
Design Parameters





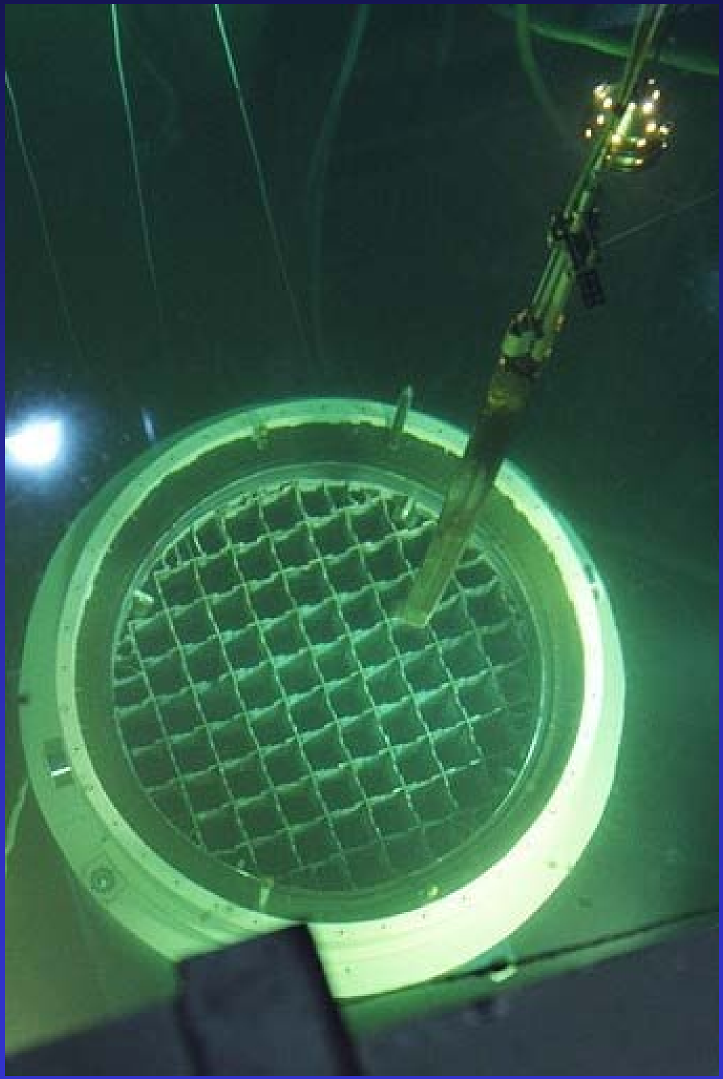
Procedures

- Safety Analysis Report (SAR) includes high-level generic procedures
  - Consistent with As-Low-As-Is-Reasonably-Achievable (ALARA) principles
  - Reviewed by SFST staff during licensing process



- Specific operating procedures
  - Developed at each site
  - Consistent with SAR
  - Consistent with 10 CFR 20
  - Inspected by NRC regional inspectors

Operations



Load fuel in cask in pool

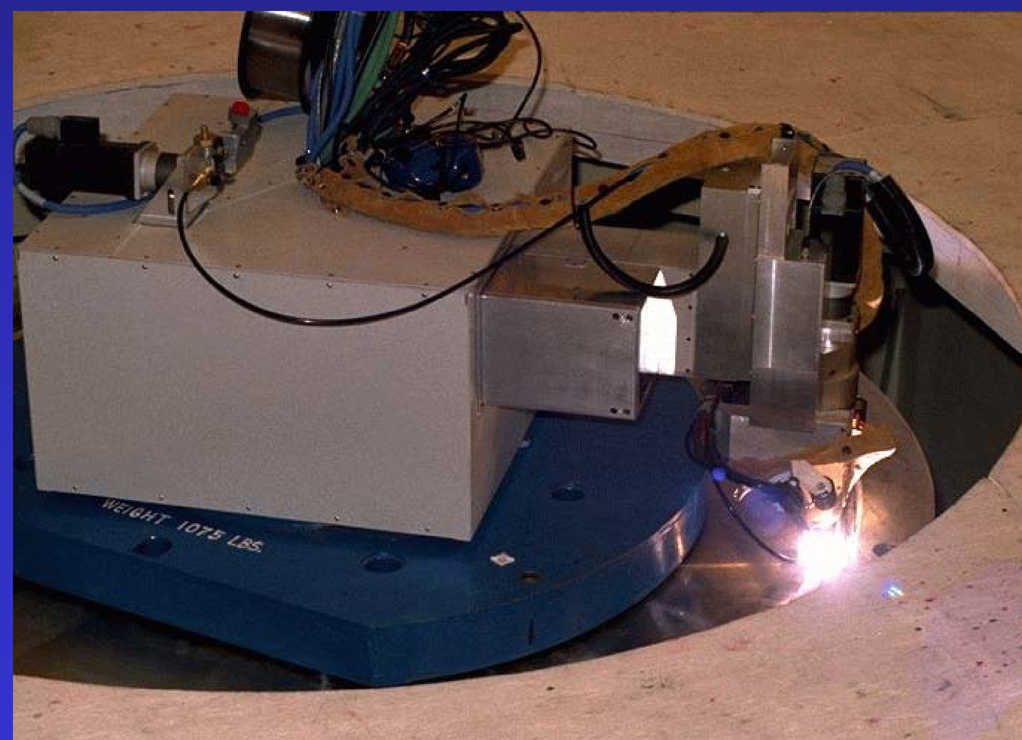
- Conducted under site's radiation protection program
- Dry run inspected by regional inspectors, assisted by SFST staff as needed

Operations

Move loaded cask to decontamination area & decontaminate cask

Operations

- Decontaminate
- Close (weld or bolt) canister
- Dry
- Seal vent & drain ports



Welding of Canister Lid

Transfer of Canister into Overpack

Transfer of Overpack to ISFSI* Pad

* Independent Spent Fuel Storage Installation

Storage Cask Array on ISFSI Pad

Transfer of Canister into Module

Horizontal Module Cask Array

Fuel Oxidation & Damaged Fuel

Dr. Robert Einziger,

Sr. Materials Engineer, SFST

Fuel oxidation

- Breached fuel in air environment can oxidize rapidly at temperatures above 250 C.
- Due to 30% expansion upon oxidation of UO_2 to U_3O_8 cladding can open allowing release of grain size particulates
- To date no cask has been licensed for storage of fuel in an oxidizing atmosphere.
- ISG-22 "Fuel Oxidation" suggests applicants demonstrate fuel oxidation won't occur by:
  - Backfilling with inert environment when draining cask for welding, or
  - Demonstrating no cladding breaches at an elevation above the drained volume, or
  - Keeping temperature of the fuel below that recommended in the ISG to prevent oxidation

Damaged fuel

- Issue addressed in ISG-1 Rev 3
- IAEA Nuclear Energy Series, NF-T-3.6, Management of Damaged Fuel, June 2009
- Damaged fuel defined as:
  - Any fuel that can not meet it's regulatory or functional requirements, or
  - Fuel assemblies with no rods having breaches greater than pinholes or hairline cracks and being able to be handled by normal means
- Various methods to handle damaged fuel
  - Remediation
  - Canning
  - Analytic determination that the fuel is still functional

ISG-25

Luis Cruz,

Thermal Engineer, SFST

ISG 25- Pressure and Helium Leakage Testing of the Confinement Boundary of Spent Fuel Dry Storage Systems

- ASME Pressure Test
  - Welded Canisters
    - Typically performed in fabrication shop for canister shell
    - If NOT Performed in fabrication shop, will accept shop helium leak rate test as meeting pressure test acceptance criteria since most canister welds are inaccessible during field pressure test
    - Closure weld pressure test done in field
  - Bolted Casks
    - Performed in fabrication shop
- Helium Leak Rate Test
  - Performed on entire confinement boundary (except as permitted by ISG-18 on final closure weld)
  - Confinement boundary typically tested in fabrication shop
  - Vent and drain port covers tested in field

Other Issues From Previous ACRS Briefing

Ron Parkhill,

Sr. Mechanical Engineer, SFST

Linkage Between Chapters

- Figure X.1 in each chapter provides overview and discipline and topic interfaces
- Review team organization
  - General Description (PM + all disciplines)
  - Principal Design Criteria (PM + all disciplines)
  - Structural (reviewer + interfaces)
  - Thermal (reviewer + interfaces)
  - Confinement (reviewer + interfaces)
  - Shielding (reviewer + interfaces)
  - Criticality (reviewer + interfaces)
  - Materials (reviewer + interfaces)
  - Operating Procedures, Acceptance Tests, & Maintenance (PM + all disciplines)
  - Radiation Protection (reviewer + interfaces)
  - Accident Analyses (PM + all disciplines)
  - CoC & Technical Specifications (PM + all disciplines)
  - Quality Assurance (reviewer + interfaces)

How are regulations met?

- Each Chapter has a Table X.1
  - Defines areas of review vs applicable regulations
- 10 CFR 72.13 defines the regulations applicable to a general license or certificate of compliance holder

Public Comments

SFST Staff:

Ron Parkhill, Sr. Mechanical Engineer

Dr. David Tang, Sr. Structural Engineer

Dr. Jorge Solis, Sr. Thermal Engineer

Dr, Zhian Li, Sr. Criticality/Shielding Engineer

Michel Call, Nuclear Engineer

Public Comments

- Only received comments from industry (NEI 192 and NAC 30 - mostly duplicated)
- Dispositioned in Appendix D to SRP
- Staff agreement on over 60% of the comments
- In previous ACRS briefing, discussed the major comments on a chapter basis

Major Public Comments

- Technical Specifications content too arbitrary (NEI 1 & 18)
  - No Change, Diversity of cask designs, plus suggested vendor content of TS. Issue marked for discussion with NEI dry storage task force.
- Replace RG 1.60 because it is too seismically conservative and replace it with NUREG/CR 6728 & 6865 (NEI 46)
  - No Change, RG 1.60 provides general guidance for determining design response spectra

Major Public Comments (Cont'd)

- Structural analysis should allow the use of elastic-plastic and other non-linear analysis as permitted by Code (NEI 49)
  - No Change. Strain based criteria not recognized by ASME Code or other standards. However, applicant can propose to use it and the staff will consider on a case by case basis.
- Level of detail (time steps being sufficiently small) in computational modeling too detailed. (NEI 58)
  - No Change. Level of detail depends upon complexity of application

Major Public Comments (Cont’d)

- Release fractions should not be used for damaged fuel since no driving force (NAC 5426 & NEI 76)
  - No data to support recommendation. Some canisters are pressurized which would provide driving force, and from accident fuel fracture. Staff recommends leaktight for damaged fuel.

Major Public Comments (Cont’d)

- Delete dose rate limits from Technical Specifications (NEI 166)
  - No change- dose rates are measurable and are used to verify cask fabrication and operation
- Delete measurements to confirm assembly burnup values (NEI 162)
  - No change- current analytical methods calculate burnup, which is not separately and independently verified through measurement

Summary

- Incorporated several ISG’s
- Updated to reflect current review practices
- Added new materials chapter
- Prioritized the review procedures
- Resolved public (industry) comments
- Improved safety focus of certification reviews

Path Forward

- Full Committee Briefing (May 6th)
- Issue Final SRP Revision 1 (June)
- Continue Work on SRP for Storage Facilities