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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

FEBRUARY 17, 2010

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:30 p.m., Dr. Michael Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman

SAID ABDEL-KHALIK

J. SAM ARMIJO

DENNIS C. BLEY

DANA A. POWERS

JOHN D. SIEBER



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NRC STAFF PRESENT:

CHRISTOPHER L. BROWN, Cognizant Staff Engineer

RAY LORSON

MICHAEL WATERS

RON PARKHILL

ELIZABETH THOMPSON

JORGE SOLIS

ZHIAN LI

DAVID TANG

ROB EINZIGER

MERAJ RAHIMI

MIKE CALL

A-G-E-N-D-A

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

(1:29 p.m.)

CHAIR RYAN: All right, if I could ask the meeting to come to order? This is a meeting of the Advisory Committee on Reactor Safeguards' Subcommittee on Radiation Protection and Nuclear Materials. I'm Michael Ryan, chairman of the subcommittee. Subcommittee members in attendance are Dr. Said Abdel-Khalik, Dr. Sam Armijo, Dr. Dana Powers who's not here yet, I guess, Dr. Dennis Bley, Mr. Jack Sieber and John Barton, our consultant, was going to participate via a bridge line but he is serving jury duty and is unavailable to join us at this hour.

The purpose of this meeting is to receive an information briefing from staff on the background information relating to spent fuel storage and the appropriate used - I'm sorry, the approach used to revise the SRP for spent fuel dry storage at a general license facility, NUREG-1536. I note that the staff will brief the subcommittee again on April 20, 2012 to discuss major changes in detail.

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



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is the designated federal official for today's meeting.

The rules for participation in today's meeting have been announced in the Federal Register as part of the notice of the meeting previously published in the Federal Register on January 29, 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 phones or BlackBerrys, put them in a mute mode or off. We have not received any requests from members of the public to make oral statements or written comments. Is there anyone on the bridge line? All right, no one is participating via the bridge line today.

A few introductory notes that I wanted to make and then I was going to invite other members of the subcommittee to do the same. We are going to receive as I mentioned in April an updated version of this NUREG that will I guess mainly incorporate public comments. So we will probably focus on those in the April 20 meeting as well as any questions that might arise from today's meeting. The agenda item 7 which

is key stakeholder comments basically by topical area, we'd be happy to hear a brief introduction about the chapter and highlight briefly the changes and why the chapter is risk-informed and how you would approach risk-informing that chapter as well as the document as a whole. At the end of the meeting the subcommittee will formulate guidance to the staff as to what it should present or concentrate on in the April briefing and items that they may want to have as follow-up items for our meeting then. Based on that input we'll make a determination of whether we'll need a half-day or a full-day meeting, you know, as that April meeting shapes up.

Previous to this topic coming before the ACRS it did come before the ACNW and the ACNW&M over several years where we dealt with issues of the dry cask storage PRA, burnup credit and moderator exclusion so we're happy to have continuity with this effort on this committee to move forward with the material before us today. Additionally, a recent ISG authored by SFST on retrievability was reviewed by Dr. Armijo to my right and Dr. Armijo decided that the ACRS did not need to review that particular ISG. So that's in front of us. With that I'd invite, Mr. Sieber, any comments?

MEMBER SIEBER: Yes, I actually do.

CHAIR RYAN: Great.

MEMBER SIEBER: I started off with my review by looking at the NUREG-1536 draft which I found very detailed and in a lot of cases pretty specific. We directed toward the so-called how-to-do-it phase of the review which has as an implication how a licensee is supposed to perform all the calculations and the materials that they are to produce to get a license. And I also noted that the document is pretty lengthy and so there's - we have a lot to cover this afternoon. We did get assignments, each member, of various areas that we are to look at in detail and my assignment was the thermal evaluation. And as we go through that I will have some questions. I read the draft SRP first, did my evaluation, then looked at industry comments and from the notes I made from my evaluation virtually I would say almost everything showed up in the industry comments so if you resolve those you probably resolve mine too.

Besides the thermal evaluation I do have interests of my own that are beyond the scope of my assignment which includes the structural properties evaluation, the materials, the criticality evaluation, radiation control and shielding, and I'm also



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interested in basically what licensees have to do from the time that they first utilize - receive and utilize the spent fuel storage casks periodically and in response to observations through the lifetime of the license for that cask. And I looked for what the license lifetime would be, and I gather it's 20 years but it's, you know, it's not definitely specific in the standard review plan that that would be the license life.

So if you want to address whether more lengthy licenses or re-licensing would be available or not I'd be interested in that and the kinds of things you would look at because interim spent fuel storage has been going on for a pretty long time. So the licensed life of a cask in existence and in use right now, licensees are either going to have to manipulate the fuel to put them in new casks or storage devices which in itself has some hazards associated with it. So I'd be interested in the ultimate lifetime.

I did read the Nuclear Assurance Corporation public comments and in that writeup the staff had their primary review of what the comment meant with regard to the staff's position on changes to the SRP and basically I thought the comments were pretty good and I thought the staff's positions were



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pretty good. NEI on the other hand, the staff has not yet provided a listing at least to my knowledge or in my document as to what the staff's response to the NEI comments would be. There's over a hundred of them as I understand. A lot of them were duplicated by NAC which was shorter and so I'd be interested probably by April when we meet again to see how the staff resolves the NEI comments, and what other comments are out there that should be addressed.

So I think I'd look forward to this meeting as - in the form of an introduction to the staff's effort in this regard. I think it's been a big effort. The product shows that there has been a lot of work put into this and so I look forward to hearing the presentations. So that would be my introductory view of this assignment.

CHAIR RYAN: Thanks, Jack. Dr. Armijo?

MEMBER ARMIJO: Yes, I concentrated my review on the materials section. I've come up with a lot of questions, but I think I'd rather wait till you give your presentation and you'll probably answer most of them. So I'll just hold for now.

CHAIR RYAN: Okay. Dr. Bley?

MEMBER BLEY: Yes, a few things. I'm not going to spend time telling you what I reviewed and



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what my questions are, but overall and all the good things I think I saw there. Two areas left me a little confused and I want to mention those. The first one I'm not sure there's a way around, but things feed each other a lot in the document, and it seems to me that many of the things in acceptance tests, rad protection, accident analyses and tech specs, the information that is used there comes out of all the other sections and I get a little confused how the links are maintained.

The other part is this risk-informed priority business and I - it first drew my attention when I kind of looked at the summary and saw there were no high-priority items in rad protection and accident analysis which on the surface seemed astounding to me and maybe that first issue I mentioned accounts for some of that. I think the main part of it might come from the structure you detail in Appendix B on how you did that ranking. I think I have to agree with you that your decision not to use the PRA because it left out so many things, I think that's important and I'm glad to see that in your ranking you're looking at worker risk as well as public risk.

The places - well, the disappointing side



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of that is that those uncertainties that were not addressed in the PRA, I'm not sure how they're being addressed anywhere and it's not been extended to cover them. The three questions you try to address in Appendix B, and maybe this is something for April you can give us some real detail on this, the likelihood that the requirement would not be met by the applicant troubles me a little bit in two ways. One is how do you really know that, and two is even the best applicants make mistakes at times and isn't that our job to look for the places they might have missed things, so a scheme that devalues the places where you think they might have made mistakes troubles me a little.

The second one is the likelihood that the staff review would find the discrepancies, when that's a low score I wonder why we don't look and see are we reviewing the right things or in the right way? And then the fact that they all get added together with the third one dealing with risk which is the only meaty one that seems to be addressing the key issues, and that one doesn't have the very high scale of a 4 where the other two do so it gets devalued right on the surface of the way you combine them. So that combination process worries me a little.



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And the last worrisome thing is defense-in-depth. And when I look at the table for defense-in-depth I don't see a table, I see a little bit of a ramble. It would be real interesting to see some of the results when this was applied, what kind of numbers were generated by your in-house experts, how they were - what the comminations look like and how you came up with the key things. Now, many of the high-priority items I'm sure will end up high no matter who does it. I'm still a little surprised on - I'm a lot surprised about the accident analysis and the rad protection, and would really like to see some of the details of how you get there. So at some point a real go-through on that ranking scheme and the methodology that adds up things that don't seem to me quite additive, and wondering why these other things dropped out of the picture is something I'd really like to hear a lot more about. And I don't think there's time on today's agenda, but I'd sure like to see that. And if you can provide us with maybe some of the tally sheets if you still have them before the next meeting that would be handy to have something to look through.

CHAIR RYAN: Okay, great. Dr. Abdel-Khalik?



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MEMBER ABDEL-KHALIK: I have no comments to make. I look forward to hearing your presentation.

CHAIR RYAN: All right. Well without further ado Mike, I guess I'll turn it over to you?

MR. LORSON: Thank you, Mr. Ryan and other members of the subcommittee. I'm Ray Lorson, the deputy director for the technical review side of the Special Storage and Transportation Division in NMSS. We are appreciative of your time and the efforts you've placed so far to take an introductory look into our efforts to revise the standard review plan. The staff has put a lot of effort into this product over the last approximately two to three years and I think what we have today is a much better product than what - which was last issued back in the late `90s. We do appreciate the comments. We'll use them to help improve the tool so that going forward we give ourselves the best tools we have in conducting our review. So thanks for your comments today and I'll turn it over to Mike.

MR. WATERS: Yes, my opening remarks are very similar to Dr. Ryan's. Again, we're happy to be here to provide information. I think we have an innovative review standard. It is unique, but I think it will ultimately improve our efficiency and safety

focus on review. I also recognize that we had hoped at this point to give you a more final version with the public comments incorporated, but we had a significant number of public comments as you mentioned and it was just in the final phases of resolving those and incorporating them. And so just as a reminder again, this is informational brief, including our risk - prioritization of the review procedures. Ultimately we want this briefing, as you mentioned, to help identify areas of interest for the future interactions with ACRS on a more final SRP. I think some of the questions that were raised just now I think we can touch here, talk about. Some of the more in-depth questions would probably be more important for the next meeting such as the risk-informing scheme. We have a few slides on that on risk. We should be available in April to talk about that.

CHAIR RYAN: I think, Mike, that's a good place to think. The takeaway part of this meeting for us will be to hopefully communicate our questions to you and to have you leave with a detailed understanding of our questions for the April brief.

MR. WATERS: That would be a good outcome.

CHAIR RYAN: And that's where I think, you know, we're not looking for a race to an answer today



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on some of these items, although I'm sure you'll touch on them, but if you can make our full committee brief responsive to what the subcommittee brings to your attention today that would be great, that's a win if we can reach that goal. So don't feel like you need to rush to an answer today unless it's just obviously in front of us, but to fully develop our questions so that you go away with a good understanding of what we'll be looking for in a follow-up meeting.

MR. WATERS: Okay. I think that's a good outcome. All right. Briefly, today's presentation will focus on two primary areas. One is dry cask storage background. Hopefully this will help put the review in some context of what we look at and what we focus on. And second is led by Ron Parkhill and the rest of the team here. We're going to give a broader review of the update project including the risk prioritization method, some key revisions to the SRP as well as some key stakeholder comments. A couple of notes.

Again, it was not our intent to have to provide a detailed discussion in any one area. We have about a contingent - a large contingent of staff, but many others did contribute to the review plan, and again, if we have questions at the end of the meeting

we can bring appropriate staff for the next follow-up meeting in April to answer those questions. And also, just to reiterate one more time as Dr. Ryan mentioned we are in the midst of resolving key stakeholder comments so we do touch upon them, we have a sampling of them we touch upon, but there may be some where we may not be - go into specific detail on the answer today until we make a final resolution on those.

Of course very quickly I just wanted to introduce the members who may not be familiar with the Division of Spent Fuel Storage and Transportation. Vonna Ordaz is the director and as Ray introduced himself, he's the deputy director of the Technical Review directorate on the left. Doug Weaver is the deputy director of License Inspection directorate. Our technical review, we're based by function, by disciplines. We have Structural Mechanics and Materials Branch, Criticality Shielding and Dose Assessment, and Thermal Containment. On the other side we have the licensing project management and the rules, inspections and policy side of the division.

Quickly, some of the responsibilities. We kind of do a lot of the oversight of dry cask storage. Also we do license certification, we license spent fuel storage facilities, we certify spent fuel storage



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systems which we're here to talk about today. We also certify transportation packages. We also have an inspection and quality assurance role. We inspect vendors, fabricators, suppliers and users. We assist regions in cask operations regionally - in regional inspection issues and we approve quality assurance programs. Then of course we have a leadership role in developing policy, regulations and guidance related to spent fuel storage as well as public outreach and coordination with other agencies. The staff performs all these functions -

MEMBER ARMIJO: I've got a quick question. Wait, just a quick question, just for - just to get caught up. How many spent fuel dry cask storage systems are there today that are certified? Certified or in operation?

MR. WATERS: There's over 1,200 casks loaded. There's a lot of design variations. It's hard to give a number because a vendor will come in and have design version A, B and C. I would say this current generation there's probably four or five major cask designs. There's older vendors had single-purpose casks, you know. I would say it's in the range of a dozen if you count the variations. There may be more variations among variations.



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MEMBER ARMIJO: Is your expectation there are going to be a large number of new casks coming in for - that we'll use this SRP to design them?

MR. WATERS: Yes. We - the current approach right now is we have the major - the major cask types have been certified and the vendors come in for amendments. They really do evolve in both capacity, materials, heat load and function and they're continually evolving some. We just heard of one last year that's kind of an underground silo. So it's a key evolution, but it's based upon - most of them are based upon the designs that currently exist. However, from time to time we will have what they call a brand new design to certify for various reasons.

MEMBER ARMIJO: Okay, thank you.

MEMBER BLEY: Can I follow that up with a question? Maybe you'll get to this later. If you have a modification come in, are you going to talk about the process whereby you decide if the modification is significant enough it's going to require additional testing or if it's something that can be handled by analysis or just presentation of it?

MR. WATERS: Well, we can address it. I think generally speaking when we get an amendment we

first scope out what has changed, what we have to review as far as the change and we generally try to, you know, honor or accept what's already been approved. If there's an issue of a new design variation that requires some testing then we would consider that. For example, when they get a new design if a higher heat load may require - which may require thermal testing, you know, it depends on the review. So that is part of our review considerations. Any additional acceptance testing is part of certification.

MEMBER BLEY: Okay.

MR. PARKHILL: Can I just add to that? For individual casks that are manufactured we have requirements that are governed by various codes, ASME code for pressure testing, we have leak test requirements per our regulation that apply to each and every cask. I think what Mike was talking about is new generation design for, you know, thermal testing that we would have to do via testing or analysis. But there are specific tests that need to be done for each and every cask.

MEMBER BLEY: Sure.

MR. WATERS: There are two basic licensing options for utilities or entities who wish to store



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spent nuclear fuel. The first option is the general license. All Part 50 licensees have been granted a general license to use a certified cask design. Obviously they're required to use a cask certified by NRC. When we certify that we actually publish the certified design in the Part 72 as part of the public rulemaking process. The public has an opportunity to comment at the end of the process on the design as part of rulemaking. And again, so we're certifying the casks then. They're not the licensee itself as far as the cask design. For our general licensee to use a cask requires them to perform a site-specific evaluation to kind of verify the compatibility of their site with the cask design parameters.

CHAIR RYAN: Under what requirements do they do that? 50.59 or?

MR. WATERS: Well, there's - we have - the major requirement is 72.212 and it requires a site evaluation. We want to verify the compatibility of the design parameter, seismic loads, site characterizations are bounded by the cask design. It also requires to consider 50.59's, if they need to be done on the Part 50 site to accommodate the cask as well.

CHAIR RYAN: Okay, thank you.



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MR. WATERS: But we have an explicit regulation that requires them to do that. And that's in Subparts K and L. I actually put an asterisk there because there's other regulations of Part 72 that apply that originally derive from site-specific licenses and that was something that we tried to clarify in the standard review plan. Now obviously the primary review plan reviews, what we're here to talk about is the spent fuel dry storage system in a general license facility.

The other option, quickly, is a site-specific license and that's, again, available to a Part 50 reactor licensee or applicant. If you want to store fuel away from the reactor site you have to use a site-specific license. Only the general license is for reactor licensees. And that's more of a traditional licensing process. There's opportunity for hearing and there's regulations. We actually have a separate standard review plan for dry storage facilities, and that addresses not only the cask system like this one does, but also addresses site characterizations, the programmatic reviews of the programs that are there as well as the infrastructure around the cask that we use to handle it.

CHAIR RYAN: I guess that would include



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the usual list of quality assurance, radiation protection, security, you know, all that sort of -

MR. WATERS: Yes, radiation protection program, quality assurance and things like that.

CHAIR RYAN: Okay.

MR. WATERS: This is a very quick snapshot of dry cask storage in the United States, it continually changes. The red dots represent those used on a site-specific license to store spent fuel or who have stored spent fuel, and the green ones represent the power reactor licensees who elected to use the general license option to store spent fuel. There are approximately 55 SSCs in operation. As I mentioned earlier I think it's around 1,250 casks now that are currently loaded across the United States of spent fuel. And every year more and more SSCs come online and we sort of find more casks to support that.

The next portion of the presentation is really kind of a quick picture show of typical cask storage operations. You know again, an important part of certification review is not only the physical or nuclear performance of the cask while it's out there in storage, but also how it performs during actual transfer and bleeding operations of the fuel. And I'm going to talk about three major technology lines of



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dry cask storage systems. And before I talk about the three, just very generally speaking every cask is different, but typically speaking the PW casks are designed now to hold between 32 to 37 fuel assemblies and typically up to 68 BWR fuel assemblies for the BWR design.

There are some higher capacities for the smaller fuel assemblies that exist at certain power plants. Minimum cooling times now are approximately at three years for storage of spent fuel and we have maximum allowable burnups on the range of 60-gigawatt days. And these are really ballpark numbers. Dose rates generated on the side of the concrete over-packs on storage are used on the order - or licensed to be on the order of a few hundred millirem. And they also use transfer casks and those have less shielding and those license systems are usually more in the multiple rem level of maximum dose rates based on the bounding fuel source terms they look at. And finally, as far as heat load capacity, the current generation is on the range of 35 to 40 kilowatts of heat removal and initial - fuel up to five percent of U-235.

The first technology I want to spend time on is what we call the welded canister overpack system. And basically as you see from the design the



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spent fuel is sealed inside an all-welded canister and the canister is placed inside a concrete overpack. Some concrete overpacks is reinforced concrete covers is actually - two steel shields of concrete poured in there. As you see from the picture, the vents, air flows from the bottom and goes around the canister, exits out the top through the roof heat from the canister. On top is a bolted cask lid. It provides additional shielding, as well protects the canister from particular accidents. One other note, I just want to note this for out west. There are some that had anchoring systems for bolting the cask down to the pad for high-seismic events.

Here are a few pictures. This is basically an MPC being received by facility, being prepared for loading. As you can see from the basket structure I believe this is one of our 68 BWR fuel assemblies. This canister will be placed into the transfer cask for loading inside the spent fuel pool.

MEMBER ARMIJO: Is this a stainless steel cask container or what?

MR. WATERS: Yes. Most of them are stainless steel. We do have some older generations that are carbon steel I believe, is that true? Yes. Here are a few pictures of transfer cask operations.



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As you see on the left, here is an MPC I believe being lowered into the spent fuel pool for loading. And typical transfer casks now weigh between 75 tons and 125 tons depending on the - I believe what drives it really today is the capacity of the cranes at the specific sites as well as any shielding needs, operational needs for that site as well. And the transfer casks are typically made out of lead steel for the gamma shielding, and most have an annular shield on the end filled with water for additional neutron shielding. And as you can see on the right the loading is essentially the same as maneuvering fuel inside a spent fuel cool rack at the site.

Once the canister is loaded a thick lid is placed on top of the canister, an MPC lid is placed on top of the canister before it's brought to the surface. It's brought to the surface through the transfer cask and usually moved to a preparation area for final preparation of the canister. Here's just a picture of an automated welding system to weld the lid on. This operation usually involves some of the highest dose rates given the proximity of the lid to the top of the fuel, so a lot of sites do use automated welding systems to do multiple passes as well as place supplemental shielding around it to help

protect the workers during the welding and the examination process of the canister.

MEMBER ARMIJO: Is the canister full of water at this point when you're welding, or has it been inerted and dried?

MR. WATERS: Yes, typically they'll bring it up and they'll drain down the water a little bit to give some head there and they'll weld it on. I'm not showing here - there's a drain port and a vent port, and once it's welded they'll do the venting and draining through the ports, and those ports will be sealed and currently they load them on racks. So yes, unless there's a crane-capacity reason they typically keep water in there as long as possible to provide that additional shielding for the workers.

MR. PARKHILL: The space is usually backfilled with an inert gas.

MEMBER ARMIJO: So it's inerted on the top. Then you're probably not - do you uncover the fuel at all?

MR. WATERS: No.

MEMBER ARMIJO: So it's always in the -

MR. WATERS: Until it's backfilled with the helium. And that's again a couple of pictures of the transfer cask operations. As you can see on the



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left there's a special platform for the workers to access the canister for the final preparation. Again, for a final closure, decontamination of top of the canister and drying, draining and drying the canister inside. For lower heat loads they use a vacuum drying process to draw the vacuum and remove all the moisture. For higher heat loads other vendors are going towards a force helium recirculation to remove the moisture in order to maintain the cladding temperatures below an acceptable limit. And on the way is a picture of the transfer cask actually made it on top of the storage overpack. And in this operation once it's made it they open the bottom shield door and the canister is physically lowered down into the storage overpack. And once lowered down, as I mentioned earlier, they clip the final overpack lid on top. And of course they then move the storage overpack out to the pad with the crawler. Some use air pads.

And here's just a picture of a particular cask system at - out on a cask at a particular ISFSI, as you can see, apologies. Someone asked what happens once they're loaded. My familiarity is once loaded all the sites have a Part 20 type of program. They do periodic surveillance, monitoring of the dose rates



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around the pad. A lot of them use TLDs on the fence line to measure coolant dose on a quarterly basis to verify that the ultimate regulatory limit is met. Some casks, some designs elect to use a monitoring system of air inlet and outlet of vent temperatures in order to detect a potential blockage event. Otherwise they do periodic surveillance, visual surveillance of the vents to verify there's no visible blockage. And there's - we have a routine maintenance surveillance that may get performed and if there's one - jump in later that they know about they can as well.

CHAIR RYAN: Is that a boundary fence or is that an exclusion fence that we're looking at?

MR. WATERS: I believe that's - this is - I'm pretty sure this is Palisades. I believe that's just an exclusion fence.

CHAIR RYAN: So what would the dose rate at that fence be, would you guess?

MR. WATERS: Well, depends on the cask. I mean, the site of the cask may be certified to be up to, you know, 200mrem usually, a fair guess. Not a fair guess, that's what I'm familiar with based on my past experience. Two millimeter per hour on the site. You know, I usually divide it by two and I get a few feet. You know, it's probably on the order of - if

it's loaded with design basis fuel that's -

CHAIR RYAN: That's one cask, but when you get 12 of them then you get some additive.

MR. WATERS: Yes, you get contributions from the first row of casks.

CHAIR RYAN: And I guess my real question is is this an area where a worker could just routinely go, or is this an inner fence and is there an outer fence where they have to have controlled access to get in between the two fences?

MR. WATERS: I'm not familiar with this particular facility. The ones I've been at the outer fence is at a much greater standoff distance and it is a protected area that you have to have special permission to go into. Liz Thompson may be able to.

MS. THOMPSON: Should I comment here for just a moment?

CHAIR RYAN: Just mention -

MS. THOMPSON: I'm Liz Thompson.

COURT REPORTER: Please speak into the microphone.

CHAIR RYAN: You've got to pull it toward you. There you go.

MS. THOMPSON: I'm Liz Thompson. I'm a health physicist in SFST. In the Part 20 program, you



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know, as you know Mike there's all the requirements for radiation areas and high radiation areas, and if this were a high-radiation area then all the controls associated with access to a high-radiation area would be in place. So I think that's kind of the general answer to the question.

CHAIR RYAN: Okay, so if it reverts back to the Part 20 requirements that's a good answer. Thank you.

MEMBER ARMIJO: I just noticed maybe - you want to finish on that subject, because I have a different question.

MR. LORSON: Just - and I think the key point from what Liz is saying is that, you know, the commercial power reactors where these are stored, they have one radiation protection program that covers all radioactive sources, this just being one.

MEMBER SIEBER: Quick question. Under Part 20 you're supposed to evaluate neutron dose and having been a worker in the military program where they used M-130s I found out after the fact that the biggest dose around transportation casks was the neutron dose which was not measured by the dosimetry that was issued at the time. It was a factor of 8 or 10 above the gamma dose. Do you monitor for that and



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do you evaluate it and is that part of the program? Because I would imagine the neutron dose there is measurable and perhaps significant.

MR. WATERS: I think the answer - well, the answer is yes. As part of the Part 20 program they monitor based on the radiation fuels they expect to have. And I know for example they do have, you know, neutron-measuring capabilities. For storage actually, usually for storage, the thick concrete, the neutron dose is a small contributor. For the previous slide I had on the transfer cask where there's much less shielding the neutron dose is a big contributor so when actually inside the plant there is a lot of neutron measurements. But for storage, neutron contribution is typically a very small contributor compared to the gammas you're getting out.

MR. LORSON: But during the transfer operations per se, during selected parts whether you're welding the lid onto the closure cask or handling the cask, those periods of time the workers will be fitted out typically with neutron dosimetry separately to detect any neutron dose that they may encounter.

CHAIR RYAN: Mike and Ray, if you could maybe just take a note to maybe give us kind of a



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detailed walk-through of the radiation dosimetry and the health physics controls at these various steps we've touched on in your answer today that would be great. Maybe even a few pictures and slides might help, actually.

MR. WATERS: Sure, we'll be happy to do that. And I keep talking in terms of generalities because the minute I say something we'll find a cask variation that doesn't meet that rule.

MEMBER SIEBER: Well, I also have experience with concrete casks and sometimes they aren't - they've got voids in them.

MR. WATERS: Yes.

MEMBER SIEBER: And so you end up with streaming doses and you don't have the shielding you think you have. I presume the environmental monitoring on that fence or somewhere close to it there's a bunch of dosimeters that are set out and picked up regularly and evaluated to determine doses.

MR. WATERS: Yes. And again, every site's a little bit different, but like I said, I know a lot do have the TLDs on the fence line, sometimes on that fence there and sometimes outer ones too.

CHAIR RYAN: There's eight of them along that fence and there's not one, so that tells you that



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maybe we're on an inner fence.

MR. WATERS: I apologize. I'm not familiar with this site.

MEMBER SIEBER: That's one conclusion you can draw.

CHAIR RYAN: You could. So I think the question is let's maybe ask for a little bit more thorough review of how the radiation protection requirements are met at the various stages from loading right through sitting on the pad and staying there for a long time.

MEMBER SIEBER: How you and the licensees knows that they're met.

MEMBER ARMIJO: In this picture you have some cables or something up there on the top of those casks that look like instrumentation. Is that some sort of monitoring instrumentation? Is that typical?

MR. WATERS: I should have picked a picture - I'm more familiar with the design, but I'm fairly certain that's the temperature - that's the cable that monitors the exit temperatures from the vent when they look at the delta, the temperature is to verify there's adequate flow. I'm pretty sure that's what that is. I would need to verify that for you.



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MEMBER ARMIJO: Does that vary from cask design to different designs and different heat loads?

MR. WATERS: Yes, part of the analysis, especially when we develop the technical specifications to do the surveillance, they do - and Jorge maybe can speak to that. They do a calculation to determine what would the delta T be, and then they based their surveillance on that calculation. Is that correct, Jorge?

MEMBER ARMIJO: Okay, thank you.

CHAIR RYAN: Jorge, just for the record would you mind saying your name into the microphone for us?

MR. SOLIS: Jorge Solis.

CHAIR RYAN: Thank you.

MR. WATERS: The next technology, and I have fewer pictures because they're almost - close to the same - is the welded canister module system. And as you can see it's similar to the one we just talked about, but obviously the canister is placed into the module horizontally. It's placed on steel rails and again, we have vents to allow air flow and there's a heavily shielded door that's placed at the point where it's loaded into. And again, here's another picture of the transfer cask for the system. I believe it's



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removing the canister from the pool area. And the next is a good picture of where they're meeting the transfer cask up with the module. Once it's meeted they will insert a hydraulic ram on the right side of this and put the canister into steel wells. Once it's secured inside they'll put a shield door as you see on the one on the left to provide additional shielding. Again, here's a picture of a cask array of multiple modules loaded at a particular site.

And the next technology is a little bit different of function. It's a bolted closure system. As you see from the diagram, essentially there's not - the one design version has the inner canister a separate canister, but in other design versions the basket is integral to the actual metallic overpack so the whole overpack is loaded inside the spent fuel pool. And instead of welded closed, it's actually a bolted cask lid that's bolted down with two concentric seals, leak-tested and that provides a final confinement. These systems have an actual seal monitoring system to detect the failure of a seal during storage operations. And several inches of steel for gamma shielding and which apply a poly-resin type of shield for neutron shielding. And again, this is a picture of them loading a full-storage cask in



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the spent fuel pool for loading.

And this is my favorite picture. This is a cask array of bolted casks at Prairie Island. I wish I had one of these on last week during the snowstorm to help melt the snow.

(Laughter)

MR. WATERS: As you can see, you can see these blue posts here. I believe these are the alarm stations that are connected to the seal monitoring system to detect any failure of a seal. The final picture, I just want to make the point that some general licensees may elect to use multiple cask systems, and this is a good example here. On the left here's a concrete canister overpack system. On the right there's a bolted closure system on the same array.

And before we turn it over to Ron, quickly I want to talk about some of the - at a very high level the regulatory bases and some of the general performance criteria. First, some key regulations. I purposely put the word "some" in there. There are many regulations that demonstrate safety compliance, but a lot of these - these we'll all want to focus on during the review. 72.236 Rule E at a high level specified certification requirements to get a cask



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certified. In some cases it refers back to the regulations. We have spent fuel specifications: remain subcritical during loading and unloading, provide sufficient shielding confinement systems to meet accident dose limits limits, normal dose limits, provide adequate heat removal capacity and ensure that a fabricated confinement area is of sufficient integrity, you know, no pinhole leaks or other deficiencies. 106(b) has accident dose limits and 104(a) has normal dose limits. I'll talk about those on the next slide. We also have 122 which talks about having - making sure the system assures the fuel can be ready, refuelable as well as cladding integrity. The idea is we don't want the cladding to degrade during storage or transfer operations during the lifetime of the storage cask.

MEMBER ABDEL-KHALIK: How many cases do you know of where after the cask was welded shut it was reopened?

MR. WATERS: I'm not aware of any casks reopened after welded shut. There have been some events where casks have been reopened. I believe the Surry ISFSI, they had some issues with a few casks. They took them back in the pool. I think they opened them up and I think unloaded them to inspect the lids,



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but I'm not aware of any where the canisters were cut open to unload or inspect the fuel.

MR. LORSON: We did the one test demonstration project at Surry a number of years back where they did open up a cask to look at the condition of the fuel. Was that a bolted cask?

MR. WATERS: That was bolted, yes.

MR. LORSON: That was bolted, okay.

MR. WATERS: Yes.

CHAIR RYAN: One of the questions in the regulations that struck me is a couple of the tables I just marked for conversation with you guys today was Figure 11.1 the overview of the radiation protection program. It's got all the chapters laid out and various arrows pointing from one section to the other. And then a similar Figure 6.1 overview of the shielding evaluation, of course the chapters and arrows are reemphasizing, reordered and so forth. And it led me to think about do you have a regulatory requirements matrix for how to meet all the requirements if I want to have a cask?

MR. WATERS: When you say "matrix" I want to make sure I understand what your vision is, but -

CHAIR RYAN: A document that tells me here's how you meet all the requirements. If you



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follow these paths and do these things you'll meet the requirements.

MR. WATERS: I hope that's - obviously it's not regulatory guide or guidance, but hopefully the SRP kind of spells that out. I mean, that's a common - we hear is, you know, we define here are the regulations, here are the acceptance criteria that meet these regulations within each chapter and here are the review procedures to verify the acceptance criteria is met.

CHAIR RYAN: It's along the way, but it's not exactly a fact certain list, if you do these things you're all set. Just the fact that these two figures, and I'm sure there are other ones in other chapters that are different, tells me it's up to me to figure out how these relationships - shielding versus work for radiation protection versus work for other topics.

MR. WATERS: You're right, and one of my last slides I'll try to step through some of that at a higher level to kind of explain relationships to the extent I can. I agree, I was a former -

CHAIR RYAN: Then you can think about it and give us a more full answer on our April 20 briefing. That would probably be a good topic to take

with you. I think Dr. Bley, you had some additional thoughts along those lines too, is that right?

MEMBER BLEY: Remind me.

(Laughter)

CHAIR RYAN: We talked a little bit earlier about some of the various interactions and relationships in the hierarchy and how various results can -

MEMBER BLEY: Oh, I had a lack of clarity on my part and something as you described might help me -

CHAIR RYAN: Again, don't take my comment or question as a criticism of these diagrams or how they relate, but if you could help us better understand how a real user or practitioner can follow those road maps through this document that would be very helpful.

MR. WATERS: Okay.

MR. LORSON: Just a general note on those diagrams is that I think it's meant for the individual reviewer to reinforce the coordination aspect of their review. Your review isn't done in isolation, it's a team effort, so I think in general that's what those diagrams tend to do is reemphasize -

CHAIR RYAN: That's a great idea, but the



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risk is if they're not directed fairly specifically you might get two different reviewers doing two different things. That's always a risk when it lacks specificity is you'll get different interpretations of where the emphasis ought to be and that can sometimes be troublesome. I think when they submit many things I can tell you that happens. But again, I just mean that as a question for us maybe to explore a little bit next time. Thank you.

MR. WATERS: And quickly, again, these are a very high level general performance criteria for normal operating conditions. 104(a) requires 25mrem per year to an individual from all casks, every fuel cycle facility. Obviously the criticality safety remains subcritical. There is a confinement - confinement criteria and shielding is included as well to maintain confinement in shielding of the fuel during short operations to meet the 25mrem limit. As I mentioned earlier, the cladding integrity criteria to maintain in the environment and maintain climate temperatures below the acceptable limits for an operation.

CHAIR RYAN: Just a question on dose limits. I know that the staff is looking at Part 20 and a potential revision to that over some period of



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time, years down the line likely. And you know, is there any interaction with what folks are doing in Europe? Because they have different dose standards and different design requirements. Do you see any issues there and what are you thinking ahead for changes to Part 20?

MR. WATERS: I'll defer to Liz if she has any information.

MS. THOMPSON: This is Liz Thompson again. Right now the staff that is looking at the Part 20 changes, several of those staff members are involved with counterparts in Europe, so I'm sure they're aware of what the dose limits are over there. Right now as I recall the path going forward is to change Part 20, some of the reactor regulations where right now there is no immediate plan to bring all the regulations up to the same dose basis. So things like this Part 72 and some of the other parts may not be brought up to the same underlying standard on the same timetable as the Part 20 change.

CHAIR RYAN: The real risk here is you design to one number and somehow a lower number comes into play in some other part of the regulation. So I just wanted to be clear that's the potential question and I'm curious as to how you thought down the road



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for that.

MEMBER SIEBER: Cask-in-cask.

MR. LORSON: Would it be fair to say though, I mean this would be a question for Liz maybe to try to address the concern. Our dose limit, we have the one dose limit that's in 72.104 which is an annual dose limit of 25mrem per year. Are the dose limits that are being looked at in terms of Part 50 or Part 20 space, would they be likely to be reduced to such a restricted point that you couldn't meet an annualized dose limit of what we have in our regulation?

MS. THOMPSON: I don't think specific numbers have been decided on yet.

MR. LORSON: Okay.

CHAIR RYAN: 25 too is a bit of an apples and oranges because 20 is workers and this is a public dose standard. So that doesn't get it lined up exactly. So I agree with Liz, specific numbers haven't been kicked around, but the potential for discontinuity certainly exists.

MR. WATERS: One thing I've learned from at least the lawyers is obviously Part 20 is a hierarchy of dose limits. The specific regulations such as Part 72 has a more specific number. That's



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the number we follow because the agency, the Commission decided that's important for the system. So I think someone mentioned Part 20 which we'd just have to change here, or could perhaps be different than Part 20.

CHAIR RYAN: And again, I think we'd appreciate your thoughts and your reflection on that question as to whether or not you want to at least comment on that eventual potential disconnect or alignment, whatever the cards bring you, as part of this revision as opposed to waiting for it to happen down the line, or at least give licensees or users a path to address it. Thank you.

MR. WATERS: All right, quickly - again, typical design conditions that are looked at during loading and unloading operations, the normal and static and lifting loads on the cask, internal pressures and the long-term storage conditions including any materials that you were to license for the certified life of the cask system. Some - there's more - normal conditions are more than these three, I'll just go through them. You look at potential equipment failures, extreme environmental temperatures, what happens on a very hot day, and potential partial vent blockage, how does the system



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perform if that were to occur. And again, a very general performance criteria for design-based accidents. The dose limit in 106 is 5rem from any design basis accident to any person beyond the controlled -

CHAIR RYAN: There is a number being kicked around there for workers. It's 2rem.

MR. WATERS: For workers, okay.

MEMBER SIEBER: What are the design-basis accidents that you considered?

MR. WATERS: Here are typical design accident conditions. Cask drop and tip over, explosive over-pressure, fire, flood, tornado, wind, missiles and earthquakes. And here's where - someone asked about the site-specific evaluation. Here's where it becomes important because a vendor will choose what are the bounding conditions and forces that are associated with these accidents, and that's what we certify yes, they can withstand this and meet the dose limits. When the general licensee takes - gets certified a cask, they need to do the evaluation that site evaluation be bound. Will for example the seismic load at their site be bounded by the seismic load analyzed for earthquake. But these are typical ones that are defined for accidents and analyzed.



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MEMBER BLEY: I'm just curious on that list, you have the vents top and bottom on all these casks to provide circulation cooling. You monitor that. I don't see a plugged vent or anything of that sort and overheating.

MR. WATERS: Yes, I - you know what, I did leave that out. There is - most systems have called adiabatic heat-up. And what happens if it gets blocked. And I think based on that they define how often do you have to surveil the overpack for blockage. For example, do you say 35 hours you reach a critical temperature limit and that's your surveillance? So that is an accident analysis that most do. I think it's also covered by flood as well. Well, that's not true. So that is one I left off.

MEMBER BLEY: Since you showed the snow.

(Laughter)

MEMBER BLEY: If you have snow or if you have a landslide or a sandstorm, something that piled up stuff around the base of one of these just typically how long do you have to clear the vents before you might get in any serious trouble with the fuel inside?

MR. WATERS: Well, my numbers are on the order of one to two days generally speaking.



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MEMBER BLEY: That's short.

MR. SOLIS: It would depend on the total decay heat.

MR. WATERS: Yes, that's correct.

MEMBER BLEY: But I'm saying either a typical or worst case -

MR. SOLIS: Twenty-four hours.

MEMBER BLEY: Wow. Okay.

MR. PARKHILL: But for snow you're obviously changing the boundary conditions.

MEMBER BLEY: Yes.

MR. PARKHILL: We analyze - is for the hottest conditions on the hottest days to come up with that number. We don't analyze for the coldest day for the heat-up which would give you a lot more and I would like snow to be around it because I think it would end up melting a lot of it.

MEMBER BLEY: Plus it's just going to have water there instead so you still wouldn't have cooling.

MR. WATERS: That's a good point. That's a termination of the -

MEMBER SIEBER: In any event, those are addressed by the SRP so otherwise he has to address it.

MEMBER ABDEL-KHALIK: What would be the initiating event for an explosive over-pressure accident?

MR. WATERS: Well, you know, some sites for example have a natural gas line or some other manmade - that could pose a threat. That would be something under consideration. We also, you know, sensitive licensees always look at it. There are sites that have gas lines. It's to cover those potential I think manmade facilities around the storage area or transfer path that may provide an accidental force upon the cask system.

MEMBER ABDEL-KHALIK: So it is - I was confused by the term "over-pressure." So this is an external event?

MR. WATERS: Yes, yes. Yes.

MEMBER ABDEL-KHALIK: Okay.

MEMBER ARMIJO: In the case of flooding where you have this vent at the bottom and then it loads up, just how severe a flood would you have to have before you get into criticality issues on the vertical cask where it starts literally filling up the bottom part?

MR. WATERS: Well, the -

MEMBER ARMIJO: Do you have a lot of



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margin there, or? I'd like their answer.

MR. WATERS: Well, first and foremost the casks are sealed so a flooding event will only surround the canister -

MEMBER ARMIJO: Yes, in between the cask and the canister. Does it provide enough moderation that would make it much difference?

MR. WATERS: I'll let - Zhian do you want to?

MR. LI: Okay. My name is Zhian Li. I'm a criticality and shielding reviewer, or engineer. So to answer your question normally for the dry cask storage system we assume the system is sealed, welded so there's no water getting into it.

MEMBER ARMIJO: Right, I know that part.

MR. LI: Yes. The k-effective for that kind of a system roughly around 0.4, in that region, is really low.

MEMBER ARMIJO: So just surrounding it with water between the concrete overpack wouldn't make any difference?

MR. LI: Right, because it's so big. The concrete is already about 12 inches thick.

MEMBER ARMIJO: Okay.

MEMBER SIEBER: And it is spent fuel.



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MEMBER ARMIJO: Well, I understand that.

MR. LI: Yes, it is spent fuel, right.

MEMBER ARMIJO: Why else would you put it there?

MEMBER SIEBER: You would have to have heavy water in order to even get close, I think.

MR. WATERS: Yes, if water got inside that would be an issue we'd want to -

MEMBER ARMIJO: That's a different story.

MR. WATERS: That is, yes.

MEMBER SIEBER: But you store it in a spent fuel pool without a criticality issue and the spent fuel pool is full of water.

MR. WATERS: Yes, and that's part of critical review. We look at the loading conditions during - inside the transfer cask and some have to rely on the borated water spent fuel pool obviously to show some criticality.

MEMBER SIEBER: Now, the spacing is closer in the ultimate storage, but the k-effective is still pretty low.

MR. WATERS: Yes. And finally, the other thing we just talked about -

MEMBER ABDEL-KHALIK: Excuse me, again back to the explosive over-pressure issue. So if



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sites select sort of a general license rather than a specific - a site-specific license, how do you define the boundary conditions for these particular accidents?

MR. TANG: David Tang, senior structural engineer. Generally the cask system certification we review the capacity of the canister to resist say flat pressure and over-pressure whatever have you and this kind of a pressure will be defined as an interface parameter which will be evaluated by the general licensees so their 72.212 evaluation. So the applicant or the licensees are to define what's applicable at the site and compare what the over-pressure may apply. So by simply comparing these kind of values and number and arrive at a decision. Many times they will retain their consultants to do site-specific evaluation to meet these parameters.

MR. LORSON: So would it be fair to say, David, that there's basically like a 2-step process? There's the over-pressure analysis that the designer does that provides a point of reference in terms of what type of over-pressure the system can withstand, and then there's a site-specific analysis that's conducted by the end user that looks at their particular facility, what could potentially cause an



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over-pressure event to ensure that whatever potentially initiating event conditions may exist that they're bounded by the design of the system. Would that be a fair?

MR. TANG: That's correct.

MR. WATERS: And finally before we turn it over to standard review plan, always boils down to these general areas review for storage. And I forgot the bullet on radiation protection. I apologize, Liz. And I'm going to try to address some of the questions about how to relate to each other. As we mentioned we have specific disciplines, you know, with structural thermal shielding, criticality, confinement and materials. Those are the primary disciplines and so we look at those and for example the shielding barrier - we'll look at the ability of the shielding system to shield the radiation. The radiation protection chapter, someone mentioned that. That really, you're right, it's kind of a compilation of other reviews. It's a compilation of the shielding review, the confinement review and a view of operations where we look at what are the doses from confinement and shielding, what are the operations and how - what are the ultimate numbers that a worker may receive or the member of the public may receive. So it's kind of



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putting those together. And they do feed each other. For example, materials and structural are really kind of the backbone. You know, you want to make sure there's structural integrity and materials integrity throughout the service life to assure adequate thermal and shielding criticality and confinement. And we all look at operating procedures and acceptance tests. They all apply to these other disciplines. I mean, you can have a great cask design, but if you don't use it correctly you're just as much trouble so we look at that. And accident analysis recognize - is high. Accident analysis is really kind of that compilization of all the disciplines put together, how does the overall system perform. The real review, for example, in a shielding or thermal accident, a structural accident will be in that structural chapter. That's where the real review happens, verifying the performance of the system structurally during an accident condition. And if you look at the accident analysis chapter it's usually a summary of what was done in the other chapters and how does everything fit together to show overall performance with accident requirements.

CHAIR RYAN: I think the key in all of that for me is - and I hear what you're saying. You



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know, some health physicists might tell you the health physics ought to be first and the rest of it feeds health physics. I think the point is all that sounds great from a phenomenological point of view, but at some point we've got to translate that into a risk perspective. So I think one of the questions you'll have is how does all that phenomenological analysis translate into what can go wrong and what are the consequences. So that's where I think we really need to understand how this work integrates on the risk platform. And again, I'm not looking for a short answer today, but that might be something to come back and tell us a little bit more about and I think Dr. Bley had questions along those lines as well.

MR. WATERS: That's a fair comment and obviously you know the structure review plan is not necessarily in alignment with what can go wrong, how likely is it and what are the consequences. As you can see it's broken out by the phenomenological disciplines.

CHAIR RYAN: And there's a value in that, not just a, you know, make the risk folks happy. It's - the value in that to me is that you're telling users of the standard review plan what's important. And you really need to pay attention to this because this is a



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risk-significant issue. This one over here of course you need to pay attention to it because we have requirements, but that we view to be fairly straightforward. So I think it's in that context of giving insight into the user of the document where the risk-significant discussion really adds value.

MEMBER SIEBER: And that's the way this standard review plan is laid out. That's where you put the effort. It's low, medium or high.

MR. WATERS: If there are any questions. I'm not sure what time we need to take a break. We can take a - well, that's up to you, Dr. Ryan. We can take a break or we can move on to actual updates to the SRP, unless there's any questions.

CHAIR RYAN: Okay. Well, that's within our time schedule just a few minutes from now, but why don't we take a 10-minute break and reconvene at 2:45. Okay? Thank you.

(Whereupon, the foregoing matter went off the record at 2:33 p.m. and went back on the record at 2:45 p.m.)

CHAIR RYAN: We will go back on the record. We're now at the point where, let's see, Ron, you're up.

MR. PARKHILL: Okay. My name is Ron

Parkhill. I'm in the Spent Fuel Storage and Transportation Division, and I'm a senior mechanical engineer. Mike has talked on this slide. Before we leave it I just wanted to touch on Mr. Sieber's question about the design life of these casks and how it's utilized. One of the public comments we had, because we had a 20-year life mentioned within the document and because the public is aware of the rulemaking that we have to extend that for 40 years, they've asked that we take that into consideration. So what we've done is made reference to the regulation that defines the design life of the cask, and the onus is on the designer and his review of this cask system to ensure that that cask will perform within the bounds of his or her expertise for that design life. And it's changing to 40 years. But that will not be explicitly called out now. We're referencing it to the regulations. There is a separate SRP that's under development. I believe we've already got public comments on it which is going to talk to the license renewal aspect. So when a current cask that's designed for 20 years or a future cask that's designed for 40 years, their life expires, another standard review plan would be governing what we look at in that. And that's - so hopefully that addresses your



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question on how we use the standard review plan.

MEMBER SIEBER: There are a number of facilities though that are approaching the 20-year limit right now, right? Is there any of them over 20 years?

MR. LORSON: Yes, and there's three facilities I'm aware of that the license has been extended for a 40-year period of renewal. But with it that requires that they follow the guidance in our - basically our standard review plan for license renewal which basically requires that they implement an aging management program that's similar to the aging management program that's used to power reactors. So if they implement the aging management program then that provides a basis for us to extend the license for an additional 40-year period.

MEMBER SIEBER: Thank you.

MR. PARKHILL: As you can tell from this slide the project has been going on for about four years. Back in April of `06 the technical staff was chartered to begin the process of updating the standard review plan with the methods that we had been using to date, standard staff practices for review. And the important thing here is this is not a contractor-developed document. This is a document



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with ownership by the staff, it was developed by the staff and we did use a contractor mainly to facilitate the processing of the document as well as for their specific expertise in risk-informing regulatory documents. So they were selected specifically for their use. Unless you have some question on the schedule we'll move on.

The structure of the standard review plan is fairly typical. We have a review objective, areas of review, a regulatory requirements section, an acceptance review, the review procedures and the evaluation findings. When we talk about risk-informing we're really prioritizing the review procedures section of the standard review plan. So this is guidance to the staff to tell them what's important to look at and what maybe you don't have to spend as much time on.

The goals of updating the SRP are originally for incorporating the ISGs. As you can see, as we mentioned before this was a document that is probably well overdue for updating. It was originally written in 1987. This is a first revision to it. In that time period we've developed up to 25, the number is higher than that. ISGs, 24 of those 25 we're addressing within this standard review plan.



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The other things that we're including here are, you know, our licensing experience, the evolution of cask technologies since the last revision, operational events are considered as well as feedback from them, and we have a significant change in our computational methodologies, specifically in thermal and in structural. What we're hoping to do with the risk-informing and somewhat of a misnomer, but we really mean prioritizing is to review the staff audits on the more important aspects of the design based on our historical perspective of casks that have come in to date.

CHAIR RYAN: I'm not sure I follow that exactly. Could you help me understand how that's risk-informed?

MR. PARKHILL: Well, I'm trying to define "risk-informing" as prioritizing. This effort and the contract that we put into place was to give the staff guidance into what was time-consuming - or what was important and you needed to spend more time on it, and what was not so important based on our prior review. Like for an example, fire for a cask concrete overpack sitting on a pad. The design basis accident for that is whatever the largest amount of fuel is in the vicinity. We did enough of those reviews to say well,



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this has never really challenged the design. Why waste additional time on it?

CHAIR RYAN: I understand on a deterministic basis that example, but I do not understand it on a risk basis. You know, a deterministic basis of this can go wrong and that can go wrong and we've got a pretty good idea how A goes wrong, so let's spend our time on B may not be the right choice based on risk. "A" still may be the riskier outcome. So how do we - you're going to have to help us, I think, understand the difference between informing on the basis of risk or informing on some other basis.

MR. PARKHILL: Well, I think the methodology that you're probably already familiar of, we'll touch a little bit on that as we go through it. Maybe as we go through that you can help me with what your question is -

CHAIR RYAN: Okay, that's fine.

MR. PARKHILL: - but what I want to leave you with is this was not a risk-informing process. This assignment from the outset or the concept was to provide the staff guidance on what is important in the -

CHAIR RYAN: Important to?

MR. PARKHILL: Important for us to spend resources on versus activities that may not be so important where we can - don't need to spend as much resources on. So it's a prioritization of what we need to do with the overall emphasis on saving staff time on limiting the amount of effort devoted to items that just in historical perspective hadn't been fruitful to generate staff time on. Like the example with the fire and the accident analysis. We had enough experience where we knew that that wasn't challenging, so why continue going through a very analytical procedure of evaluating that when there was no bang for the buck. The design was already - we've already demonstrated in our minds that it was safe. And that's all based on a historical perspective. Granted, you know, if a new design comes in, you know, all of these insights are based on what we've learned to date. So if something is different, you know, then -

CHAIR RYAN: So fire is not so important anymore because of the magnitude of the consequences irrespective of the probability of it occurring, is that what you're saying?

MR. PARKHILL: Well, I'd put it in a -

CHAIR RYAN: Therefore we're not going to



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spend time on it?

MR. PARKHILL: Yes, that it didn't result in any adverse consequences.

CHAIR RYAN: So probability didn't enter into that decision?

MR. PARKHILL: No.

MR. LORSON: If I could add something to Ron's discussion, we'll go through the process that we followed to kind of characterize everything in high, medium, low. So we'll talk about the process, but you know, fundamentally when you talk about risk-informing a process you look at what's the probability of some type of initiating event occurring and what are the consequences should it occur. In the context of what we do in the area of design reviews, for us the initiating event is what's the probability that an error could be introduced into the design either by the applicant or designer, or by their own staff reviewers failing to identify the particular -

CHAIR RYAN: Or the fabricator.

MR. LORSON: Or the fabricator also. Fabrication is something that, you know, we have the requirements in the procedures and operational procedures and quality assurance programs for the fabrication. We inspect those separately, separate



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from the design reviews that we do for the application.

CHAIR RYAN: But it seems to me, again I stand corrected if I'm wrong, but it seems to me that what you're doing is compartmentalizing the risk triplet, and you're looking at one compartment of that risk triplet. What can go wrong, how likely is it and what are the consequences. You're focused on, it seems like, you know, what are the event sequences that can lead to something happening.

MR. LORSON: I think what we're looking at -

CHAIR RYAN: Deciding which of those you really need to focus on for a yet - reason I don't understand.

MR. LORSON: Right. Well, I guess what we'd look at in terms of what can go wrong, we're looking at what are all the design requirements that come into play. Every one of those is potentially an issue.

CHAIR RYAN: That's not what can go wrong, that's what are the design requirements.

MR. LORSON: What are the design requirements and then how likely is it a particular design requirement will not be met and how likely is



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it that we won't pick it up during the review process. I think those parts all sum together toward what's the likelihood that an error could occur. And then the consequences if the error were to occur is where we get into the consequences piece. You know, we can look at the process in a little bit more detail and we'll have -

CHAIR RYAN: Okay, maybe I'll understand it better as we go along.

MR. LORSON: Okay.

CHAIR RYAN: I'm a little - it doesn't line up with my understanding of a risk-informing approach.

MR. LORSON: Okay.

MEMBER ABDEL-KHALIK: I have a question about the second bullet. Are the reviewers required to do independent computations to - and if so, do they have state-of-the-art computational tools to do so?

MR. PARKHILL: The second part of the question is yes, we have state-of-the-art computational methods. The first part is the judgment based on the specific design that's coming in, whether or not we need to utilize that. If there's a very large margin, if it's, you know, a revision with a relatively low heat load, and again, it's based on the

judgment of the reviewer and -

MEMBER ABDEL-KHALIK: The trend is going in the opposite direction where the heat loads are continually increasing a number of -

MR. PARKHILL: And all new designs that I'm aware of that we come in are going through a very rigorous computational evaluation, yes.

MEMBER BLEY: Ron, if I understood your prioritization scheme, the individual reviewer would only consider doing independent calculations if it was in one of the high-priority areas.

MR. PARKHILL: Again, the general answer is yes, but it's still up to their discretion. Nothing is so scripted here that the individual reviewer can't use his own best judgment here. And you know, what we've gone through is really kind of an exercise in knowledge transfer to take the experience that the staff has gained and put it down on paper. And unfortunately, that's always a historical perspective. We don't know what's coming in. Of course, as you say, the trend is going up for heat loads. But you know, the point being is that we are limited with our experience and that's what we're relying on when we go and you know, prioritize the review procedures sections. And that was the focus

from the get-go on this assignment, was to basically go through and provide the staff some guidance. And we were fortunate enough to come up with a process that makes it somewhat repetitive you know, or hopefully repetitive enough if you get the same people. But once we get into that you'll have a little better feeling for how we went about what we did. But I don't want to leave you with the impression that this is a risk-driven exercise where the PRA is a basis for it and all sorts of data. It was not. It's based on the judgment of experienced staff reviewers and their evaluation and answer to the questions we'll talk about shortly.

MEMBER BLEY: When I look in some areas here, not yours, I see a lot of reviewers for applications in other areas are new to the NRC, new to actually the technology and new to the systems they're reviewing. How is your staff? Are they all experienced or heavily experienced, or the other way?

MR. PARKHILL: We have some very experienced, talented people, and we also are suffering as an organization from those people moving on to other things, and we bring in new people. Part of the reason that this project has taken so long is people, is that case work has been taking as a

priority for us which is our product to the stakeholders as well as staff turnover. Fortunately we have, you know, very competent staff that's been here and we've been able to promote and hold on to. So that's just the reality of the thing right now, but we do have from a computational standpoint and, you know, Dr. Solis over there comes to mind as a leader in computational fluid dynamics. We also have contracts, you know, with P&L and you know to assist us in reviews that get to be what we consider to be cutting-edge or new technology coming in. But the exercise here was originally envisioned to see how best we can utilize our existing staff that could be shrinking at any moment and utilizing some savings in FTE. So this was the vision that was laid out before us to go and try to prioritize our work. And we don't have the risk data, you know, in fact from a PRA you never get into the level of detail in how we go about design activities. Fortunately that knowledge exists in the minds of our experienced reviewers and how best to capture it.

MEMBER BLEY: For this whole risk-informed process you said you had a contractor. Was that P&L?

MR. PARKHILL: No, it was - it's ISL.

MEMBER BLEY: Oh, ISL.



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MR. PARKHILL: Information Systems Laboratories.

MEMBER BLEY: Appendix B is kind of brief. Is there a report from ISL that we could look at that lays out the basis for this whole scheme?

MR. PARKHILL: I think there's - actually, we had them write Appendix B for us, and that was - there's probably something else in the earlier design aspect of the project, but I'm not sure it would be added information. We do have those sheets that you alluded to with a rating and we've learned from that. The next go-around we do with this, those will be a little bit more - or better documented let's say. But we do have them. If there's any other questions I guess I'll continue on here.

The last part of that as far as being risk-informing is that, again, this is a guide to the reviewer. Again, it's in his mind's eye how he utilized it. If a design comes in that's different then - or vastly different, then he probably would be wise to follow his nose rather than the guidance here. But if it's a design that's basically just upping the heat load, same configuration, then there's some lessons learned that we, you know, we took an effort to document here.

CHAIR RYAN: That's a slightly different definition if you will of risk-informed.

MR. PARKHILL: It is. That's why I want to get it right up front because I can tell you that you guys were having a different expectation and this is really a - when we say "risk-informed" we're prioritizing it. I have a theory on -

CHAIR RYAN: I caution you that that would misinform - no pun intended - lots of folks that read the document.

MR. PARKHILL: Well you see, there is going to be - when we get into the methodology there is, you know, the last question that talks about a risk aspect. So there is a consideration of it. We had the contractor go in and say hey look, look at the PRA that's been done for this, tell us how we can use this. How can we take the benefit of that knowledge and incorporate it in the process. We had him go through that exercise. And you know, they really couldn't come up with an effective way of utilizing that. The data is just not there for what we're looking at. You know, we're looking at design and we're not looking at kind of event-driven things. How well do they do it, how well do they build it.

MEMBER ARMIJO: But there's a lot of



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operational stuff in here, at least I got the feeling there was. The loading of these canisters.

MR. PARKHILL: Yes. We have a chapter on -

MEMBER ARMIJO: That's where I would think the greatest risks are, really. Otherwise these are passive systems that are robust designs.

MR. LORSON: When -

MEMBER ARMIJO: - they just sit there.

MR. LORSON: - you start to look through the various scenarios of what could go wrong, for example, we look at some of our accident scenarios. What could go wrong in an accident scenario? Well, if I were to lose my confinement boundary, that could potentially be a driver to some type of radiological type of event. You know, again, we were looking at the perspective of the system as designed performing its storage function, what are all the various aspects of the design that we need to provide the most attention to when we do our review. The thermal loading. How do we ensure that the thermal loading doesn't, you know, exceed the criteria. So we're really looking from that perspective. We also did consider the - you know, the operational sections of the chapters all get their own individual assessment

in terms of contribution to - or how do they contribute to potential bad things happening.

CHAIR RYAN: Well you know, if you just take three different pieces: loading the cask, moving it from one place to another and then having it sit in static storage with all the monitoring and management systems in place. I see three different horizons of, you know, risk management challenges there. That's Sam's point. So I would expect that if this is a risk kind of way to think about these casks I'd be dividing things up in at least those three bins. And there would probably be subdivided bins under each one of those three major areas as to how the risk should be evaluated. I don't expect to say well, if you're loading a cask, here are the risk things you need to think about and here's how you need to think about them. But what I'm hearing is that's not the way this is organized and you really mean something slightly different when you say "risk-informed."

MR. LORSON: Right.

MR. WATERS: This is Mike Waters. I want to add my thoughts to that. I think as you, you know, the Commission's policy on risk-informed is SECY-98-0144. I think on the overall level I think we're using what I would call risk insights to inform this.



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The risk insights are qualitative risk insights and I think you're right, to some degree we don't know the probability of an accident happening. The regulation is deterministic in nature, we're looking at - we're beginning with design basis events. Staff is going to already have to analyze this to begin with so we don't necessarily focus on the likelihood of that happening. But once it does happen, what is that consequence to the cask system? How does it perform? I think that was kind of one of Ron's - with the fire, you know, we already assume the fire happens. We're not going to spend more time looking at the probability of it happening, but we know the impact on the cask is very low. And those qualitative insights I think is part of the methodology, where those what I call risk insights into this. And that's a little skewed from the traditional risk-informed definition of doing more of a quantitative risk assessment.

MEMBER ABDEL-KHALIK: You know, my concern is that these qualitative approaches may really miss the need for step changes in technology. Example: going from vacuum drying to forced-flow drying. That was done at some point because vacuum drying proved to be ineffective at a given heat load. So how do you capture this in a qualitative sense?

MR. WATERS: Well, in a qualitative sense we would obviously look at the proposed operation and as applicant demonstrated based on performance of the drying system that it will sufficiently dry fuel without exceeding limits. Do we have any data on performance of that? The answer is no, it is a new system. And I kind of do - because we are approving new things and we're using engineering judgment to determine that it is safe and compliant with the regulations. And we're using operational data on some of these evolving technologies. I think I probably circled around your question, but I understand it.

MR. LORSON: Well I mean, you know, what I would add to Mike's statement there is when we're talking risk-informing, okay, what we're talking about is what's the appropriate level of staff review effort in a particular area of an application that we believe is necessary based upon our operational experience and our expert opinions. In the case of established drying systems that have been used for certain heat loads we have experience in reviewing those systems. If some applicant were to come in with a different approach for drying the fuel that's something that if you look in our standard review plan, you know, because of the uniqueness and novelty of the design it



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would trigger us to do a more rigorous review. So, you know, it's a way of prioritizing and adjusting the staff review level based upon -

MEMBER ABDEL-KHALIK: I'm concerned about the inverse problem where you may be happy with the current technology and you get to a point where it's no longer applicable, or no longer sufficient.

MR. LORSON: And that's where, you know, we conduct reviews of applications as one aspect of what we do in regulatory oversight, but we also do inspections. We have an expectation that applicants will have corrective action programs in place and these Part 50 licensees when they load these containers, if they're not able to achieve the required conditions to ensure that the fuel is dry then they have provisions within their corrective action programs to make adjustments and that would have to get fed back to us through the inspection, enforcement process. We have other tools out there to drive us to the right condition.

CHAIR RYAN: So it would seem to me, Ray, that if you're doing all those things which are under this last bullet of staff audits and so forth, and evaluating various aspects of the use of, the design of or the modification of casks, the people involved,



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you ought to have some process to gather that information and analyze it to determine where are the risks, or where are the areas of certainty and uncertainty in these various systems that would then guide you to say we need to spend more time on, you know, cooling, or we need to spend more time on concrete issues because of whatever's happening with concrete, or not, you know, not happening with concrete and think out loud about that. But that to me is more of the nature of risk-informing, or gaining risk insights from what's happening rather than, you know, trying to give the impression that you have an understanding of what can go wrong, how likely is it and what are the consequences because you don't, from what you've said.

MR. LORSON: I think we do have operational experience and we're all - the folks who go out and do the inspections are the same folks - or not the same folks, but we're all in the same division, so we do have a lot of communiques that go back and forth.

CHAIR RYAN: I don't doubt they're gathering good operational information, that's absolutely right.

MR. LORSON: Right.

CHAIR RYAN: I'm sure that everybody who does an inspection does a very good, thorough job of that, but the question isn't are they doing good inspections. The question is are we inspecting the right things.

MR. LORSON: Right.

CHAIR RYAN: And how do we know if we're inspecting the right things? We don't, unless we have risk insights as to what, you know, from a risk insight perspective should be the things we inspect.

MEMBER ARMIJO: Well, experience can give you the insights, but I think it's the choice of label, risk-informed focus which means very specific things to some people and that's not what you're doing, at least from my standpoint. I don't fault what you're doing, I think it's the right way to go, but calling it risk-informed I think is -

MR. LORSON: That's an excellent point.

MEMBER ARMIJO: That just drives us off into expectations of something that isn't there.

MEMBER BLEY: There's another piece of it that bothers me. And from what you guys are saying, maybe this gets fixed in your discussions as you go through this evaluation. But this scheme of the three questions plus defense-in-depth with the scale that



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comes out if it's - you add them all up, if it's 1 to 5 it's low, I can easily think of counter examples here where we think it's real unlikely that the applicant would have made this error. We think it's kind of medium whether we'd catch it or not, but it turns out to be something that's of high consequence, and maybe not terribly unlikely. You can keep those separate, use them either way. And if something like that comes up where what would be the risk measure, the probability and the consequences could be kind of high, then the fact that your review method wouldn't find it could lead you to not even look, to put it down in the low category where in fact what you ought to do is come up with a new way to review it so you could find if it were a problem. So the idea that some things could get hidden by the schema because it's in fact not what some of us would call risk-informed, but those first two questions could bury something of potential significance that worries me. Your qualitative looking and discussions might make that not happen, but the schema could let that happen very easily. That's where I'm uncomfortable with it.

MR. LORSON: I think you're right, there is a happy ending to the story.

MEMBER BLEY: Good.



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(Laughter)

MR. LORSON: We've had a lot of these. You know, these are not new discussions. We've been having this discussion for a long period of time. But you know, when you actually look at how could you potentially answer some of the questions, could it drive you into looking at the wrong things, that's certainly a concern. When we looked at and we went through the methodology and we answered all the questions and we came up with the numbers and we looked at the distribution of rankings across each of the review chapters, and again that's what we're really trying to do here is how do we adjust the review effort applied by the staff on each individual chapter of the standard review plan. What we came up with when we kind of stepped back and looked from the balcony looking down, we thought that we looked like we came to the pretty much right place in terms of we were focusing the highest attention on the areas that looked like they were the most important to us. And we'll go through that in a little bit to kind of look at the distribution in terms of how we came -

MEMBER BLEY: Before the day is over will you qualitatively convince me that it's reasonable that there be nothing of high priority in accident



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analysis and rad protection? That just - that one just seems so counter-intuitive to me. Maybe those things get picked up somewhere else, but how can it be that the accident analysis doesn't really deserve a good, hard look?

CHAIR RYAN: One aspect that I think what Dennis is pointing to is doing it chapter by chapter may not be the best way to think about risk. Risk, you know, it's a system risk, it's not an individual discipline risk.

MR. LORSON: Right.

CHAIR RYAN: I think that's confusing to us as you're probably figuring out.

MR. LORSON: Absolutely. It's clear.

MR. LI: Okay, this is Zhian Li. I'm a senior criticality shielding reviewer. Let me give you some - my two cents here to see whether we can. First of all, I think this guidance document is really - guides the reviewer to see which area you are likely - or a higher likelihood of making mistakes or safety significance. And then guiding this reviewer say, okay, this is an area you probably should pay more attention. And also addressing the other member. I don't know the name. Dr. Khalik? Okay. Sorry, I apologize for not being able to pronounce your name.

MEMBER ABDEL-KHALIK: That's quite all right.

MR. LI: Okay. As the new design, new application came in, the new kind of a technology the applicant used, we would move our focus more on the concentration - look at those new things to see whether it be a kind of a likelihood of making more mistakes or kind of have a safety significance impact. So certainly we would, as we go we would adapt to the new technology. So I think we heard your concern. I think we will take them back and think about those and address the issues hopefully.

MR. LORSON: I mean, if I could just - I think to take Mr. Bley's point, you know, when you look at risk tells you risk insights can be used to direct you where to look. You know, if I'm at a power reactor it tells me what do I inspect. Well, I want to go out and inspect my refueling water storage tank isolation valve because that's a major contributor to risk, right? And you can do that through a detailed mathematical model. When you're fabricating a storage cask it's one component that's being manufactured that requires inspection and oversight. So you can look at a number of the critical inspection properties for the manufacturing and non-destructive examination testing,



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you know, as it's being manufactured in a facility. So our scope of what, you know, we physically can evaluate the design of many if not all aspects of the systems that we're licensing and we can inspect a significant portion of the activities that go into the overall manufacturing of the system which is a little different than some of our counterparts in the reactor world where you have to pick and choose from amongst tens of thousands of components to pick the right things to go out and look at. So it just puts it in a little bit different perspective. But I do agree with the point that maybe when we use the term "risk-informing" it creates different impressions in terms of folks' minds in terms of what we're really doing.

CHAIR RYAN: Yes, a dry storage cask may not be a really complicated system like a reactor, but it's still a system. There are individual components to manufacture, they're purchased as-is and they're put together, and they perform a system function. And so I - just because it's a fairly simple system compared to, say, a reactor, it's not without system risk.

MEMBER ARMIJO: If you don't have failure data though, what can you do with it? You have to intent probability that a weld will leak even though



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it passed its helium leak check at some time. So you don't have any experience that that's ever happened, but so how do you really do a mathematical risk analysis? This is more of an expert system that - it's an expertise-focused, experience-focused review, what I see. It has pitfalls, but I don't think they're - the reviewer isn't kind of asleep at the wheel. He'll know that he's out of his range that has been kind of identified ranges where he should be very comfortable with that part of the review and very cautious with another part of the review.

MR. EINZIGER: An example where you have to depend upon the qualifications of the reviewer that recently came up, it was on the leak testing of the lid of a cask and this was a 5-inch thick cask head and they were trying to see does it leak at the $10^{-5}$ range through the cask; not through the weld, through the piece. Now, if you're looking in the $10^{-5}$ range the chances of leaking through that stringer, through that head is next to zero. If you were telling me you had to leak test that to $10^{-10}$ the probability of getting helium leak through a stringer in that 5-inch thick head would be something you would have to test for. You're depending upon the knowledge of the reviewer to be able to determine whether an item has



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to be delved into in detail or whether it seems to pass the Ho-Ho test.

MEMBER ARMIJO: I agree with you.

MEMBER BLEY: I'm still at the point - you gave me Appendix B to sort of say we have this structure that now gives us a way to do this maybe rigorously or somehow, and I get these scores that I add up. I think those can lead you astray. If you told me you thought about those three questions and argued it through and came up through your discussions with the priorities I'd be much, you know. Even though I like doing risk analysis and I think there are ways you can do it, I'd be much happier than having an arithmetical system that looks to me like it can lead you into trouble. I hope your discussions keep you from that, but there's nothing in what I read that helps me understand how that - so enough from me on that.

MR. PARKHILL: Okay. All right, well I think we got your message and hopefully you better understand what we're doing here as far as the use of the word "risk" and I guess we'll take a hit on it as being a misnomer to say the least. Well, part of the benefits of doing a risk-informed process, and I think this discussion has gotten beyond the slides so I'll

try to go through these quickly here, is that what we're trying to do is increase the staff focus on those items that we consider to be important. Some low-priority items theoretically could be missed, but in - by us, but hopefully they would not be of a consequence that would present a problem based on our experience. And the third bullet has to do with unique designs that come in. The reviewer still needs to make determinations on whether or not it's within the bounds of what we've seen previously, deviations from standard practice as well as the uniqueness of the submittal.

CHAIR RYAN: In terms of design novelty? Is that what you're thinking of?

MR. PARKHILL: Yes, yes.

CHAIR RYAN: That makes me comfortable in the sense that a novel design that's got lots of new features, materials, all the whistles go off and everybody starts saying well, we've got something brand new here, we've got to start over. That makes sense to me. And again, I think that what we're all maybe struggling a little bit with is how do you - how have you institutionalized expert practice from your experience so that it's applied systematically and uniformly? I'm thinking about Dr. Armijo's example of



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the helium leak test, so that you know you're inside the wheelhouse and well within it from the range of experience you're drawing of. More importantly, how does one practitioner communicate that to the next, a teammate practitioner, here's what we're looking for, and here's why, and here are the parameters, and here's the features, and events and processes we're all interested in evaluating to understand whether we're still in the wheelhouse or not.

MR. LORSON: Right. I think we have a number - I think that's an excellent question given that we have a number of staff that are up here that are in the mid part of their careers and then we have newer staff also. How do you transfer knowledge is something that is a big focus across the agency. We have a pretty active knowledge management team within our division. We do periodic training sessions. We have - we're updating a knowledge management type of website so that folks can put in RAI responses and show how they've worked through some specific parts of different applications. When the folks do the review it's generally the practice where the branch chiefs will, if they have a more junior reviewer will ask a more senior reviewer to kind of work with them and kind of apprentice under them for a couple of reviews,



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or parts of the reviews till they get up to speed. We have - each of our technical disciplines has kind of a - I would call it a community practice type group where they'll meet periodically for example. We have a group, the sizzlers, that does thermal review and it's all the thermal reviewers. They meet, they talk about the different things they're seeing in applications, where the problems were, the challenges, the uniqueness so they can kind of share experience there. But to answer your point directly, I think that it's a definite focus area for us here in the near term is to figure out how to take what we learn as we complete our review and to institutionalize it. And we think that through effective use of our knowledge management tools and website that it will lead us in the right -

CHAIR RYAN: And I'm not exactly sure how to best capture it in the standard review plan, but somehow there ought to be a tie back to the standard review plan that gets people to, you know, because one day we all win the lottery and leave and spend our money somewhere else, but you know, what's left behind is going to be what's in writing. The standard review plan says there are knowledge management resources on these topics, chapter by chapter here's the knowledge



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management resources are that you've developed and done something along those lines. That I think helps get to the how do you think about some of these issues in terms of their priority.

MR. EINZIGER: That's usually the driving force for writing an ISG, that there's been an issue that's come up that's spurred a lot of conversation among the staff and as a result we want to codify our opinion on this issue. So we write down what the issue is, what we see as a suitable solution to that issue. That doesn't mean that the applicant is bound by having to use that solution, it says we've thought about the issue and this is what we think is a solution to the issue. If you want to us that solution, fine. We're not going to spend a lot of time looking at the review. If you decide you want to tackle that issue in a different manner then it's incumbent upon you to provide proof that you solved the issue.

CHAIR RYAN: Maybe the ISGs are a way to tie this together a little bit.

MR. WATERS: I think the answer is yes. I actually view the standard review plan as one of - as a primary knowledge management tool. That does tell the reviewer what to look at. And using the vacuum



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drying example, we don't want one reviewer not to look at that. The standard review plan looks at it and we're doing our review, we don't look at everything. The standard review plan defines what do we audit. I think what's low, medium, high is always going to be debatable, but I think the purpose was to provide an additional focal lens based on what you need to look at, to what depth you need to look at it. In a general guidepost there's always caveats, there's special considerations. So I think the SRP and ISG is one of the knowledge management tools to ensure a consistent review from reviewer to reviewer. With all that additional focus we can say look at the vacuum drying system. One reviewer may spend several days on it when he or she could be looking at something more important in theory and vice versa.

MR. EINZIGER: We will admit that there are things just like the vacuum drying that probably need an ISG, but in the priority of work that needs to be done just haven't gotten around to it. If you look there is documentation on vacuum drying, what we have seen and what's the basis for it and when it's applicable. Now, the forced helium drying came out, it was a system that was developed because the temperatures were going too high for the high burnup



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fuel to vacuum dry it, and so they developed a new system. Now I know I've spent countless hours looking into the patents on that, looking into the testing they've done. They have done a lot of testing on that system, especially over in Russia and come to the conclusion that this system does work if it's within its bounds. Have I sat down yet and put that in an ISG? No. Should I put it in an ISG before I retire? Yes. We're in a particularly funny group because - the structural and materials. We have four people with a cumulative experience of about 120 years in the field and four other people with a cumulative experience of about 10 years in the field, and so knowledge transfer is very important to us.

MR. LORSON: So we've got folks in the middle of their careers, right? Folks at the other end.

MR. PARKHILL: For the record, I'm not in my middle part of my career.

CHAIR RYAN: On you go, Ron. Take it away.

MR. PARKHILL: Okay. Let's go - I think we covered that. This is - we've discussed this. This is how we use high, medium and low. Again, this was the prime directive in starting this project.

That was the purpose of doing this and what we - I'll call prioritization and not risk-informing, but that was the focus of this activity. And so what did we really mean? I think we've touched on this already. It is that if something is classified high in the review procedures only, that's the only thing we've done this to, is we're going to spend more effort, the staff is going to - as you can see, that last bullet there, here's some rough numbers, you know. For high, medium, low we're looking at 60/30/10 percent of the staff's time. The important thing to remember about low is we're not going to ignore anything. We're still going to look at it, but it's not going to be that in-depth review. You know, we're going to see that they've addressed the issue and follow our nose if it doesn't sound right. But - and there's some other items there that provide some guidance.

MEMBER ARMIJO: For example, in the high review priority criticality analysis if I remember right was always going to get - could always be - something be high. It might be easy to do. You might be able to do a criticality analysis pretty quick, but would you always do an independent confirmatory analysis of criticality?

MR. LI: Yes, we do.



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MEMBER ARMIJO: Even though you probably have plenty of margin, you'd still -

MR. LI: Right. Do a confirmatory analysis.

MEMBER ARMIJO: Okay.

MR. LI: In general.

MR. PARKHILL: And we have a table at the end of this, I'm not sure we'll get there, but it'll give you a feel for the number of things and disciplines that we've classified as high, medium and low per chapters. Hopefully that'll give you a warm, fuzzy feeling there.

MR. WATERS: I want to correct one thing Zhian said. There's not usually a criticality - there's not really that much margin. We're usually right on that administrative limit. There are some amendments where the k-effective may be lowered and so we do a confirmatory analysis, but the designs are usually right on the administrative limit. We usually do a confirmatory review.

MEMBER ARMIJO: Really? Okay, you do not have - you don't have lots and lots of margin on criticality.

MR. RAHIMI: Meraj Rahimi, project manager. We normally do under the Part 72 analysis



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that is done in the pool normally, and they go with a fresh fuel assumption. That's why they're very close to the limit and they use the - they rely on the boron in the pool as the means of the criticality control. So generally, you know, you're talking about 1,800 to 2,100 ppm, that's what they need, but the assumption is a fresh fuel assumption. That's why they're very close.

MEMBER ARMIJO: Very close on the end? That's an artificial situation because the spent fuel is far -

MR. RAHIMI: You're right, I mean it is burned fuel and on the reactor side on the other hand they take credit - burnup credit for the pool analysis. And only under solvent boron - boron-dilution event they assume burnup credit. But for the 72, for that particular analysis a fresh fuel assumption, that's why they get very close theoretically to that limit.

MR. LORSON: Okay, just as a point for discussion here. We're basically 45 minutes into Ron's 20-minute session.

(Laughter)

MEMBER ARMIJO: We've got 70-some to go.

MR. LORSON: Right. What I would suggest



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is that Ron, maybe you make whatever key points you want to make on the process to try to address some of the concerns we've heard and then what we'll do is try to get into the chapters. And if, you know, we can go through all the chapters, we have the staff here, or if there's particular chapters that are more interesting than others we could rearrange the order so we make sure that we capture all the chapters you really want to hear about given the time we have allotted. It's 3:30 and we're running a little behind schedule.

MR. PARKHILL: I got the message. Speed it up. Okay, the approach from the NRC staff standpoint was that this was a big project, it was not driven by any one individual. It required a team for each discipline. We established leads and those leads were responsible for getting consensus opinion within their group. We updated - the staff updated the review procedures to reflect our new guidance that we wanted to incorporate and the staff also in application of the risk, or the prioritization methodology was the one that made the determination, the answering of the specific questions. The contractor ISL was used to facilitate putting together the document. They initially administratively added

the ISGs. Subsequently the staff verified and redid some, and then they're big development was in developing the risk-informing process and we'll talk about the details of how that went about a little bit later. And then they documented the risk-informing process, or prioritization process.

Like we said many times hopefully here we just applied this to the review procedure section. We did not try to apply it to any other, like the regulations or acceptance criteria. Initially ISL did not have a canned methodology to help us prioritize this. There were three methods that were headed up by three individuals over there that were very independent from one another. This was kind of like the three bears, one of them turned out to be too complicated, one of them turned out to be unworkable, and the one we ended up with seemed to be the good median between the two. And the method that was selected was by ISL and the staff jointly. We also had the services of NMSS's SLS on risk Dennis Damon who was actively involved in this process and worked with ISL in developing the process. The process like we said before is based on the judgment of experienced technical staff before we retire.

And here's the methodology. We answered



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three questions here and you've probably all become familiar with this, but basically asked three questions and add up the scores to get a risk score. So the first question is the likelihood that the requirement will not be met by the applicant. And again we go zero to four. The second question is the likelihood that the staff will find the discrepancy. Generally we gave ourselves good grades on that, surprising. We try to be objective, but you know, that's - so I don't think we gave us - there was a likelihood that we would miss it even though I do have an example here shortly regarding helium leak testing where that turned out not to be the case. And then we made a judgment as to the overall risk of that. We provide qualitative as well as quantitative guidance there, but again we're going high/medium/low as to the risk significance of this. What happens if - and not all these questions were intuitively obvious. What happens if the containment fails? Is the risk high? Well intuitively you would say yes because bad things particulate can come out. But then there's an aspect to this that says well, what material are they using. They're using ductile stainless steel. What's the likelihood of ductile stainless steel, you know, failing under any category? So in that specific



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question the materials aspect to the evaluation came to the surface and the containment from the risk standpoint was rated relatively low because we had no data saying that we had failures of this material. So it's kind of a feel for one example of how we went about the logic there.

MEMBER BLEY: Just - I like what you just said. If you read the words that are here, it says either use the likelihood or use the potential consequence and you used both which makes sense, which isn't quite what's written down.

MR. PARKHILL: We could - and we looked at weighting them, you know, because they have a different score system. We sat down through this process and said well, should risk be 40 percent and the other two 30 percent and do a weighted average. And it can be - we have the data, we can still do that, but I think when we see what we came up with we were kind of happy with the outcome. Because what we're trying -

MEMBER BLEY: That might be a key, but on the other hand just the very scale biases it for the first two questions having more import than the risk one because they can have fours and zeroes, where the risk one can't have either a four or a zero in its



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score. Go ahead.

MR. PARKHILL: Okay. Okay.

MEMBER ABDEL-KHALIK: I guess I'm troubled by the second question more than the other two. The other two are obvious, the first and third. But the second question, it sort of implies that if something is so subtle that it is highly unlikely that you would find that discrepancy it sort of pushes it down to well, if you're not going to find it, don't worry about it.

MEMBER BLEY: And why wouldn't it instead force you to come up with a better way to review it?

MR. PARKHILL: Well, it's also saying do we really look at some of these things? It's not only are we going to miss it, the question is are we going to look at it. And some of the aspects are we weren't looking at them for various -

MEMBER ABDEL-KHALIK: You're not answering my question though.

MR. LORSON: I think Question 2 - I agree with you. Question 2 could lead you to think if you answer Question 2 you say likelihood that the staff reviewer will find the discrepancy. If you say it's not likely than you say it's going to drive you into not looking at it. And I think that's not - I don't

think Question 2 is worded clearly to meet the intent of what we were really focusing on which is - what it really I think is intended to convey is what areas of staff review have traditionally found the most problems. And I guess the view is those areas are most problematic in the designs and those are where we want to continue to focus on as opposed to areas where we've done a lot of looking and historically have not found problems. So I think the way we word it is not particularly clear, and I understand your point. Also, Ron mentioned we have the data. The one thing that we did, because you know, again I also am looking at this. We had some of the same questions. We took out the Question 2 results and we tried to normalize the results and what we found was very little difference in terms of the overall distribution of rankings in terms of what was high, what was medium and what was low. There was a few that may have changed. There was nothing that went higher. A few things may have slipped a little bit lower, but I didn't recall -

CHAIR RYAN: Ray, I did a couple of things here that are right along those lines. I ranked the issues based on the total priority column. So in that ranking materials is number one, structural is number

two, thermal's number three, criticality is number four, five is operational procedures and then it goes on down from there. When I do the same rankings based on the high priorities, it's criticality, materials, thermal/structural, it tied, and then shielding. So the same issues seem to come out whether I worry about high, low, medium, or total. So I'm asking what is this ranking telling me? Is it really as analytic as it would appear on first blush? And the answer is no.

MR. PARKHILL: The short answer is. What are we trying to accomplish? We're trying to rate the things and give the staff guidance on where to focus their effort. And granted we came up with a methodology. There was a much more cumbersome methodology to come up with this, but it was something that was hopefully repeatable and was documented. And again, we got some results that we think we're happy with. We got some -

CHAIR RYAN: Well, what I'm telling you is it has the appearance of being analytical and it doesn't really seem to be.

MR. PARKHILL: Well, like I said before, Question 2, surprisingly the staff didn't rate themselves bad.

CHAIR RYAN: I'm not focused on Question



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2. I'm asking a different question, Ron. I'm trying to tell you that when you just sort of sift out what these numbers really mean, you know, the rankings on high-priority issues and the rankings on total number of issues or total priorities of issues are the same, by issue. So I guess - I mean, to me it sounds like that your experience insights are what's important and what's not is probably what's driving this. And that's not maybe a bad thing.

MR. LORSON: Right. Well, I think you're probably right. You look at Question 1, likelihood requirement will not be met. We have a lot of operational experience where we've seen common problems and I think that factors into the minds that these are the areas we really need to focus on.

CHAIR RYAN: Maybe that's better to just admit that and then move forward with that thinking and recognizing that, you know, the collective insight or the wisdom of the 160 years of experience might be leading in the right direction.

MEMBER BLEY: And I wouldn't even say "admit." I would say use that. Instead of claiming it's this other bunch of arithmetic.

CHAIR RYAN: I just - I'm a little nervous about the fact that it looks awfully analytic when it



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really boils down to the fact that you're using your 100-plus years of experience to guide you.

MR. LORSON: Right. We actually did use this process and apply this process and what we came up with is a distribution that was consistent with what our experience -

CHAIR RYAN: Well, it's on the next slide.

MR. LORSON: And it's on the next slide.

CHAIR RYAN: But on that next slide you rank them based on total versus high, you get roughly the same issues coming up to the top.

MR. LORSON: Right.

CHAIR RYAN: So, what does it tell me? It tells me it's not all that analytic.

MR. LORSON: And it's an expert opinion approach.

CHAIR RYAN: You could maybe even claim that you have insights that are more than just opinion, they're analytic insights. You haven't formed these opinions based on just, you know, let's flip coins and figure it out. Let's do the analysis over X, Y, Z casks and units and designs and material science questions and all the rest, and you've decided what floats to the top. So these things are at issue because of the experience insights that what floats to



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the top.

MR. EINZIGER: But wouldn't you expect that since it was the senior staff who sat down and said yes, this is high and this is low?

CHAIR RYAN: Now you're on my point.

MR. EINZIGER: Look at this from another point of view. This is the senior staff telling the junior staff during their reviews what they start out looking at as important and then they look at the thing and use their opinions to find out well, maybe something else is important, but this is where they start to look.

CHAIR RYAN: And this is how to analytically pull the string.

MR. LORSON: What I'm sensing is not necessarily disagreement with the approach, it's the characterization of the approach. That's where -

CHAIR RYAN: Now we're -

MEMBER BLEY: I think if you gave this Appendix B to some of your junior staff who could go through and make the individual pieces, maybe they wouldn't recognize they had nonsense when they came out the end if they had nonsense, where you probably would and would fix it so that your final one makes sense.



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MR. LORSON: Right. I think it's the characterization and how we describe things in Appendix B that's the source of concern. I understand that. I think we'll need to look at that and see what we can do to try to address the concern.

MEMBER ARMIJO: I was kind of surprised at your summary of priority results. I guess that's the next slide.

MR. LORSON: Is that the next slide?

MEMBER ARMIJO: Not quite. But if you want to go there we can. But operating procedures came out with only two in the high and 11 in the total which is - to me that's where, you know, just from my judgment and I'm not in this business, but that's where people can screw up in the operations.

CHAIR RYAN: Sam, on the ranking, that operational procedures ranked fifth based on total and was at the bottom based on high-priority issues.

MEMBER ARMIJO: Yes. So that to me was a little counter-intuitive. I wonder why that -

MR. PARKHILL: Well, the operating procedures, radiation protection and the accident analysis area is that you know -

MEMBER ARMIJO: Maybe if you add them all up, I don't know.

CHAIR RYAN: Well, the most important issue based on the total is materials.

MEMBER ARMIJO: Yes, because it touches a lot of things, but you know, I think the materials if properly selected are passive components and when they just sit there -

MR. EINZIGER: Don't rate them by total. Total is just the number of questions - of areas that we had to look at. If we had another category, Category Z that had a thousand questions in it there would be a thousand over there.

MEMBER ARMIJO: Maybe I'm misunderstanding.

MEMBER BLEY: By the schema, 90 percent of the review should be on the highs and mediums. So those are the only ones that matter if we're really following.

MEMBER SIEBER: It seems to me because for example structural comes out the highest. And if you look at the accidents that they've had, what have they had? Dropped casks, you know.

MEMBER ARMIJO: Well, that's operations.

MEMBER SIEBER: They have to have a structure - the next thing that comes along is day by day or year by year, higher and higher burnup fuel.

So what's that mean? It's normal.

MR. PARKHILL: Well, the total just refers to the number of items that are in the review procedure section that we broke down as independent from the other items. That's all the total.

MEMBER SIEBER: Now in the thermal area you know you're recommending and basing the SRP on a pretty sophisticated analysis for a relatively simple problem. Computational fluid dynamics to me is pretty sophisticated. The advantage of the simpler way is you've got plenty of margin because you build margin into it. So the question is do I want lots of margin and not precisely know the answer, or do I want to know the answer well and move right up to it.

MR. PARKHILL: Right. That's an outstanding point. We don't control the margin that we have to review the design. That's controlled by the applicant, you know. They have a load that they're applying for a license for. So but though, that then in turn drives our review.

MEMBER SIEBER: But I've spent more time pondering this outside this meeting than we have in here and I ultimately came to the conclusion that this isn't a bad approach. I would just like not to call it risk-informed.



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MR. PARKHILL: Right.

MEMBER SIEBER: It's work prioritization.

MR. PARKHILL: Right.

MEMBER SIEBER: And it's based on complexity and in some sense the consequences of things that could happen. And if you - and so I come away - that's why I've stayed quiet until now - with the belief that you probably have got it pretty good as far as prioritizing the work.

MR. PARKHILL: Okay. I'm going to go backward just for a minute. We didn't talk about defense-in-depth. Defense-in-depth was separate from risk and it was used to evaluate the - whatever it is that we're reviewing in the review procedure section. Most things were not - didn't have a defense-in-depth component. But the way the method as you can read is is that you come up with a rating system for defense-in-depth and defense-in-depth can only raise the score. We never used it to lower the score. So we're always looking to elevate the item rather than to bring it down. And then you made a determination let's say if risk was high and defense-in-depth was low or medium, which one would you use to, you know, was controlling. And generally you would take the higher score. You would never lower it based on



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defense-in-depth.

MEMBER BLEY: So you don't combine them. You take the higher of the two.

MR. PARKHILL: Yes. It's an option. So there's the summary results. Some would look at it as a decent distribution. What it means is there's 35 items that we would spend less time on and 64, about the same amount, and then 44, more time on. Again, this is all with the caveat if the staff is pressed with heavy case work which we have been for quite awhile. If you don't have that heavy workload then maybe you're not going to use this. You're going to look at all these items, again, at the reviewer's discretion.

Okay, and now we're going to get into what actually changed in the standard review plans. And under the general changes we changed the title. It previously had the word "cask" in it because we also have systems that are called "vaults." We took the word "cask" out and because it applies to a general license facility under Part 50 we added that. The title previously was somewhat confusing to some people so we tried to clarify it. We changed the format to generally agree with its sister SRP which is for facilities. At one time these were being revised

concurrently, but because of staff availability and resources we decided to put that on hold and soon we're going to kick off the review - dating that once we get the lessons learned from this. We don't want to be trying to do that when we have some possible input from you coming on this. We also corrected the references. There is a Regulation 72.13 which basically says what regulations apply to a general license facility, a specific facility, and the vendors.

So previously the document inappropriately referenced some site-specific regulatory bases, references, regulations, and we took those out and made it consistent with 72.13. We incorporated the ISGs between 1 and 25. That does not include 24 which was not included. The big effort was a new materials chapter starting from ground zero. This was a major undertaking to take and capture all of what we've been doing in various other disciplines and put them in a format. And everybody that works on that, including Bob, kudos go to. He did the lion's share work on that. We deleted the decommissioning chapter that was previously in there because it didn't apply. This is under a Part 50 license so decommissioning really doesn't apply. And then we just consolidated our



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references. We said how we risk-informed in Appendix B. We didn't want to hide what we were doing. And then we listed the ISGs that we incorporated and what you don't have is the last one where we take all of our comments that we get from stakeholders and incorporate them.

One thing on helium leak testing because we had some problems here recently that came to us, is the one item where we change from the public comment. It was low. We raised it to medium based on the feedback that we recently got. We found out they weren't doing it and so - which isn't good. So that's documented also in Appendix D. We're not changing it. You know, what we change, and we haven't gone through the public comment period, we're documenting there when we think we have basis for it. So again, we're not trying to do anything behind closed doors.

Here's the overall changes that took place. On the left-hand side is the old standard review plan format, on the right-hand side is the new. We're pretty good when we get down to Chapter 5 and we shifted the chapters somewhat. Again, we had to add a materials chapter. We didn't want to put it at the end because the perception would be that that would reduce the importance of it. It's right up

there with the rest of them, if not more so. And we took out the decommissioning chapter and then we added the appendices that we wanted to and the ones they had before were - they had a glossary and we put that up in the thing.

So we had one public comment on this basically saying from the industry that this will make it hard on applications coming in because we may have to change the format to agree with your new standard review plan. The answer to that was that's not true. If it's an amendment you continue with the same standard review plan that you used before. If it's a new application you use the new standard review plan.

Here's the ISGs that we incorporated. Documented on the left-hand side is whether we added it, whether or not it applied, whether it was superseded. When it says administratively, there were two ISGs that were in parallel public concurrence with the standard review plan and we're incorporating them now. ISG 2, Rev. 1 on fuel retrievability and then ISG 25 which is on pressure and helium leak testing. So those will be added. The caveat with ISG 25, it was already in the acceptance test chapter and so it was there within the document that we put out for public comment because - and again, I guess because of



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the visibility aspect we put it out on its own for public comments. One thing about - that's an anomaly with all these ISGs, not all of them went out in the - for public comments, just due to our process at the time. They were all available in the public arena and I think I can say with 99 percent confidence that most of the - that 99 percent of the changes that we made in here were available to the public already in some form. They weren't necessarily gone out for public comments, but they were in RAIs and other various regulatory documents that were available to the public. So there wasn't a unique changes that were added here that weren't already in some form available to the public.

MEMBER ARMIJO: Ron, just to make sure I understand, the - for example, when you incorporate the ISG, it's not incorporated by reference, it's actually the words and the content that's in the text of the -

MEMBER BLEY: The ISG is gone now. The ISG still exists as a separate document.

MR. PARKHILL: It does because it does not - it doesn't only apply to the standard review plan. We've got four standard review plans. It's incorporated - if it applies to all four. But we

would have to change all the ones that it applies to. It's a little bit of a tracking thing. But keep in mind the ISG is just a convenient way, quick to change the standard review plan because you can see how quickly we get these things out. Once every, what was it, 13 years now. So yes, it's a very useful tool. And when this project kicked off in `95 management came in and said hey, you've got all these issues flying around, you know, we want some way to document them, focus management attention, technical attention on them, so they created the ISG process. It was mainly for tracking and identification of the issue. The public comment aspect of it wasn't, you know, in their minds' eye at the time, but we eventually got there to put these things out for public comment.

MEMBER BLEY: And the materials information that's now in Chapter 8 was not in ISGs. It was just scattered.

MR. PARKHILL: Some of it was.

MR. LORSON: Some of it was in ISGs. Some of it was spread all over.

MR. PARKHILL: When we get to that chapter you'll see what ISGs we incorporated and per the chapter.

MEMBER SIEBER: 11, 15, 18 and 22.

MR. PARKHILL: Someone's reading ahead. Okay, Introduction, Chapter 1. Meraj is going to talk to this. What we're going to do is tell you what we changed in each one of these chapters and a key comment or two.

MR. LORSON: Before we start, we had allotted the lion's share of the discussion to go through each individual chapter discussions and right now we have about an hour till the end here. Are there any particular chapters we want to put to the front that are more important in the minds of folks that are interested, or where you may have had questions on? We can rearrange the order that we present them.

MEMBER ARMIJO: I had some questions and comments on the materials Chapter 8.

MR. LORSON: Materials? Okay.

MEMBER ABDEL-KHALIK: We can stay as long as necessary.

MR. LORSON: Yes, that's fine.

MEMBER ARMIJO: We're not going anywhere tonight.

CHAIR RYAN: We'll just be quiet and not have a lot of questions and let you go ahead.

MR. PARKHILL: We have a unanimous consent



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among the staff.

MR. LORSON: All right. Then let's -

MR. PARKHILL: Do you want to go in the order?

MR. LORSON: Yes. Let's go ahead.

MR. RAHIMI: Okay. Chapter 1, as Ron mentioned, one of the ISGs that was incorporated was ISG 2 regarding fuel retrievability definition. In terms of enhancement, I guess Ron covered all these level of efforts associated with ranking of high, medium and low, and description of risk. But I guess what I want to talk a little bit the last item under Enhancement. What we did, we actually emphasized and reinforced in the SRP regarding the guidance for the cask certified for transportation as well, that the consideration should be given to transportability of the system. And that's generally what we're seeing these days now. The application that they are receiving that they - they were licensed for storage, you know, 10, 15, 20 years ago. Now they're coming in for transport certificate and they really did not give consideration to the transportability in terms of doing the testing at the time of fabrication. Of course, no burnup credit. You know, one of them, VSC 24, they submitted the application for transport.



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They couldn't even pass the structural criteria. It was carbon steel and subsequently going to withdraw that. So but I guess 20 years ago the VSC, you know, I guess it wasn't designed only for storage. But we are getting a lot of applications now that they were licensed under storage, but they want certificate for transport. So we emphasize this part in the SRP.

And in terms of the key stakeholder comments, I guess the main comment that we got on Chapter 1 was about the discussion of a tech spec. And the comment was okay, what is the criteria, why - more comparison with the Part 50. You know, why do you - what's the basis for including some of these design parameters in the tech spec. So that's one that the I guess staff will be responding to that comment. That's basically mainly Chapter 1. Chapter 3, structural.

MR. PARKHILL: I'll just add to the tech spec. The industry was concerned that we were being kind of arbitrary and capricious with what we were putting in there and some of the words we've softened up and put in a description of all the things that the staff needs to consider before putting in there. I mean, we don't relinquish our right to do that because it's covered under regulation because I think the

actual regulation seems - it is worded "Commission deems appropriate." So I think we tried to satisfy the thrust of their comment by softening some words in the writeup.

MR. RAHIMI: You might see that the comment, there were a couple of comments on tech spec and again, it's a difference. I guess the commenter kept talking about the Part 50, you know, tech spec, but I guess we have to remind them it's a different system. It's a passive system versus active system. So.

MR. LORSON: But I thought there was a comment?

MEMBER ARMIJO: Well, it was - the way I read that they - one of the comments was they thought you were basically creating regulations by putting stuff into tech specs that wasn't covered, at least their interpretation, in the regulation somewhere.

MR. PARKHILL: Everything we put in there we think has a good purpose and reason for it. One of the things they wanted us to take out that's probably close to your heart was dose measurement. They said well hey, you don't have to take dose measurement, you've already designed it for that. Well, we think it's an important measurable parameter to leave in

there because it gives something that you can inspect. Everything else is, you know, not so readily readable. And that's an example. It's not so much that we changed anything, but putting this out for public comment provided a forum for the industry to say hey, these are issues that have been kind of rubbing us the wrong way for awhile and now we're going to comment on it. So it's not like we're changing anything here. We - as objectively as we can we looked at what we were doing and we think we're right as far as what the content of the technical specification is. There was some wording that we changed because the wording wasn't too appropriate for the document and softened the wording up. But the thrust is still there.

MR. EINZIGER: Counsel has told us that the only thing that's enforceable is what's in the tech specs or the CoC. As a result if there's something that the staff feels is very important to safety and shouldn't be changed without getting further review by the NRC, the only way we have to guarantee it won't be changed is by putting it in the tech specs.

MR. PARKHILL: Our 72.48 process allows them to change things that like Bob said isn't in the

tech specs or the CoC. So things you don't want them to change without checking with us we put in there. And I don't think we've been too outrageous with our inclusion there.

Okay, Chapter 3, David Tang.

MR. TANG: Before I get into the subject I want to recognize that about four or five years ago there was NUREG/CR-1864 published for the storage cask PRA evaluation which has these details dealing with the handling aspects, what kind of initiations and the consequences, and so on and so forth. So that was done by the research.

Getting to Chapter 3, we added to ISGs to codify them. ISG 12 deals with buckling of the fuel rod during the end-drop accident for the cask. And it has been there for more than 10 years and it was outcome out of some earlier Lawrence Livermore Lab report which was not that usable for us because many other considerations such as the mass of the fuel clad are to be conceived, and so on and so forth. ISG 21 which at that time published about three years ago covered both the thermal and the structural evaluation, and I think that Dr. Solis will talk about that as well. And we captured that part in Chapter 3 as part of the appendix. This particular ISG was



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reviewed by the industry and about five years ago there was a workshop to that extent. They provide comments back and we had a Commission meeting in this case. So in the sense that we have codified this particular ISG and in addition to that, other enhancements in the sense that we provide the additional clarifications what we thought has been available to the users, the reviewer and applicants as well. How to do the structural analysis and how to do a structural evaluation for that purpose. For instance, in this case we have - because of the traditional analyses for the containment boundary for the confinement boundary for the storage cask has been banking on the, say, subsection in B from the reactor side of the ASME code. And that again came out of the NUREG Reg Guide 7.6 which was a reg guide for the containment boundary for shipping casks. So there's some kind of lineage. At one time it was captured in the Revision 0, the first publication of this document. So we continue to use these subsections for the structural evaluation. Meanwhile, the industry has published a Revision 3 code which applies to both storage and transportation of nuclear waste and radioactive materials. Yet we haven't got the chance to review the details of these Revision 3 code so we

haven't been able to endorse them yet. We mentioned that this code was available so it will be on a case-by-case basis. If applicants elect to use the Revision 3 code, then we will take a closer look at that.

Another enhancement we have in this revision is to clarify that for the non-mechanistic tip-over accident. Indeed, we have experimental data which is captured in NUREG/CR-6608 published about 12 years ago, and Lawrence Livermore Lab helped us to do the testing. And that - with their scale, they did the drop test, the end drop and side drop and the tip over has been used by all these major vendors as a basis for them to quantify their tip-over analyses computation method through some kind of - dynamic method of formulation for them. So again it's very helpful and we just codify and provide - say, provide the linkage how to access this kind of data and how to use the data.

The third part of the enhancement we considered deals with design earthquake motion deformation. And through this rulemaking 72.103 we now allow the probabilistic seismic hazard analysis as part of the process, including also the sensitivity analysis for defining the earthquake motion for the



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ISFSI application. The other part of the enhancement we consider meaningful is to consider the ISFSI pad flexibility, calculating the pad seismic intensity or the level for evaluating the sliding and the overturning potential of a cask, of a freestanding cask which is in accordance with the provision of ANSI 57.29, the load combinations and the gradient effects.

Getting to the next slide and the way we have all together a few - like here, we identify four areas which we believe the comments we agree with - we agree with the comments and the more meaningful others. And they are all dealing with clarification. The first one deals with the analysis method and then the materials property such as any elastic behavior of the materials, and the potential elastic-plastic performance of containment boundary. And also, the basket. And we allowed in the SAR they were conflicting in the write-up. So we basically agree with their comments and revised the language and the wording to clarify that any elastic-plastic analysis except in accordance with ASME code Appendix F. That kind of details.

And there was comments about Reg Guide 160 in the sense to say it was excessive, provides excessive conservatism for the cask evaluation. And



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we pointed out that it was a top tier kind of a regulation and over the NUREG/CR. In fact, these two NUREG/CR'S I think you have to deal with perhaps dealing with the, say, hazard analysis part and also normal graph approach to evaluate the cask stability. So those - those kind of details we just provide additional clarification there. And the third bullet the same as the first bullet basically. Elastic-plastic materials behavior and the way we just clarified. And the last one, again, it was inconsistency in our SRP writeup in the revision, the first revision, issuance. The ANSI standard N14.6 dealing with special lifting device say for transportation cask. Many of these storage casks vendors called it out as their standard as well. And they adopt particular standard which permit NDE-type of evaluation on annual basis in lieu of the load testing. So again, it was a clarification I think. Those help the chapter to be more useful and to provide some clarity, how to follow that. Thank you.

MR. PARKHILL: Jorge Solis?

MR. SOLIS: On the thermal evaluation chapter, basically some of the updates were to include the ISG 11, the cladding consideration for storage of spent fuel, basically to prescribe the maximum



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temperature that they can achieve during storage and during transfer operations. Also, David mentioned we refer to the ISG 21 computational modeling software. That's the appendix to this chapter. Key enhancements included general guidance on the computation of fluid dynamics analyses that some of the designs used. Also, a guidance on characterization of external and internal floats to properly model the natural convection, and the use of the porous media to model spent fuel assemblies inside a storage.

We have many comments on thermal, but some of the key comments basically big question, the level of detail of the staff in the review. They also object that they needed to provide an annotation of input files. They say that that's too prescriptive, that that's needed for what actually - the staff is unsure. There are errors in the analysis. And also, they object to limiting convection to the outer surface of the cask and that's not the case anymore since it is well known that internal convection is happening and we allow the other vendors to take care for that.

MEMBER ARMIJO: You do allow that?

MR. SOLIS: Yes. Yes, that's -

MEMBER ARMIJO: A misunderstanding?

MR. SOLIS: That's going to be a response.

MEMBER ABDEL-KHALIK: So why do you think people misread?

MR. SOLIS: Misread?

MEMBER ABDEL-KHALIK: Yes. If they would say that you're not allowing the convection within the cask -

MR. SOLIS: Yes. It was left over in the review. It was not removed in the document for public comments.

MEMBER ARMIJO: It should have been.

MR. PARKHILL: For conservatism, allowing natural circulation was not allowed. So remove that -

MR. SOLIS: Yes, but I mean normally the vendors know that we allow them to take credit.

MEMBER ARMIJO: So I just wanted to clean up the language.

MR. SOLIS: Yes.

MEMBER SIEBER: If you go to computational fluid dynamics, that includes a convective flow consideration in the process. So it's really in there, right?

MR. SOLIS: Yes.

MEMBER SIEBER: And compared to the other two heat transfer methods it's low-level.



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MR. WATERS: I think it's historical perspective here. Tends to usually go we do not allow credit for internal convection. Actually, the state of the art was not there to prove it. We struggled 10 years to prove first cask designs to take credit for internal convection, a lot of computational fluid dynamics analyses were done to prove it to us. Limited data to prove, and it really goes on. I think what happened was the original SRP did not allow it. We eventually did allow internal convection in later cask designs. I think you just said we forgot to take that phrase out of the SRP and that was one that - I think it was more of an administrative error not taking that out.

MEMBER SIEBER: That would be helpful.

MEMBER ABDEL-KHALIK: So the comment is valid.

MR. LORSON: It's a valid comment. You know, just to kind of show you how things tie together, we were talking earlier about helium leak testing. Well, why is that important to us? Well, one is you want to define your confinement boundary, but it's very important when you're taking credit for that internal convection of helium that you retain it as a function of time. And so that's how this stuff



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starts to tie together when you're talking, you know, risk-important aspects of what we review.

MEMBER SIEBER: And when you take the leap and consider that fuel is a porous material, the convective heat transfer sort of disappears, doesn't it? The pathways are no longer -

MEMBER ABDEL-KHALIK: - what they're allowing to flow through. I think a porous media and going around the basket.

MR. LORSON: We don't assume the cladding is porous, right? We're just talking the porosity of the basket and the fuel can go -

MR. SOLIS: Well, it's basically - it's an economic way to represent the fuel assemblies, really. You don't have - it's very unpractical to model each thing. So we represent it using porous media.

MEMBER ABDEL-KHALIK: Just a homogenization technique for the calculation.

MR. SOLIS: Exactly.

MEMBER SIEBER: Well, the critical parts is where the grid strats are.

MR. SOLIS: It would be -

MEMBER SIEBER: The hard part to model is where the grid strats are and that's the critical location.

MEMBER ARMIJO: I don't know about that, but you know, it's just a thermal modeling methodology that you've chosen that kind of represents what's - and it's backed up by experiment I would hope.

MR. SOLIS: Yes.

MEMBER SIEBER: But that doesn't mean that a licensee can't use a more sophisticated method?

MR. SOLIS: Oh no, they can -

MEMBER SIEBER: - can do whatever they want, it's what you would do to confirm.

MR. SOLIS: Yes, just because porous media is traditionally used and it was misapplied. We felt the need to provide further guidance on how to properly use it.

MEMBER SIEBER: Okay.

MR. PARKHILL: One thing I hope you glean from the comments as we talk about them, the document was greatly enhanced by the public comment process. There was a large number - I don't have the specific percentage - but that we incorporated. So we're not stonewalling anybody here. If they made a good comment, we incorporated it.

On the confinement, we had two ISGs. One ISG 5 that had been around for quite awhile. It basically documented the method we used for



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determining dose at the site boundary which wasn't previously documented there. We incorporated that. And the latest ISG 25 which is in - was in parallel public concurrence on helium leak testing and pressure testing of the confinement boundary, that was included. Other enhancements that we added was clarification to pressure-test the entire confinement boundary. No news there. That's ASME code all over and they've committed to that. Also, we clarified the shop helium leak test. If they don't do a shop hydro is that and they only do a field hydro and you don't have access to the welds. Well the field hydro is done while the cask is inside of a transfer cask, so you only have access to the top. So you can't meet the acceptance criteria for checking for no leakage. So if they opt to do the hydro in the field we said we would accept the shop helium leak test. So - and ISG 25 basically says you should do a shop helium leak test to meet the regulatory requirements as defined in 72.236 area.

MEMBER ARMIJO: I had a confusion on that.

MR. PARKHILL: Which one?

MEMBER ARMIJO: There's an exemption for leak testing and it applies to the closure welds that are typically made in the field, and I had a problem



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defining is a closure weld the redundant weld?

MR. PARKHILL: Yes.

MEMBER ARMIJO: Okay.

MR. PARKHILL: Yes, and we have a specific ISG 18 that addressed that. And they had to meet a lot of criteria to get that exemption. One, there's got to be a redundant ceiling which is a requirement of the regulations. You've got to have the fracture mechanics and that cap analysis to justify the spacing for your liquid penetrant examination for the three layers of welds. So there was - and you've got to have ductile stainless steel. So that was a specific exemption granted specifically for that application. It does not apply and the fact that we've got two welds reduces the possibility of a leak. So that was an exemption granted for that specific application, nothing else.

MEMBER ARMIJO: Okay, thank you.

MR. LORSON: You know, this kind of gets into, you know, you have a graded approach to how you apply a regulatory requirement. In this particular case there are some good operational safety reasons why that is an impractical area to measure. You're going to be doing it after the cask is loaded when you have a high dose rate, high temperatures and there's



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an industrial safety and radiological concern associated with that. And so we felt for the reasons that Ron mentioned that it was an acceptable tradeoff between worker safety and the overall satisfaction that the cask is properly constructed.

MEMBER ARMIJO: In the space between that closure cap and the confinement seal or cap, is there helium in there also or is that just air?

MR. PARKHILL: Typically the first weld is the one that they actually test. You have your vent and drain ports on it which have also we call them "hockey pucks" - go USA - but those are welded on top of the vents and drain ports. There's a little valve, quick disconnect valve, but we don't rely on the valves for containment so there has to be, you know, these sealed welds with two of them there. And so to answer your question is there helium there? Probably not. But we don't need it because we're really testing generally the first weld for the helium leak test on that because we have a positive source of helium on the other side of that. And a lot of these casks are up to seven atmospheres when they're normally loaded to get the heat transfer density from the helium for them to support natural convection. So when it's just loaded it could be five to seven



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atmospheres on the newer designs. That's how we get the heat out.

MEMBER ARMIJO: Yes, okay, good. Thank you.

MR. PARKHILL: Stakeholders comments in the confinement area. Let's see. They basically ask us to just reference the high level, it's good enough just to reference the ASME code. We kind of disagree with that and this is all subject to management approval, but we like the additional level of detail because it avoids misinterpretation of - or use of the code. So there's a level of detail that we feel comfortable with there. The second bullet questions the acceptance test as deemed necessary, as deemed acceptable. Actually those words "as deemed acceptable" come right out of the regulations 72.82, the Commission has the right to invoke tests it deems acceptable and we have a longstanding historical precedent for what tests we're doing. We're not imposing anything new on them there.

The third bullet was raised both by NAC and as you pointed out - or duplicated by NAC but they questioned the release fractions. They wanted to use the release fractions that is in one of our guidance documents, and generally for damaged fuel we don't



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allow that generally because those release fractions were based on measurements of one rod with one crack and when you get damaged fuel we don't have the data to support that. So generally we asked them not to use those restrictive release fractions which limit the amount of fuel coming out. Either provide data to show that those release fractions are justified which they don't have, or go leak tight. So we're kind of failing on the side of uncertainty here, but ensuring that the cask is actually tested to the ANSI 14.5 standards of leak tightness. That's been our practice and once again this has been our longstanding practice and they're using this as an opportunity to challenge something that we've been doing for awhile.

MR. LORSON: Say Ron, with respect to the acceptance testing, would it be fair to say that the acceptance tests that we require are all things that are contained in some other industry consensus standard or guide?

MR. PARKHILL: I'll say yes with a reprieve just in case I'm wrong.

(Laughter)

MR. PARKHILL: As far as I - I can't think of any. The next is Shielding and we have Dr. Zhian Li.



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MR. LI: Okay. We'll just quickly go over this shielding part. First of all, we add three ISGs basically incorporates those ISG languages into the SRP. The first one is to use the bounding source term in the evaluation. That really defined the relationship between the enrichment and the burnup for spent fuel. In general, lower enrichment - for the given burnup, lower enrichment would have a higher source term. The second one is define the real individual and the site boundaries, really the activities for the duration and the defined exposure time.

CHAIR RYAN: So that'll be a site-specific and realistic case?

MR. LI: Well, this is a general. Not only site-specific, but also when the applicant came in they will give you the boundary, the how big a parameter this ISFSI is designed for, the minimal.

CHAIR RYAN: Right. Wait a minute. It's either the minimal boundary that's allowed, or a realistic boundary? What is it?

MR. LORSON: I think when we do the analysis we make certain assumptions regarding distance to the site boundary and cask array configuration.



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CHAIR RYAN: Sure. So I mean, you have the array and you have a radius of a circle around it, and that's it?

MR. LORSON: Right. But well then, when you get into the 72.212 analysis that's done by the individual end user because again, we're issuing a general license that can be used by potentially any power plant in the country.

CHAIR RYAN: Yes.

MR. LORSON: That individual licensee then would perform a site-specific analysis to show what the impact is on their particular site to show that they can still meet the dose limits that are prescribed in 72.104. And then that is an inspectible parameter that we look at as part of the site inspection process.

CHAIR RYAN: So would they do that by saying well my fence line is no closer than 50 feet from the radius you assume so I'm okay, or they do their own calculation?

MR. LORSON: They would do - typically they would do their own calculations to show that for their own site that they can install the canister and meet the requirements of 72.104. So it's a site-specific analysis that really ensures for a particular



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configuration that it's going to meet the requirements.

MR. LI: Their general license also has the assumption says that the minimal boundary is this big a size, and based -

CHAIR RYAN: I mean, that's an obvious assumption going in, but they still have to do their own calculation.

MR. LI: Yes. That's the second step.

CHAIR RYAN: So the assumption really doesn't matter.

MR. LI: Well -

MS. THOMPSON: Can I add something here? Because this ISG also deals with the radiation protection chapter so there's some common area here. And the real individual has to do somewhat with where the person and somewhat with how you characterize the person. They don't have to be there 100 percent of the time and that's where - but for the license - and that's mostly with the 72.212 because when you're doing the general licensing you don't know where the person is for any given site. But for your licensing, the way I think we put it in both chapters is if you do your analysis for the minimum regulatory separation between the ISFSI and the controlled area boundary



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which is 100 meters, then we don't put any specific limitations on where that system can be used. Just the user has to make sure that for his site he can structure his site so that he meets the dose limits. All right, but if in your analysis you make some other assumption like the minimum distance for your system is going to be 200 meters and you don't analyze down to what the dose rates are at 100 meters then you have to make that 200 meters a tech spec condition for use of your system, okay? So I think that's where this distance thing comes in.

CHAIR RYAN: Well, it would make obvious sense I think to me anyway that if I meet it at 100 meters and I'm good at 200 meters I don't really care about a tech spec. I mean that's okay.

MS. THOMPSON: Right. From a - as a reviewer for these systems, if they can show that their system meets it at 100 meters with no intervening shielding structure then we're happy. If they show that they have to go out to 250 meters without any intervening shielding structure then we say okay, you need to structure your tech spec for this system to somehow take consideration of this if you don't give us that analysis for the 100 meters, okay? If you give us the analysis for 100 meters but



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you still show that it's going to take more distance, then you won't necessarily have a tech spec, but you need to have something in your system documentation that says users, you should take note that this system is going to need you to either have a larger site or to consider constructing a berm or something between your controlled area boundary and your ISFSI.

CHAIR RYAN: That's great. Thank you, Liz.

MR. PARKHILL: Yes, thank you. Okay.

MR. LI: Let's see. Well, the third one is basically we consider the use of supplemental shielding like a berm sometimes, or a concrete wall that the applicant says our system simply has to use some kind of additional shielding. In that case if the design is based on the supplemental shielding and we have to evaluate this based on that assumptions.

Well, there are some - quite a few comments from the public and some are real good. We adapt them and put them - revise our SRP. Some we don't really agree with them. The following are just some - three kind of we think they're most significant. The first one is a shielding analysis do not need to be bounded which is no. We do not agree with that. For example, if I have 100 casks, 95 of



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them are meeting the requirement, would that be representative? Yes, it is representative, but it's not bounding. Five of them would be not meeting the requirement so we said no, we disagree with that. We will keep that requirement. So regarding use of the latest computer code, latest version of the computer code we said okay, we'll consider that and Ray has a good letter addressed to AEI and the whole industry. He said yes we hear you, and we agree partially with you. You do not necessarily need the latest version. However, if the vendor, for example like Oak Ridge or the Los Alamos - Oak Ridge is doing the SCALE computer code system, Los Alamos is developing the MCNP code system. We said if they find some significant deficiencies the user would have to bring up their evaluation and include that kind of consideration to make a justification, their evaluation where the older version is still okay.

MEMBER ABDEL-KHALIK: Would this be similar to a Part 21?

MR. LI: This - not really.

MR. LORSON: It really gets into the case of let's have a code zero, Revision 0 of the code. Then the software developer performs a Revision 1 to the code and after a period of time no longer supports



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Revision 0 to the code. Well, potentially you can get into a Part 21 issue where somebody may subsequently identify a defect with Part 0 that's non-conservative, so that would be reportable under Part 21 which is one avenue to address problems within the use of a code that's no longer supported. But the other piece of it is if you get into our regulations on design control, design assurance, you know, there's a requirement that you as the designer demonstrate that the methodologies you use for performing your calculations are sufficiently robust and have all the required quality measurements and attributes. And so to that extent if the developer is no longer - the software developer is no longer supporting the version of the code it becomes - it's incumbent on the applicant to demonstrate that they are performing all the necessary quality assurance checks as part of use of a non-supported code. So they're assuming that responsibility from what was previously performed by the software developer. So the guidance we give to our staff is to see if they're using the latest version of the code. We typically update to the latest versions of the codes as they become available. Applicants typically would prefer to use whatever existing code they have and not have to buy the new



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software package. We say okay, that's fine, but you need to be able to demonstrate that it's still performing in a quality manner and you have incorporated all the operating experience and guidance and things that are maybe out there to show that it's still performing acceptably well. But part of it could be captured by Part 21, but you know, there's the potential that maybe there's issues out there with the code that the software developer may not necessarily identify as a Part 21 issue, but it may just get fixed in a later revision of the code.

MEMBER ABDEL-KHALIK: Well, what if there are no issues with the older versions of the code, they're just enhancements that come out? Would you require licensees to go back and redo the analysis using the newer versions?

MR. LORSON: No, no. If the applicant can demonstrate that use of the old code is acceptable and that there's no issues out there associated with use of the code then they're permitted to use the older version of the code even if it's not supported, but then they are assuming the role that's typically performed by the software purveyor.

CHAIR RYAN: Ray, I'm stuck here. If I use Rev 0 of the code, submit something and you

approve it and everything is A-okay, that's great. I'm done.

MR. LORSON: Right.

CHAIR RYAN: Now, Rev 1 comes out. Do I have any obligation to you to reprove Rev 0?

MR. LORSON: No, no. No, but your obligation is, Rev 1 comes out and the software developer stops conducting updates for Rev 0, okay? It may not be a problem, but what you lose as a part of that is you lose that operational experience network of code problems and issues that are getting fixed. So while we may -

CHAIR RYAN: I don't get that. I'm sorry, I don't get that.

MS. THOMPSON: I think an added point here - Liz Thompson again. This is only an issue when you submit a new analysis to us. If you submit a new application or an amendment, but you try to run it on the same code that you submitted to us 15 years ago and all the cross-sections have changed and you haven't updated the cross-section database because you can't get it from the developer because he doesn't support it anymore, and oh by the way, you ran that on a different fuel but you know, it's still kind of the same, it's still uranium-based, but I mean the shape's

all different, and the size is different.

CHAIR RYAN: I'm with you. Those things -

MR. LORSON: There's a whole series of pedigree that the software developers are doing as part of supporting a code.

MEMBER SIEBER: The only exception to that is if the software developer issues a Part 21 that says this version of the code does not give the right answer.

CHAIR RYAN: No, that's clear as a bell.

MR. LORSON: Then absolutely we would have to go back and evaluate -

MEMBER SIEBER: Then why do you have to re-analyze for a change to your certificate.

MR. LORSON: Right, if you're analyzing for a change to certificate then you need to be able to demonstrate that use of a non-supported older code still meets all the entry input assumptions that are required by your configuration.

MEMBER SIEBER: No change? You don't have to do any?

MR. LORSON: Right.

MR. LI: That's exactly right, yes. Okay. So also - but I'm not the lead author for the criticality part, but I will kind of go through the



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slides anyway.

MR. PARKHILL: Did we cover that last bullet?

MR. LI: Oh, we didn't? Oh, sorry about that. Okay. So the last one is about the kind of eliminate dose rate limits. I think we talked about this before in the earlier - we kind of disagree. Basically this is the only thing inspectible, only parameter we can see to detect any major deficiency in the fabrication process, not only the design basis, but also the fabrication process. If we get something wrong or load fuel which has a substantially higher dose rate kind of a source term, really this is the only place that we can detect - do an early detection. And also, this is the site boundary dose rate is evaluated to the base on the source term at the surface of the cask.

MR. LORSON: The other thing is if we take out the dose rate limits from the technical specifications then we allow the vendors under the 72.48 process to modify the shielding configuration such that in some cases we've had examples where they've gotten large dose rates through 72.48 modifications of casks that we weren't going to know about. So by having this in there it gives us



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assurance that they're not going to make significant modifications to the shielding. Why would they do that? They may have a customer, they may have a crane limitation. In order to meet their crane limitation you can support it by removal of shielding. So this gives us kind of a check and balance in our process.

MEMBER BLEY: Isn't there a requirement in 48 about changing the dose limits when you make these changes?

MR. LORSON: There's no specific limit related to dose on 72.48. 72.48 is a whole separate topic and we're looking at what we can do to make that more clear in terms of implementation. It's kind of like a 50.59 process -

MEMBER BLEY: Yes, I know -

MR. LORSON: We go through a series of questions. But folks have made some changes under 72.48 that you look at and say hmm, that wasn't something we really were thinking about when we wrote the rule.

MEMBER SIEBER: The range is not limited, the total dose is.

MR. LORSON: Right. There's no limit on total dose, other than -

MEMBER SIEBER: Not the rate.

MR. LORSON: Right. We don't limit dose rate, exactly.

MEMBER ARMIJO: I had a question. In reading through the SRP you have something in here, the neutron shielding materials aren't identified as important to safety, and it was - it came out in a discussion about polymeric neutron shielding materials. And my question is why aren't shielding materials considered important to safety? Clarification, because this is an SRP, not a regulation, but why is that your interpretation?

MR. EINZIGER: It didn't come from the materials people.

MEMBER ARMIJO: I couldn't understand it because it reads kind of funny. It says, "Polymeric neutron shielding materials which are usually proprietary are not considered important to safety." And so my question is well, are metallic or concrete shielding materials considered important to safety, or is polymeric exempt because it's proprietary? So I got confused. So I don't know.

MR. LI: I think that we may need to look at it again, the language. The intention was -

MEMBER ARMIJO: But it wouldn't be in the tech specs or anything else related if it wasn't.



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MR. LI: I don't think that should be in part of the tech specs. Let's go back and look at the language again. And I think that's a good point. Actually, the dry cask system, those like a metallic, boral or polymer absorber is only for criticality purpose. For shielding it's basically - it relies on the concrete overpack.

MEMBER ARMIJO: I thought there was polymeric outside of the?

MR. LI: No.

MR. LORSON: I think in the interest of time we'll take the question back. I think the reference for important to safety we have a separate guidance document out there that classifies different components within the dry storage system based upon a quality classification of A, B, or C. So I think what we'll do is we'll go back, take the question back and give you more of an answer.

MEMBER ARMIJO: My concern is that these are the kind of materials, think in terms of life extension. These are the kind of things that can degrade with time under radiation and temperature and everything else, and they may lose their shielding properties.

MR. LI: We've got it covered.

MEMBER ARMIJO: You've got it covered? Okay.

MR. LI: We'll take the last question and look at the SRP again, and then make sure we don't have any kind of misrepresentation of what the intention was.

MR. RAHIMI: And that reading, that was from Chapter 6, Shielding, SRP?

MEMBER ARMIJO: It was actually in the Materials Chapter 8, but since you were talking about -

(Laughter)

MEMBER ARMIJO: The words are in Chapter 8, but - I had a line number if I can find it again.

MEMBER BLEY: 7480-something.

MEMBER ARMIJO: God, you've got a good memory. Okay, let's see if I can get the line number. Sorry. 7480. Okay, well it was in there and I was kind of confusing. I don't know.

CHAIR RYAN: All right, let's press on.

MR. LI: Okay. Regarding the criticality chapter we included the recommendation ISG 8 recommendation for burnup credits. Since we get here I would answer this question earlier regarding the dry cask, the k-effective under the flooded and non-



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flooded. So this actually would be more of a 2-part operation. The first part is really the loading and unloading parts which the cask is flooded. Under that condition we really have to either use the soluble boron in the cask to grab credit or use the burnup credit. Because using fresh fuel assumption, the cask - like a 37, 40 BWR fuel assemblies, or 60-some BWR fuel assembly, we are the criticality limit. They won't be able to make it. So either - the other second part is really the dry storage stage and that, there's no water in there. There's basically no moderation. And then we consider since the casks are mostly kind of welded because the moderator would not have the chance to get into the inside of the cask. For outside flooding, we would basically add a little bit reflection if you want to see that, but really it won't be much because of the 12 inches of concrete already probably met the reflection, the neutron reflection or thermalization, if anything.

So in order to meet the criticality requirement under the flooded condition we - the applicants or the industry has been pushing for the burnup credits. The fuel is burned, then - we have been working on the ISGs on the burnup credit and then we incorporate some of them. We're still getting a



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new revision, still working on I think Revision 3 on the ISG 8 for burnup credit, what kind of a credit they can take. Then this also gets into the benchmark of their code. If you want to take the burnup credit it really gets the average inventory, the spent fuel inventory, the inventory calculated. So that's - we probably won't get into details on that part.

And then also there's some enhancement. There's the provision for crediting burnable neutron absorbers. Some of the applicants says we have the burnable neutron absorber like a poison rod in there, and then we can take a credit. We normally do not give that kind of a credit because we really don't know the precise history or the inventory, how much still remain in there. We're really not clear. So -

MEMBER ARMIJO: But you take a penalty on, for example, residual gadolinium on - in operations. You would think that you'd get a credit for it in spent fuel storage. So it's an issue of how much of that do you credit.

MR. LI: Exactly.

MEMBER ARMIJO: Maybe some of it should be credited, but maybe not at all.

MR. LI: But we will give a consideration if the applicant can provide a sufficient



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justification. Otherwise we cannot say okay, you tell us -

MEMBER ARMIJO: The outcome number.

MR. LI: Yes, pick a number, 25 is left.

MEMBER ARMIJO: But there's always a residual gadolinium penalty.

MR. LI: Always.

MEMBER ARMIJO: Even if you burn it all up it's still a problem.

MR. LI: Right.

MEMBER ARMIJO: It's not like boron.

MR. LI: Right. Exactly. Well, even boron, there's kind of a -

MEMBER ARMIJO: Pretty much all gone in high burnup fuel. The gadolinium is not quite that way. Anyway, okay.

MR. LI: So but if - again, if the applicants - we do have the provision. If an applicant does want credit for that they would have to provide adequate analysis. Okay. And then the next one is the reactivity effect from non-fuel hardware, like a partial rod, a power-shape rod. If they want to take credit they would have to show yes, they did the analysis adequate.

The next one is about the damaged fuel.



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Damaged fuel is kind of the - you have the reconfiguration of fuel geometry. Then you will have to analyze. The final one is we bring this aligned with the ANSI 8.1. We not accept the code to code comparison. Here, the code to code is the computation of code, like MCNP or the SCALE system. They do the criticality analysis. We only accept as the benchmark with the experimental systems.

The next one, the - we have the stakeholders, the comments. They want to delete a reference to the burnup measurement. I would defer this question, this topic to Mike Call. He's very familiar with this area.

MR. CALL: You're taking a risk on that one. I'm Mike Call. I'm also a criticality and shielding reviewer in SFST. One of the concerns I think just to kind of also put some perspective on the changes with burnup credit. I don't think we've seen anything in the storage area that has requested credit for the burnup of the fuel. A major driver for burnup credit has been in the transportation side of things. And one of the sticking points as you come about is what kind of burnup - assigned burnup value do we allow for the fuel assemblies that are loaded into a cask. And as part of the guidance that we have in the



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current ISG 8 version that is based upon doing some physical measurement to confirm the burnup of the assembly. Now, you can't measure burnup, but you use a system that will give you a signal from which you can infer the burnup and it's not going to be something that's exact, but it'll give you the good feeling, the confidence, the reasonable assurance that we need to say yes, that is the signal that we would anticipate from an assembly that's burned to that level.

So the current guidance is for a burnup measure to be - what we call a burnup measurement in that regard to be performed. We've been interacting with industry and we know that they have some heartburn with wanting to do that. And so as part of the looking into revising our guidance as Zhian mentioned earlier this is one area that we are considering and looking at available information and data and experience to inform the upcoming revision to the guidance to see where we might go with this.

MEMBER ARMIJO: Let me make sure I understand this. If they request a burnup credit, then you would require that - you currently would require that they do some sort of a measurement to verify that they know what the burnup is?



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MR. CALL: Right. For particular assemblies that would go into - that would be loaded in the cap. So this would be an operational procedure. There would be a check to verify that that gets -

MEMBER ARMIJO: Of course they'll argue that they know the burnup by virtue of the reactor.

MR. CALL: Right.

MR. LORSON: And so this is just a second check, it's an administrative control if you will to ensure that a misload hasn't occurred that could result in the loading of an under-burned assembly into your cask, that you know, is kind of a final check to ensure that you haven't loaded something in there that's under-burned that could result in a higher k-effective than what you predicted.

CHAIR RYAN: So that would be reduced by measurement or just by paperwork?

MR. LORSON: You just, well, you have the administrative controls which is paperwork controls and records and so on and so forth, and then this is a second administrative control if you will that's layered on top of the existing administrative controls to ensure that you haven't misloaded an incorrect assembly to a cask.



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MEMBER ARMIJO: But is this new? Is this a new requirement?

MR. LORSON: Oh, this is a requirement that's been in place for a period of time and it's something we received a comment from that it's an unnecessary conservatism if you will. Now, what we are doing is we have - actually we have an ongoing user need with research to look at the history of misloads, when they've occurred, how they've occurred and to try to from that get some bounding number in terms of what's the probability of a misload, and then if you take the probability of misload with an inventory of a particular spent fuel pool, how likely is it that you could get a criticality event resulting from a combination of the two.

MEMBER ARMIJO: Through overheating or something else, right?

MR. LORSON: Yes.

MEMBER SIEBER: You would know if you had a misload in the reactor very easily during operations, so it would be identified pretty early.

MR. LORSON: In the reactor. But you wouldn't know whether or not -

MEMBER SIEBER: If you had a switch in the spent fuel pool that's a different matter.



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MR. LORSON: Exactly.

MEMBER SIEBER: On the other hand, a burnup measurement is not an easy thing to do.

MR. LORSON: Right.

MR. RAHIMI: Just to clarify the questions, I mean right now it references ISG 8 Rev 2 in terms of ISG 8 Rev 2. In there it says a physical measurement confirmation of the burnup.

CHAIR RYAN: So there is a measurement requirement now.

MR. RAHIMI: In the ISG, yes. It is a recommendation.

CHAIR RYAN: Not a requirement now. It's guidance now.

MR. RAHIMI: It isn't staff guidance, but if you want to prevent misloads you need to do a physical measurement. However, as Ray pointed out, we have been getting applications for casks that has already been loaded 20 years ago, 15 years ago. They want transport certificate, they want burnup credit and we are looking at some type of a misload analysis, probabilistic approach to address this issue.

CHAIR RYAN: As opposed to a measurement?

MR. LI: Also, this is the international standards that basically kind of practice. The GSR-1



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which is the transportation standard require measurement for spent fuel transportation.

MR. RAHIMI: Yes, in the international regulation they spell out specifically. They say, you know, thou shalt perform a physical verification of the burnup.

MEMBER ARMIJO: But short of taking fuel to a hot cell and doing a cask burnup analysis, what method you use?

MR. RAHIMI: Oh, there are methods. There are Fork detector for example which you do - easily demonstrated at several reactors. I mean you go to the device and you take a gamma neutron reading from the assembly, you correlate it to your records.

MEMBER ARMIJO: Something like a poor man's gamma scan?

MR. RAHIMI: Exactly. And then you can actually screen out any anomalies in that. So it's more verification. You still rely on your reactor record, correlate it to your reactor record.

MR. LORSON: The burnup measurement is just an added conservatism. It's confirming that you've picked up the right assemblies and you haven't put anything in there that's under-burnt significantly.



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MR. RAHIMI: Yes, because there have been, you know, a lot of misloads has happened and are happening.

MR. LORSON: There have been misloads. A lot is something -

MR. RAHIMI: There have been misloads that has happened. That's the reason that it's in there.

MR. LORSON: Right.

MEMBER ARMIJO: Okay, thank you.

MR. LI: Okay, that concludes the criticality and shielding part.

MR. PARKHILL: Bob Einziger?

MR. EINZIGER: I am Bob Einziger. I'm a senior materials scientist and I'm a solid state physicist by training. I disagree with the - Mike Ryan on what's the most important discipline in this review. Because an applicant looked in the wrong column in the ASME guide and picked a steel with the wrong properties the bolts fell during a tip-over, the lid fell off and the fuel fell out. So the root of all problems always lead back to materials.

CHAIR RYAN: You're the expert materials scientist. I stand corrected, Bob.

MR. EINZIGER: Now the interesting thing is with materials being the heart of everything



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there's no materials chapter in the SRP that's currently available to the reviewers and the applicant. There was an attempt awhile back to rectify this by putting in an ISG 15 which dealt with materials. We felt it was important that we start gathering all the materials properties in one place. Part of the reason of this is that sometimes you'd see tables of materials properties in three different chapters. It might be in the structural chapter, the thermal chapter, the confinement chapter and sometimes they weren't always the same. And so at least if they're in one place they have no excuse by picking different numbers out. And over the years because there was no materials chapter a lot of ISGs were developed dealing with specific issues.

Now, materials reviews are done a little bit differently than some of the other reviews in the sense that materials is a very broad area. Because you're an expert in steels doesn't make you an expert in polymers or make you an expert in concrete, and so a lot of the reviews that we do are split up among people within the group so that a person who's an expert in absorbers might do the absorber part of the materials review, and somebody that's an expert in steels would do those. But in this SRP revision one



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of the things we did is made the attempt to get all the materials information in one chapter. So what you'll see in the other chapters should only be links to the materials that says okay, there's a materials issue here, coordinate with the materials reviewer, et cetera. We incorporated a number of ISGs, the one on damaged fuel, the one on fuel retrievability, the one on the cladding, ISG 11, the cladding considerations for storage. That's the one that sets the temperature limits. There's also an ISG on welds and also one on rod oxidation and splitting. Now, if you go to the section in the website and you look at the ISG and then you go back to the materials chapter that says okay, where is this ISG, it won't become necessarily apparent. Because the ISGs as they're written have a big background and then it has a section that deals with guidance, these are the things to look for. And so for the most part when you go to the materials section you'll find the thing split up, all the guidances in one area and then all the background and supporting material are in other areas.

It's important to note there is nothing in the materials section that has not been in the public purview before, either as an ISG or through RAIs or other means. There's no new information. We did have



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a number of enhancements. One of them was the definition of burnup and the reason for that is that burnup is sort of a misused term. Is it rod burnup, is it the peak rod burnup, is it the average rod burnup, is it the core burnup, is it the sector burnup? What are you referring to and people just talk about "burnup." And in fact, for the criticality people they're looking at one burnup, yet when we specify what we're going to look at for fuel temperatures in the ISG 11 we state that everything is applicable to the current license burnup in a reactor, and the current license burnup is 62.5 peak rod average, and that's different than what the criticality people have. So you'll see it in the definition section that there's a burnup - clarification of the burnup definition.

There was a number of other enhancements, mainly for clarifications. Naturally, because it was a new section there were lots of questions, far more than any other discipline and I'm not going to go into them. Some of them they were just questioning guidance that was there before, some of them they had valid questions and it was corrected. In other cases it was a matter of the language wasn't clarifying and so we clarified the language. And that's pretty much



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the upshot of the materials section.

MR. PARKHILL: Okay, operating procedures.

MEMBER ARMIJO: I had a - actually, I like the materials section. It was very informative and there are some areas that I don't know much about that Bob gave me a couple of papers that I'll read related to the cladding and degradation of the cladding in the event you've got a breach somewhere. But I was put off by one - some paragraphs, your lines in 7511 through 7522 which I think -

MS. THOMPSON: Excuse me just a minute. If you could give section numbers instead of lines? Your line numbers don't seem to match up with ours, so are you looking at like a Word file or something?

MEMBER ARMIJO: I'm looking at whatever I was given by the staff.

MS. THOMPSON: Well, is it a PDF or Word?

MEMBER ARMIJO: Unfortunately that's what I have. It's in - it's a PDF and it's got all these lines.

MR. LORSON: In structural properties, perhaps?

MEMBER ARMIJO: Yes, it's related to materials properties for important-to-safety components.

MR. LORSON: Right, right.

MEMBER ARMIJO: And here the issue was there was a longstanding staff position that held that the ASME code values must be used for these components. But apparently some people had proposed using certified test results.

MR. LORSON: Right.

MEMBER ARMIJO: Okay? And you don't want to use that. And I don't have a problem with that, but it goes on, and I think the wording should really be either "deleted" or "changed." Let me read it to you.

MR. LORSON: Right. Yes, we're aware of that section. We think -

MEMBER ARMIJO: "Steel producers are," okay, that one, it alleges that steep producers are kind of untrustworthy characters and will do all sorts of bad things. I think it's really not helpful to have that in there. I think -

MR. EINZIGER: That's been a subject of discussion. If it hasn't been changed already then it will be.

MR. LORSON: We agree with that comment. The wording isn't appropriate.

MEMBER ARMIJO: Yes, it isn't appropriate



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and not that I disagree with your position, it's a good position. If somebody wants to get better credit for properties let them go get a code case on the material. Then you'd be fine with that.

MR. LORSON: Right. No, we agree, the wording there isn't - we don't agree with the wording.

MEMBER ARMIJO: So anyway, that's really my only - you've answered a lot of my questions in the course of the discussion of other sections, so that's really all I had in the materials area.

MR. LORSON: Ray?

MR. PARKHILL: Okay, operating procedures. The one enhancement that we had had to do with the pressurized test that's done to ensure that the cask is dry. And what we wanted them to do was not just isolate the vacuum pump by closing the value because we're worried about a single leakage through a valve that is not important to safety. So what we're asking them to do is either shut down the vacuum pump or open the suction to atmosphere so that you will - if - because if you had a leaking valve you would skew the test in the wrong direction. So if that valve is leaking we want it to rise the pressure in there to make sure, you know, that it's being performed properly. It's not a new issue, it's one of our

repetitive comments that we had out on the - in the public domain.

Key comments from the stakeholders. When it came to specialized tools and equipment they wanted us to change it to limiting a description to just their function rather than use and operation. We respectively disagree. We want to know for specialized tools exactly what they're doing so you know they won't - well, have a better understanding of what they're doing and we're worried about misapplication. So they were trying to just limit it which could have been to just a title change - or I mean a description of the title, what the tool is used for rather than how it's used. Delete requirement to re-evacuate and refill the canister with helium. We agree with that. Experience has shown that one evacuation and then filling with helium has sufficed. So we agree to that. And going to radiation protection, Elizabeth Thompson.

MEMBER ABDEL-KHALIK: I'm sorry, I'm just going backwards here. There's an item in the stakeholder comments in the materials that questions the need of creep analysis for aluminum. What is the basis for that comment?

MR. EINZIGER: Why did they make the

comment? I don't know why they made the comment. The reason that we require creep is because there's components made of aluminum and the temperature range is much lower for aluminum than for the zircalloy or the cladding, and if you - if you get creep of that then the whole thing can slump and you change the configuration for the criticality calculations and for the shielding calculations.

MEMBER ABDEL-KHALIK: And for the thermal analysis.

MR. EINZIGER: Right. And so we want them to show that those components aren't going to slump, essentially.

MEMBER ABDEL-KHALIK: So the comment was made without any rational explanation of why this is -

MEMBER ARMIJO: Unless it's a real cold -

MEMBER ABDEL-KHALIK: Well, it's pretty hot.

MR. EINZIGER: Let me just - that was the creep - yes, I've got it, I've got it, 125. The comment was, "Analysis of creep for all aluminum-based structural materials including those only supporting deadweight, any kind of loading, there is no sound basis for requiring the creep review of materials that have no structural function except bearing accident

loads through their thickness and supporting their own deadweight during normal storage." And our response to that was that the gap analysis can change drastically if the aluminum components increase the basket gap. That was our response to it.

MEMBER ABDEL-KHALIK: Yes, I understand.

MR. EINZIGER: And why - I mean, that was the totality of the comment so -

MEMBER ABDEL-KHALIK: I understand your response.

MR. EINZIGER: Okay.

MR. PARKHILL: But we did make a change there too. We clarified -

MR. EINZIGER: Yes, there was a clarification change.

MR. PARKHILL: Okay. Once again, Elizabeth Thompson.

MS. THOMPSON: Okay. I'll talk for just a couple of minutes about the radiation protection chapter. In revising this chapter we incorporated one ISG, that's ISG 13 dealing with the real individual. We've mentioned this earlier with respect to the shielding chapter. The changes are along the same lines.

Other enhancements that we made were to -

in line with what Ron mentioned earlier about Part 72.13 which specifies which parts of 10 CFR Part 72 apply to general licensees, which parts apply to CoC holders, which parts apply to specific licensees. There were some references in this standard review plan that referred to parts of Part 72 that weren't supported for the way it was parsed out in 72.13 so we had to make some changes there. One of the major specific changes that we made is based on OGC's recommendation. We took out the guidance for a reviewer to look at an applicant's ALARA policy. We still look at whether they seem to have considered ALARA in their design and their operations, but we no longer check for whether they have an ALARA policy.

CHAIR RYAN: Why would OGC worry about that? Just out of curiosity. I guess I have to ask them.

MS. THOMPSON: Well, because when we started pushing them as to what parts of Part 72 we could use, they started taking a closer look and said well, this thing that you read as applying based on 72.13 does not apply.

CHAIR RYAN: Oh, okay.

MS. THOMPSON: Therefore, your basis for having the reviewers look for this, there's no

regulatory basis for that. So since we can't instantaneously change Part 72, NRC doesn't work that way -

CHAIR RYAN: Yes, but you can look at their radiation protection program part of which is their ALARA program, part of which is their ALARA policy.

MS. THOMPSON: Well, that's for a licensee and that's inspectible, but for these cask designers they don't have a radioactive material licenses, they don't have radiation protection programs, so we don't have any avenue to look at that stuff. So we're kind of pushed -

CHAIR RYAN: I'm sure they get it in the design specs from a potential customer.

MR. LORSON: And we inspect it as part of an onsite inspection for the loading phase.

MS. THOMPSON: Then we had a few comments, luckily most of them with shielding. But one of the comments was they request that we delete the word "retrieval" from the dose estimates. We declined that and provided them some justification because there are requirements in 10 CFR Part 72 that fuel be retrievable. And if there is any difference in how operations are done for retrieving the fuel versus



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loading the fuel into the storage overpack then the designer is the one that would be most aware of that and be able to tell us about any differences in the expected doses. So we left that. Another one was questioning whether there was really any point to performing dose versus distance analyses for a single cask for a hypothetical array, and we clarified some things in the text but told them yes, there's a reason for that too. But we did provide some clarification so that maybe the rationale would be more apparent to them. And unless there are any questions?

MR. PARKHILL: Okay, we're going to go to Chapter 13. I don't think we had any significant changes in accident analysis. We didn't prepare a slide. Technical specifications. Basically we clarified within the SRP what features of the cask should have NRC approval before actually changing. We noted the authority granted under 72.48 and the significant stakeholder comments we've talked about is the tech specs. We talked about that in Chapter 1 and I don't think we need to repeat that right now.

Quality assurance, Jim Pearson would have been here but he's not. The enhancement that we made to the current QA review practices was to document what we do in the office. So just a matter of



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documenting our current practice. Added specific examples. That second bullet, what we're actually doing is clarifying the level of detail required for a QA program. The third bullet, streamline the text of the acceptance criteria, we basically reduced the amount of the text in that chapter. Under the significant stakeholder comments we deleted receipt inspection from Chapter 9 because that has to do with operations and it was out of place there. Delete mention of - okay, for the last bullet we originally had that they used the latest revision of the qualification for inspection personnel and we agreed that to give them credit for older references to, like, SNTC-1a for qualification of inspectors.

And from a summary standpoint what we have done here, we have incorporated several ISGs, we've updated to reflect our current practices, added a new materials chapter which was a big item like I said. We maybe will just delete risk-informing.

MEMBER ARMIJO: I think you might be happier people if you did that.

MR. PARKHILL: Yes. We will now say, and I think we'll make that change, prioritization review procedures. We got significant public comments many of which we incorporated and they helped improve the



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product. Some we disagreed with and we're documenting what we've done in Attachment D which you have yet to see. And I think we've helped improve our process here for reviews by this document. If nothing else, knowledge transfer. And I think that concludes - let's see, path forward. Am I on a roll? Okay.

MR. LORSON: I'm a little nervous. The last time you gave a presentation over-ran by 9 hours, so.

MR. PARKHILL: I think probably my word is mud here, but hopefully we'll give you this document in March. We'll be done with it by then and we'll give you an updated copy of the standard review plan to support our subcommittee meeting in April. I think it's April 20, Chris? The full committee meeting, briefing, that's May 4? Okay. And then we're hoping to issue this thing sometime in June - "zune" which is soon for June. And then we're going to continue work on the 15.67 as we get the input back from this to see if we have any changes. But that's our next project.

CHAIR RYAN: Thanks, Ron.

MR. LORSON: Can I ask just one question for clarification? We've had a lot of comments and questions from the subcommittee here today and what we've done is we've tried to take notes and highlight



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the areas that are things that need to be addressed. Would it be appropriate if we consolidated those in an email and forwarded it to maybe Mike just to make sure we've captured accurately everything that you?

CHAIR RYAN: What I think you have available to you is the transcript as well.

MR. LORSON: Okay.

CHAIR RYAN: You can read whatever you want in the transcript.

MR. LORSON: Okay.

CHAIR RYAN: And then if you want to discuss any clarifications you do it with Chris. That's the best way to get that done. And I think the transcript is the record so that's why we'll -

MR. LORSON: Understand.

CHAIR RYAN: So I mean, the idea is if there's something that just doesn't make any sense, you know, we can sure provide it, but it's best to work through Chris.

MR. LORSON: No, I understand. That's good.

CHAIR RYAN: But our goal is to get to the next briefing where the document is a little further along and you've heard what we've got to say. Hopefully some of the things we've raised to you

you'll address in that revision and on we go with a subcommittee meeting followed by the full committee briefing. And let me add, thank you very much for a very informative afternoon. It's a real healthy discussion. I think we've given you our views, you sure shared with us you're thinking and we've learned a lot so it's really I think an extremely productive setting up for the final subcommittee meeting and then on to the full committee. So time well spent I think by all of us.

MR. LORSON: I think we agree. I think we got some outstanding comments that will help us make the document better. That's what we're striving to do.

CHAIR RYAN: Yahoo. Right. All right with that, any other business, any other comments?

MR. BROWN: Do you want a full day in April or a half day?

CHAIR RYAN: I think - I don't know, Chris.

MR. BROWN: I've got to think about this one here. I'll get back with the staff on that.

CHAIR RYAN: Yes, let's see what we think. I mean, I think somewhere in between the two might be right.



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MEMBER BLEY: We're going to get a draft in March, right?

MR. PARKHILL: Yes.

CHAIR RYAN: We'll work it out. Okay, that sounds good. All right, thanks. With that, with no further business we'll adjourn.

(Whereupon, the foregoing matter went off the record at 5:24 p.m.)

# Updating and Risk Informing the Standard Review Plan for Dry Storage Systems (NUREG-1536)

## Information 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**

**- February 17, 2010 -**

# Opening Remarks

**Raymond Lorson, Deputy Director**
**Technical Review Directorate**
**Division of Spent Fuel Storage and Transportation**

# Purpose

- Provide an information briefing on the update to the standard review plan (SRP) for dry storage systems
- Identify areas of interest for future interactions with ACRS on the final SRP

# Today's Presentation

- Dry Cask Storage Background
  - Division of Spent Fuel Storage and Transportation
  - Typical Dry Cask Storage Operations
  - Regulatory Basis and Design Basis
- SRP Update Project
  - Overall Project Approach
  - Risk Prioritization
  - Key Revisions to SRP
  - Key Stakeholder Comments
- Path Forward

# Division of Spent Fuel Storage and Transportation

# Division of Spent Fuel Storage and Transportation (SFST)

**Division of Spent Fuel Storage and Transportation**
**Vonna Ordaz, Director**

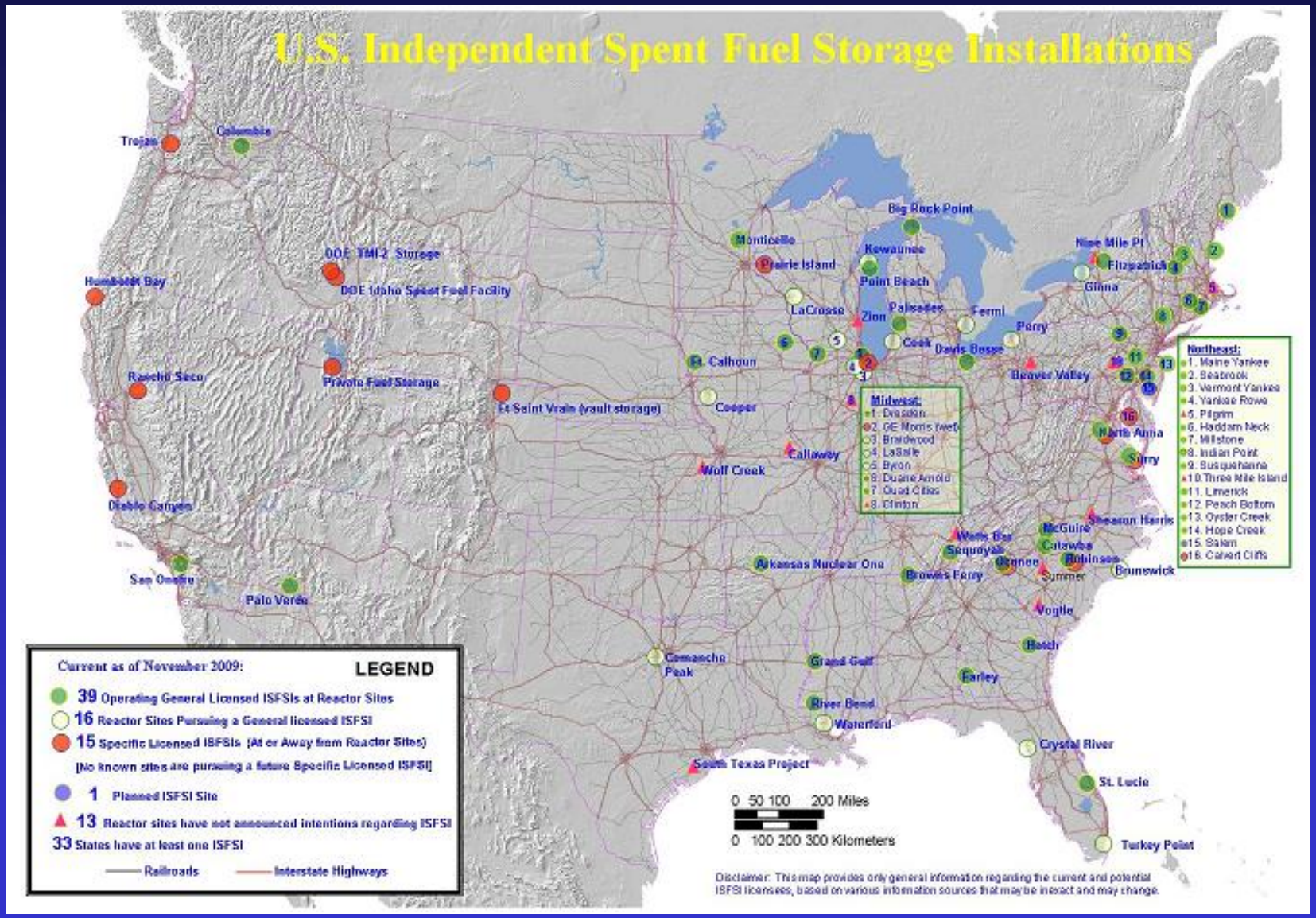
- **Technical Review Directorate**
  - **Structural Mechanics and Materials**
  - **Criticality, Shielding, and Dose Assessment**
  - **Thermal and Containment**
- **Licensing and Inspection Directorate**
  - **Licensing**
  - **Rules, Inspections, and Operations**

# Options for Spent Fuel Storage

- General License
  - Granted only to Part 50 licensees
  - Requires use of certified cask design
  - Certificate application submitted to NRC by a cask vendor
  - Requires site evaluation by licensee to verify compatibility with cask design parameters
  - 10 CFR Part 72 Subparts K-L*
  - NUREG-1536 – Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility

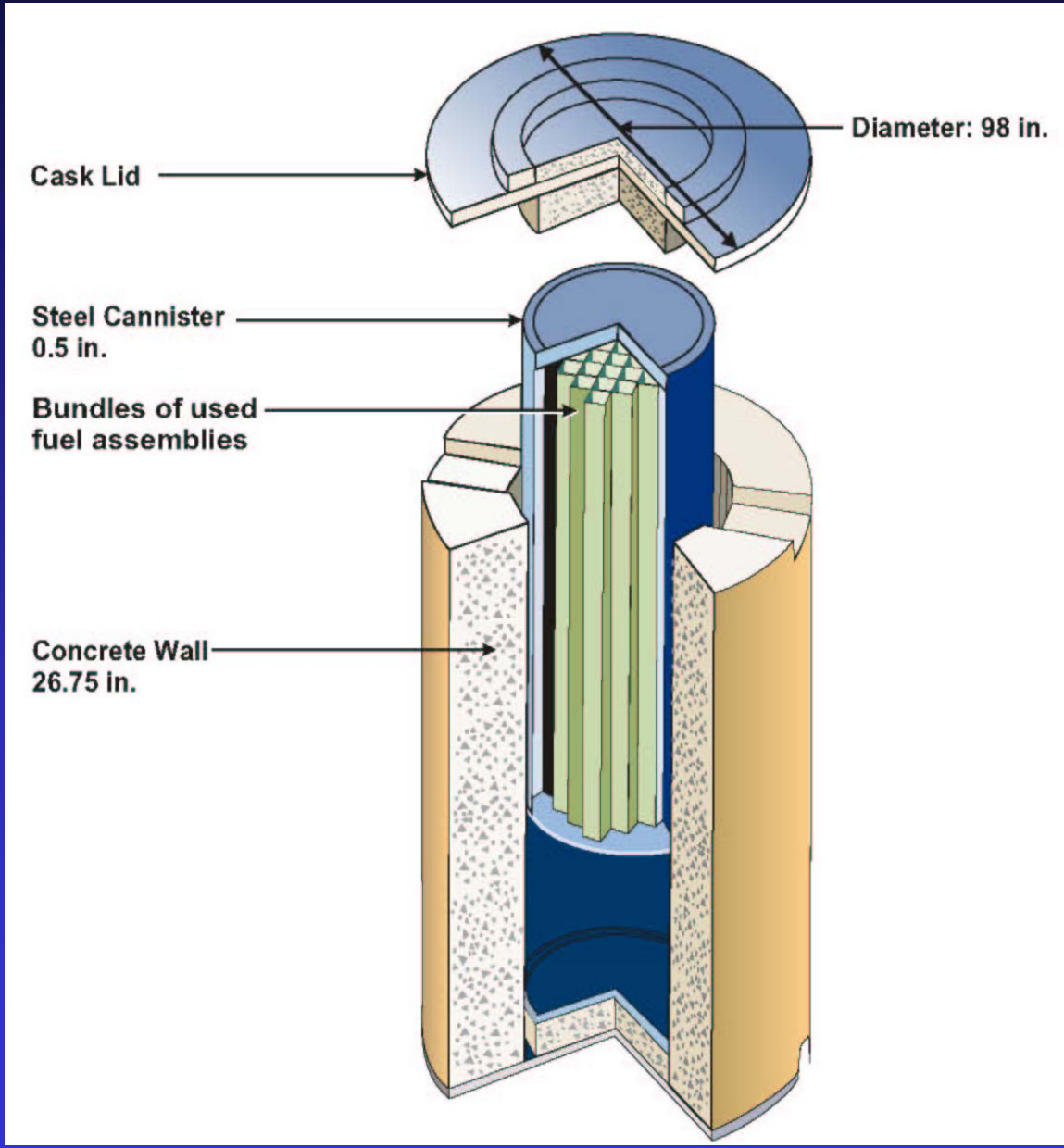
- Site Specific License
  - Available to Part 50 (reactor) licensees and other applicants
  - Required for away-from-reactor sites
  - Opportunity for Hearing
  - 10 CFR Part 72 Subparts A - J
  - NUREG-1567 – Standard Review Plan for Dry Storage Facilities

# Storage in the U.S.



# Typical Dry Storage Cask Operations

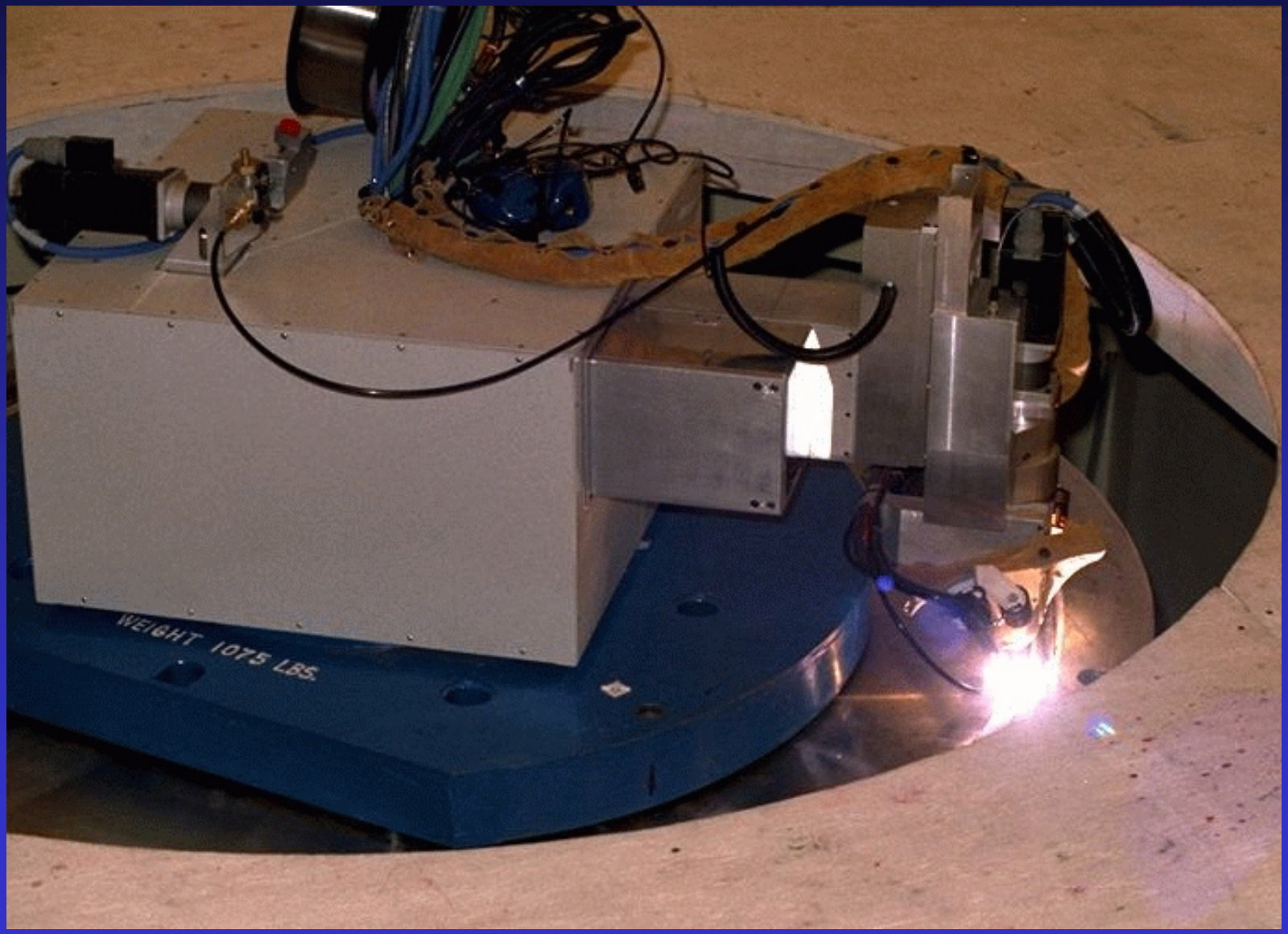
# Welded Canister – Overpack System



# Preparation of Empty Canister

# Fuel Loading in Transfer Cask

# Welding of Canister Lid

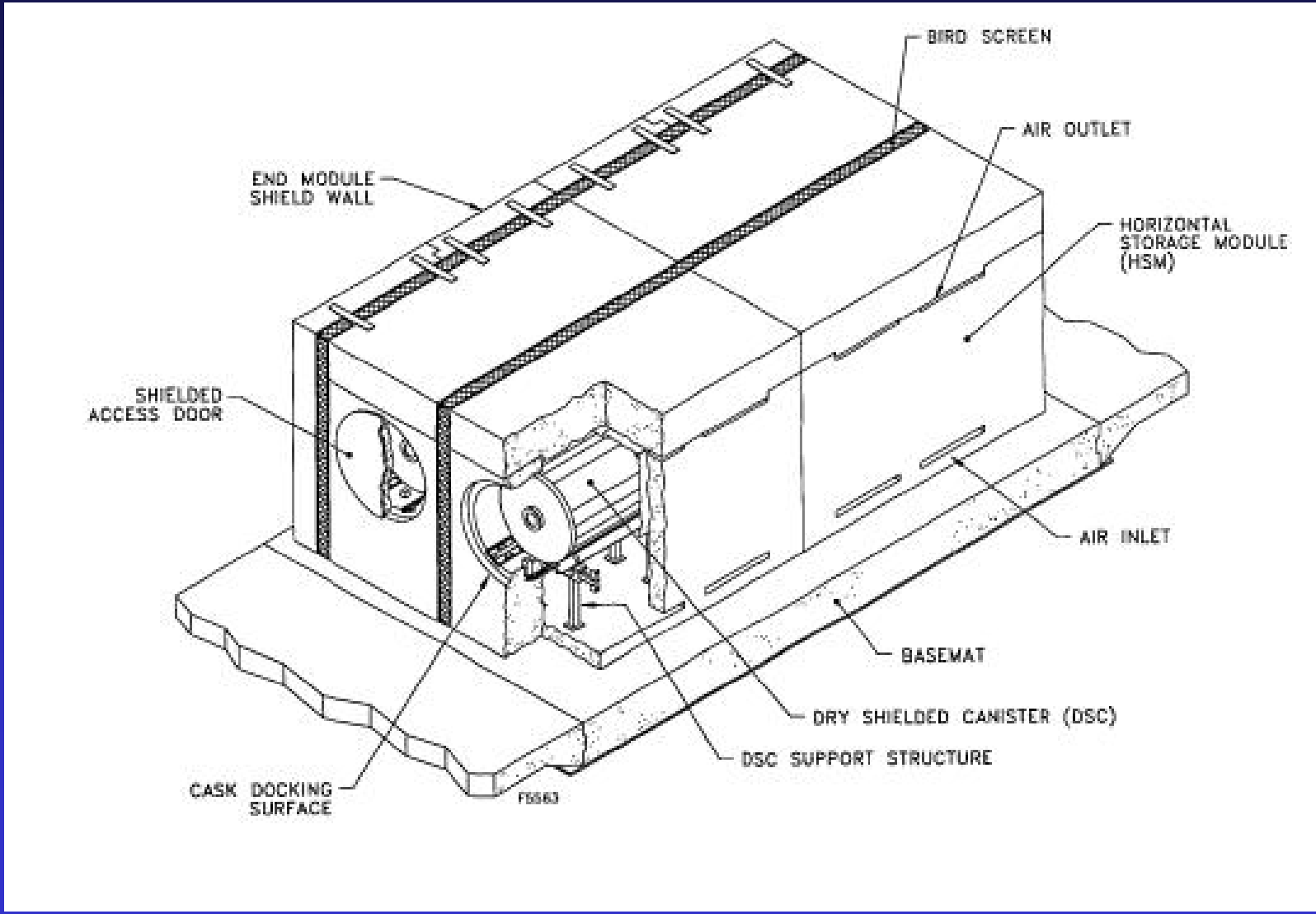


# Transfer of Canister into Overpack

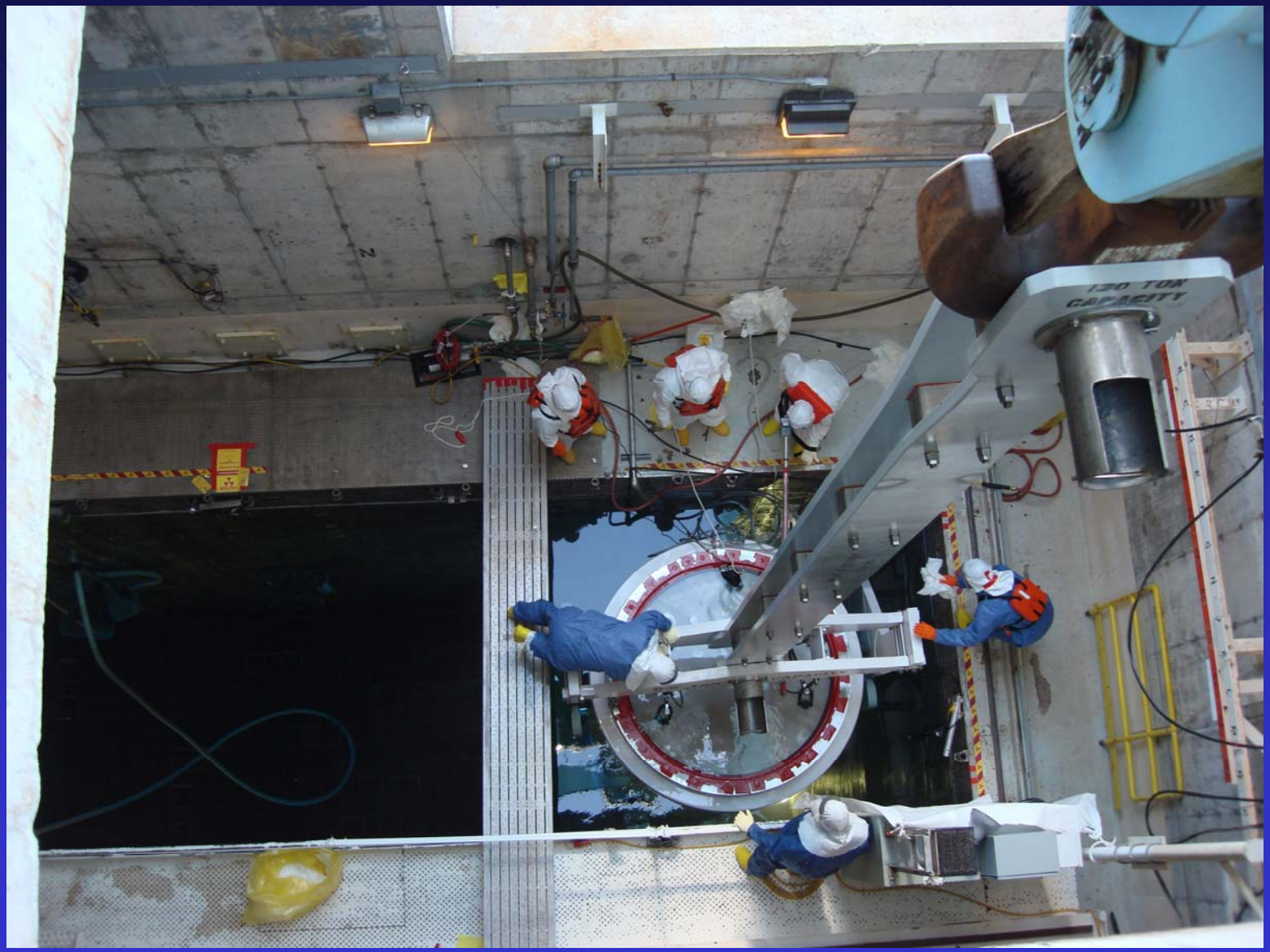
# Transfer of Overpack to ISFSI Pad

# Storage Cask Array on ISFSI Pad

# Welded Canister – Module System



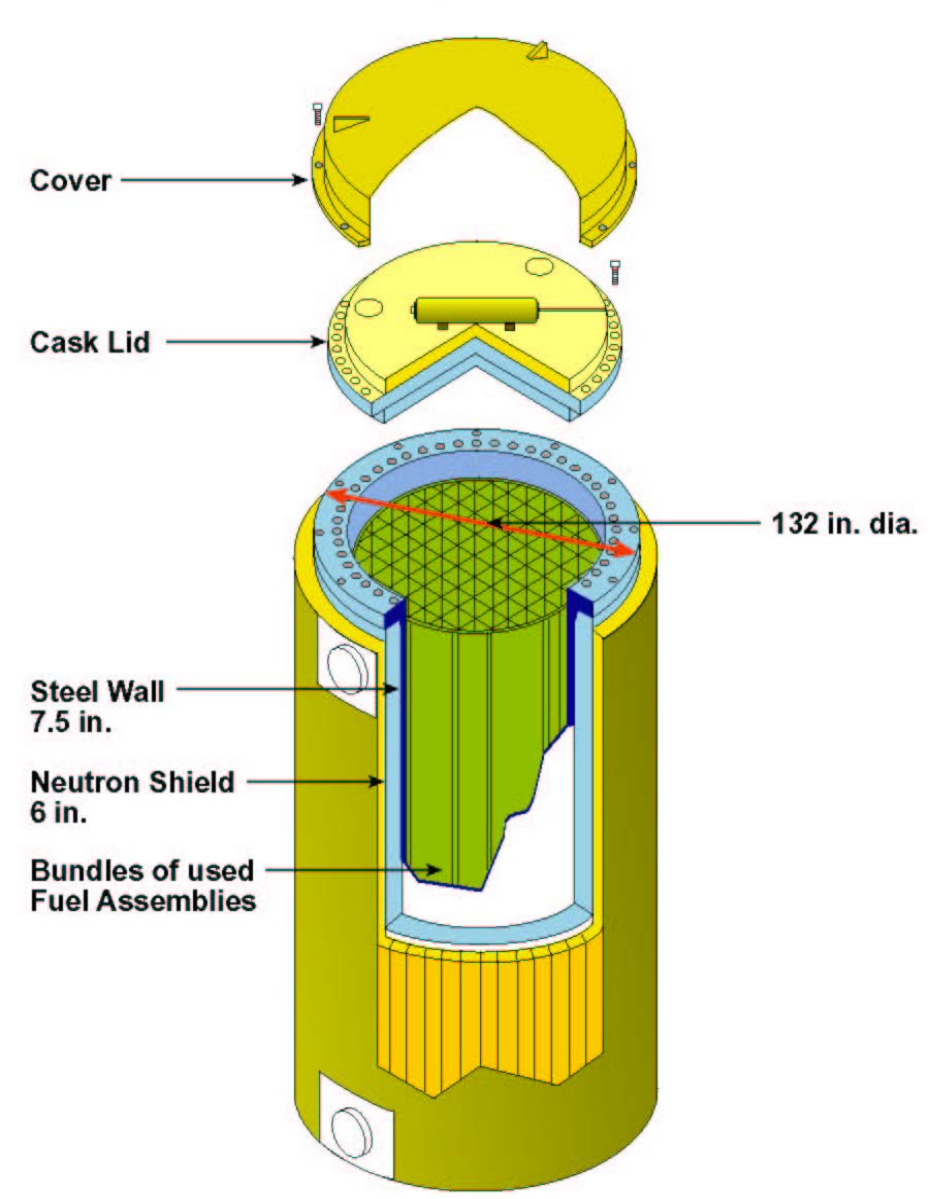
# Loading of Transfer Cask



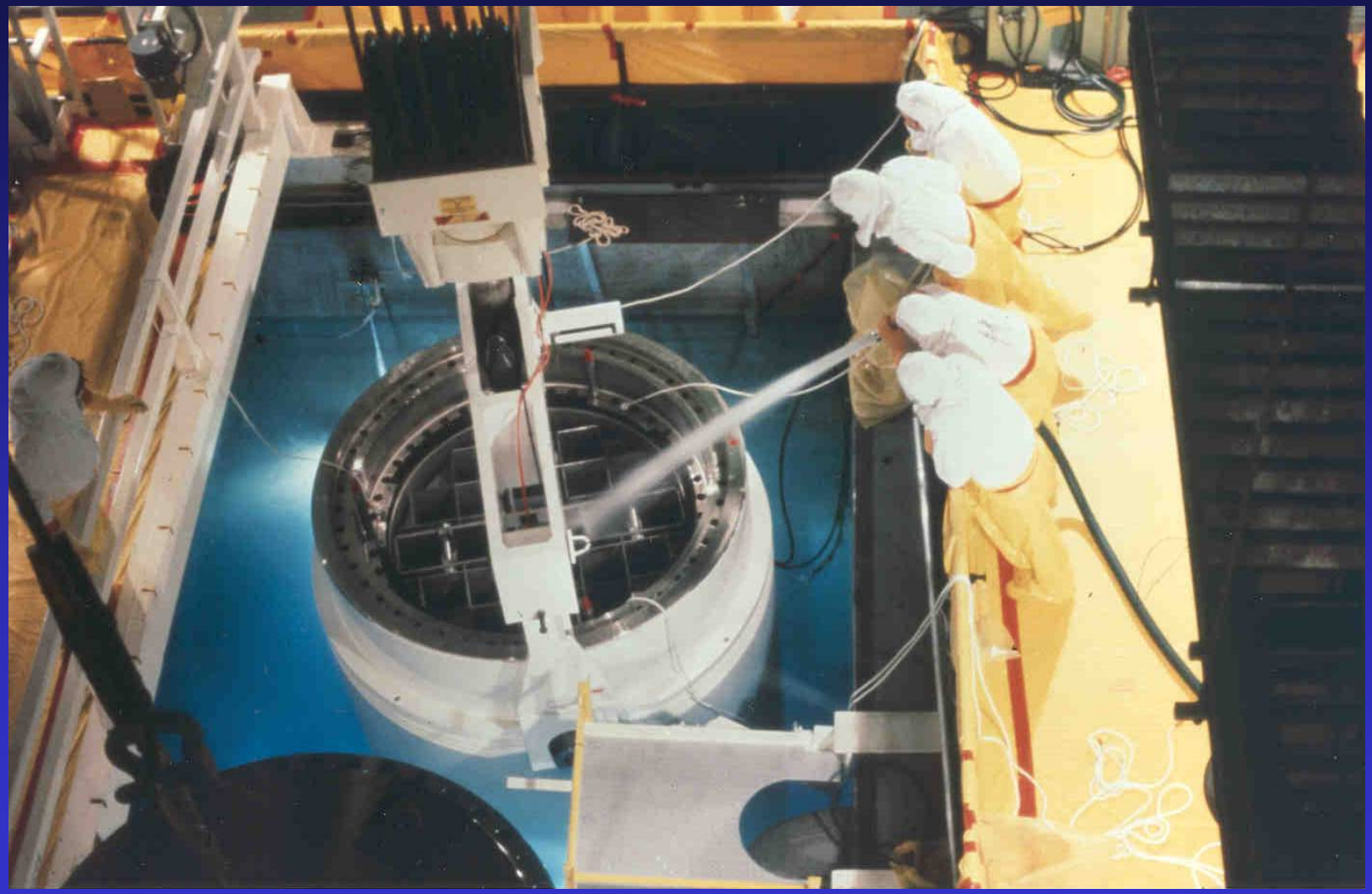
# Transfer of Canister into Module

# Module Cask Array

# Bolted-Closure System



# Loading of Storage Cask in Pool



# Storage Array on ISFSI

# Use of Multiple Designs

# Regulatory Basis and General Performance Criteria

# Some Key Regulations

- 10 CFR 72.236 – Storage Cask Certification
  - (a) Spent fuel specifications
  - (c) Remain subcritical during loading
  - (d) Sufficient shielding and confinement systmes
  - (e) Adequate Heat Removal Capacity
  - (j) Integrity of confinement barrier
- 10 CFR 72.106(b) – Accident Dose Limits
- 10 CFR 72.104(a) – Normal Dose Limits
- 10 CFR 72.122(l) – Ready Retrieval / Cladding

# General Performance Criteria (Normal and Off-Normal Conditions)

- **Dose limits:** 25 mrem/yr (all casks)
- **Criticality Safety:** Remain subcritical during loading operations
- **Confinement:** Maintain confinement during storage operations
- **Cladding Integrity:** Maintain inert environment and cladding temperatures during operations

# Typical Design Conditions

- **Normal Conditions**
  - Loading and Unloading Operations
  - Normal Loads and Internal Pressures
  - Long-Term Storage Conditions

- **Off-Normal Conditions**
  - Equipment Failures
  - Extreme Environmental Temperatures
  - Partial Vent Blockage

# General Performance Criteria (Design Basis Accidents)

- **Dose limits:** 5 rem for Design-Basis Accidents
- **Criticality Safety:** Remain subcritical including consideration of double contingency principle
- **Confinement:** Reasonably maintain confinement under accident conditions

# Typical Design Conditions (Accidents)

- **Accident Conditions**
  - Cask Drop and Tipover
  - Explosive Overpressure
  - Fire
  - Flood
  - Tornado Wind and Missiles
  - Earthquakes

# Review Areas for Storage

- General Description
- Principal Design Criteria
- Structural
- Thermal
- Shielding
- Criticality
- Confinement
- Materials
- Operating Procedures, Acceptance Tests, & Maintenance
- Accident Analyses
- CoC & Technical Specifications

# History of Storage SRP Project

| | |
|---|---|
| • Staff begins technical updating | 4/06 |
| • Contract Awarded to ISL | 10/06 |
| • Completes Technical input (updates) | 11/06 |
| • Completes Risk prioritization process | 2/08 |
| • Contractor provides risk-prioritized version | 12/08 |
| • FRN Issued for Public Comments | 4/15/09 |
| • Public Comments Received | 7/15/09 |
| • ACRS Subcommittee Briefing | 2/17/10 |

# Standard Review Plan Structure

- Review Objective
- Areas of Review
- Regulatory Requirements
- Acceptance Criteria
- Review Procedures
- Evaluation Findings

# Goals of SRP Update

- Incorporate staff Interim Staff Guidance into SRP
  - Original SRP published in 1997
  - 25 staff ISG's developed from 1998 – 2010
- Update SRP procedures to reflect current review practices
  - Consider past licensing experiences
  - Consider evolution of cask technologies since 1996
  - Consider operational events
  - Consider best practices in computational methodologies
- Risk-Inform the review procedures
  - Focus staff audit reviews on the more important issues
  - Prioritize each procedure by high, medium or low designation
  - Priority designations serve as "guideposts" to the reviewer
  - Not PRA based; Qualitative risk factors developed by experienced reviewers

# Risk-Informed Focus

- Focus audit review on areas of safety significance
- Some low priority review items could theoretically escape NRC detection (if insufficient by applicant)
  - But they would be of lower regulatory significance
- Reviewer may still opt to adjust effort for procedures in consideration of unique design factors
  - Margins
  - Deviations from Standard Practice
  - Design Novelty

# Review Priorities

- High Review Priority
  - Comprehensive audit of analytical methods, assumptions, and references
  - Independent Confirmatory analyses
  - Approximately 60% of staff review effort
- Medium Review Priority
  - Normal audit of key analytical methods, key assumptions & references
  - Staff audits submittal for completeness and correctness,
  - Approximately 30% of staff review effort
- Low Review Priority
  - Staff ensures submittal contains required information
  - Cursory review, no in depth review of correctness
  - Approximately 10% of staff review effort
  - Staff still address defienicies if detected
  - Does not preclude applicant from performing high quality analyses in these areas

# Approach

- NRC staff
  - Team assembled, discipline leads established for technical content
  - Enhanced review procedures to reflect current review practices
  - Advise contractor on risk factors

- Contractor assistance (ISL)
  - Facilitated NUREGs revision (format, editing, document production)
  - Administratively added ISGs
  - Developed risk informing process
  - Facilitated risk prioritization of procedures

# Risk-Informed Prioritization Method

- Develop risk prioritization method for individual review procedures of each SRP Chapter
  - Regulations and Acceptance Criteria not ranked
- Three methods were pilot tested by ISL against criticality and thermal chapters
- Method selected by ISL and staff was determined to be best suited for SFST audit needs
- Based on judgment of experienced technical staff

# Prioritization Methodology

| | |
|---|---|
| (1) Likelihood that requirement will not be met | **VH**=4, likely to occur, P>.5<br>**H**=3, Probably will occur, 0.1< P < 0.5<br>**M**=2, May occur, 0.03< P< 0.1<br>**L**=1, Unlikely to occur, 0.01<P< 0.03<br>**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<br>**M**=2, may occur or moderate consequences, <$10^{-3}$/yr but >$10^{-5}$/yr or<br>5-25 rem to worker or 0.1-1 rem to public<br>**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<br>**Medium** is 6 to 8<br>**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<br>-a low, medium or high likelihood and/or consequence, then the item should be a low, medium or high, respectively<br>-Same as (3) for low, medium or high<br>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 |

# Summary of Priority 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** |

# Standard Review Plan Revisions

# General SRP Changes

- Title changed from “Dry Cask Storage Systems” to “SF Dry Storage Systems at a General License Facility”
- Changed format to generally agree with SRP for Facilities NUREG-1567
- Corrected regulatory references per update 10 CFR 72.13
- Incorporated applicable ISGs between 1 thru 25
- New Materials Chapter
- Deleted Decommissioning Chapter (under Part 50)
- Appendix A - Consolidated References
- Appendix B - Risk Informed Review Procedure
- Appendix C - List of Incorporated ISGs
- Appendix D – Response to Stakeholder Comments

# Changes – Organizational Comparison of Old Version with New

| Standard Review Plan for Dry Cask Storage Systems (old) | Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility (new) |
|---|---|
| ABSTRACT | ABSTRACT |
| TABLE OF CONTENTS | TABLE OF CONTENTS |
| | LIST OF FIGURES |
| | LIST OF TABLES |
| | ACRONYMS AND ABBREVIATIONS |
| | UNITS |
| DEFINITIONS | GLOSSARY |
| INTRODUCTION | INTRODUCTION |
| Ch 1 General Description | Ch 1 General Information Evaluation |
| Ch 2 Principle Design Criteria | Ch 2 Principle Design Criteria Evaluation |
| Ch 3 Structural Evaluation | Ch.3 Structural Evaluation<br>Appendix 3A Computational Modeling Software |
| Ch 4 Thermal Evaluation | Ch 4 Thermal Evaluation |
| Ch 5 Shielding Evaluation | Ch 5 Confinement Evaluation |
| Ch 6 Criticality Evaluation | Ch 6 Shielding Evaluation |

# Changes – Organizational Comparison of Old Version with New

| | |
|---|---|
| Ch 7 Confinement Evaluation | Ch 7 Criticality Evaluation |
| Ch 8 Operating Procedures | Ch 8 Materials Evaluation |
| Ch 9 Acceptance Tests & Maintenance Program | Ch 9 Operating Procedures Evaluation |
| Ch 10 Radiation Protection | Ch 10 Acceptance Tests & Maintenance Program Evaluation |
| Ch 11 Accident Analyses | Ch 11 Radiation Protection Evaluation |
| Ch. 12 Conditions for Case Use– Operating Controls and limits or Technical Specifications | Ch 12 Accident Analyses Evaluation |
| Ch 13 Quality Assurance | Ch 13 Technical Specifications and Operational controls and Limits Evaluation |
| Ch 14 Decommissioning | Ch 14 Quality Assurance Evaluation |
| Appendix A- Sample Checklist for Evaluating Quality Assurance Program Elements for Dry Cask Storage Systems | Appendix A- Consolidated References |
| Appendix B-Materials and Components of HLW Storage | Appendix B- Process for Risk Informing The Standard Review Plan for Dry Storage Systems |
| Appendix C- Glossary | Appendix C- ISGs Incorporated into SRP |

# Incorporation of ISGs

| ISGs | Title | Status |
|---|---|---|
| ISG 1, Rev. 2 | Damaged Fuel | Added |
| ISG 2, Rev. 1 | Fuel Retrievability | Added (Administratively) |
| ISG 3 | Post Accident Recovery and Compliance with 10 CFR 72.122(l) | Added |
| ISG 4, Rev. 1 | Cask Closure Weld Inspections | Superseded by ISGs 15 & 18 |
| ISG 5, Rev. 1 | Confinement Evaluation | Added |
| ISG 6 | Establishing Minimum Initial Enrichment for the Bounding Design Basis Fuel Assembly(s) | Added |
| ISG 7 | Establishing Minimum Initial Enrichment for the Bounding Design Basis Fuel Assembly(s) | Added |
| ISG 8, Rev. 2 | Burnup Credit in the Criticality Safety Analyses of PWR Spent Fuel in Transport and Storage Casks | Added |
| ISG 9, Rev. 1 | Storage of Components Associated with Fuel Assemblies | Added |

# Incorporation of ISGs (cont'd.)

| | | |
|---|---|---|
| ISG 10, Rev. 1 | Alternatives to the ASME Code | Added |
| ISG 11, Rev. 3 | Cladding Considerations for the Transportation and Storage of Spent Fuel | Added |
| ISG 12, Rev. 1 | Buckling of Irradiated Fuel Under Bottom End Drop Conditions | Added |
| ISG 13 | Real Individual | Added |
| ISG 14 | Supplemental Shielding | Added |
| ISG 15 | Materials Evaluation | Added |
| ISG 16 | Emergency Planning | NA |
| ISG 17 | Interim Storage of Greater Than Class C Waste | NA |
| ISG 18, Rev. 1 | The Design & Testing of Lid Welds on Austenitic Stainless Steel Canisters as Confinement Boundary for Spent Fuel Storage | Added |

# Incorporation of ISGs (cont'd.)

| | | |
|---|---|---|
| ISG 19 | Moderator Exclusion Under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel Under the Requirements of 10 CFR 71.55(e) | NA |
| ISG 20 | Transportation Package Design Changes Authorized Under 10 CFR Part 71 Without Prior NRC Approval | NA |
| ISG 21 | Use of Computational Modeling Software | Added |
| ISG 22 | Potential Rod Splitting Due to Exposure to an Oxidizing Atmosphere During Short-Term Cask Loading Operations in LWR or Other Uranium Oxide Based Fuel | Added |
| ISG 23 (draft) | Neutron Absorbers | Not Added |
| ISG 25 (draft) | Pressure and Helium Leakage Testing of the Confinement Boundary of Spent Fuel Storage Casks | Added (Administratively) |

# Introduction & Chapter 1

- ISG Incorporation
  - ISG-2: Fuel Retrievability definition
- Enhancements
  - Added description of how risk priority is used
  - Defined level of effort associated with rankings of High, Medium and Low
  - Added description of how current ISGs are to be used in conjunction with SRP review procedures
  - Added guidance for casks certified for transportation (Part 71) that may be approved under Part 72
- Key Stakeholder Comments
  - Discussion of technical specifications in “Review Process” discussion.

# Chapter 3: Structural

- ISG Incorporation
  - ISG-12: Buckling of fuel cladding during drops
  - ISG-21: Use of Computational Modeling Software

- Other Enhancements
  - ASME Sec. III, Div. 3 code available, but NRC has not endorsed it
  - Cask tipover model benchmark guidelines, per NUREG/CR-6608
  - Design earthquake motion, per 72.103, for casks after 10/16/03
  - ISFSI pad seismic analysis – pad flexibility effect on cask response

# Chapter 3: Structural (Cont'd.)

- Key Stakeholder Comments
  - Questions "no deformation or damage" for design basis accident and natural phenomenon
  - Replace RG 1.60 with NUREG/CRs 6728 & 6865
  - Allow elastic-plastic and other non-linear analysis permitted by ASME Code
  - Permit NDE in lieu of periodic trunnion load testing per ANSI N14.6

# Chapter 4: Thermal

- ISG Updates
  - ISG-11: Cladding Consideration for Storage of Spent Fuel
  - ISG-21: Computational Modeling Software

- Other Enhancements
  - General Guidance on Computational Fluid Dynamics Analyses
  - Characterization of External and Internal Flows to Properly Model Natural Convection
  - Use of Porous Media to Model Spent Fuel Assemblies

# Chapter 4: Thermal (Cont'd.)

- Key Stakeholder Comments
  - Questions level of detail (time steps being sufficiently small) being included in NRC staff review
  - Objects to discussion of annotation of input files being too prescriptive
  - Objects to limiting convection to outer surface of cask

# Chapter 5: Confinement

- ISG Incorporation
  - ISG-5: Methodology for determining dose at site boundary
  - ISG-25 (draft): Helium leak test of confinement boundary

- Other Enhancements
  - Require pressure testing of entire confinement boundary
  - Accepts shop helium leakage test as meeting field hydro acceptance of no leakage for shell

# Chapter 5: Confinement (Cont'd.)

- Key Stakeholder Comments
  - Questions level of detail in citing ASME Code
  - Questions Acceptance Tests basis as 'tests deemed acceptable'
  - States that release fractions should not be used for damaged fuel since no driving force

# Chapter 6: Shielding

- ISG Incorporation
  - ISG-6: Use of bounding source term
  - ISG-13: Site boundary dose analyses and ALARA consideration
  - ISG-14: Use of supplemental shielding

- Other enhancements
  - Revised Definitions
  - Revised procedures to coordinate with materials reviewer for new neutron absorber materials

# Chapter 6: Shielding (Cont'd.)

- Key Stakeholder Comments
  - Shielding analyses do not need to be bounding
  - Questions use of latest released computer code version to perform analysis
  - Delete dose rate limits from Technical Specifications

# Chapter 7: Criticality

- ISG Incorporation
  - ISG-8: Recommendations for burnup credit
- Guidance Enhancements
  - Provisions for crediting burnable neutron absorbers
  - Consideration of reactivity effects from non-fuel hardware
  - Analytical considerations for damaged fuel
  - Align use of code-to-code comparisons per ANSI - 8.1

# Chapter 7: Criticality (Cont'd.)

- Key Stakeholder Comment
  - Delete reference to performing measurements to confirm assembly burnup values

# Chapter 8: Materials

- New Materials chapter
  - Expands upon ISG-15 for Materials Evaluation
  - Previous materials guidance located in other discipline chapters integrated into new chapter
- ISG Incorporation
  - ISG 1: Damaged Fuel
  - ISG 2, Rev. 1: Fuel Retrievability Definition
  - ISG 11: Cladding Considerations for Storage
  - ISG 18: Design & Testing of Lid Welds
  - ISG 22: Potential Rod Splitting from Oxidation
- Other Enhancements
  - Definition of Burnup updated
  - Guidance for evaluating coatings and neutron absorbers

# Chapter 8: Materials (Cont'd.)

- Key Stakeholder Comments
  - Questions release fractions from damaged fuel
  - Questions reference to ASME Section II, Div 3
  - Questions need of creep analysis for aluminum
  - Requests deletion of restriction on the use of zinc and aluminum in contact with wet concrete to avoid chemical reaction

# Chapter 9: Operating Procedures

- Enhancements
  - Clarify for pressure rise test that vacuum pump needs to be either shut down or its suction vented to atmosphere
- Key Stakeholder Comments
  - For specialized tools and equipment, suggest changing description of ‘use and operation’ to ‘function’
  - Delete requirement to re-evacuate and refill the canister with helium

# Chapter 11: Radiation Protection

- ISG Incorporation
  - ISG-13 “Real Individual”: Defines requirements
- Other Enhancements
  - Eliminate review of applicant’s ALARA policy (based on OGC input) Key Comments

# Chapter 11: Radiation Protection (Cont'd.)

- Key Stakeholder Comments
  - Requests that 'retrieval' be excluded from dose estimates
  - Questions the validity of performing dose vs. distance analyses from a hypothetical ISFSI

# Chapter 13:Technical Specifications and Operating Controls and Limits

- Guidance Enhancements
  - Clarified consideration of cask features, operations, and assumptions that should have prior NRC approval before changes
  - Noted change authority granted under 72.48

- Key Stakeholder Comments
  - Basis for content of TS is vague, subjective, not risk-informed and not consistent with practice in NRR

# Chapter 14: Quality Assurance Updates

- Enhancements
  - Revised to reflect current QA review practices
  - Added specific examples for use in determining acceptability of QA program description based on wording from Regulatory Guide 7.10's, Regulatory Position
  - Streamlined  the text of "Acceptance Criteria"

- Key Stakeholder Comments
  - Delete 'receipt inspection' from Ch 9
  - Delete mention of inspection personal qualification from Ch 9 and or change their qualification reference from "current revision of"

# Summary

- Incorporated several ISG's
- Updated to reflect current review practices
- Added new materials chapter
- Risk-Informed and prioritized the review procedures
- Resolution of public comments underway
- Improved safety focus of certification reviews

# Path Forward

- Provide Draft SRP Revision 1C to ACRS (March)
- ACRS Subcommittee Briefing (April)
- Full Committee Briefing (May)
- Issue Final SRP Revision 1 (June)
- Continue Work on SRP for Storage Facilities

# Questions