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NUCLEAR REGULATORY COMMISSION

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TECHNICAL SESSION - TH29

THE BENEFITS OF RISK-INFORMED DECISIONMAKING FOR DRY CASK SPENT NUCLEAR FUEL STORAGE SYSTEMS

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THURSDAY,

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The Technical Session met via Video-Teleconference, at 10:30 a.m. EST, Tim McCartin, Senior Level Advisor, Division of Fuel Management, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission, presiding.

PRESENT:

TIM MCCARTIN, Senior Level Advisor, Division of Fuel Management, NMSS/NRC

BRIAN WAGNER, Reliability and Risk Engineer, Performance & Reliability Branch, Division of Risk Analysis, RES/NRC

ROD MCCULLUM, Senior Director of Used Fuel and Decommissioning, Nuclear Energy Institute

KIMBERLY MANZIONE, Licensing and Engineering Service Manager, Holtec International

ZITA MARTIN, Retired, Tennessee Valley Authority

P R O C E E D I N G S

10:30 a.m.

MR. MCCARTIN: Before beginning the presentations, I want to give some brief context for risk informing as a process. It's using risk information, both qualitative and quantitative, to help focus designs, approaches and reviews consistent with safety significance.

The NRC has a long history of conducting probabilistic risk assessments to support its safety mission. It's important to note that it's not a static process. Risk information and risk informing activities will continue to evolve as operational experience and information grows.

There are really two aspects to risk informing. One certainly is the development of this risk information and the collection of experience and data to help one understand the risk significance.

But the other is, well, what do you do with that information? If you just collect the information and didn't do anything with it, it really wouldn't be risk informing.

And so in today's presentations, we will be talking to both of these aspects, both the

development and the understanding of risk information as well as, well, how is it implemented, say, for a regulatory agency at the NRC in terms of reaping the benefits of the risk information?

Next slide, please. Probabilistic risk studies continue to provide quantitative analysis of dry cask storage. Past studies have shown the resilience of dry cask storage designs to a wide range of potential accidents, including loading operations. Some of these documented studies were conducted more than 10 years ago.

EPRI conducted a study in 2004 for a bolted cask. NRC did a study later, a pilot study that looked at welded canisters. The BSC for the Department of Energy and the Yucca Mountain Application did some analysis of storage systems on aging pads.

And so there was information out there. But it's also important, as I mentioned, this is not a static process. Information continues to grow. It's important to critically evaluate those initial risk studies, update the assessments with further modeling activities, experience and information.

NRC's Office of Nuclear Regulatory

Research is doing just that today. There's a Level 3 PRA that will update some of this earlier risk assessment work that NRC did. Brian Wagner will be talking about this as well as other initiatives to enhance NRC's risk information.

Additionally, Zita Martin will be making a presentation that looks at operational risks and the experience she brings to the table in terms of the activities and risks associated with dry cask storage.

That's the first part of the element of risk informing. You have to develop and have an experience base.

Next slide, please. But next, well, what are you going to do with that information? It's just as important to how do we fold that into the regulatory process?

There are some recent initiatives at the NRC for risk informing that have been undertaken as pilot programs. First there was a -- with the assistance of Idaho National Laboratories, a risk tool was developed to assist the development of risk information in dry cask storage amendment reviews.

NRC has also conducted a pilot program to

use risk insights in a graded approach to ensure the information in an amendment is an appropriate place in either the license or the final safety analysis report to ensure that there is an appropriate and necessary regulatory oversight. It depends on where it is. It gives different flexibilities for the use of that information.

These pilot programs have been conducted in cooperation and input certainly from the industry. I would never want to suggest the NRC is doing this in isolation. We also conduct public meetings to assist the input from all stakeholders.

But there's also another aspect of these initiatives where industry led efforts. NEI submitted a white paper to the NRC in looking at defining spent fuel performance safety margins that provides the industry perspective on the experience with loading and maintenance of dry cask spent nuclear fuel storage in transportation systems with a goal to improve the regulatory framework for licensing these systems.

Rod McCullum from NEI, the Nuclear Energy Institute, will provide some industry perspectives related to that white paper but also perspectives on

these types of initiatives that have occurred since that paper was submitted in 2019.

Topical reports are also an example of another approach for risk informing NRC's ever revolving program. Kim Manzione will close our presentation with perspectives on the use of risk information in the development of topical reports.

So you can see today we're going to talk to both aspects, both development of information and use of that information.

Next slide. The panel represents a wide range of perspectives and experience for dry cask storage. I think the discussions today benefit from this wide variety of perspectives with a common goal of ensuring reasonable assurance of adequate protection that benefits both the NRC and all stakeholders.

So as a brief introduction, Brian Wagner, as I mentioned, is an NRC employee in the Office of Nuclear Regulatory Research. He's a reliability and risk engineer and specializes in topics related to risk-informed spent fuel storage and transportation.

Our second speaker will be Rod McCullum, who has been working on regulatory issues at NEI since

1998, but has over 35 years of experience in nuclear engineering, licensing, management, regulatory policy experience.

Currently, he leads industry efforts to reduce business risks associated with used fuel management, commercial nuclear power plant decommissioning, emergent material degradation issues in a variety of topics. He brings a lot of experience to the table.

Next, Zita Martin, who recently retired as the senior spent fuel program manager for the Tennessee Valley Authority, TVA. In her role there, she was responsible for developing and ensuring program implementation of TVA spent fuel management strategies.

Zita has over 42 years of experience working in the nuclear power industry dealing with all aspects of nuclear fuel fabrication and design, fuel and core performance, criticality, heat load analyses and wet and dry storage.

And finally Kim Manzione is the licensing manager for Holtec International. She is responsible for all of Holtec's licensing actions for spent fuel storage and transportation casks both domestically

and internationally.

She is responsible for supervising the preparation and engineering change documentation to support client activities at Holtec Manufacturing facilities.

Kim has over 14 years of experience in the nuclear power industry. And all of this wealth of experience and different views brings to the table good discussion we hope will follow because it's a benefit that everyone has different perspectives, different viewpoints. Bringing that information to the table to risk inform for that common goal of adequate safety is critically important to the NRC.

And without further ado, I want to stop my introduction and we will lead off with our first presenter, Brian Wagner. Thank you.

MR. WAGNER: Thanks, Tim. As Tim mentioned, my name is Brian Wagner. I'm a reliability and risk engineer in the Division of Risk Analysis in the Office of Nuclear Regulatory Research at the NRC, Nuclear Regulatory Commission.

So today I'm going to talk about -- we can go to the next slide. I'm going to talk about some of the challenges and benefits to risk informing

dry casks. I'll talk a little bit about the background on risk informing at the NRC, specifically for the dry cask area. I'll talk about some of the benefits and challenges as well as some current research that we're doing.

Next slide. Okay, background. I'm not going to talk about any of these in detail. I'm just going to kind of give a sampling of some of these documents.

The first category is guidance, a certain number of policy and plans to increase the use of information in the regulatory framework at the NRC.

The first one I want to mention is the PRA Policy Statement that we put out in 1995, which basically says to -- it was the Commission direction that the Agency should increase the use of risk in all regulatory matters to the extent practical.

We produced a -- we call it the RIDM document, which is Risk-Informed Decisionmaking for Nuclear Materials and Waste Applications. And that was guidance to help staff apply the risk-informed approach for regulatory decision-making. That was back in 2008.

And then most recently here is NUREG-

2150, which I don't have the title there, but it's a proposed risk management regulatory framework. And it provides a kind of strategic vision and options for adopting a risk-informed regulatory framework.

So, you know, we've been looking for opportunities -- I'm sorry. I meant to mention 2150 was not just reactors. It tried to include kind of all purviews of the NRC, including waste and casks and all those things.

So we've been looking for opportunities to risk-inform dry casks for a while. And, you know, we made some progress in some areas, and we're trying to keep moving the ball forward with that.

And there's been a number of -- I think to mention these briefly, a couple of dry cask risk studies. The first category is transportation. There's been really two major risk studies for that. The first was performed by the NRC, published in 2007, which was NUREG-1864. That was considered a pilot, a dry cask PRA, to kind of showcase methodology that could be used for potential future dry cask PRAs were they performed.

And then around the same time, EPRI, the Electric Power Research Institute, was also working

on a dry cask PRA. To some degree they were meant to be complementary efforts, one was a PWR, one was a BWR and one went to the welded cask and one went to the bolted cask. So, you know, they had largely consistent results although they were somewhat different.

Additionally, we performed a number of transportation risk assessments. The NRC has been doing that every 10 years or so. The first one we got there is back in 1977, and there's been four of them, most recently in 2014.

They all found transportation risks to be, you know, acceptably low. The newer studies used some updated methods. I calculated lower risks from accidents, although similar doses from regular operation.

Next slide. Okay. I want to talk about some of the benefits to risk informing dry cask reviews. And basically, it's the same benefit, the same kinds of benefits as risk-informing reactors or anything else for that matter.

You know, these previous dry cask PRAs have generally found the risks to be low, which is to say, you know, spent fuel is dangerous, and there is

a lot of spent fuel in these casks. But if properly managed, the risks can be low.

And this raises the possibility that there might be additional margin that we can take advantage of in risk informing, which means that we can maybe reduce the regulatory burden on some less risk significant aspects and focus on more risk significant aspects so we don't really need to focus on the areas with low risk and also have low uncertainty. We can focus on the areas that have high risk or maybe higher uncertainty in the results.

And an advantage of PRA is that it's a systematic process, which really creates a framework that you can do a lot of things with. You can identify some of the more risk significant aspects, which are maybe areas where you want additional data and additional analysis.

You can more easily test the importance of some of your assumptions. Once you have this framework, once you've, you know, done the math, it's easier to input different assumptions, add failure mechanisms and see what the results of that would be.

And it gives you a framework to evaluate the significance of additional, like, new failure

mechanisms. I'll actually talk about an example of that later or try and do that.

And so most of these benefits, you know, the rest of PRA, they're not necessarily unique to PRA. Some of it is just having a systematic process.

Next slide. So there's some challenges to realizing these benefits. The previous dry cask PRAs that have been done, they have limitations in data, scope, what types of casks were considered. So you really need to be mindful of these limitations when attempting to use this risk information. You need to make sure that the insights from those studies really apply to the situation that you're looking at.

And kind of one example of that is, you know, when you look at the reactor context, there are some components that are just so plentiful in so many reactors that were running for so long that you really just have data. You almost need to model some of these things. Some of these things, like, you know, pumps and valves, we simply just collect data.

So then even some things that would be uncertainties, even some unknown unknowns, just get revealed in the data. And I'm kind of thinking like corrosion and some aging mechanisms where maybe you

didn't know that was a failure mechanism but it just happened over and over so you just have data on it at least to some degree.

Whereas that's less true for casks. There are just fewer casks. They haven't been around for as long. You load each of them once. So there is definitely some areas, and it's not completely unique. But there are some areas where you just don't have the same level of data, and you need to be a little more careful with some of your unknowns and uncertainties.

There are some, you know, areas where you don't have as much failure data or as much analytical data. One example is the behavior of fuel or accident conditions in some of these very low probability events. There's just not great data in some of those areas and that can be a challenge.

And when data is lacking, PRAs tend to use generic analyses or conservative analyses. And that can kind of skew your results, particularly if you have inconsistent conservatisms. So you got to be careful with that, particularly when you're ranking the -- looking for relative ranking of risks compared to each other. You've got to be careful if

one risk is kind of high, but it's not considerably compared to another one.

Also a lot of these calculations are -- you know, some of them are not necessarily done probabilistically all the way through. So you need to be -- particularly with the conservative assumptions, you need to be careful of, kind of, clip it to the facts in your success criteria calculations where, you know, if you're just over the line or just under the line, it makes a huge difference. If the cask is not breached, you know, the risk is extremely low or zero where if it is breached, it's at least fractionally much higher than that.

So you need to be careful of those sorts of things and really make sure that your assumptions are robust for the situations you're looking at.

So the work protection, this is more of a caution than a challenge really. It's just that, you know, worker risk is not usually included in PRAs. It's usually just out of scope. And we have to be a little careful about that with casks because the consequences tend to be a lot lower than we're used to for reactors. But there are some cases where, like, for drop events, the release might happen very

quickly. And there is often for some of these processes a lot of workers almost right next to the cask.

So there could be cases where, you know, you calculate the risk offsite, and it can be extremely low but that doesn't mean that there's not perhaps a significant risk to the workers. So as we do these things, you know, we need to be careful that we're continuing to protect the workers in the process.

And I don't have a list on here, but, of course, challenges cost. It's not free to risk inform. You've got to develop the risk information, the processes, et cetera, that just takes -- it takes time. It takes effort. And in some cases it's going to be worth that time and effort and in some cases it's not. And, of course, there's not as much money flying around for dry casks as there is for, like, reactors. So, you know, it's not always going to be feasible to spend tens of millions of dollars doing analysis unless there's really going to be the benefit there.

Next slide. Okay. I'm going to talk a little bit about some current research. The first

one is this Level 3 PRA project. This is a pretty big project. It's a full-scope comprehensive site Level 3 PRA.

You know, it's perhaps unfortunate naming because it's a Level 3 PRA, but what we really mean is it's all PRA levels, Levels 1, 2 and 3, which is to say it considers all the way from initiating events through fuel damage through offsite release to offsite consequences.

And it also includes all major radiological sources at the site. So a lot of previous PRAs are just initiating events for the reactor at power. This includes low power shutdown. It includes spent fuel pool. And it includes dry casks being stored, loaded and stored at the reactor. So it's a significantly increased scope compared to a lot of previous PRAs.

So this work is directed by the Commission, and it's around SECY-11-0089 back in 2011 so we've been working on this for over 10 years now, especially considering the pre-work we did before that. And we have a number of objectives for this projects.

We want to reflect some technical

advances that have occurred since we published NUREG-1150, which was I think all the way back in 1990. We've gotten new scope considerations for the emissions, the pools in dry cask storage, and we want to get new updated insights out of it.

A lot has changed in the industry in the last 30 years. And we want to see how that hashes out in a probabilistic risk analysis. And to see, you know, with these new scope considerations, see how the risks compare to each other to a degree, you know, how reactors at power compared to low compared to spent fuels in dry cask.

Another goal is just to maintain and enhance the PRA capability of the staff at the NRC and to a lesser extent that the various last contractors that are helping us with it.

Next slide. All right. So, all right, for the dry cask portion of the Level 3 PRA model, you know, we started with the methods in NUREG-1864, the previous dry cask pilot, pilot dry cask PRA. And we updated the models here that we thought would benefit from improvements.

One example is we wanted to look at detailed event identification, particularly given

that there's less of a knowledge base for dry cask PRAs. We really wanted to make sure that we're capturing everything to look at it in the first place.

So we did a hazard and operability analysis, a HAZOP, to really try to do a thorough job of identifying emission events and dispositioning them in some way, even if it's to be screened.

We did an initial analysis for some sequences, particularly risk-significant scenarios. We screened some others. So we just want to refine that in some areas.

We did some additional structural analysis because that was an area that was thought to be pretty high risk. Well one of the higher risks in NUREG-1864. I won't say high risk. So we really drilled on that event, did some additional structural analysis there.

We enhanced and re-evaluated the concepts model. That's previously been identified several times as a pretty major source of uncertainty for dry casks, and it's of course informed. At least in principle, there's a lot of material that is actually in the cask. So you really want to know how much of that you might be able to get out. So that's

something we really drilled into a lot more than we had in some previous analyses.

So the results were -- we found general consistency with some previous dry cask PRAs. It is a somewhat different mix of the contributions to that risk. We, you know, expect this to give insight on what information we have and what additional information we can benefit from.

And, again, as I mentioned in the benefits of risk-informed dry cask is having the model and the updated analyses really gives us the basis for doing additional analysis sensitivities considering new events, having a model to kind of plug those into.

And the status is we pretty much finished the technical work. There's a few things that we are, you know, responding to comments and things, but we're largely done. So the report is being reviewed, and we're hoping to release a draft publicly later this year.

Next slide. The next big thing that we're doing, which I guess isn't purely a research effort, but it's developing the risk tool and job aid. Really, the goal of this is to use risk

information to focus lessons and reviews on the areas that are going to have a higher risk significance rather than the areas that might have some lower risk significance.

So we worked with a contractor, Idaho National Laboratories. They developed the actual risk tool report, which is publicly available in our agency-wide document management system under the Accession Number I've given here.

And it consists of two pieces. There's a tree diagram, which gives a preliminary explanation of the risks. It's organized by component and is color coded. I'll show a picture of it on the next slide. And then the rationale document, that's, you know, why it was given that risk significance.

And this information is pulled from, you know, previous risk studies, safety margin investigations, some safety evaluation reports and input from NRC technical reviewers.

So the status of this is -- oh and additionally there's a job aid that provides instructions for using the risk tool.

We have been doing some pilot applications with this. We're reviewing insights

from those. And we're continuing discussions about how to integrate this into our processes and how to use this information.

Next slide. You know, I understand you're not going to be able to see this really. It's just to give you an idea of what the risk tool report looks like. On the left is the cover page. The top right is the tree diagram. So you can kind of see what the structure looks like. It's organizing things by component and color coding the risk significance. And then on the bottom right is the rationale so there's just text there.

Next slide, last slide. So, yes, the scenario, we're trying to kind of use some of the risk insights and models. We're looking at risk informing the consideration of chloride-induced stress corrosion cracking, CISCC. And there's several aspects of this project. Only some of it is risk informing it.

So we're looking at enhancing the staff's understanding of the technical issues key to successfully managing CISCC.

We want to look at, you know, what parameters are really affecting the growth rates from

CISCC. We want to look at mitigation repair methods. And then there's the risk informing piece. This just recently started. So the first step that we're working on now is reviewing this risk information, what sequences are relevant to CISCC and then we want to evaluate, based on those results, we want to evaluate which risk sequences that exist in current PRAs are relevant to CISCC, which ones CISCC might affect.

And then depending on how that goes, next year we're planning on doing some probabilistic assessment. Not a full PRA, not a full probabilistic risk assessment but just some probabilistic analyses, you know, to see how CISCC might affect these sequences and what the risk looks like.

And the point of all of this is to have some kind of risk base, yes, risk information to inform what the inspection frequencies are. So that's all I have. Thanks.

MR. MCCARTIN: Excellent. Thank you, Brian. I believe we have some polling questions that if we could go to them would be useful. And RIDM is risk-informed decisionmaking in terms of implementing that at the NRC.

Well, I see a strong push for we need to do more. Certainly there isn't anything that has not done enough so it's always good to get perspectives. And I like the strong support for doing more in terms of risk-informed decisionmaking.

Okay. If we could go to the next question. And this is sort of the same question but directed more at the industry. The next question. It seems like that was similar to both the NRC and industry.

Have used risk-informed as far as an official technical process. That's good to see. At least close to 50 percent possibly yes. It's bouncing around.

And then I believe the last polling question at this point. Did the risk-informed decisionmaking process result in a different outcome than you expected?

Okay. And then I think there's one last one possibly? Yes. Sort of an opinion is the nuclear industry safer today? Strong views going for yes.

Well, thank you for participating in those polling questions. Always interesting to see

other views. With that, we'll go to our next presentation, which is Rod McCullum from the Nuclear Energy Institute.

MR. MCCULLUM: Thank you, Tim. I hope everyone can hear me if I can get a thumbs up from one of my other panelists. Okay. Head nods work, too.

And good to see you, again, Tim. I'm out here at the Waste Management Conference in Phoenix, Arizona, where we are having some of the same repository geology discussions that you and I used to have back in the day. And I'm pleased to inform you that geologists are still rock stars.

And I think that also I want to compliment Brian for shedding some light on the risk tool. We think that is important. We think risk informing is important in this area particularly. And so we're looking forward to seeing more visibility on that. It looked like you had some cool screens that you can share and explain your decisionmaking processes there. So that's probably a good use of technology.

I will warn everybody that this entire presentation is a metaphor. So I will welcome your

challenging questions at the end to try to poke holes in the metaphor to work on how things fit within the metaphor.

My presentation is entitled safety focus not risk informing and that's with a purpose because improved safety focus is what you get when you are successfully risk inform, when you risk inform a process.

So, you know, that's why we are doing this. And I will tell you, maybe as an incentive to stick around until the end of my presentation, I will explain why this is important at the end of the presentation.

And I was glad also to hear, Tim, you mentioned experience based being important to risk informing, and Brian, you have talked about the importance of having enough data. I would suggest that in dry cask storage, yes on both accounts. Since 1986, we've accumulated a massive experience base.

In over 36 years, we've loaded 3,600 casks. That's kind of an interesting coincidence in the numbers there. And we've done so. We've been very safe. And we continue to be very safe. And now

that those tasks have been out there a while, we continue to innovate and drive safety improvements in our aging management technologies.

So this area is ripe for risk informing. We have data. We have an experience base. So let's jump into the metaphor if I can have the next slide.

So this is a very crude representation of perhaps an aperture like on a camera. It works differently than a camera. You see the three primary things we do to make sure we're safe here.

One is regulation. And of course, that has to be the circle closest to safety. None of the other circles, neither of the other circles can get inside or on top of regulation because that would mean we would be doing something less than the regulation. So that is the minimum level of protection.

And then the next level is the licensing basis. We must negotiate our licensing basis. And that's what a licensing process is, a negotiation, so that not only is it outside or bigger. It's within the regulation, but it's an outside circle. So maybe the metaphor falls already. But it needs to be more than the regulation. It's both thicker, and it

extends farther out.

And then the third circle is our own licensing controls and procedures. They certainly have to comply with our licensing base and regulations. They can't get on top of those circles either. The space you see in between the circles is what I would call margin. And this is the thing we've -- and Brian and Tim, you alluded to this, we've been working on performance margins.

And trying to -- as you get more data and you're experience base sharpens, you can indeed shrink these margins. The thickness of the outer circles grows as you put more and more things under licensing control.

We've not seen a need to change the regulation. 10 CFR Part 72 and Part 71 work pretty well. NRC reaffirmed recently Part 71 in the transportation readiness assessment. So we've got a really good regulation. It's a performance-based regulation, which is why that circle is not as thick as the other two. But we still have plenty of margin in our licensing bases and in the other things we do.

So, again, as we use our experience base to tighten these circles, to bring them closer

together, to strengthen the outer circle so we're relying less on just the regulation, that's how we become safer. That's how we improve our safety focus. So the lens on the camera -- you're focusing the lens on the camera. You're tightening the aperture.

And so if we can go further into the metaphor now on the next slide, you'll see two things coming up, the guidance and rulemaking. Again, you can bring the regulation in tighter with rulemaking, but we don't suggest doing that in dry storage. We like the regulation we have.

Guidance, both from the NRC and as Brian alluded to, from industry at times, we could also bring the circles closer together. And I'm not moving the circles physically. First of all I don't want to make you dizzy with my poor PowerPoint skills, and second of all, I think this is in the eye of the beholder. I would like you all to be thinking about how you see this space between the circles and what we can do get these circles closer together and improving our safety focus and in strengthening the licensee control circles.

So going on to the next slide. I think

we took a big step with the performance margin tools. We've done pilots. We've done PIRTs, which is are phenomena identification and risk ranking tables. In other words, we figure out between the experts what's important.

So we really have tightened the circles a lot with the performance margin tools. The risk tool is one of the things that came out of the performance margin effort. The goal of the performance margin effort was to understand what's in these margins to tighten these circles, to not have excess margin which causes us to lose our safety focus.

If you're thinking way out to the sides of the rings instead of the red prize in the center, you know, again your safety focus is blurring. The camera is going out of focus. So the performance margin tools, if we use them smartly, we can tighten these circles.

And, again, the thickness, I would ask you to envision the thickness of the licensee controlled circle is expanding as we do this. A big goal of most of the performance margin efforts was to get more information under licensee control, either

on a licensing basis expanding the thickness of that circle, the protectiveness of that circle, or even beyond the licensing basis.

And the NRC's risk tool goes hand-in-hand with that because NRC is now also tailoring its reviews. What information do you need to review based on the risk significance, based on NRC's understanding of the performance margin, which again after 3,600 casks in 36 years, we do have a very -- we have the ability to sharpen the focus. We have the ability. We know what we need to know to tighten the aperture here.

So we look forward to a lot of things on the NRC side continuing to sharpen our focus, continuing to tighten the aperture here so we can be both safer and more efficient. The dry cask story safety record is really impressive. So it gives you an idea.

However, when we were making great progress through the margins effort and sharpening our focus on safety and tightening these circles, we started to see inspection findings and RAIs that still are not safety significant. Hopefully, the risk, tool addresses the non-safety significant RAIs.

And I will here allude to and quite honestly to the short-term operations tornado scenario. We have been working on this -- it's not safety significant. Everyone in NRC and industry agrees it's not safety significant. NRC has repeatedly said there's no need to delay loading.

What the short-term tornado issue is when we load a dry cast, we move from a position that is analyzed for tornado missile impact inside a building typically to another position that is analyzed for tornado missile impacts out on the ISFSI pad.

And as we make that journey with those crawlers and cranes and, you know, putting lids on and all of that, we do pass through for short periods of time in these periods of time configurations where we do not have a tornado missile analysis.

The generic issue for industry here, and this has been consistent with the way our licensing bases were constructed over the last 36 years is that we don't need a tornado missile impact for every single configuration that we go through. That would be a tremendous expenditure of resources, and it wouldn't lead us to do anything different.

But nevertheless, we continue to discuss

this issue. There continues to be a lack of agreement and alignment on what really the licensing bases mean here. We've been at this for five months. I can tell you I have never seen an issue which has taken up in that kind of a time period as many management attention units in both NRC and industry as the short-term operations tornado.

We all agree it's not safety significant. But we can't figure out how to disposition the issue. That is causing us to widen our aperture and blur our focus on safety. So what do we do about that?

Well, enter the very low safety significance issue resolution process. And we're hoping still that we can address the short-term tornado operations issue with that. We can bring our focus back to the red prize in the center. We can tighten the aperture. We can make these things work better together. We can capitalize on the margins we now understand.

And I think, you know, while we're going through some growing pains using the VLSSIR process, if I'm allowed to use an acronym that convoluted, you know, on the tornado issue, this is something we really need to become proficient on in the world of

dry cast storage because, again, you know, I think Brian said it, how you see risk informing light reactors. We've traditionally actually been less risk informed in dry storage, where we've had more detailed licensing bases, more detailed RAIs where those licensing bases are under review than reactors, even though we've had these tremendous safety margins all along and we now understand them better.

So I would really invite my colleagues at NRC to engage in making dry cask storage a real area, a test bed, an area of focus where we use this process and maybe teach the rest of NRC a little bit. Because, you know, this is important in everything we're looking at that our lens be tightly focused on safety, and we may not be diverting our resources with issues that are not important to safety.

So now I come to the conclusion and that will explain why this is important. We are living in a very dangerous world right now. I don't have to tell you that. I actually caught myself on the airplane to Phoenix thinking, well, what happens if there's a nuclear war breaking out while I'm up here and my plan has no place to land? And then I told somebody at the conference that. And they reminded

me, oh, you don't have to worry about that. The electromagnetic pulse will just cause your plane to fall from the sky. So, okay, one less thing to worry about.

But in this more dangerous world, and I will tell you that climate change is just as much an existential threat as Vladimir Putin, but, you know, it's a threat that comes at us slower. And you saw a lot of data about that threat in the last session if you were in on the changing weather session. And kudos to NRC for putting that one together.

So whatever our existential threats are, we have to have energy security to get through them. And that energy security has to be achieved without putting more carbon into the atmosphere.

So out here in Phoenix, we've been talking a lot about the fuel cycle issues in advanced reactors. And I was on a panel yesterday here where we talked about that. And there are a lot of challenges.

You know, fortunately, we've got this experience basically with dry cask storage of fuels that are pretty much the same across the board and very well understood. We've really improved the

materials in and around the casks as much as we can. And I'm sure, Kim, you'll continue to innovate to be more competitive, but, you know, so we've gotten to a good place. But we're going to be challenged in the future in terms of new fuel types, different types of materials we're going to have to use in these systems.

If our aperture is blurry, if we're not tightly focused, if these circles are not close together and if the outer circles are not thick and strong, we're going to struggle. And that's going to have a negative impact on industry's journey towards carbon free energy.

Not only will dry cask storage become difficult when these new fuels come out of the reactors, that's kind of far down the line, but public perception will, you know, well, these guys seem not to be able to focus on safety here. People notice that.

We're having these discussions in public, and I'm kind of breaking the fourth wall here a little bit, but, you know, when we have these discussions in public, and we're not aligned. Again, and these discussions, if none of the things are safety

problems, why we are we even having them?

And then the third reason is, and I think this is the most compelling reason why it is important that we really use dry cask storage as an opportunity to hone our risk-informing muscles is because we have the understanding and the inherent safety of these systems with no moving parts.

We can do more. We can use the VLSSIR process for example more than they can in the reactor sites. We don't need PRAs. We can do it simpler. In short dry cask storage, if we continue to sharpen our safety focus to what I want to call as qualitative risk informing because I don't think, and Brian you said it, do we really want to spend tens of millions of dollars doing dry cask PRA's? I don't think anybody in this session wants to unless there's a real PRA fan in here somewhere. I apologize to you if that's the case.

So, you know, the survival of our planet does rely on carbon free energy and on energy security. And we get that with a whole lot of really cool advanced nuclear technologies.

In order for these technologies to be successful, in order for them to be economically

competitive, first of all we can't have the backend tying us off. And second of all we have to sharpen our focus, tighten our aperture across the industry in every aspect of the reactors and the fuel and the used fuel.

So, guys, we got a great opportunity here. So let's go and let's do this. I look forward to continuing to work with my colleagues in industry and the NRC to drive risk informing through the dry cask storage knowledge base we have. And with that, I'll conclude. And I guess we're taking questions at the end so thank you.

MR. MCCARTIN: Yes. Thank you, Rod, for a lot of interesting concepts and challenges to the NRC. Always appreciated. We do have a few polling questions also at this point if we could bring those up, at least the first one.

Do you think the use of engineering analysis is adequately reflected in PRA models? And of course I would say, you know, this is always -- it probably should be answered in a risk-informed way that you can always add more detail but given the uncertainties, is there enough?

Let's see. We have a lot of good risk

analysts out there. It depends. A lot of it is, the purpose of the analysis is always a key part of is it adequate.

MR. MCCULLUM: Tim, that speaks volumes.

MR. MCCARTIN: Interesting. Could we go to the next question? Do you think risk-informed decisionmaking for dry cask storage systems would benefit if PRA analyses were updated?

And the last polling question at this time. And here it's sort of where do you think the focus should be in terms of benefitting the most for updating? Certainly all of the above and handling and operational accidents are figuring prominently.

That's a good lead in to our next speaker. And Zita Martin will be bringing her years of experience at the Tennessee Valley Authority in her presentation that looks at operational risks and concerns of handling, et cetera. Zita?

MS. MARTIN: Good morning. Next slide, please. So I will set up this presentation with an introduction. I'll walk you through the years with some experiences in Part 72 dry cask storage not used solving issues, not using a risk-informed process.

I'll walk you through some more recent

experiences where risk was taken into account in the solutions, in arriving at the solutions and discuss a little bit of where do we go from here as an industry with risk-informed decisionmaking?

Next slide. So two things my bio tells you. First of all, I'm old. And second of all I've seen the storage side of the industry grow significantly. So with that in mind, while there have been many changes over the span of my career, one thing remained constant. The goal is safety. And as Tim mentioned earlier, reasonable assurance of adequate protection is the goal. Safety is a main priority, has been and always will be, both nuclear safety and industrial safety.

Utilities have to comply, however, with the letter of the law with literal compliance, I'm sure everybody knows that term, not just the intent, which is safety. So utilities are required to comply with the regulations so a durable record is required. And what I mean by that is that we mean some guidance, something to point to it that says if you do this, you're going to meet the regulations and meet the letter of the law.

However, compliance sometimes leads to

increased industrial risk or increased dose as you will see later.

Next slide. So I'm briefly going to go through a couple of issues that came up early on in the industry. Initially, burnup measurements were required in the initial version of an Interim Staff Guidance to confirm reactor records prior to loading fuel in casks.

Burnup is an important parameter for design and loading of casks as it relates to dose and heat loads. However, the industry argued on the basis of risk, burnup measurements added dose, time and cost without a commensurate benefit to the health and safety of the public due to the accuracy of the already existing measurements.

However, and this is where communication comes into play, early in Part 72, NRC personnel had no Part 50 experience, but industry assumed they knew the Part 50 part of the operation and what we did to arrive at those burnup measurements. So we were talking over each other essentially during a lot of the discussions and that is where communication is key, and continued open lines of communication between industry and NRC is key.

So SGA Rev. 3 in 2012 contains the right solution. However, it took many years for the NRC and the industry to agree in 20 years for a durable record, which is I guess encased in NUREG-2215, which wasn't published until mid-2020. So as you can tell it took 20 years to resolve a relatively simple issue because we weren't really looking at the risk.

Next slide. Another issue that came up in the early days was Westinghouse top nozzle stress corrosion issue. The issue was identified in 2001 at a utility. The stress corrosion cracking basically affected the handling of fuel assemblies. The assemblies then required modification for handling.

The discussion on how these modifications -- whether these modifications could be loaded into casks ensued. It took many years and many meetings to come to a determination the process to generate a durable record on what that conclusion was.

It was initiated in 2010. Again, you're seeing a time span here where things take a long time to resolve. The durable record resulted in a -- was the NRC letter issued in 2012 with an official risk, a regulatory issue summary, published in late 2013.

So, again, 13 years to resolve a relatively simple issue.

The benefit of this was NEI resurrected the regulatory issue resolution protocol, or the RIRP process, with a lot of success. This process has been successfully used for several issues since. And it keeps people focused on gaps and solutions to the problem.

Next slide. Another early experience issue was what we call stack-up, the initial questions by the NRC. So, I guess, we fast forward about 10 years and we get to 2010 where the NRC stars asking questions about stack-up and then officially issues a URI, unresolved issue, document in early 2011.

The issue began with questions on the analytical methods used for the unrestrained stack-up configuration during the loading process. It was an issue of compliance.

The initial questions were about analytical methods related -- a different analytical method was used in the 5059 evaluation evaluating the Part 50 part of the plan and the 7248 evaluation evaluating the dry storage side of the process, and

obviously, the same methods should be used in both. So that's where the compliance issue came in.

Almost six years to resolve a compliance issue for basically the process of stack-up, which is the transfer cask being on top of the overpacked to transfer the canister with the fuel down into the concrete overpacked for storage outside on the ISFSI pad.

So as I stated in Slide 3, compliance sometimes leads to increase in industrial risk and increased dose, meeting the letter of the law versus the intent, which the intent is safety.

So until the issue was resolved, loading was performed with physical restraints, which caused industrial safety concerns and increased dose because you had these monstrous restraints that had to be added to make sure that during a seismic event the cask would not tip over when the analysis showed that it would not. But still, because of the compliance issue, we were required to do that if we were loading.

Some loadings were cancelled or delayed, causing additional problems for the utilities from the problem of, you know, managing your pool. And, again, all these things caused increased dose and

time and planning.

What started out as a compliance issue resulted in the NRC prescribing what the analysis should look like, so risk. It was generated in 2015 and describes the seismic analysis details for a stack-up configuration.

This resulted in a benefit in the sense that the risk provided guidance for the industry, but it took too long to resolve. Again, we're looking at a pattern here where it takes, you know, 10, or even longer in some cases, years to resolve an issue that really was not a safety issue but more of a compliance issue.

Next slide. So fast forward another nine or so years and we get to the Performance Margin white paper that we discussed already. The industry initiated this paper as a result of the high burnup fuel demonstration project, which provided, you know, very favorable results.

The high burnup fuel demo loaded an instrument in the cask and measured parameters inside the cask. The results showed large margins. Heat loads were significantly lower than predicted. So as Rod pointed out, we thought we, you know, needed

to take advantage of that margin.

We sent the white paper to the NRC. Some of the recommendations in the white paper were a graded approached. Some of these graded approach or at least one pilot was initiated earlier through the RIRP process and another recommendation was to convene some PIRTs. Those were the phenomena identification and ranking tables, which we had four topics initially identified to address in PIRT.

And what the PIRTs do is they rank the items or the characteristics based on the significance and impact to safety. What that results in is the accuracy of less significant characteristics are less important. Again, it brings risk into the equation.

Next slide. So going into a little more detail into the graded approach, two graded approach pilots were proposed and initiated. As I said earlier, one of them had already been initiated through the RIRP process and that one was to improve the format and contact of the certificate of compliance and the tech specs of the cask systems.

That one basically reformatted and reduced the content or tried to streamline the

certificate in the tech specs. The second pilot, the graded approach pilot, was one that aimed to alternative licensing strategies, again, based on the significance of the change. You make a small change, you add a fuel assembly type or something to that nature and it may not require as big of a review or as detailed of a review as if you, let's say, changed a heat load or increased a heat load of the systems.

So although the initial effort was significant here, since we were developing a new process, I believe this will provide large benefits allowing us to concentrate on important items as Rod has, you know, pointed out.

This allows for the appropriate level of effort for the cask vendors and staff of NRC reviews depending on the significance of the change so efficiency improvements for both the industry and the NRC.

Next slide. The PIRT's four categories were initially identified to perform PIRTs on, thermal, decay heat, fuel performance and gross rupture, which I'll talk on the next slide.

The first meeting of the PIRT teams was in October of 2019. EPRI led the effort and their

reports on these PIRTs were published in mid-2020. Now you can see when we incorporate risk how the time frame has shrunk because we're concentrating and not really worried about the insignificant stuff. We're concentrating on the important things.

And the EPRI reports, the PIRTs identified substantial margins and opportunities for regulatory safety and operational benefits using potential alternative fuel performance metrics.

So the PIRTs identified potential relaxation of specific regulatory limits based on the latest data.

The options for use of margins discussed by the industry was also a result of a PIRT in that it was -- or should I say as a result of the PIRT, we think that there are other options for the use of margins.

The benefit to this is, again, faster NRC reviews, depending on margin to limit and increased operational flexibilities for utilities and the vendors, efficiency improvements for both NRC and vendors due to the focus on risk or the impact to safety. Again, if you look at this effort, a relatively short period of time to come to the correct

conclusions when we focus on risk.

Next slide. So the fourth PIRT looked at gross rupture. The first meeting of the -- the intent was to define gross rupture, to define what fuel needs to be placed into individual cans before loading into casks. You don't want something that is falling apart to be placed into the can because obviously the vendors have to analyze some configuration. So the term gross rupture was developed.

So the expert team determined that some level of fuel failure can be tolerated in canisters without compromising safety. So this led to developing a new metric for defining gross rupture. And as you can see, the new metric was detection of transuranics in the RCS. If you detect transuranics, you have gross rupture and then you have to look for which assembly has the gross rupture.

The old metric or should I say the current metric because I'm not sure that this has been implemented yet, is that the clad defect, it can be no greater than 1 millimeter. So as you can see, it's a vast improvement based on safety.

The PIRT report with recommendations was

issued in December of 2021. So it took us a year to make the significant determination when we just looked at the risk and the safety of what we were doing.

The benefit is that there were significantly fewer assemblies required to be canned basically place it in an individual can before we actually loaded it into the canister. This saves utilities significant time, cost and dose because it's less work over the fuel, less work over the spent fuel pool. Again, pointing out in a relatively short period of time to come to the correct conclusions when we focus on risk.

Next slide. So what should we concentrate on? When issues arise, we need to ask so what? What is the safety concern? The advantage of my career in both wet and dry storage is that I look at this as optimizing the cask loadings to benefit the Part 50 spent fuel storage side of the house operation in criticality, heat loads, et cetera.

So when fuel issues arise and large chunks of your fuel populations are not available to load into canisters, such as the top nozzle stress

corrosion cracking issue, or campaigns are delayed or canceled such as with the stack-up issue, this causes real problems in your plan and in your optimization of what you load. It can cause you to have campaigns that are higher in dose than they should be because you have to load hotter fuel. You know, that's just one example of some of the impacts of these issues.

So the bottom line is that we must focus on items that impact safety. This will ensure that utilities and the NRC attention and resources are not diverted but rather focused on the right things, a quick resolution of significant issues when you focus is on safety.

We have come a long way in my 40 plus years career in the industry and 20 plus years in the dry storage side of the house in how we, and I say we, the NRC and industry, approach issues and come to a resolution.

And this is a good thing. There's good open lines of communication and discussions and honest and open lines of communication and discussion and, again, this is a good thing as long as we make decisions based on risk and the safety impact. So thank you. That's my presentation.

MR. MCCARTIN: Thank you, Zita, for some very interesting thoughts and viewpoints in a historical perspective.

Our final presentation is Kim Manzione, who will give us some perspectives with respect to industry led topical reports. Kim?

MS. MANZIONE: Thank you. And I'm acutely aware of the time here so I'll try and do this efficiently. So you can go to the next slide.

So I'm going to talk a little bit about topical reports and how Holtec has attempted to use them kind of in the Part 72 space. They've been used in operating reactor's Part 50 world before. They have not been used, at least not to any great lengths, in the Part 72 world.

The idea would be that these topical reports would increase the efficiency of our other licensing actions. So often when a vendor such as Holtec submits an amendment to our storage license, it's for a specific site that needs it for a specific loading and has a specific time frame. And so the approach that we're taking in this topical report is to hopefully move some of the risk informing type issues outside of that amendment process that has a

need and has a schedule and allows us to address them fully and then incorporate them into an amendment later.

So I'm going to talk about two different topical reports that we've been working on over the past couple years. So you can go to the next slide.

The first one we submitted was a thermal topical report. So for those of you who are not familiar with spent fuel storage casks, they passively dissipate the heat from stored fuel. The underlying concern is to ensure that temperature limits of the fuel and the materials in the rest of the system remain within limits.

Up until now, the NRC has reviewed these kind of individualized loading patterns, we'll call, them, in each CoC amendment. Holtec has been very involved in plant decommissioning. And as we were supporting some of those plants, we determined that if you looked very specifically at the plant's fuel inventory, you could come up with a loading plan or two for that site specifically that would allow more optimal loading patterns.

And in terms of optimal, it both reduces the time -- the defueling time so you can get fuel

out of the pool quicker as well as even lower dose. If you can correctly load the assemblies into certain locations, you can use some of the self-shielding of older, cooler assemblies to help shield the hotter, newer assemblies.

So you can get an optimization both in terms of dose to the workers, which obviously is a huge benefit as well as speed, which is also good for getting the fuel out of the pool.

We realized very quickly that if we were going to introduce these through license amendments, that would be incredibly burdensome. Each site would have its own optimal pattern. And to start having to do an amendment for each individual site just seemed a little bit overkill for both us and for the NRC and kind of defeats the whole purpose of the Part 72 general license process, which is to have this kind of overarching license that can be implemented at any site.

So you can go to the next slide. So what we came up with was a generic method to establish allowable heat load patterns. So we set out specific acceptance criteria, which are risk informed because they are dealing with specifically the performance of

the fuel, the performance of the system, those acceptance criteria are the underlying criteria that we try and meet. The heat load patterns that we put in the COC were always intended to meet these same acceptance criteria. So it's the same acceptance criteria we've always used but that now is the end goal rather than just meeting a heat load pattern.

But the calculations to show how a site meets those acceptance criteria are left to the licensee probably with the support of the vendor such as Holtec. And so that's what I kind of outlined. This really focuses on the risk, which would be a system component, having a temperature outside what it is rated for, what it is intended to perform to.

So you can go to the next slide. So we submitted the thermal topical report in March. And this was a huge success, quite frankly, because we had a final SER by September of 2021. That is faster than just about any amendment I've ever been a part of in my nearly 10 years at Holtec.

So really credit to the NRC staff for prioritizing this and working with us. It was an approach that was already based on what staff had reviewed in our generic FSARS so it wasn't

necessarily significantly new technical details to review but still all credit to the staff for working with us.

We also utilized something that the staff was calling regulatory audits. And what that allowed us to do was have our technical experts sit with the technical reviewers and talk through questions before RAIs were issued and so that when we went to respond and when we went to provide the technical information, the two sides technical had already talked together and knew exactly kind of what everybody was looking for and what we were able to provide. So I want to really give the staff a lot of credit for that kind of review.

But then I'll go to the next slide and talk about a few of the challenges we've had now with this topical report. So the way Part 72 works is the only way a site can implement something under a general license is if it is an NRC CoC. And so we have to roll this into a CoC amendment, which essentially says please follow the method in the topical report if you'd like to develop your own loading pattern. Simply that is what it says.

The NRC has informed us that they expect

a roughly 22 month review time of this amendment to incorporate a topical report that they have already reviewed and approved. And so I think we have a few concerns on our side just about is that really an efficient use of everyone's time to spend that many months reviewing something that is already technically complete?

And the difficulties we're kind of running into is more of an implementation process. And this kind of aligns with what Zita was saying in terms of some of the issues that take us a very long time are these kind of compliance issues. And we need to find a better way to address those because they aren't safety significant.

And so one of the ones we keep stumbling on is the 7248 and change control provisions. Part 72 has a description already in it of how to do change control. But with the introduction of the topical report, there have been some struggles with NRC staff in trying to figure out are we still allowed to use the change control process that's already outlined in Part 72?

So on our end we're really struggling with, I guess, why this is a new problem to solve

when maybe we thought it was already solved? So I think there's not a lot of -- I think we're struggling with the risk informing on that side in that the technical approach has already been reviewed and approved, but the implementation and the compliance and the change control of it is what is now going to take twice as long as really the technical part.

So then I'll go into the next slide and say we took some of the lessons we learned from the topical report and then also wanted to roll them into the shielding topical report, which kind of has been alluded to earlier in some of the talks.

Again, one of the underlying safety functions of the systems is to provide shielding for the fuel that is stored within. The current CoCs have some very complicated fuel qualification tables. Sometimes it's an equation, sometimes it's a table, but we'll just call them FQTs for convenience. And they establish allowable combinations of burnup, enrichment and cooling time.

You can go to the next slide. But, again, the underlying criteria that we have here is the dose rates. It doesn't particularly matter what the enrichment of a fuel assembly is if the dose that

it's giving off to either the work or the public is extremely minimal, right? It's not the combination that I care about, it's what's the actual risk to a worker or to the public.

And so we developed a topical report that risk informs the process again by focusing on that acceptance criteria. The dose rate is the acceptance criteria. We would subject that acceptance criteria to NRC review and then licensees again would have the ability to do the calculation to determine the combination of fuel that meets those criteria.

So you can got to the next slide. We submitted this in May of this year as a generic for the whole industry. It's not specific to Holtec systems. It's currently under review by NRC. We're hoping the review will be done this year.

The current challenge on this one, and again it kind of goes back to risk informing, is that the RAIs we have gotten and responded to on this ask for a significant level of detail even beyond in some cases what's already in the FSARs and the CoCs that exist today.

And so if we are going to be so overly prescriptive in the methodology and not allowing any

changes, right -- if the underlying concern is the dose rate, we again at Holtec and I think throughout the industry are struggling with some of the limitations imposed by the questions in this topical report.

It doesn't give us any sort of flexibility, and we might as well just have the fuel qualification tables in there if it's going to be so prescriptive that those combinations can't change regardless of what the dose rate is.

So I'll go to the last slide and hopefully I caught us up a little bit on time. Sorry if I'm talking too quickly. So the topical reports, we've certainly seen a benefit in terms of the risk-informed reviews. It has very much allowed us to focus on the underlying safety criteria, the temperature limits, the dose rates, which are the underlying safety criteria for everything that is written in our CoCs and FSARs.

But we haven't yet been able to gain that efficiency in reviews that we were really hoping to gain. Implementing the topical report into the CoC seems to be an extreme difficulty that we were not really expecting. And then these kind of limitations

that have been put on that seem to go against the principal of focusing on the underlying safety criteria, they've really limited the usefulness of these topical reports.

So one of the things that -- I don't expect an answer -- I'm just throwing this out there today, is maybe topical reports isn't the right way to go. Maybe this is something that we should be doing just as part of our CoCs. Maybe rather than doing a thermal topical report, we should have just built into the CoC in the first place. If it's going to be a two year review cycle, maybe I should just build it in there in the first place.

In the CoC, define the actual safety metric that we are trying to hit instead of trying to do these surrogates of fuel qualification tables, of heat load patterns and define that just up front in the CoC.

This is something that we proposed very early on in the thermal topical report discussion. And we sort of got directed, and that's fine, in the way of the topical report. But maybe it's something that we need to revisit as we look at these kind of degraded approaches that are going in the risk

informing. Maybe it is something that we need to look at. Is this kind of focus on the underlying safety criteria something we can just build into the CoC?

So just food for thought as we kind of go forward from someone who has spent a lot of time talking about topical reports in the last couple years. And that's the last thing I had on my slide. So I think that's it for me. Thanks.

MR. MCCARTIN: Thank you very much, Kim, for catching us up to a degree. I apologize for you having to -- you talked very fast, but it was very clear.

I guess we may be able to get to one question. But I would like to point to a phrase that former Chairman Svinicki used a few years back. And she called it the frustratingly ponderous pace of the regulatory process.

She did not mean it as criticism as much as a recognition that things move very slowly and deliberatively. But I will say that's why risk informing is an evolving process. I've heard a lot of good things today. Continued discussion can only benefit that. And I think we all want to be more

efficient.

And with that, I know we don't have much time, but could we bring up a question or two? And I'm not -- at least, I have not -- I can't see any comments. Oh, here's one.

Will the NRC update dry cask storage transportation PRA studies using updated MELCOR modeling to estimate canister to environmental release fractions? Will these updated studies consider aging degradation as a new failure mechanism? I'll say probably. Brian, if you could take that comment about updating using MELCOR?

MR. WAGNER: Yes, I was afraid you were going to say that. The answer is I don't know. I mean, I know we're always updating MELCOR modeling in general. I'm not super involved in the transportation PRAs.

You know, we just did one in 2014. So I'm not sure if we have another one in the pipeline yet. So, yes, I mean, obviously the canister environmental release fractions are an important aspect. And we want to get the best estimate of those that we can given the data that's available. Unfortunately, that's all I've got on that.

MR. MCCARTIN: Thank you, Brian, yes. And certainly in that comment, that estimating the release of material from a canister is a very important aspect and the studies to date have carried with it a number of assumptions. And so it is important to the extent we can update things. Rod, you have your hand raised.

MR. MCCULLUM: Yes, Tim. And I don't want to comment on MELCOR, but I do want to go back to your quote of Chairman Svinicki. She was dedicated throughout her term to making the process less ponderous. Yes, we must recognize it's ponderous for a reason, but we also must recognize for nuclear energy to be a competitive way to decarbonize and stabilize our planet that we have to become less ponderous.

And I just want to use that as an opportunity to reiterate that dry cask storage is an excellent place to flex our muscles, to strengthen our muscles in this regard.

MR. MCCARTIN: I appreciate that. We have another question that we may have a little bit of time -- well, no, we do not. I don't know if we can continue. Can we go a little bit over? I don't

know if that's possible. Okay.

There was a question about how do members of the panel see risk insights being applied to the transportation of spent nuclear fuel and high level waste? And I'll go with -- let's just go around the table. I'll go first.

I think it's always useful to look at the risks associated with transportation. There have been some recent risk studies. They also estimate the amount of release from a severe accident is one of the more dominant assumptions and parameters, but it is certainly similar to dry cask storage. Transportation casks have been shown to be very reliable and robust. And it takes a very significant accident to cause any release. I'll turn to Brian.

MR. WAGNER: Yes. I don't have much to add other than that's something that we thought out a little bit and might look into doing, perhaps in a similar vein of the risk tool because.

Because yes, I think some of the same principles apply that we see, you know, kind of we've seen that there may be some margin there.

We've got to be, of course, careful. But there might be some places where we can take advantage

of some of that margin.

MR. MCCULLUM: Yes, Tim, I can weigh in on that, and I think it goes back to what you said at the beginning about the experience base. We have 1,300 shipments of used fuel conducted in the United States. I believe most of those are regulated or many of those are regulated by NRC.

And if we start shipping to interim storage or repository, which I believe we should and the former sooner rather than later, you know, that experience base is going to grow. And I think it's going to give us -- you know, as that experience base grows, we're going to have more well-defined answers to what you said, Tim, which is that you're not going to have a significant release.

I think that being able to demonstrate that and act on that is important because transportation, a large scale transportation campaign makes railroads nervous. They're not nervous because they think they're dangerous. They know that much other cargo is way more dangerous than spent fuel.

But they're nervous because, you know, they're thinking, well, these dedicated trains they might mess up our efficient commerce. And if our

regulatory framework for transportation is efficient, I think we're actually reducing the possibilities for, you know, delays and concerns to choke commerce.

So I think it's important to our nation to help commerce that we do learn from the experience base when we start a large scale shipping campaign.

MR. MCCARTIN: Thank you, Rod. And if I could, let's go to one more question, and then I think it would be appropriate to wrap up. I apologize to not getting to all the comments. But this one, are there general findings being seen for long-term storage of spent fuel at decommissioned reactor sites and might these change? And what efforts are focused on revisiting these conclusions?

And certainly long-term storage is a fact of the current situation in the U.S. Aging management programs are in place that continue to look at information to support that the safety relevant structure system and components continue to function as they're intended.

And so I'm not aware of any information to date coming out of aging management programs that would suggest any of the conclusions from dry cask storage have changed. However, I'm happy to hear any

of the other panel members to provide perspectives on that.

MR. MCCULLUM: I think aging management is the key. And I'll point out that every 40 years, and hopefully we're not extending licenses for multiple periods of 40 years at least at the decommissioned sites. We might do that at an interim site.

But, you know, we will have to look at our aging management programs, which are quite sophisticated. And thanks to Kim and her colleagues in the industry, we have the ability to continue to extend our assurance of safety if we need be through aging management, the technologies we brought to bear already. And I'm thinking decades down the road, those technologies will be even more sophisticated.

MR. MCCARTIN: Yes. Agreed, Rod. I mean, that's part of -- when I speak of risk informing, it continues to evolve both what kinds of programs we have and what information, what it's telling us. Aging management programs 20 years ago weren't there. No one was doing it.

Today they are with just that goal of we want to continue to ensure that safety is maintained.

And, you know, I can't predict the future clearly. But I think it is appropriate that the information continues to be collected. We continue to analyze it to better understand what, if any, issues might arise in the future.

MR. WAGNER: And I would just point out that, yes, we do have aging management programs. And as I mentioned for the CISCC, there is at least one example of where we're looking at how that would affect our failure results and what our failure results tell us about those corrosion issues.

MR. MCCARTIN: And with that, I would just like to end the session today. I very much appreciate the views from all of our panel members, comments, the polling questions and emphasize again that risk informing evolves.

And I think I know at NRC I think we all come to work. We can do better and be it more efficient, be in a different focus, whatever. And that's that evolving nature of risk informing. We need to continue to challenge ourselves to be a better regulator.

And with that, I would like to ask if any of the panel members want to say any concluding

remarks themselves, just raise your hand. Okay. My panel members are comfortable with that possibly as a concluding remark.

I really appreciate everyone's attendance at this. And I very much appreciate once again the views that at least cause us at NRC to think harder and think about everything we do. Thank you very much.

MR. MCCULLUM: Thank you, Tim.

(Whereupon, the above-entitled matter went off the record at 11:38 a.m.)