Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title:	Advisory Committee on Reactor Safeguards 711th Full Committee Meeting
Docket Number:	(n/a)
Location:	teleconference
Date:	Wednesday, December 6, 2023

Work Order No.: NRC-2654 Pages 1-175

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1716 14th Street, N.W.
Washington, D.C. 20009
(202) 234-4433

DISCLAIMER

UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

711TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

OPEN SESSION

+ + + + +

WEDNESDAY

DECEMBER 6, 2023

+ + + + +

The Advisory Committee met via hybrid In-Person and Video-Teleconference, at 8:30 a.m. EST, Joy L. Rempe, Chairman, presiding.

COMMITTEE MEMBERS:

JOY L. REMPE, Chairman

WALTER L. KIRCHNER, Vice Chairman

DAVID A. PETTI, Member-at-Large*

RONALD BALLINGER, Member*

CHARLES H. BROWN, JR., Member

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member*

GREGORY H. HANLON, Member

JOSE MARCH-LEUBA, Member
ROBERT P. MARTIN, Member*
THOMAS E. ROBERTS, Member
MATTHEW W. SUNSERI, Member*

ACRS CONSULTANT:
DENNIS BLEY
STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:
DEREK WIDMAYER

ALSO PRESENT:
HAROLD ADKINS, PNNL
GARILL COLES, PNNL
AMY CUBBAGE, NRR*
ROBERT ELLIOTT, NRR
ANDERS GILBERTSON, NRR
SHANA HELTON, NMSS
STEVEN LYNCH, NRR
STEVE MAHERAS, PNNL
JONATHAN MARCANO, NMSS
TIM McCARTIN, NMSS
WILLIAM RECKLEY, NRR*
JOSEPH SEBROSKY, NRR

JESSE SEYMOUR, NRR*

JEFF WAKSMAN, DoD

BERNIE WHITE, NMSS

* present via video-teleconference

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

(8:30 a.m.)

CHAIR REMPE: So good morning. This meeting will now come to order. This is the first day of the 711th meeting of the Advisory Committee on Reactor Safeguards.

I'm Joy Rempe, Chairman of the ACRS. Other members in attendance are Ron Ballinger and Vicki Bier. Charles Brown will be here shortly. He appears to be held up in traffic.

Vesna Dimitrijevic, Greg Halnon, Walt Kirchner, Jose March-Leuba, Bob Martin, Dave Petti, Tom Roberts, and Matt Sunseri. We do have a quorum today and the committee is meeting in-person and virtually.

The ACRS was established by the Atomic Energy Act and is governed by the Federal Advisory Committee Act. The ACRS section of the USNRC public website provides information about the history of this committee and documents such as our charter, bylaws, federal register notices for meetings, letter reports, and transcripts of all full and subcommittee open meetings, including all slides presented at such meetings.

The Committee provides its advice on

safety matters to the Commission throughout its publicly available letter reports. The federal register notice announcing this meeting was published on November 13th, 2023.

This announcement provided a meeting agenda as well as instructions for interested parties to submit written documents and request opportunities to address the Committee. The designated federal officer for today's meeting is Mr. Derek Widmayer.

The communications channel has been opened to allow members of the public to monitor the open portions of the meeting. The ACRS does invite members of the public to use the MS Teams link to view slides and other discussion materials during these open sessions.

The MS Teams link information was placed in the federal register notice and agenda on the ACRS public website. We have not received any written comments or requests to make oral statements from members of the public regarding today's sessions.

However, periodically the meeting will be open to accept comments from participants listening to our meetings. Written comments may be forwarded to Mr. Derek Widmayer, today's federal -- today's designated federal officer.

During today's meeting, the committee will consider the following topics: Technology Inclusive Content of Application Project, Advanced Reactor Content of Application Project, TICAP/ARCAP guidance, and transportation framework for microreactors. A transcript of open portions of the meeting is being kept, and it's requested the speakers identify themselves and speak with sufficient clarity and volume so they can be readily heard.

Additionally, participants should mute themselves when not speaking. Do any of my colleagues have any comments? Oh, somebody does.

VICE CHAIR KIRCHNER: Yes, Madam Chair. We would be remiss to not recognize an important transition, and so on behalf of the Committee I would just like to note that as Dr. Rempe completes her second term as Chair of the Committee, we want to all acknowledge your dedication and efforts for the Committee and service, and a very distinguished career to go along with it.

So on behalf of the Committee, thank you. And I also would be remiss if I didn't remind you that you're still chair until midnight, 12:31.

CHAIR REMPE: To sign those last letters.

VICE CHAIR KIRCHNER: Thank you for your

service.

CHAIR REMPE: Thank you, Vice Chair. It's been an honor to serve. If there aren't any other comments, then, I'd like to ask Dave Petti to lead us through our first topic of today's meeting. Dave?

MEMBER PETTI: Hey. Good morning, everyone. Before we get into the details, is anybody -- Joe, anybody from, you know, management want to make a statement?

MR. LYNCH: Yes. This is Steven Lynch, the chief of the advanced reactor policy branch. Thank you all for meeting with us today. The NRC staff is dedicated to the development of guidance to support the effective licensing of non-light water reactors.

Today we are going to share with the members our work related to the preparation of the Technology-Inclusive Content of Application Project, or TICAP, and Advanced Reactor Content of Application Project, or ARCAP guidance.

The purpose of these guidance documents is to provide technology-inclusive, risk-informed, and performance-based application guidance for non-light water reactor application, with an emphasis on portions of the safety analysis report derived using the Licensing Modernization Project, or LMP process to identify licensing basis events, classify and establish performance criteria for structures, systems, and components, and evaluate defense in-depth.

These documents represent the culmination of years of work supported by NRC staff experts in licensing, policy, and technical disciplines, and have benefitted from feedback provided by the ACRS and various subcommittee meetings, and formal comments provided by stakeholders.

We look forward to engaging with the members on these important documents today. I will now turn the presentation over to our staff, leading off with our primary lead for this effort, Joe Sebrosky.

MR. SEBROSKY: Good morning. My name's Joe SEBROSKY. I'm a senior project manager in the Advanced Reactor Policy Branch, and as Steve noted on slide 2, as Steve noted, the purpose of this meeting is to provide a high-level overview of TICAP, specifically Regulatory Guide 1.253 and the nine ARCAP interim staff guidance documents.

So as far as the agenda goes, we'll provide a high-level overview of the ARCAP and TICAP structure, a discussion of the Licensing Modernization Project, providing additional background on LMP based on questions that were raised during the subcommittee meetings on this topic.

And then we'll get into a discussion of Regulatory Guide 1.253, and then just a high-level overview of the nine ARCAP ISGs.

VICE CHAIR KIRCHNER: Could you move your microphone closer to the --

MR. SEBROSKY: Is it any better? On Slide 3, what I'm showing -- it's kind of a busy slide, but this is a listing of the 10 documents that we're going to be discussing today, and if you look at the bottom, you'll see draft reg guide 1404, rev 0, and you'll also see draft reg guide 1404 rev 1.

What we did is we went out with two separate comment periods for draft -- reg guide 1404, which is the basis for reg guide 1.253. Rev 1 was issued to provide additional guidance related to probabilistic risk assessment at the construction permit stage, and my colleague Anders Gilbertson is going to be discussing what was in revision 1 in that area.

And if you look at the bullets up at the top, we issued nine draft ISGs in rev 0 of the reg guide -- draft reg guide in May of 2023. And then we issued rev 1 in September of 2023.

All of the documents that are in this table are -- appear on our public web page, and there's a link on this slide to that public web page. If you go to table 2, that web page -- you'll find a link to all of these documents.

You also see you have succession number links for these documents, and then the regulations.gov doc it IDs. All the way over on the right column, you'll see the number of comments that we received on the various documents, and it's -- I like to point out that the most comments that we received are on the draft regulatory guide.

We received 73 comments on rev 0 and then 30 comments on rev 1. The second document that received the most comments were the ARCAP -- was the ARCAP Roadmap ISG. That's to be expected. Those two documents are the two most important documents that we issue for public comment.

On slide 4, the purpose of this slide is just to let the ACRS know and the stakeholders know that we made 20 documents available a month prior to the ACRS subcommittee meeting to support the interactions with the ACRS. And if you open up the link on this page, you're going to find the 20 documents.

There's 10 documents associated with the various guidance documents, and then there's also 10 comment resolution tables. And when you look at the guidance documents themselves, you'll see ID numbers associated with the changes that we made as a result of the comments.

And you can go back to the comment resolution table, and you'll see the comment and the comment response that led to the change in the document. And as I indicated earlier, the ARCAP/TICAP public web page provides links to key meetings and documents associated with the development of these 10 guidance documents.

So the next couple slides, just providing a high-level background on what ARCAP and TICAP is all about. The guidance we're developing, as Steve Lynch, my boss, indicated, are guidances for developing and reviewing technology-inclusive, risk-informed, and performance-based guidance for non-light water reactor applications. It's limited to non-light water reactor applications at this time.

It's also limited to 10 CFR Part 50 and 52 applications. And we prioritize the development of this guidance based on the near-term prospects for non-LWR applicants that tend to use the LMP process. We do intend down the road to revise the guidance to support Part 53 rulemaking language based on the commission decision and direction on Part 53.

On Slide 6 -- so ARCAP is broad in nature. It's intended to cover guidance for non-LWR applications. Here's a listing of the different applications. So you see for Part 50, you have construction permits and operating licenses.

It's intended to support that, and under Part 52 it's intended to support combined licenses, design certifications, standard design approvals, and manufacturing licenses.

You do see an asterisk on standard design approvals and manufacturing licenses. At this time, reg guide 1.253 does not currently address manufacturing licenses and standard design approvals.

If an applicant -- if a manufacturing license or a CA applicant chooses to use the LMP process, they're encouraged to discuss their plans with the NRC during the pre-application phase. The ARCAP ISGs, however, do include standard design approval and manufacturing licenses.

MEMBER HALNON: Hey, Joe, in many places

throughout this, we talk about, if you want to do some -- just something different. We encourage the applicant to talk pre-application, which -- it's a lot more importance in that, obviously, because of the potential impact to the strategy that they're going to try to employ to get an application.

When you say that, are you encouraging it because you say there is a pathway that you already envision that could be done, or that you're just -- bring me a rock and we'll let you know if it's okay?

MR. SEBROWSKY: I think it's the former. We believe there is a pathway, and it's just a matter of -- the encouragement is to prevent surprises.

MEMBER HALNON: Okay. So when we hear that, we -- at least, we are encouraged that there is a pathway and that we're not just saying, you know, let's discuss it because 50-50 chance of getting it. You think they're -- you'll be able to work with the applicant to come through with some reasonable regulatory pathway?

MR. SEBROWSKY: Yeah. In the specific case of manufacturing licenses and standard design approvals, we believe the guidance that is provided in reg guide 1.253 and you've got 2107 when it comes to certs, is generally going to be applicable. I think the committee's been briefed on the manufacturing license SECY paper that's going to be going forward. And there's a lot of options for manufacturing licenses.

So it's -- that was one of the comments we received, was add additional guidance for manufacturing licenses, and it became somewhat burdensome to figure out how you would do that, given some of the things that are being considered in that SECY paper.

MEMBER HANLON: Okay.

CHAIR REMPE: I have a question about SDAs. I recall in recent times, the SDA has been given something that's gone through a certification for designs, and it's kind of, oh, let's do this too since we've got all the material.

Now we're reaching a situation where some folks are going to do SDAs for things that aren't certified design, and can they get away with a lot less material and just say, oh, we're going to leave after the COL? Is there some minimum threshold that they've got to provide?

MR. SEBROWSKY: Yes. So I'll try to answer that question. Bill Reckley, I believe you're on the line, so -- and I believe Amy Cubbage (phonetic) is also on the line, so they can help if I mischaracterize it.

So the difference between and SDA and the design cert at a high level from my perspective is an applicant under a standard design approval is allowed to say, here are the areas for which we're looking for our standard design approval. They can limit the amount of material that they're looking for approval.

You don't have that same option with the design cert. The design cert is based on final FSAR-type level information, and you are allowed things like operational programs that clearly fall outside of a design cert, wouldn't be the responsibility of an applicant.

When you look at the design certification, you see things like COL action items that essentially say, okay. This radiation protection program is something that's outside the scope and is going to be expected to be addressed as part of the COL. So --

CHAIR REMPE: Can they go to extremes and say, well, we only want to do the -- I don't know, the ECCS. We're not going to do, I don't know, a lot of other major aspects of the design. It just seems like -- is there a critical set of material that they've got to cover? Or are you -- some that you don't --

MR. SEBROWSKY: I don't know. I just know that there is --

MS. CUBBAGE: Joe --

MR. SEBROWSKY: You don't --

MS. CUBBAGE: Joe, could I?

MR. SEBROWSKY: Yeah. Go ahead, Amy.

MS. CUBBAGE: Yeah. Hi, Amy Cubbage, NRC staff, just to kind of add to what Joe is saying. So in best practice, all of the -- it used to be called final design approvals, now it's standard design approvals -- were for the full scope as you mentioned, Dr. Rempe. It was kind of in concert with a design cert. It was an extra step. It used to be a mandatory step prior to design certification was to get the final design approval.

But the rules do allow for a standard design approval of a complete design, or major portions thereof. So the idea of what a major portion is somewhat up for discussion.

However, you know, anything that is not resolved would be the responsibility of the COL applicant. And even with the standard design approval, there is -- since there's no rulemaking or hearing, the whole standard design approval would be up for hearing opportunity for the combined license applicant. Did you have any more specific question on that, Dr. Rempe?

CHAIR REMPE: No. You've answered my question. It's a fuzzy area of what a major portion thereof is --

MS. CUBBAGE: Yeah, and --

CHAIR REMPE: That's communicated well to applicants as well as the popular press, and what is coming down the pike. And this is beyond the scope of this meeting. I realize it. But I saw --

MS. CUBBAGE: The one thing I could offer is that for the portions of the design that the SDA applicant is not providing, they would be required to provide interface requirements and conceptual design that would help us to be able to assess the portion of the design that they are seeking staff-level approval of.

CHAIR REMPE: I think it may come up to be a problem in the future, but we'll see.

MS. CUBBAGE: Yeah. In practice, if it's the scenario you suggested, like maybe it's just the ECCS or just some analytical tools, the applicant would probably be better served using the topical report process.

CHAIR REMPE: Thank you. Go ahead.

MR. SEBROWSKY: Thanks, Amy. So continuing on with the slide, the last bullet down at the bottom, the point that we were trying to make is ARCAP encompasses TICAP. TICAP is guidance for off-normal reactor states only. It's based on the licensing modernization project. But ARCAP encompasses both TICAP and everything else that's needed for a license application.

MEMBER BROWN: What's off-normal mean? Maybe I forgot.

MR. SEBROWSKY: So when you look at -- as Steve Lynch mentioned, one of the things that the LMP, the licensing modernization project, does it is identifies the licensing basis events, and the SSC categorization. So by definition, you're looking at design basis and accident-type things which you would not expect.

MEMBER BROWN: That's what you mean by off-normal?

MR. SEBROWSKY: Yes.

MEMBER BROWN: Fundamentally beyond design bases?

MR. SEBROWSKY: No. So there's design basis accident --

MEMBER BROWN: Right.

MR. SEBROWSKY: And we'll be getting to this in a little bit.

MEMBER BROWN: Oh, okay.

MR. SEBROWSKY: Yeah, not a normal --

MEMBER BROWN: Yeah, that's what I'm trying to get --

MR. SEBROWSKY: So, for example, LMP -- we have a chapter 9 on normal effluence. We have an ISG, ARCAP ISG, on Chapter 9 for normal effluence. The LMP process doesn't look at that. What Chapter 9 does is it provides guidance to ensure that we have sufficient information in the application to ensure that normal effluence, you'll meet the end of the line requirements if that's the (8:51:57 phonetic) RR 20.

MEMBER BROWN: Okay, thanks.

MR. SEBROWSKY: So on slide 7, as I just stated, the TICAP scope is governed by the LMP process, and I mentioned a couple times that the LMP process is used just like the licensing basis events, develop SSC, structured systems and component categorizations to ensure defense and depth is considered.

Industry developed the key portions of the TICAP guidance, and you find that in NEI 2107. The second bullet gives you the link for that document, and reg guide 1.253, which was issued as DG 1404, proposed to endorse NEI 2107 revision 1 with clarifications and additions.

There's a sub-bullet here that at this time there's no proposed exceptions in the reg guide. There's only clarifications and additions. The next four slides -- and I'll be looking to Bill Reckley, who's on the team, to go over these slides.

These are new slides from what we presented in the ACRS meeting, and the reason we're providing this background is there were some questions that were asked. How the full scope here is developed, and also a question about how chemical effects are considered, and also the difference between a fundamental safety function and a required safety function.

So the first two slides out of four just give the background on the LMP, some of the key guidance documents, NEI 1804 rev 1. There's a link to that document. Reg guide 1.233, which endorses NEI 1804, and there's a link on this slide to that document. And finally, the last ink is the reg guide 1.247, which is the trial use PRA guidance for non-light water reactors.

On slide 9, it's just a reminder that the

LMP process has been endorsed by both the ACRS and the Commission. Because it's so fundamental, the staff decided to request that the Commission approve this process. So what you see here on this slide is the link to the SECY paper that requested the Commission review the approval process, and then the staff requirements memorandum endorsed it.

Also on this page, you see a reference to an ACRS letter. The ACRS was involved with the development of the LMP throughout the process, including a review of reg guide 1.233.

They were also specifically asked to take a look at the basis that was in the SECY paper, and there's just a quote from the ACRS letter that recommended that the Commission adopt the proposed approach.

So those are the two background slides, and then on this slide, slide 10 and slide 11, I am going to be relying on Bill Reckley to help out on these slides.

So there were two questions that were asked in the subcommittee meeting. What's the difference between a fundamental safety function and a required safety function, which we'll address on slide 11. There was also a question about how are chemical attacks considered for some of the designs, like a high-temperature gas cooled reactor. How is that considered under the fundamental safety functions?

So this first bullet talks about the fundamental safety functions, which are typically sometimes shorthand referred to as control, cool, and contain. Control heat generation. Control heat removal and retain radionuclides.

The asterisk for the fundamental safety functions, you know, it's said even sequences involving chemical attacks such as air and water intrusion in a high-temperature gas cooled reactor are considered one addressing fundamental safety issues. And we'll walk through that in the next slide.

What this slide also shows is, you look to the right and you'll see, this is figure 3.3. It's from a flow chart for NEI 1804, and it discusses how you develop the PRA.

And it's a bit of an eye chart, but the reason that you have a circle there, a dotted circle, is embedded in the development of the full scope PRA on the front end is an expectation that a hazard analysis is done.

And it lists examples in NEI 1804, what

type of hazard analysis is expected to be performed on the front end and iterated throughout the development of the full scope PRA. And the examples that are provided are process hazard analysis, failure modes and effects analysis, and reactor-specific initiating events. Before I go on to slide 11, Bill Reckley, is there anything you wanted to add on slide 10?

MR. RECKLEY: No, I think you did it. Again, the message is that built in to the LMP is your iterating on both the design and the PRA and the analysis. And a key part of that is to do a thorough assessment of what can go wrong, the hazards analysis, and, as Joe mentioned, it points out to use PHAs or process hazards analysis, and vary your modes and effects analysis.

So another reference people can look at during the development of Part 53, the staff developed a DG 1413 that the Committee -- actually, the Committee recommended we develop, and we developed it. And it also has a discussion of basically how to look through and make sure we are identifying and adequately addressing hazards, whether you use the LMP or not. So I --

MEMBER PETTI: This is Dave. I had a sort of a fine point that surprised me. Are the fundamental safety functions only have to be identified in design basis space, or does it have the full licensing basis? So if you felt, for instance, chemical attack was a design basis event only, does that mean it's not a fundamental safety function?

MR. RECKLEY: Well, we'll get into chemical attacks specifically on the next slide.

MEMBER PETTI: Okay.

MR. RECKLEY: Let's do it there, because there's a little flow chart that we can use.

MEMBER PETTI: Okay.

MEMBER MARTIN: Bob Martin. I had a few questions back in the subcommittee on the hazards analysis, and it would be out of character if I just didn't say something to that regard. But one of my points back in, I guess last month, was that the specificity on hazard analysis currently in what you all drafted is still very high-level.

And while I know there's, you know, a camp that would argue that, you know, it provides the greatest amount of freedom, it also provides the greatest amount of subjectivity. And that -- you know, while I'm not going to try to steer the ship in any direction, but down the road I think we're going to need more specificity with how to prepare those analyses so that you have the certainty downstream, which downstream will be in PRAs, in the selection of events, that you have some objectivity to those final results.

Otherwise, we'll find ourselves in debates about, you know, this choice, that choice, and it'll just be never-ending. So just a comment, but --

MR. RECKLEY: Yeah. I would just make an observation. I think we agree with you. However, the guidance that we're doing at this point is -- one of the limitations is it's technology-inclusive, and the more specific you get, the harder it is to stay out of particular technologies or events because the specific hazards or the specific vulnerabilities start to tend to be dependent on the technology.

And so what I would expect is, as we go forward, starting at what you say is a relatively high level here, as we start to address individual technologies, it will be inevitable that we'll get more specific.

MEMBER MARTIN: Just to finish my thought, is the Department of Energy has a methodology that is of the same -- technology-inclusive, and I would certainly encourage you all to look at what they have done there for that process.

MEMBER BIER: This is Vicki Bier. One follow-up to Bob's comment. At a meeting in Wisconsin on Monday, I found myself telling colleagues that the paperwork for getting through the regulatory process seems inversely related to how prescriptive it is.

If you have an extremely prescriptive regulation, you need exactly this kind of gauge or valve or whatever. You can -- you don't -- you have no flexibility in design or operation or whatever, but you can get through the approval process trivially. Somebody comes and looks and says, yes. You have the right thing in place, or you're testing the pump often enough or whatever, and it's a very easy approval.

Whereas if you have a very open-ended regulation, you can need thousands of pages of paper to justify how you're complying or why you should be viewed as complying.

So I understand the issue of not wanting to be too prescriptive, but it creates its own burdens going that route, so just a comment.

MR. SEBROWSKY: So moving on to slide 11, and again, I'll look to Bill Reckley for help on this, so I'll do the introductions. So one of the questions that was asked on the subcommittee meeting was a simple question: what's the different between a fundamental safety function and a required safety function?

So the first two bullets, you see the definition of a fundamental safety function -- safety functions that, as the previous slide noted, control, cool, and contain.

When it comes to required safety functions, this definition of required safety functions comes out of NEI 1804, and there's a reason why we have a frequency consequence curve on this slide in the lower left-hand corner.

So I'll read the definition: a PRA safety -- a required safety function is a PRA safety function that is required to be fulfilled to maintain the consequences of one or more design basis events, or the frequency of one or more high consequence beyond design basis events, inside the frequency consequence target.

So to highlight the definition, what you see in the figure in the lower left-hand corner is a frequency consequence curve. And you see a horizontal line. That horizontal line goes to the definition of design basis events -- the consequence of one or more design basis events inside the frequency consequence curve. So that's one of the aspects of a required safety function.

The vertical line goes to the second part of the definition -- one or more high-consequence beyond design basis events inside the frequency consequence curve. So that's what you see as far as the vertical line that's shown on the slide.

Required safety functions are addressed for required safety functions by safety-related structures, systems, and components and are analyzed as part of the design basis accidents.

MEMBER HANLON: So those arrows are not meant to say that exclusively safety function has to reduce the dose. It's just showing it has to be on that side, left side of the curve.

MR. SEBROWSKY: That's correct.

MEMBER HANLON: Okay.

MR. SEBROWSKY: And then on the right, what we have again, it's a bit of an eye chart and I'll ask Bill to walk through it. But it's an example from a modular high-temperature gas cooled reactor and how the required safety functions for this particular design were developed using the process that's outlined in NEI 1804.

And Bill, I'll turn it over to you to walk through that.

MR. RECKLEY: Okay. And as the previous slide showed -- I mean, I know we can get wrapped around the axle talking about safety functions. But in general, the fundamental safety functions are a place to start when you're doing the design, right, even a conceptual design.

If I'm designing a car, I can start off with the notion that I need to stop the car, right? I have to have the ability to stop the car. I don't need -- I can assume that from the start.

But as Joe said, the required safety functions, they take on a special meaning because we are starting to put in the functional requirements. They are needed in order to limit the consequences for the frequency of particular sets of transients.

Now for the MHGGR, we often use this example of how the required safety functions were generated for the MHGGR, and you can see there's some design choices that are made as you go down through.

But you start on the premise that we need to contain the radionuclides, and then how is that done? You get down to the middle for the MHGGR. The emphasis was to control the transport from the core, and so that goes to the development of the trisofuel (phonetic) concept, to keep -- the best way to do it for that design is to keep the radionuclides within the core itself.

So what is needed to do that? Well, you need to be able to control the reactivity. You need to be able to remove the heat. And for the MHGGR, they laid out separately that because the intrusion of air or steam could affect not -- the graphite, the structure of the core itself, that was identified as a required safety function.

Sometimes that's treated more in terms of an event, the challenges; for example, heat removal, if you don't maintain the geometries. But it's also been a convention just to identify that separately as a required safety function.

And then given that design decision, the other thing we're showing on this slide is that HGGRs in general have proposed, then, that the role of something like a containment structure or the reactor building in this case could be there for defense and depth.

But it's not necessarily going to be identified as a way to fulfill the required safety function and thereby warrant a designation as safety-related.

So that kind of is our attempt to explain the difference. But it's not surprising when you look down at the bottom that two out of the three of those are basically the same as the fundamental safety functions, because the fundamental safety functions have basically been defined based on years of experience.

And like I say, a lot of it's just kind of common sense that if I'm going to make a car, I have to be able to stop it. If I'm going to make a reactor, I need to be able to remove the heat.

CHAIR REMPE: This is Joy, and it's clear my question wasn't very clear at the subcommittee meeting. It wasn't that I needed to understand the differences between the fundamental safety functions and the required safety functions. It was, how will the reader interpret the guidance and what's in the guidance to understand what to do.

I note that 1804 doesn't mention the word "chemical attack." It has the one word chemical, but it's way back on page 95. It's on something not related to the safety functions.

It doesn't mention air ingress. It doesn't mention water ingress. At the beginning of reg guide -- or of -- I guess it was -- jeepers. It was, like, 2107, I believe, they talk about the fact that 1.233 has a different interpretation of fundamental safety functions than what NEI had. But it's fundamentally the same.

And then if you get into the actual 2107, when they go through an example, they have a statement that says the fundamental safety functions of controlling heat generation, controlling heat removal, controlling chemical attack, and retaining radionuclides have been achieved.

As you've mentioned, Bill, as you did in Part 53, I really liked what you did to outline that with stopping a car, that what you want to do as a nuclear regulatory agency is control radiation release. And then you have supporting safety functions that help you accomplish that objective.

And what I was simply saying is, I think the reg guide, the draft guide that you have here, ought to explicitly say, if you want to go this time with what the NEI folks did in 2107 and let the applicants know your expectations that they would have to identify what they believe are the fundamental safety functions for their design.

Because yeah, with the HGGR, folks know to worry about control chemical attack and air ingress and oxidation of graphite. But there's other designs that might have graphite where perhaps they don't worry about combustible gas generation from their graphite.

And I just think the guidance needs to highlight that somewhere, is what I was trying to get to, not to explain to me what it means, but to make sure that the applicants have it in the guide. Okay?

MR. RECKLEY: Okay. I -- yeah. At a high level, I think -- and I understand what you're saying, that there's a problem staying always at the high level. But at the high level, we would argue that should be done on the previous slide when you're doing your process hazards analysis, failure modes and effects analysis, and other evaluations of what can go wrong inside a reactor. But I understand what you're saying.

CHAIR REMPE: Yeah. Just make sure the applicants know what you want them to do --

MR. RECKLEY: Right.

CHAIR REMPE: -- is all I'm trying to say. Include in the documentation.

MR. RECKLEY: All right.

CHAIR REMPE: Thank you.

MEMBER BIER: I have one other minor comment on the frequency consequence curve. It's kind of off-topic for the things we really need to address today, but I'm providing it just because I made the same comment at a different presentation last month, and it's still relevant here.

I realize these curves are pretty commonly used, but I'm not really thrilled with them because, for example, if a particular reactor design went slightly above the curve at one consequence level but was way, way, way below the curve at most other consequence levels, I would view that as being kind of overall favorable, and not ding them for having slightly exceeded the curve.

So I'm just providing that as kind of food for thought, not that I expect any response, but --

MR. RECKLEY: The general response is, this is a tool we help in our decision making. I would agree with you. Hopefully we never come down to it's black and white, and this is the answer, not just, it is a tool that helps us in the decision making.

MEMBER BIER: Perfect, thank you.

MEMBER ROBERTS: Yeah, this is Tom Roberts. Bill, you may have just answered the question I was about to ask, but I look at the bottom right of that curve, and there's a requirement to look at cliff edge effects in the LMP and there's a requirement to address uncertainty -- things like completeness uncertainty in the analysis.

The way the curve is drawn, it implies that five times 10 to the minus seven, you can do basically whatever you want. And the way I read the requirement for a cliff edge assessment and the uncertainties is, that's not the case.

There are other assessments that need to be done to test either the uncertainty or the veracity of -- do you really know that five times 10 to the minus seven?

And if there was a characteristic where you had a right turn like this curve shows, I would think that would be almost the definition of a cliff edge effect if you then need to go consider whether other actions are needed.

I was wondering if you had any observations on that, and --

MR. RECKLEY: Well, just --

MEMBER ROBERTS: -- do I have that right?

MR. RECKLEY: You have it right, and you cite the cautions that we've expressed did not look at five times 10 to the minus seven as a bright line cutoff value, because you do need to look below it to look for uncertainties.

You need to look below it to look for cliff edge kind of effects, and some of this is addressed in the PRA standard as well, that you need to look below it just because you're going to add up all the risks later on for comparison to the cumulative risk measures.

And the events that are below it can contribute to that as well. So just -- yeah, generally, yes. You have it right.

MEMBER ROBERTS: Yeah, I found very little finding a definition for the process or expectations for cliff edge effects determination, and I was wondering if that was something you had thought about adding more guidance to.

There's an FAQ that I think INL put out, one of the guidance documents for LMP that says, well, it's not really a PRA. It's more of a sensitivity analysis based on the design.

And I was wondering if you think there's enough guidance out there, or whether more ought to be provided, or whether it's just a matter of getting experience and then deciding after there's more experience whether there's more guidance needed.

MR. RECKLEY: To my knowledge, we don't have anything under development. So I think at this point we'll see, at least with the applicants that we're dealing with, if that seems to be an issue. But it's a good observation, but we'll take it back as something to think about.

MEMBER ROBERTS: Sure. It's in the regulatory guide 1.242 --

MR. RECKLEY: Right.

MEMBER ROBERTS: -- an EPZ determination. So that's an opportunity, certainly, to gain experience from the next few months.

MR. RECKLEY: Right.

MEMBER ROBERTS: Thank you.

MEMBER BROWN: Bill, this is Charlie Brown. On this slide and the previous slide, I just couldn't resist to jump in to use your car example since that seems to be a favorite example these days.

Obviously, if you've got a car, you said you're going to need brakes. But if you don't know what to do with the brakes, do you know what the car looks like? Is it going to have steering? Are you going to have doors? Are you going to have windows? How much weight does it have to carry? What load does it have to deal with?

So for some reason, we lose sight of the bigger picture by not having an architecture of what we're doing. What we're doing with this kind of boggles my mind to think that I could control core heat generation. A radioactivity control system does that in today's plants.

You have to have a side, independent thing that rapidly shuts it down if your control -- your major control reactivity system doesn't work or you have some excursion you can't imagine, just because some analysis said I'm at 10 to the minus seven or 10 to the minus eight.

For some reason, when I look at these and we discuss it, we lose sight of -- what is the architecture of the plant I look at if these points are valid and the core heat generation and the removal of core heat, chemical attack, et cetera.

But you really need to know what the car looks like before you can start piecing these pieces together. So an example would be if you have -- and you can do it non-prescriptively -- what we've done focusing on even the light water reactors when we get something new in, or the reactor trip and safeguard systems.

We want to see the architecture. What does the system look like? And then you can define -- you can build it with brick. You can build it with pneumatics, mag amps, backing tubes, transistors, integrated circuits, microprocessors, or FPGAs. It doesn't matter if you know what the architecture looks like.

And then you can say if it's independent and redundant and then has some other criteria, some fundamentals, then you know you've got something that you can work with. I've missed that a little bit in focusing on, what does the plant look like?

And yet we focused on -- I don't disagree with these fundamental features, but you need to have an architecture of what the plant looks like in order to assess each one of them. And that's not really covered a whole lot in these discussions, or at least I missed them. It's just a bigger point.

MR. RECKLEY: Yeah. Basically, that's part of the iterative process that we talk about, and the fact that all of these things like remove core heat, if you then go on in the process, you know, the flow chart doesn't stop here. The flow chart actually kind of starts here, that you will determine all the specifics and, as you've referred to it as, the architecture that will be needed.

Obviously, to know how to remove core heat, I need to know how much core heat. Does that amount of core heat compare to my heat removal capability that then that will provide feedback into how quickly, for example, my reactivity control system needs to work?

So all of that -- agree with you, Charlie. It's just that we're at -- we're talking at the 50,000 foot level but you're exactly right. At one point, all of these designs have to get deep down into the grass. Mixing metaphors here, but anyway, Joe, I'll turn it back to you, I think, unless there's more questions on LMP.

This was intended just to be a little background. If we need to, this will keep coming up -- the LMP and as we're trying to work through its first implementation on the advanced reactor demonstration program plants. So, you know, whenever we need to -- whenever the committee thinks it would be useful, we can come back and have similar discussions.

VICE CHAIR KIRCHNER: Just -- this is Walt Kirchner. Just one observation -- I think the crux of the problem, Charlie, and somewhat related to your observation is that when you get to this stage with that definition, how do you classify the SSCs?

I think that's where the -- you know, there's going to be, I think, between the NRC and the applicants, that's where there's going to be the major rub because whether you call it safety-related, or important to safety, or all the old -- we've got the RTNSS or whatever the other definitions were.

It's going to be a question of, what's the quality of that component that helps keep you below the line on the FC targets, and to what quality does it have to be designed, built, and tested, and its pedigree? And I think that's really where this will become a little more problematic in the implementation. It's just an observation. It doesn't require a response.

MEMBER MARTIN: Let me add to that. I will say a lot of the questions related to the ambiguity associated with the actual implementation of, you know, a whole preparation of the safety case.

There is certainly precedent and, you know, associated with past rulemaking where, you know, the NRC or maybe more in the case of, you know, getting support from the research branch of preparing a -- kind of a thorough demonstration sample problem, which conveys a level of expectation maybe beyond anything else that's been done. And I know, maybe that's easy responses.

NEI has, you know, unseeable problems. I would say that's not the same as, you know, when the NRC does that. And it's never too late, say, to initiate an effort like that. But I do think industry would probably appreciate some sample problem that's been initiated by the NRC that maybe clears up some of these questions.

Throwing that out there, but an example I'm giving is -- in my own experience is with the rule change and the ED8, or, you know, 50.46, or best estimate LOCA. They went through extensive exercise demonstrating, you know, what best estimate LOCA would look like through the code scaling applicability and certainty process. Very technical, brought in technical experts from labs and such.

I think it added a lot of credibility and addressed a lot of that ambiguity with such a significant rule change. Again, not a rule change in this case, but it is leading towards major change. And relying on industry to demonstrate is not the same as doing it yourself.

MR. SEBROWSKY: Thank you. So we'll move

on to slide 12. The reason that we went into the background on the licensing modernization project is because it's a key input to NEI 2107 and the TICAP guidance.

What the slide shows now in the red highlight is the portion of the safety analysis report that is derived from NEI 2107 based on the LMP process. So you see we're going to a 12-chapter format for the SAR versus an 18- or 19-chapter format that you see for light water reactors.

And just to point out, when you talk about LMP being -- addressing licensing basis events, you see that in chapter 3, SSC categorization. You see a discussion of how that's developed in chapter 5, and then safety-related SSCs would be expected to be shown in chapter 6, and non-safety related with special treatment in chapter 7.

The plant programs associated with ensuring the reliability and availability of those SSCs that you assumed in the full scope PRA would be in chapter 8.

The next portion of this slide is highlighting the overall expectation for the guidance and what we would expect in an application. And it goes beyond the SAR. But what this shows is you see chapter 9, 10, 11, and 12 coming from specific ARCAP ISGs. You see a highlighted box down below on the chapter 2, which is site information. That is not something that's developed by the LMP process. And over on the right, you see additional portions of the application, including things such as tech specs.

MEMBER HANLON: Joe, did you -- in our subcommittee, we talked a little bit about the notable absence of decommissioning strategies in this. Did you all think about that, and seeing where that could fit?

MR. SEBROWSKY: Yeah. We have thought about it, but we haven't come up with an answer yet.

MEMBER HANLON: Okay. Clearly it's not as critical as the ones you have there, but it certainly is showing up to be quite an expensive and regulatory complex -- I think more than hat we expected. So thanks. I'll be looking forward to seeing where that might fit.

MR. SEBROWSKY: So again, what this slide is showing with the red highlighted boxes is where -- how we address by the ARCAP ISGs the other part of the applications. 9, 10, 11, and 12 have separate ISGs as well as chapter 2.

And then you will see, for the additional portions of the applications, in some cases we developed a separate and distinct ISG. For example, for tech specs in service inspection and service testing, and also for prior protection for operations.

In other cases, the ARCAP roadmap ISG itself points to and develops the guidance for other portions of what we expect in the application.

So slide 13, some of the common changes that we made, the ISGs and the TICAP reg guide is applicable now only for non-light water reactors. We recommend that if a light water reactor applicant wants to use ARCAP and TICAP, since it is technology-inclusive, that they engage in pre-application discussions with the staff.

All ISGs now provide applicant guidance as well as NRC staff review guidance, and we removed references that did not have a complete NRC staff review.

In some cases, if you look at Appendix Delta of the ARCAP roadmap ISG, you will see that we do list ISGs that are in development that could result in a future revision to our ISGs.

One of the things that we stress is the importance of principal design criteria. TICAP guidance covers the principal design criteria associated with the licensing modernization project. That's for off-normal conditions.

If you look at the ARCAP roadmap ISG, it also provides expectations for principal design criteria for normal operations like those associated with a control of normal effluence to ensure that you meet 10 CFR part 20 underlying requirements.

There is a backstop and reg guide 1.232 does provide guidance for developing principal design criteria for non-light water reactors that is available for reviewer and applicant consideration.

The ARCAP -- because of the importance of principal design criteria, it's recommended that during the pre-application phase, the identification of those principal design criteria are discuss with the staff.

So what I'd like to do now is turn it over to my colleague, Anders Gilbertson, to walk through reg guide 1.253. Anders?

MR. GILBERTSON: Okay. Thank you, Joe. Good morning, ACRS committee members. My name is Anders Gilberston. I'm a senior project manager in the policy branch and DANU. And this morning, I'll just be going over a quick overview of the TICAP guidance and the staff's endorsement thereof in reg guide 1.253. Slide 16, please.

So I'll step through some of these points relatively quickly, because it's really just a matter of sort of re-emphasizing some of the things that Joe mentioned earlier.

Just generally overall, you know, the TICAP guidance is a technology-inclusive approach for developing the content of applications. It's based on the LMP methodology like we've talked about.

And really, the guidance is intended to promote more efficient development and review of those LMP-based applications, understanding they're going to look a little different than what we are used to seeing.

Along those lines, the structure of the TICAP-based safety analysis report differs from the traditional structure of an SAR based on the LWR standard review plan. And of course that's again as a matter of accommodating the outcomes that come from implementing the LMP methodology.

And I'm skipping to the last point. We've already kind of talked about the LMP, that TICAP is governed by the LMP methodology. You know, the LMP is not just risk-informed and performance-based, but it's also PRA-led.

So in that regard, you know, one of the points to emphasize here is that the optimal endpoint of the development of the PRA to support implementation of LMP is a logic model, a PRA logic model that addresses all sources, hazards, and all plant operating states.

And it comprises the full spectrum of analyses that start from initiators and go all the way out to consequences. So as we understand looking at our previous discussion about the frequency consequence curve.

However, in this context, you know, the guidance that we developed in reg guide 1.253, appendix Alpha in particular, we recognize that when we're using LMP in the two-step licensing process in Part 50, it's understood that, generally speaking the LMP methodology is going to be implemented to some intermediate stage of completion in doing that.

The information that's provided at the construction permit stage is preliminary in nature. The staff are making different findings at the CP stage. So recognizing that that situation, that we also acknowledge the PRAs supporting the construction permit application, it's very likely going to be something less than this sort of so-called optimal endpoint.

It's not that it couldn't be more mature and more well-developed or nearly complete, but for the most part, understanding the flexibility that's intended to be afforded by the two-step process, that's generally what we expect to see.

So accordingly, it's important for us to understand and establish what the minimum needed is for an acceptable PRA supports the LMP-based construction permit application as a matter of helping the staff determine how they would arrive at their findings under a 10 CFR 5035 alpha and other related construction permit regulations.

And so, of course, this is the subject of the guidance in appendix alpha to reg guide 1.253, and this has direct relationships to the content of a construction permit application. Slide 17, please.

So this graphic is really just to show the general high-level structure of the first eight chapters of the safety analysis report, resulting from using NEI 2107 and also just to provide the overall -- a synopsis of the purpose of reg guide 1.253.

As I mentioned in the last slide, the structure is notably different from the SAR structure dictated by the standard review plan, and I'll talk about that in a little more detail on the next slide.

But again, this structure is really tailored to foster a better understanding of the licensing basis as it's developed through the process of implementing the LMP methodology. We can go to slide 18, please.

Okay. So given the prominent roles of PRA and the LMP methodology, much of the information in chapters 1 through 8 of the SAR dictated -- that are dictated by the TICAP guidance, either directly or indirectly related to or derived from the PRA itself.

So because TICAP dictates this new SAR structure, we developed this visual map which we sort of have affectionately termed this Where's Waldo graphic to help identify where risk and PRA-related information is expected to be found in the first eight chapters.

To be clear, that label is not to say that the PRA information is considered to be obscured or hidden as though you're trying to find Waldo. Rather, it's more to convey that familiarization with this new structure may require some extra attention.

And to that point, for example, the TICAP guidance in the structure, it doesn't include a chapter on severe accidents like you'd find in chapter

19 for an LWR SAR, and that would otherwise be expected to contain much of the information on a PRA.

And instead, that information, as shown in this color-coded diagram, would be located in chapters 1 and 2, and the related results to the PRA and other PRA-derived information would largely be addressed in chapters 3, 4, and 5.

So again, this was assembled and we used this as kind of a tool to help the staff understand where we're going to find this information as a matter of helping us determine what this guidance on PRA acceptability for the construction permit stage would look like. Slide 19, please. Okay.

And continuing along with that theme, this is another diagram that we presented at the subcommittee meeting earlier this year. And again, this diagram really is intended to provide a visual representation of the overall process for implementing the LMP methodology, and the development of the PRA that goes along with it and related engineering analyses as it relates to the two-step licensing process.

I would emphasize that this is a somewhat simplistic diagram. For example, you don't see representations of the iterations that would occur.

So that -- they still are there. They're just not shown here because this was more focused on trying to arrive at what information.

And what we would expect to see in the CP application itself, and then helping -- and using that information to help us backtrack and understand, given our understanding of the PRA acceptability paradigm, that we have -- the staff have described other guidance documents like reg guide 1.247 and 1.200, what that guidance ought to look like. Okay. So slide 20, please.

All right. For just the last couple of slides that I have to present on, I just wanted to focus on a couple of key points -- a few key points of that guidance in appendix alpha. The first point being that, like I mentioned before, it talks about addressing all sources, hazards, and plant operating states.

So the term "address" is taken to mean that these items are identified and dispositioned, as we've shown here, and where dispositioning means that they are accounted for by one of the four sub-bullets.

So either modeled directly in the PRA logic model, screened out of the PRA logic model through some acceptable screening processes, accounted for using the risk-informed supplemental evaluations, or accounted for using the design basis hazard levels for the hazards other than internal events.

And Joe, if you can cue the animation, the next box here, I just want to point out that generally speaking the guidance in NEI 2107 talks about the PRA in a very general sense. And this is really -- this -- just to emphasize that in that context what we're taking that to mean is really the PRA logic model, screening analyses, and the risk-informed supplemental evaluations that would really comprise this sort of more general conceptual notion of the PRA.

And that comes with an understanding that the staff have provided definitions of what a PRA is in reg guide 1.247, which is a little more specific than this. Moving on to the next point, as I mentioned previously, to be minimally acceptable, the PRA logic model supporting the LMP-based CP application should at a minimum represent the internal events and power reactor contributions to risk.

Now that's a relatively limited scope. However, the thinking behind that is that such a PRA would help demonstrate the applicant's ability to develop the essential elements of the PRA logic model that are needed to represent the plant and its response to perturbations, establish the foundation for the PRA that will evolve as the LMP methodology progresses and design information matures.

And also, you know, while the staff -- we've described that -- we're describing what is minimally acceptable for the PRA logic model. From a practical standpoint, achieving only the minimally-acceptable PRA logic model is generally not expected to realize the full benefits afforded by the LMP methodology as a matter of design optimization.

So the staff are charged with providing and developing this guidance to help describe what is needed as a matter of arriving at a regulatory finding. So that's a different thing than realizing the benefits, the full benefits of the LMP methodology.

And so it's just to acknowledge that design -- we understand design information at the CP stage is preliminary in nature. We're not -- staff aren't making a final safety finding like we will at the OL stage.

It's important to note that the effectiveness of implementing LMP at the construction permit stage will necessarily depend on both the maturity of the design and the maturity of the PRA.

MEMBER ROBERTS: Two questions. One's --

MR. GILBERTSON: Yes.

MEMBER ROBERTS: Did you say appendix B on the title of the slide?

MR. GILBERTSON: So -- okay. So in the draft guide, DG 1404, it was designated as appendix bravo. Based on some of the public comments we got, we eliminated what was appendix alpha in the DG, and what was appendix bravo was elevated to appendix --

MEMBER ROBERTS: Oh, okay. Thank you.

MR. GILBERTSON: Yes.

MEMBER ROBERTS: The third sub-bullet there, category using risk-informed supplemental evaluations, would that include the cliff edge effects determination? Because I was looking at the text of appendix B, which I guess is appendix A now, and it specifically refers to NUREG 1855 is what you mean by risk-informed supplemental evaluations. But I would also include the cliff edge effects determinations? Have you all included?

MR. GILBERTSON: Yes. So, it could. It could. I would note that while that is an option for a designer, there are requirements in the non-LWR PRA standard that do specifically address cliff edge effects.

So if an applicant were so inclined to try to meet and adhere to those requirements at the construction permit stage, they may address it through the PRA logic model as well.

MEMBER ROBERTS: As a general comment, going through the whole 21 chapter 7 and the reg guide, I didn't see a whole lot of discussion on cliff edge effects. So I'm not sure where I would find it in your Where's Waldo diagram. Where's it at, Waldo?

It seems like it might be here in that third sub-bullet, but dead even in the text it doesn't talk about cliff edge effects as far as the scope of these risk-informed supplemental evaluations. So, something to think about, whether it needs to be more clear enunciation of what's expected in the application and where it would be for cliff edge effect determinations, given its use in analyses like the emergent planning zone. Thanks.

MR. GILBERTSON: Understood.

MEMBER HANLON: And there's one other question, maybe comment. Given that the CP stage is, as you mentioned, not necessarily a very mature design -- probably more than a concept but less than a -- you know, less than an actual plant design. Do you concede or perceive that potentially when you get to the OL application stage, there would be a significant difference in the licensing basis event selections and/or chapter content?

MR. GILBERTSON: It's -- yes. There -- we generally expect that there will be some differences. I think generally that's going to depend on the amount of -- I guess, the amount of enterprise risk than an applicant is willing to take.

If they're employing conservative assumptions leading up to the construction permit application, understanding that they are -- from that point forward, they're going to start engaging in procurement, actual construction, and they're going to be doing things that are difficult to change, you know, it's possible you could see things that, as they go forward and they realize that some of those conservatisms were not entirely necessary, maybe we start to see things.

There's some class of SSC classifications that could go from safety-related to non-safety related special treatments. And it could go the other way as well. They could make a decision. So yeah, I think that's certainly a possibility, and it's something the staff will certainly be paying attention to.

MEMBER HANLON: So my comment is, if you look at -- if you take economics out of the equation of viability of these plants, and just look at the safety aspect, this works really well.

You add the economics back in. Presently, we're seeing seed money. We're seeing grant money, a lot of things that are pushing a design forward, maybe beyond where a minimal construction permit application might see.

As we get further into it, we're seeing some vendors drop off or seeing some of our applicants drop out. We're seeing some potential customers move away from this because of the economics of it, not anything to do with the safety or anything like that. It's all the economics.

And my comment and perception is that feels like the construction permits, if they do come in, they're going to come in as close to minimally acceptable as possible, if nothing else as a marketing tool to say, I have a -- that you could buy and move forward with.

So I think that's spread between what you see in construction permit and operating wise this is going to continue to widen with construction permit going more towards the minimal now. So it's just a -- it's a perception at this point, but I think that we need to be ready for some significant difference between a construction permit application and an operating license if we get to that point.

MR. GILBERTSON: Yes. I think that's a good observation, and, you know, that sort of points to the enterprise risk that then really is being taken on by applicants.

And I think having a well-defined process like LMP where you understand what your endpoint needs to be; that at the end of the day when you have completed your PRA, you are also going to subject it to normal processes like a peer review and understanding that we have established, endorsed processes, you know, procedures for that.

So I think that helps, but yeah. How that ends up will remain to be seen.

MEMBER HANLON: One last question on -- I can wait till the -- I'll have a comment at the end on the ISGs, but it's more process-oriented so we'll go on after.

MR. GILBERTSON: Okay.

MEMBER MARTIN: I mean, a follow-up on your comment, Greg, or at least a thought as you were expressing your last comment. In looking at the statement about the LMP-based construction permit application, I keyed on the word "at a minimum" or "as a minimum."

And I agree that what you're focusing on is, you know, the right, you know, right emphasis. But whenever you say something like "at a minimum," it begs the question, is -- where is that line? And even with the focus on internal events, power reactor PRA logic models, you could still stretch that model out, you know, almost indefinitely.

What guardrails would you have, you know, for a review process that comes in with, you know, just rock? Now to lead the witness, I do think that there's a role for deterministic analyses to serve and to define guardrails.

I mean, I think, you know, roles of non-safety equipment can certainly impact the progress of an event, and certainly in the early stage of design, you know, there is a considerable amount of uncertainty with the role of those SSCs that have been otherwise, maybe, deterministically evaluated as non-safety.

Anyway, would you please comment on what are -- first, the guardrails and whether you see the value of other kinds of analyses to kind of tell the full story first?

MR. GILBERTSON: Yeah. So I think the guardrails in this regard, and what we were generally thinking of when we developed this guidance, really those technical elements in the non-LWR PRA standard that are affiliated with the internal events, the fundamental foundational elements of the PRA.

Embedded in that are the deterministic analysis that you absolutely have to have to represent the plant response, plant behavior, which includes your thermohydraulics analyses; influence of operator actions on, you know, how it's expected to be operated; timing of your accident sequences.

And while in many -- you know, for a PRA, those analyses may be rolled up to be representative of certain classes of event sequences as a matter of helping to simplify the problem. And you're not doing a -- for example, a SOARCA-type analyses for every single event sequence or cut set.

Those deterministic analyses do underpin the PRA, and are -- yeah. They're absolutely crucial. So if you don't have that and we can't see that you're representing your plant behavior appropriately, that's a big issue. So I would say those are the sort of guardrails. Okay? Okay. Slide 21, please.

VICE CHAIR KIRCHNER: Anders, just before you go on, I think buried in the previous slide in the major subheading it said -- hazards analysis. Let me just look at your slide. What I'm thinking about is a particular, at the CP stage, consideration of seismic hazards.

Maybe just that -- as you were just saying, maybe that's an example of the deterministic analysis that a first-order cut should be done for, you know, what's the safe shutdown, earthquake or the equivalent, because that's such a dominant factor going into the construction phase. Is that what you were implying or guiding or asking for in that place in the -- sorry for that. The slide --

MR. GILBERTSON: Slide --

VICE CHAIR KIRCHNER: Slide 20, sorry. For hazards other than internal events, does that include for seismic?

MR. GILBERTSON: It -- well, yeah. That could be. That could be one example of it. And I do actually -- on the next slide, that's actually one of the examples that I give about when we talk about the applicants' plan for further developing their PRA.

So yes, at the CP stage, you know, seismic may fall into this category of being accounted for by this category of DBHLs, if you will. And yes, yeah. There -- it's -- at the end of the day, one of the things that we're looking for is understanding how all of these risk contributors have been considered.

Again, do they meet the QHOs -- I'm sorry. Not do they meet the QHOs, have they provided at least a qualitative explanation of how they think the QHOs could be met at the CP stage.

They're not required to meet them at the CP stage, understanding that -- for example, for seismic, if they did something that was akin to a margins analysis where they're just characterizing the margin they have, and there's not -- there are no event sequences, per se, going out and calculating consequences.

We would still expect to see some sort of characterization based on that seismic risk of how that impacts the QHOs, so -- okay? All right. Slide 21, please.

Okay. So just to wrap this up, so some of the other key points -- again, at the construction permit stage, the -- a self-assessment of the PRA logic model, the screening analyses, and the risk-informed supplementary evaluations is something that we view as being very important and can help reduce the need for in-depth NRC review.

This is the sort of thing that would allow us to help -- to focus more on key assumptions and sources of uncertainty as we're looking at the PRA. It is possible that such a self-assessment could take the form of a peer review at the construction permit application stage, but it's not required as such.

But it is notable, again, like I mentioned before, we do have established processes that have been endorsed by the NRC staff to that effect. Another thing we wanted to point out is that as you follow the guidance in reg guide 1.253, one of the outcomes would be these preliminary -- a complete set of licensing basis events and SSC classifications that are provided.

And again, the completeness of those items is going to be contingent or related to the amount of preliminary design information, and it should be consistent with that, understanding that there can be varying degrees of maturity in that design information.

And then, of course, the applicant's determination of risk metrics and comparisons with the QHOs like I had previously mentioned.

And then finally, understanding the PRA will continue to evolve. Another important piece is understanding, like I said, the applicant's plan for evolving and continuing to develop their PRA as they construct -- as they iterate on their design and get to the final design information.

So like I mentioned, if they are using a seismic DBHL at the CP stage, understanding how they're going to transition from using a DBHL to a seismic PRA, POL stage, would be an important aspect of evaluating the construction permit application.

And then of course as the -- you know, CP holders are always encouraged to keep NRC staff apprised of changes to their completion plan that would expect to significantly affect the facility, the design.

MEMBER DIMITRIJEVIC: This is Vesna Dimitrijevic. You know, so far I didn't really, you know, feel I have to comment on everything. But here, I did feel, you know, how can you say yet complete? I mean, what does that mean, yet complete? Obviously, it's not going to be complete in this stage. You know, design is preliminary. A lot of hazards wasn't considered. The PRA would be significantly different in the OL stage.

So for that part, the SSC classification would not be complete in that stage. So why did you feel you had to say here, yet complete? You didn't say yet complete for CP stage. Why do you say here yet complete?

MR. GILBERTSON: Yes, so -- right. Thank you. So what that is really referring to is in this idea that the information's provided on the set of LBEs and SSC classifications. That completeness is really dependent on the consistency with the preliminary design information provided at the time of the CP application.

So really, that's what that is intended to mean. We understand it's not -- there may be new LBEs that are identified as they develop detailed PRA models leading up to the OL stage.

So it's -- perhaps it's -- you know, completeness is also a matter of meeting the requirements under 10 CFR 50 34 alpha as it relates to assessing the risk of the facility and of the operation of the facility which, again, implies that you're looking for the full scope of risk contributors to which that facility could be exposed.

Does that help answer the question?

MEMBER DIMITRIJEVIC: Well, no. You know, this is just -- you have discussed in previous slides how not complete that is. I mean, you know, talking just -- you answered power and things like that. So obviously, if -- you know, and you're referring to alpha which is just, you know, the -- you're after this alpha which is just ASME PRA standard which define the scope.

This is not satisfying scope, so it's definitely, you know, minimal expectation is far complete scope. So I just want to say, I don't see why you need to say this here because it's definitely not right. And let me just ask you something by -- we just mentioned this appendix alpha.

You have two tables in the end of appendix alpha, and the first one, A2, and A3. Are you familiar with them? You know, because in A2, it's just defined minimum requirements, the minimum -- the, you know, the high-level requirements expected for PRA to meet in this stage, right? That's your A2 table.

MR. GILBERTSON: Correct.

MEMBER DIMITRIJEVIC: And here I wasn't really sure what does the A3 table present, because it says just additional, you know. The first one is minimally acceptable and the next one is with additional PRA elements. Is that table supposed to define expectation in OL phase or it's just -- I wasn't sure what the function of table A3 in appendix A was.

MR. GILBERTSON: Okay, yeah. Thank you. So the short answer to that is no. It doesn't provide expectations for the OL stage. What table alpha 3 is intended to do is, you know, when the staff went through this exercise of applying the process in the non-LWR PRA standard to determine what supporting requirements would be applicable for the construction permit stage, we were considering a very broad range of potential design maturities.

And what we didn't want to have happen was that an applicant comes in and they end up doing quite a bit more beyond just an internal events model. They try to address other external hazards and such using the PRA standard, and not have those staff positions available to them.

Again, they're not requirements and nothing in those tables are intended to -- either for table A2 or A3 -- are intended to imply that there is necessary compliance. And we've actually -- we've augmented some of the -- there's a short preamble we've added before those tables to that effect. So it's really just a matter of saying, look. The staff went through this process.

We consider a very broad range of design maturities, you know, as a matter of hopefully helping applicants understand where we're at with some of those requirements, should they choose to try and meet them.

MEMBER DIMITRIJEVIC: Well, it's not just design maturity that you tend to put in the first thing. It's a scope, you know. It's not just design maturity. It is the scope of the PRA which is in the -- you know, significantly changed between those two phases, you know. And, you know, in your SAR after the first two chapters, which are really heavy with information, then it comes this next, you know, for the TICAP, the next, you know, six chapters which may all significantly change, you know, when the scope of the PRA change. So, I mean, I sort of, like, don't really have a good idea how this all is going to work, so --

MR. GILBERTSON: Okay. Yeah, I guess as far as scope, I guess I would probably relate the same point that, again, it was -- if an applicant chose to try and meet a broader scope, we wanted to make sure that they had that information available to them of what the staff thought. And determining, you know, in terms of scope, that's in some regards identifying the supporting requirements.

And then, of course, level of detail would be sort of analogous to which of the capability categories. So we're trying to address those four aspects of PRA acceptability: scope, level of detail, PRA technical elements, and plant representation. But I take your point that it's -- how those tables end up being used and met, we'll have to -- we'll see how applicants come in with that.

MEMBER MARCH-LEUBA: This is Jose --

MEMBER DIMITRIJEVIC: Okay. Thanks.

MEMBER MARCH-LEUBA: Let me ask this from a different point of view. We'll think outside the box. I think all the discussion we're having is academic because you're talking the difficulty of the first of a kind reactor, but the only justification for having to spend so much effort, time, and money on these methodologies because we're not having a resurgence in the nuclear industry. And we're going to maybe land from 10 to 20 of a kind.

By the time you're building the second one, CP and OL are going to be 90 percent equal, and then you build the fifth, they're going to be 99.9 percent equal, and you'll be reusing the PRA that you did for -- during number four.

So the first of a kind can be this exception, and certainly the applicant would have to construct a risk. If they change the design too much they will have to do some extra work. But the expectation this will work, the projects, maybe this here we have some problems. So I think the discussion is not -- it's an exception, different kinds of exception.

MR. GILBERTSON: Yes. I would definitely agree with -- yeah. The first of a kind is going to be quite unique as they figure out how to navigate this, as well as the staff --

MEMBER MARCH-LEUBA: Yeah.

MR. GILBERTSON: -- and the lessons learned as they go along in understanding what do they need? What do they not need? What's good enough?

MEMBER MARCH-LEUBA: The methodology we work, the second, third, and fourth -- certainly for the 20th.

MR. GILBERTSON: Yes, yes. That is the intent. Okay. If there are no more questions, I'll turn it back to Joe. Thank you.

MR. SEBROSKY: So the rest of the presentation is overview of the various ARCAP ISGs.

We already talked about the ARCAP roadmap. This slide just provides additional information. Previously I mentioned that, in some cases, the ARCAP roadmap ISG will point to different guidance documents. Like for the first eight chapters, it's pointing to reg guide 1.253 or for technical specifications pointing to the ARCAP ISG on technical specifications.

When you look at the ARCAP roadmap, you'll notice that some of the guidance itself contained, like, for emergency plant security, financial qualifications and insurance and liability. There are four appendices in the ARCAP roadmap ISG. The appendix A is a pre-application guidance. Back in 2021, we had talked to the ACRS at a high level about what would be in appendix A.

Appendix B, the applicability of regulations to non-light water reactors back in previous discussions with the ACRS in 2021, we just referred to a white paper that was under development. We ended up capturing that white paper and putting it in appendix B.

Appendix charlie is construction permit guidance. When you look at that appendix, you're going to see that it lifts much of the interim staff guidance for light water reactors that are applicable for both light and non-light water reactors. It's italicized in that appendix, and then there's non-italicized text that's specific to non-light water reactors.

Appendix delta, as I indicated previously, that's a listing of some of the draft documents that are under development that could affect future revisions to the ISGs. The reason that the listing in the additional portions of the application is shown on the right of this slide is, that is the general format of the ISG.

You'll see the discussion of the first 12 chapters, and then you'll see a section on tech specs and it follows the format. For chapter 2, I previously discussed and it's on the slide. It's outside -- the site information and characterization is outside the scope of the LMP process, so chapter 2 of the ISG provides guidance on the scope and approach for selecting the external hazards which must be considered in the plant design.

The selection of the external hazards is to be informed by probabilistic external hazards analysis once supported by available methods, data, standards, and guides. If that's not available, then additional deterministic analysis is expected to be used.

Chapter 2 does limit the amount of information that needs to be provided in the SAR to that necessary to establish design basis external hazards. Other information we expect would be available by audit in some cases, and supporting things that are on the document.

Chapter 2 does refer to existing site evaluation guidance that you find for light water reactors in various reg guides where appropriate, and it is based on the requirements in 10 CFR Part 100 sub-part B.

Chapter 9 and 10, these again are associated with normal operations. Chapter 9 is for normal effluence, control of routine plant effluence, plant contamination, and solid waste. Chapter 10 is for control of occupational doses.

Previously, when we briefed the subcommittee on Chapter 11, which is organization and human interactions, Jesse Seymour provided these overview slides. Jesse is available via Teams to answer any questions, but I'll be doing a Chapter 11 overview on this slide and the next.

So Chapter 11 covers organization and human systems interactions. Like the other ARCAP chapters, Chapter 11 provides guidance for both applicants and staff. The chapter draws upon the existing NUREG 0800 standard review plan where appropriate. But where it does, it also adapts the guidance to make it technology-inclusive for non-light water reactor use.

A portion of Chapter 11 provides guidance regarding the construction, management, and operating organization in a manner that parallels that of NUREG 0800, but does so at a higher level while still covering a similar scope in areas like staffing, training, and qualifications.

The chapter also incorporates an underlying assumption that advanced non-light water reactor applicants coming in under 50 -- 10 CFR Parts 50 and 52 will need to navigate applicability issues for some regulations, and potential exemptions for others. So this is addressed as relevant within the scope of the guides.

A key example is that of licensed operator staffing, where the exemption process of NUREG 1791 is explicitly called out. Importantly, though, there is no treatment of either remote or autonomous operations within the guidance, and in that sense, Chapter 11 remains geared towards what would be considered to be more traditional concepts of operations.

Additionally, a number of lessons learned from both the OL combined license and new scale design certification review processes are incorporated as well. This includes staff takeaways concerning the cold licensing of operators at plants that are under construction. Finally, guidance is also provided for evaluating the adequacy of human factors, considerations within an application as well as whether HFE-related post-Three Mile Island requirements have been appropriately addressed.

MEMBER HANLON: Joe, that doesn't preclude an applicant coming in and engaging on remote or autonomous operations. It's just, there's no guidance for it. Correct?

MR. SEBROSKY: That's correct. Jesse, did you want to elaborate on that?

MR. SEYMOUR: Yeah, Joe. That's a -- this is Jesse Seymour from the operator licensing and human factors branch. You know, you characterized it correctly, and, you know, just to, you know, reiterate that point, you know, applicants can come in and have those engagements with us and talk about, you know, remote and autonomous, you know, potential considerations.

Our current stance is that, you know, if we do have those types of outreach, we would, you know, use some of the work that we have done shaping our thinking for Part 53 and elsewhere to inform how we would approach those types of discussions and any potential exemption or request that may come down the pike. But again, we're not explicitly speaking to that.

You know, again, this is geared more towards the traditional, you know, locally staffed, right there at the plant concept of operations where the operators are there.

MEMBER HANLON: Thanks, Jesse.

MR. SEBROSKY: So the last bullet on this slide just notes that the guidance that's in this chapter supplements the licensing modernization project guidance and the TICAP guidance. Jesse, is there anything else on Chapter 11 that you wanted to bring to the committee's attention?

MR. SEYMOUR: No, Joe. That covers everything. Thank you.

MR. SEBROSKY: Thanks. So I'll move on to Chapter 12. So Chapter 12 is post-manufacturing construction inspection, testing, and analysis program.

And it's -- the purpose of this ISG is to demonstrate to the extent possible that the safety-related and safety-significant structures, systems, and components were constructed and will operate in accordance with the design and as described in the safety analysis report.

Phase 1 guidance in the ISG is associated with pre-fuel load operation and includes program application content that will support making a finding that the constructed plant has met the requirements that will allow an operating license to be issued under 10 CFR Part 50, or fuel to be loaded under 10 CFR Part 52.

Phase 2 guidance is associated with post-fuel load operations and covers initial startup testing up to and including initial power exception testing. The ISG differentiates between Part 52 applicants that must include inspections, tests, analysis, and acceptance criteria, or ITAC, and 10 CFR Part 50 applications that are not required to include an ITAC.

The requirements that describe pre-operational testing and initial operations are found in 10 CFR 5034 B6 triple I which describes information to be included in the final safety analysis report in

10 CFR 5279 A28 for combined license applicants.

The last two bullets on this slide reiterate that the guidances both for pre-operational testing prior to fuel load and initial startup testing after initial fuel load up to and including initial power testing. That's Chapter 12.

The next three slides cover the ISGs that are outside the traditional SAR structure. This slide is on the ARCAP ISG associated with in-service inspection and in-service testing. The ARCAP in-service inspection and in-service testing interim staff guidance is based on the use of plant-specific probabilistic risk assessment to identify the structures, systems, and components to be included in the programs.

The in-service inspection guidance is based on ASME boiling pressure vessel code section 11 division 2 for developing the in-service inspection program using risk information and an expert panel. And in ASME boiler pressure vessel code section 3 division 5 are designs using high-temperature materials.

The ISG notes that the ASME is developing a code case for flaw evaluation for high-temperature materials, and until the code case is issued and approved by the NRC, an applicant should provide appropriate justification for flaw evaluation acceptance criteria for any components in which the temperature exceeds the temperature limits on the approved ASME.

On slide 30, which discusses the in-service testing portion of the ISG, the in-service testing guidance is based on existing in-service testing program approach with additional guidance for passive components. The ISG notes that ASME is developing the OM 2 code that will provide high-level requirements for in-service testing activities for non-light water reactors.

Like the in-service inspection guidance, the guidance relies on client's specific risk information to determine the scope of the in-service testing program and proposed testing frequencies.

The next slide is the ISG associated with technical specifications. The reason we developed the ISG is the text in 10 CFR 56, regulations for tech specs contents, needs to be adapted to correlate to the analysis and outputs of the risk-informed licensing modernization project approach described in NEI 1804.

The guidance addresses contents -- content for tech spec administrative control sections and provides a recommended tech spec format. This is the last slide for the ISGs, and it's associated with fire protection for operations.

The staff developed the ARCAP ISG for fire protection for operations to provide guidance for non-light water reactors. Fire protection for the design for non-light water reactors is covered by a combination of the ARCAP roadmap ISG and the TICAP guidance.

Although NFPA 805 does not apply to non-light water reactors, the concepts associated with the risk-informed approach are captured in the ISG. The elements in the ISG include management, policy, and program direction and the responsibility of those individuals responsible for the program implementation and the integrated combination of procedures and personnel that will implement the fire protection program activities. So with that slide, that ends the presentation.

MEMBER HANLON: Joe, I had one last question on the tech spec. The way your word was on there made me think of a new question, and today's -- well, by the nature of tech specs, they're deterministic and that's what the operators need to use to determine whether they're in or out of the allowed operating envelopes.

But the industry has developed two, that I know of, risk-informed tech spec approaches with completion times and surveillance intervals. This -- is that reflected? I don't know the answer to it. Is that reflected in those risk-informed methods of applying tech specs? Is that reflected in this new regime?

MR. SEBROSKY: So we don't specifically call out those initiatives in the ISG. And I'll look to Rob Elliot, who's in the room. If I mischaracterize anything, he's the person who helped us with the tech specs.

What it does, it doesn't go into that level of detail. What it does, is when you look at the 5036 criteria and you try to use that criteria on an LMP-based project, it doesn't match. So what you see in the guidance is essentially tables that say, here's the 5036 criteria, and it repeats it. And it'll say in the right-hand column, this is the output from the LMP that you can use to address that portion of tech specs. So it's at a higher level than --

MEMBER HANLON: Okay.

MR. SEBROSKY: -- those initiatives that

you were discussing. And -- Rob, is there anything else?

MR. ELLIOTT: -- my microphone here.

MR. SEBROSKY: So that green --

MR. ELLIOT: Yeah, so as Joe says, it addresses the criteria for establishing what needs to be LCOs, how you would also apply the LMP guidance for safety limits, and going over safety system settings. It encourages use of a similar format and content as the standard tech specs, which means that risk-informed completion times and risk-informed frequency control programs would be available to the licensee to utilize, same as it would for any other programmatic element. And there are other risk-informed improvements that have been made and are continuing to be made, you know, or we're working on today, such as risk-informed improvements to LCO 303.

MEMBER HANLON: Okay. So like my previous comment, it doesn't preclude them coming in and saying, this is how I want to apply tech specs in a risk-informed way, and it provides -- does provide adequate guidance for the staff to not, you know, reject it but to actually take a hard look at it, that maybe it's a good approach.

MR. ELLIOTT: Yeah, it does not.

MEMBER HANLON: Okay.

MR. ELLIOT: Typically with tech specs, though, you're right. The deterministic aspect of it is operability, right?

MEMBER HANLON: Right.

MR. ELLIOTT: And operability is not risk-informed. Operability either -- it can perform a safety function or it cannot. But as far as determining what the content of the tech specs are, that can be risk-informed.

MEMBER HANLON: Okay. I just want to make sure that we weren't ignoring the improvements we've made in the risk-informed approach to the tech specs previously. And I wasn't -- ignoring is a strong word. But, I mean, maybe in round of --

MR. ELLIOTT: Those options are made available to the applicant.

MEMBER HANLON: Okay. Thanks. I appreciate it. Thanks, Rob.

MEMBER PETTI: Could we get that repeated for the court reporter?

MR. ELLIOTT: Rob Elliott of the tech spec branch. Rob Elliott of the tech spec branch. That ends our presentation.

MEMBER PETTI: Okay. Yeah, thank you. At

this point, I'm thinking that we've been at this for two hours, and maybe we ought to take a break and then we can come back and have a discussion among the members and the next steps.

CHAIR REMPE: Dave?

MEMBER PETTI: Yeah? Or do you want to go for public comment, I guess?

CHAIR REMPE: I'd go for public comment first --

MEMBER PETTI: Yeah.

CHAIR REMPE: -- and then I think I need to let the court reporter go. Are you going to present the letter, or do you have in your mind you want to have some discussion before you present the letter?

MEMBER PETTI: No. I mean, I'm ready to present the letter. I'm actually making some changes right now based on some really good comments I heard, some ideas, so --

CHAIR REMPE: Okay. So anyway, let's go ahead and do public comment --

MEMBER DIMITRIJEVIC: The first case, if you guys are not going to have a discussion, I just want to add something in this moment, which was part of discussion during this meeting. And because under something which Jose said, that this was academic, I just want to make sure that we understand how much scope of the PRA is going to change.

Because in the minimalist PRA, we are not going to have a different plant operating state. We are not going to have an internal flood. We are not going to have internal fire. We are not going to have a seismic -- any other hazards, high winds, external flooding.

So all of those things will be added in the later stage, and that will totally change the scope of the PRA and also risk profile. So it's not just about design. Design can stay totally the same as in CP phase. It's the scope of the PRA that will change, and I can explain if anybody has a question, why those things are not likely to be part of the CP because that agreement is not layout, cable send layout, there is no shutdown schedule, things like that.

So it is when the scope totally change, risk profile is totally going to change. And therefore, risk information is going to change. I just wanted to add this for the benefit of the members to keep that in mind.

MEMBER PETTI: Okay. Thank you, Vesna.

Let's do public comment. Anybody wishing to make a comment, please unmute yourself, identify your name and your organization and your comment. I don't see anything. Does anybody in the room see anything?

CHAIR REMPE: No.

MEMBER PETTI: Okay. Then I recommend we take a 15-minute break and move to --

CHAIR REMPE: Before we do that --

MEMBER PETTI: Yeah.

CHAIR REMPE: Before we do that, first of all, I'd like to ask -- tell the court reporter we're done for the time period and to please come back at 1:00 p.m., okay? Thank you. And then I agree with your suggestion, Dave. Let's do -- because you did say you have a couple of changes. Do you think 15 minutes is enough, or you want to --

MEMBER PETTI: Absolutely. Absolutely. No. I can do it in 15.

CHAIR REMPE: Okay. So if I do my math correctly, that means we'll come back at 10 till 11:00 on the east coast. Does that sound right to everybody? Okay. Thank you. We're going to be recessed, then.

(Whereupon, the above-entitled matter went off the record at 10:35 a.m. and resumed at 1:00 p.m.)

CHAIR REMPE: Okay, I have it's 1:00 p.m. on the East Coast and we're back in session. And I'd like to ask Member Ballinger to lead us through the NMSS topic.

MEMBER BALLINGER: Thank you, Madam Chair. I'm violating my own rules. Thank you, Madam Chairman. Today's presentation is a bit of a shrunk version of the same presentation, which we had at a subcommittee meeting. And so we requested that we have this presentation after which we'll have deliberations on whether or not we decide to write a letter as a committee. We have a draft of a draft, which is available. Which if we decide to do so, we'll go into that afterwards. So with that, Shana, are you ready? Do you want to make a few words?

MS. HELTON: Yes, thank you. So thank you for the opportunity to be here today to present before the full committee. As you said, this is going to give the members an update essentially from the November 17th subcommittee that we had on this same topic. And just would like to note a couple things. This is for one, a very high priority project for NMSS. As we continue fulfilling our regulatory role of ensuring that advanced technologies are maybe used safely and securely.

And I want to just extend a thanks to everybody whose at the table for this meeting, including Jeff Waksman from the Strategic Capabilities Office, Harold Adkins, Steve Maheras, and Garill Coles from the Pacific Northwest National Laboratory. Of course, Bernie is at the table and behind me we have Brian Wagner, Tim McCartin, Jonathan Marcano from the NRC all with a great deal of expertise who will contribute to a good discussion today. I'd also like to note that Steve Short and Peter Lowry from PNNL and Virgil Peoples from INL supported the subcommittee meeting and will be in attendance through Teams for this meeting today.

So those are the folks in the room and supporting online. There have been many other staff across the NRC and NMSS, NRR, and NSER who've been involved, as well as staff from the U.S. Department of Transportation. And they all deserve a lot of credit for supporting our evaluation of the risk methodology that you'll hear about today.

So we appreciate the views that ACRS has on this matter. After the subcommittee, we went back and talked through what we heard. And our goal today is to be responsive to some of the views that we heard back on November 17th and answer any questions that the full committee might have. So thanks again for the opportunity. And as you know from Dr. Ballinger, this is shorter than we had on the 17th. I'll stop there and turn it over. Thank you.

MEMBER BALLINGER: Two things, I'm remiss. For the Court Reporter, the person speaking was Shana Helton. And do we need to identify those members that are conflicted?

FEMALE SPEAKER: Yes.

MEMBER BALLINGER: And that would be Bob Martin and --

FEMALE SPEAKER: Dave Petti.

MEMBER BALLINGER: -- Dave Petti. Okay. Dave's -- So those are the two that are conflicted. So what that means is that any deliberations that we do, they can't participate in. So with that, is it Jeff that's going do the -- do the deed?

MR. WAKSMAN: Yes. Again, I just want to thank everyone for coming together today. You know, I do think that this is going to be important. I don't know what my opinion is worth, but I do think that the short-term path forward for advanced reactors is going to be micro-reactors. I think they're more forgiving from a regulatory perspective. And I think their cost is low enough that you can get to an nth of a kind on them and get that learning and be able to -- be able to make this happen. But admittedly, I think a lot of the micro-reactor developers have a hand wavy approach to how they're actually going to move these things in the real world. And that's really what we're here to do is to make it actually rigorous. You know, how do we actually regulate actual micro-reactors in the real world?

So obviously a lot of appreciation for my team at PNNL and that works at PNNL, as well as, you know, the NRC team and Bernie and Shana and everybody else. And so that said, I'm going to evacuate this table for someone smart enough to answer any technical questions and I'll be sitting over there in case anybody needs me.

CHAIR REMPE: Folks online say they can't hear. And both of the -- all the three indicators I have say they should be.

MR. BURKHART: This is Larry Burkhart. Can someone online verify if you can hear us or not?

(simultaneous speaking)

CHAIR REMPE: Sorry for the interruption.

MR. WAKSMAN: Can I get an audio check for my mic?

(simultaneous speaking)

MR. WAKSMAN: So as I was saying, I'll be over in that part of the room. And I'm going to let the folks at the table who can answer the technical questions, take their place here. So thank you and look forward to a good discussion.

MR. BLEY: This is Dennis Bley. May I ask you a quick one? It's not technical. You made a strong statement about the low cost of the micro-reactors and I guess I wouldn't challenge that on a per plant basis. How about on a per megawatt basis? Do you have any basis for saying it's a lower cost option?

MR. WAKSMAN: Well, this is just my opinion and I'm not trying to speak for the industry here. I think everybody would agree that on a per megawatt basis, micro-reactors are going to be more expensive than larger reactors. But the idea is that the capital cost to get to a unit in taxi, get electricity production is what would in raw dollars be less. From my position, you'd hope so. So I don't believe, you know, my position that the federal government is going to go and purchase ten AP-1000s any time soon. But they could purchase ten micro-reactors. That could be budgeted. So that's why I think we could get to nth of a kind and get that learning in the same way that in the space world where I used to work at NASA, you know, space (inaudible) we're building enough rockets that they get the learning that a rocket that launches once every two years will never get. But that's just my opinion with all the standard caveats. I don't speak for the Department of Defense when I make statements like that. Does that answer your question?

MR. BLEY: That's what I expected. Thanks.

MR. ADKINS: This is Harold Adkins. I'd like to thank the ACRS for having us back to discuss the risk-informed licensing methodology. Next slide please. One of the things that we're going to do today is in the interest of time, move very quickly through the front matter because it's merely close to a repeat of what we presented previously. And we want to get to trying to answer the ACRS's questions that they had for us a little more completely than last time.

Again, to provide some background information. The purpose is to propose this risk-informed regulatory approach for the transportation of transportable nuclear power plants in support of an NRC draft safety evaluation. I'm going to give a brief description, but we'll skip through that very quickly -- briskly. And then a description of proposed risk-informed regulatory pathway, overview of proposed risk evaluation guidelines very brief, discussion some quantitative risk assessment process details and the fact that we're leveraging PRA defense in depth and safety margin to return back to an equivalent safety set. And then go through some minor example results. And then we'll get to brief clarification response to questions that the ACRS raised on November 17th.

Next slide please. One of the things that I want to warn you here real quickly, this slide image on the right is merely a cartoon. Okay? And one of the things that we're going to provide a little more detail to is what the conveyance would look like and all the rigor that goes into a standard transport versus what you see as basically a slightly overweight transport that's depicted here.

You know, just to recap, many of the advanced reactor vendors are developing TNPPs to make higher density energy readily available for DoD applications, HADR, and also clean zero carbon energy for a variety of austere and off-grid locations. And the main objective here is these TNPP inventions would be factory produced, fueled, acceptance tested, and deployed as sealed units. And the main thing that we're focusing on is the post-use transport, which would provide the highest radionuclide inventory. And that would largely be held up in the reactor module.

So when I use the acronym TNPP, what we're referring to is the reactor module because that would likely still present the same issue if you were able to transport the whole plant. And the example that we use is Project Pele.

Next slide please. So just to go back through the risks -- the need for risk-informed regulatory approach. Right now, the intent and the understanding is that this risk-informed evaluation approach would only apply to hypothetical accident conditions. There's always the intent to be able to meet the performance requirements that would be associated with the normal conditions of transport. And what I'm referring to is the sequential 30-foot drop, crush, puncture, free drop, 30 minute engulfing fire, things of that nature.

And what we plan on doing is -- and what we're proposing is leveraging compensatory measures, defense-in-depth, and a philosophy to establish equivalent safety back to the state that the codified regulatory requirements would lead us to. And also this only applies to a TRISO-fueled reactor similar to the demonstration item that we identified that we're interested in possibly licensing for transport in the future.

And one last clarification is for the time being as Jeff stated on our previous interaction that there is no intent at this time at all to transport Pele off site from the INL reservation. As we've also discussed, one of the things that we're looking at right now is the best possible pathway is through 10 CFR 71.12, which is an exemption process. And that isn't to take all of the requirements off the table. is to meet largely all the requirements with the exception of maybe one or two that were heavily challenged based on the state of the reactor design and where the codified regulatory requirements apply to thick wall pressure vessels and the gap that is provided by those too until they come together over time when the regulatory requirements possibly change in how they consider TNPPs more in line with how they're defined.

I think it went into the exemption process, what we prefer and then the associated idea that we're conveying here with the exception. There are some other opportunities. We could leverage a special packaging authorization, but that would only give you a one-time shipment. And we're talking about a single time per year shipment -- two shipments total.

Next slide please. So reasoning behind the selection of this regulatory approval pathway is that PRAs have been used and utilized all the way from the 70s for nuclear reactor licensing, WASH-1400 gives quite a bit of detail. Not the 70's, I apologize, it was proposed in the 70s, but has been used since the 2000s to apply risk-informed licensing applications. PRA has also been used to assess dry cast storage and transportation. And one final thing to note is that risks of transportings to the nuclear field at Yucca Mountain repository by truck and rail. What was proposed in that is exactly what we're discussing today and the implications associated with what would happen over that transit duration and things of that nature in the exact some way.

We're proposing this to the NRC to aid in the development in the near term per approval pathway to drive advanced factory-produced TNPP development and deployment. And also to bridge the gap between the framework -- the current regulatory framework that exists around thick wall pressure vessels and current TNPP technology until the codified regulatory requirements if there's a need to change would more so accommodate TNPPs or at least the technology would grow and refine to the extent that it would meet all those codified regulatory requirements. This would also provide some buffer time for strategic regulatory considerations and possible rule making in the future if that's needed.

Next slide. I'd like to hand this over to Garrill Coles, my colleague.

MR. COLES: Thanks, Harold. I'm going to do the next four or five slides on the risk-informed process itself. Really high overview. So we contend -- PNL contends the demonstration of acceptable risks if an exemption process is used as indicated by Harold, will require a quantitative risk assessment given possible complexities and uncertainties about the package performance potential risk to the public. And the fact is this will a first of a kind endeavor. The PRA provides such a rigorous quantitative approach concerning risk evaluation guidelines, assessment using PRA worked best when supported by guidelines about acceptable risk because that provides a key basis for risk-informed decision making. However, regulatory risk evaluation guidelines using PRA do not exist for transportation packages like they do for cited nuclear power plants.

That said, risk-informed decision making guidance is proposed for nuclear material and waste applications in a 2008 NRC report referred to in this presentation as a 2008 RIDM -- risk-informed decision making report. This guidance included proposed quantitative health guidelines developed from the NRC safety policy statement. But this approach has not been endorsed for use by NRC for transportation.

Next slide. However, PNLL proposes surrogate measures for the qualitative health guidelines proposed in the RIDM report. In the same way that core damage frequency and large earlier release fractions are used instead of health effects are risk-informed advocations for the current fleet of nuclear power plants as justified in NRC NUREG 1.200. Specifically PNL proposes formulating goals in terms of pairs of radiological dose and lack and limits to individual receptors.

(audio interference)

MR. COLES: So you know, frequency is a likelihood measure. That's the most direct way in this case. And using the examples where we derive the pairs from, those were all done, including the LMP sample, they used the frequency. This is a common way and that's what's used currently for the current --

MEMBER MARCH-LEUBA: Well, that is applied to us, visionary reactor to a person living in the -- on the boundary, which is leaving them a whole year. Whereas this reactor is moving through my house. And then it spends a minute in front of my house. Think about it because these units don't make sense to me.

MR. COLES: Okay. I'm not sure what the question is.

MEMBER DIMITRIJEVIC: Hi. This is Vesna Dimitrijevic. I just wanted to add something that Jose completely right. You have mixed a little here. It's a different event sequence frequency because that includes both likelihood and frequency. When you say active, then frequency, you know, frequency can be bigger than one because you can have more than two events or three events per the year. So you have to really define what do you mean by this. And I mean having that for transport, then it would be, you know, what is the probability of having accident by transport. What would, you know, correspond to this number by active -- Frequency is not the likelihood. Likelihood is, that will have the units. Frequency, you know, -- Likelihood includes probably to get them with frequency. So you know, as I said, frequency can be bigger than one, you know, because it defines the number of the events. So you have to actually re-define your Y axis.

MR. COLES: So what I heard you say was using frequency, you could have frequencies greater than one. If you look at the current slide, you'll see that these frequencies are quite low. So these are very rare events. The use of the language up here, probabilistic risk assessment that we're talking about. So we don't entertain -- If we thought we could have an event that was close to one, we would -- that's a nonstarter. We would never do a transfer. Right?

(simultaneous speaking)

MEMBER DIMITRIJEVIC: -- after the event is something which, you know, defines event and then probability that you will have a release in this case when you're talking about. So that mix of dustings is the small, but just probability that you will have, you know, traffic accident or something, those numbers -- those are the event numbers. That's what I'm trying to tell you, which means you're going to have an event, which causes the sequence of events. You know, how the package responds to those events. And those probabilities are rather small, you know?

MR. COLES: I'll just repeat, right, that for the current fleet of nuclear power plants, this metric of frequency, core damaged frequency is the primary risk metric that's used in risk-informed applications currently. And in this discipline of probabilistic risk assessment, the use of frequency is the most common metric -- likelihood metric that's used.

MEMBER DIMITRIJEVIC: Yes. Okay, so this is very good. I can explain to you what I'm trying to say on core damage frequency. Core damage frequency is caused by a bunch of events. You know, one of the events could be just regular (indiscernible due to accent) and frequency of (indiscernible due to accent) per the air could be bigger than months for the year. Then the question is how do systems respond? So if you have a (indiscernible due to accent), which of course let's say 1.2 times per year, as long as you have it worked out for PWR and everything else looks fine, probability of systems failing is small. So this is not an event itself. It's event sequence. It's event (indiscernible due to accent) respond to mitigating systems.

MR. COLES: I don't think I have an argument with anything you've said just now.

MEMBER DIMITRIJEVIC: But when you say "accident", what is that? When you say "accident frequency", what do you consider accident?

(simultaneous speaking)

MEMBER DIMITRIJEVIC: -- then like direct fire or how did the package respond to that? What is the accident?

MR. COLES: So to use your explanation, when I said "accident frequency", we meant to refer to the entire scenario, whatever that is. Now unlike nuclear power plants where there's mitigating systems and you know, to provide some measure of protection against an initiating event, road accidents -- there really isn't any mitigating systems. So the initiating event generally determines the likelihood of the entire accident scenario. So when I say "accident frequency", I do mean the entire scenario if that helps.

MEMBER DIMITRIJEVIC: Right. So you can call it "accident sequence frequency", that would be more accurate. But then the Jose points happens. If you're only transporting this once in three years, right, then do you consider this in this initial think tank process response? See, it's not really clear when you say "once per year". And how many units you do per year? It's different than when you have a standard unit. You know? So I had to look in the (indiscernible due to accent) to see how you can define this more precisely when it comes to the units. I mean, you know, is this per transport or based on the number of transports you have per year?

MEMBER BALLINGER: Can I propose a metallurgical get out of jail free card? You're only going to transport it once per year.

MALE SPEAKER: That's right.

MEMBER BALLINGER: So in effect, that scale on the left can be --

MALE SPEAKER: Precisely.

MEMBER BALLINGER: -- per transport if it's only one --

MALE SPEAKER: Precisely.

MEMBER BALLINGER: -- and then a little note on the bottom that says oh, by the way, if you're more than one, does it just scale or am I way out of -- way out of bounds? I need to get Vicki's and Vesna's --

VICE CHAIR KIRCHNER: It depends on the transport route, among other things --

MEMBER BALLINGER: Yeah.

VICE CHAIR KIRCHNER: -- because it's a moving --

MEMBER BALLINGER: Yeah, yeah.

VICE CHAIR KIRCHNER: -- source term. But I think -- I guess the way I was looking at it, Jose told us that this is per accident frequency per transport.

CHAIR REMPE: It's per year per transport. I think they actually did some calculations to say this is the frequency per year, but they assumed a --

(simultaneous speaking)

CHAIR REMPE: Yeah, but if they have four of them going to different locations, it would be four. So you need to change the Y axis to say per transport per year or per year per transport. It's up to you. But I think that's what you need on this graph and it would avoid this problem. Right?

MEMBER BALLINGER: It's really a simple fix by just changing the scale.

MEMBER BIER: I mean a couple of comments. First of all, there still are mitigating features because the cask itself is a mitigating feature. It's not like every time the truck rolls off the side of the road, you automatically have a disaster. And you know, but also like following up on Vesna's point, if you're doing a PRA for a stationary power plant, you may eventually have the results in terms of frequency per year, but you have different events that are measured in different ways. So the likelihood of a pump failing to start is per time you ask it to start, not per hour or per year. So anyway, I don't think it's a huge issue in terms of the methodology, but I think it should be clarified just for explanation.

MR. COLES: Thank you. This slide shows our process using PRA. The primary difference between our process a conventional PRA, and that would be used for reactors for example, is that we use the accident development process to select and define what we call bounding representative accidents. These are accidents that are similar nominalogically. We add the frequency of each of those accident scenarios and we use the worse case consequences of the accidents in that group. So the bounding representative accidents, so truly (audio interference)

MEMBER BIER: Quick clarification. When you look at the frequency of that bounding accident or whatever the arm, I guess is representative -- not reactor -- the bounding representative accident, is the frequency of that exact event or all of the events bounded by that event?

MR. COLES: So it's all the events in the group, you know, so we actually add them together.

MEMBER BIER: Okay.

MR. COLES: I'm not going to go through the steps. The primary steps, right, are identification of the accident sequences. You see, I used the word "accident scenarios" there on the slide. And then, you know, we determine the likelihood of those bounding representative accidents. And the consequences are an important part of this analysis also to perform -- any PRA is to perform an uncertainty analysis. And in this case, we performed quite a few sensitivity studies because of certain modeling assumptions.

MEMBER MARCH-LEUBA: How do you develop the likelihood on number five? Is the proposal here or do you look at the number of (audio interference)

MR. COLES: There's kind of two kinds of uncertainty. One is what we call parametric uncertainty. That has to do with data. Another kind of uncertain is what we call model uncertainty. It has to do with our uncertainty about assumptions we make. So we looked at both of those things. Each element of the PRA, we made a quite long list of all the assumptions and bases -- assumptions that were made to perform for example identification of access or determination of consequences. And we examined each of those in turn and we performed sensitivity studies where we thought that a different assumption could produce a different result.

For the kind of uncertainty that we call parametric uncertainty, has to do with data. So we did the best that we could with the data available. But there's not as much -- This is sort of a new endeavor. There's not a lot of road data. But to the extent we could, we kind of did a hybrid uncertainty analysis where we tried to understand the variability. Right? There's some variability state to state and year to year, an actual rate -- accident crash rate can go up or down a little bit.

MEMBER MARCH-LEUBA: You need the Department of Transportation statistics of how many miles of track in a year and how many accidents happen. I mean it will depend on the type of accident because everybody's had a fender bender. I don't know anybody that (indiscernible due to accent).

MR. COLES: I have to indicate that we did use GIS and all kinds of other like in the previous slide set --

(simultaneous speaking)

MEMBER MARCH-LEUBA: The Court Reporter is going to try to say mumbo jumbo.

MALE SPEAKER: Okay. Got you.

MR. MAHERAS: We're going to talk about this more on Slide No. 12, but we did use -- we did use Department of Transportation vehicle accident rate data as the starting point in the analysis.

MEMBER BALLINGER: Excuse me. You need to state your name for the Court Reporter.

MR. ADKINS: That was Steve Maheras.

MR. MAHERAS: Thank you, Harold. And that rate is composed of two parts. Right? The first part is the number of accidents that take place. But I also need the mileage traveled for the class of trucks that I'm interested in analyzing. It would be inappropriate to take the number of accidents for trucks and divide it by passenger car mileage for example. So I need a --

(simultaneous speaking)

MR. MAHERAS: Yeah. And the type of --

MEMBER MARCH-LEUBA: On 495, there's an accident every day.

MR. MAHERAS: Right. Exactly right. Exactly right. Now I will say though -- I will say though that the Department of Transportation only reports in distinct functional road types. So interstates, highways, et cetera. So we get what we get in terms of our accident rate data.

MEMBER MARCH-LEUBA: So basically there is a -- You can just define the number of years. You may not be able to assign an uncertainty with much vigor, but you can just define.

MR. MAHERAS: Yes.

MR. WAKSMAN: By the way, Steve, wasn't it a point that you made last time that folks who drive these sorts of trucks, these are special permitted drivers and generally safer -- you would be avoiding particularly difficult routes. So while there's uncertainty, these could be viewed as almost like a bounding. The real frequency would be probably less.

MR. MAHERAS: Well, yes, Jeff. We've been doing an examination of the number of accident for these very large trucks. And it looks to us based on data that we just got from our DOT colleagues that these very large trucks encompass about 0.6 percent of the total number of accidents. Now that's the good news. Right? The bad news is that DOT does not collect data for these very large trucks anymore. They subsume it into data from smaller trucks. So they gave us what they had, but what they had is a little bit dated in nature.

We also talked to the Canadians about what they do with their accident rate data. And they also collect data for trucks of 26,000 pounds and higher and Pele would be a truck of about 150,000 pounds. So there's a difference here. Right? And we're limited by the data that's collected by the agencies.

MEMBER BALLINGER: I wonder why the 23,000 or 26,000 because the standard tractor trailer is -- the limit is about -- usually about 60,000 pounds for the kind you see on the road. And when you get above that, the permitting, I just spent an extra 3-1/2 hours coming back from Syracuse to Boston following a large load. It took up three lanes with police cars and had a backup behind it about 12 miles long because of the restrictions that they had to have on these very large loads. So if they got in an accident, it would have been, I don't know what.

MR. MAHERAS: Right. I mean we've all seen these very large loads. A typical semi, about 70 feet tall including the tractor and the trailer. Our load would be closer to about 94 feet long, including the trailer, the tractor, and the stinger on the end. So you know, semi, 80,000 pounds. Our load 150,000 pounds. A semi, five axels usually. Ours, nine axels. So there are some important distinctions that need to be made between what our load would look like and a regular semi that goes down the highway would look like.

MR. COLES: Actually, Steve has a slide that he's going to go into in a lot of detail a little bit later. So maybe we can just go onto the next slide and we'll get to Steve's slide in a minute.

I just wanted to show you again, a summary of the demonstration PRA risk results against the proposed risk evaluation guidelines. We see that there's just one BRA -- bounding representative accident that falls above the line. This is what we call hard impact road accident that leads to release of radioactive material and degraded shielding. It's defined by collision with a very heavy vehicle with unyielding objects like bridge abutments. And there was a lot of detail in the datasets to understand what the crash involved. And so we were able to parse those into objects that were heavy and objects that were light.

Next slide. So this is where we start our discussion of followup issues from the last meeting. As we understood it from the committee, one concern that was brought up was this concern of edge effects, which is something that is discussed in our report. That was Tom maybe. Yeah. So one possible example of a cliff edge effect is -- in PNNLs opinion is criticality because it occurs at least in our demonstration at very low frequencies, less than five _ per year. But it could produce a proportionately greater dose than other kinds of accidents. Because other kinds of accidents, we're damaging the containment and we're releasing a certain amount of material.

In this case, we have a completely different phenomenon. We have criticality. So what we say in the report was found to be acceptable because of its low likelihood using our risk evaluation guidelines. It really should be investigated further because of this effect. Other factors -- We did examine other factors. We didn't identify anything else that we thought represented a cliff edge effect. We did keep good track of all of our assumptions. But that's something that an actual application would have to think about -- take into account.

The second issue is --

MR. MAHERAS: Just to clarify what you

just said. So you're saying that the criticality would no longer be considered acceptable based on probability because of the cliff edge effect assessment or you'd have to think about it some more?

MR. COLES: In an actual application, we're saying that even though -- even though it's low enough that we would find it acceptable using our proposed risk evaluation guidelines, the applicant should still take a look at cliff edge effects. And we're suggesting this might be an example of that criticality.

MR. MAHERAS: Yeah. And I think you -- How do we understand by what you mean by you would consider it acceptable? And it seems like you're saying you would consider it to have met a risk metric, but because the risk-informed approach requires more than just meeting numeric metrics, you would not consider it acceptable subject to additional evaluation that might bring it into acceptability based on some other analysis. I think that's kind of what I'm getting to.

MR. COLES: You said that really well, better than I did.

CHAIR REMPE: So I have a question. We often write letter reports where we give the staff advice on what they should have in their safety evaluation. I'm hearing you're thinking about making some changes with that graph, putting "per transport". With this adding some additional text, what is your plan? I mean it's really not our purview to be advising PNNL, what to do with their report. But what's going to happen on this? I mean this seems like the best approach is for the staff to recommend some changes, then you guys do whatever.

MR. COLES: So if I understand the question, you said do we have plans to change the risk evaluation guidelines? No. We do have a slide to show you in total what needs to be considered in an application. And if we haven't answered your question then -- I think we intend to answer your question in that slide.

CHAIR REMPE: Yeah. Okay. So --

MR. COLES: But we're not going to change the guidelines.

(simultaneous speaking)

CHAIR REMPE: Maybe an applicant will see this slide to ACRS sometime in the future. But our best pathway is to provide the staff guidance on what they should put in their evaluation of this report is the point I'm trying to make here because we really have no purview for --

(simultaneous speaking)

MEMBER BALLINGER: With any letter that we would write would feed back to PNNL through the staff --

CHAIR REMPE: Absolutely.

MEMBER BALLINGER: -- so I mean it's covered.

CHAIR REMPE: Yeah.

(simultaneous speaking)

MEMBER BALLINGER: -- feels that this warrants more information, more analysis, they will say so. And any applicant that would come later on would run into that.

CHAIR REMPE: Absolutely. But I'm just making the point, it's nice of you to say that this should be evaluated. You may have a slide coming up, but our pathway is really just a letter to the staff.

VICE CHAIR KIRCHNER: Is this one just a very design dependent issue? It's generically treated. I mean, you know, the existing rules are treated generically. But if you're seeing that -- I assume this is just using the Pele design. Right? So there are design options that they can implement to mitigate the consequence and perhaps -- I don't know about the frequency. I don't know exactly which event this is, but I'm assuming it's complete water submersion.

MR. WHITE: So this is Bernie White, NRC staff. We'll talk a little bit in our presentation about criticality safety. One of the requirements for a package approval is to be subcritical.

VICE CHAIR KIRCHNER: Right.

MR. WHITE: We have never received an exemption request from that.

MALE SPEAKER: Yeah. I would hope not.

(simultaneous speaking)

MR. WHITE: Therefore, any package we approve will be subcritical.

MR. MARCANO: This is Jonathan Marcano, NRC. Dr. Rempe, in our evaluation endorsement, we do have the caveat of one single shipment per year as part of the calculation of the frequencies. And that's also on the PNNL report. It is clearly caveated. So we do have some notes that talks about the specificity of the calculation of the frequency.

MALE SPEAKER: Thank you, Jonathan Marcano.

MR. COLES: So on this slide, we just had -- We were talking about recovery. I guess we were about to talk about recovery. Is that right? Yeah. So regarding -- someone suggested -- I think someone on this side -- that we consider recovery. The way we think about recovery is recovery -- it can involve increased occupational dose for radiation protection workers. Right? But that dose -- occupational dose is managed by recovery plant, which Steve will talk a little bit more about, under a Radiation Protection Program. And it's not managed under the risk evaluation guidelines. And it's small in comparison to the dose directly from an accident.

Reduction of accident risk, if it's even possible -- remember not quite like a wreck -- you have a crash, let's say and you damage the raptor. The release is over in probably minutes. So the way we think about recovery is that occupational dose to radiation workers.

Number three, multiple shipments -- I think -- Did we discuss that enough? I think we did. Yeah. And then while we're not seeking generic approval just to be clear, PNL believes that the proposed approach could have generic applicability. And in fact, a similar approach was used for the National Nuclear Safety Administration, a package that didn't meet the codified requirements. However, that said, PNL believes the approach could be demonstrated for other modes of transport and other types of packages because the demonstration would no doubt provide useful insights.

So with that, I'm going to turn the next slides over to Steve Maheras.

MR. MAHERAS: Thanks, Garill. So the issue of state level accident rates versus route-specific accident rates is an issue that you will find in every transportation risk assessment that you'll ever work on. For perspective as I said before, a Pele truck, it would weigh about 150,000 pounds. A normal semi, 80,000 pounds. The data though starts off at a weight of 26,000 pounds. So when you're 150,000 pounds, you require a state-issued permit for each and every state that you operate on. And these permits are designed to provide a measure of safety for that load going down the road.

They specify things like requiring a survey of the route because if my load does not fit, it does not ship. So the infrastructure has to be able to handle the load. Often times you will see in permits, time of day and day of week restrictions. You'll often see specification of the tires and the spacing on the axels. You'll see specification of the speed that the load can travel, warning signs and lights, use of escorts, et cetera.

The other point to consider that vehicle mile data, the denominator in the accident rate equation is not reported for specific locations. So DOT reports for functional system levels. That's like interstates, other freeways, expressways, et cetera or they report by vehicle type or road type level. Interstates, arterials, other roads, et cetera. So really we are stuck with state-specific accident rate data as low as we can go in dividing up the data.

So in addition, the existing analyses were not designed to estimate the risk at any one point on the route. Rather, they were designed to integrate the risk over the entire route in a manner that's consistent with the risk evaluation guidelines. And so the way these routes were developed was the first thing that we did was we ran a routing computer code to give us a route that complied with DOT routing rules for spent fuel. So that was our baseline.

And then we looked at that route and said are there any deviations that we would like to also analyze? So for this particular route, Idaho Falls, (inaudible), we said well, let's look at taking the bypass around Denver. The bypass around Denver is not an interstate so it is not a state-preferred route. So it did not come up in my original routing analysis going down from Idaho Falls, but it makes sense to try to bypass the population in Denver. Okay?

VICE CHAIR KIRCHNER: It's a better quality route.

MR. MAHERAS: It's brand new too. It's brand new. It's a toll road. I don't know how much they charge for our load. I have no idea. But yeah, it's a very good road and it bypasses the population center. And it bypasses the mousetrap in particular. Right? And so it is a reasonable augmentation to discuss with the state if we were to ship. Right?

So after we get the accident rates, right --

MEMBER ROBERTS: Steve --

MR. MAHERAS: Yes.

MEMBER ROBERTS: -- I had a -- Over here. I had a question about qualitative, you know, societal risk kind of goals. And it seems like something would motivate you to take the bypass rather than going through Denver. There's really nothing that I'm saying in your risk metrics that would drive that. It's just more of a qualitative after the fact, let's go and see what we can do to minimize risk because there's something else driving the desire to go around Denver, instead of going through Denver.

MR. MAHERAS: No. It was more like looking at a map to see if the route makes sense. Right? Because you know, we have all these great computer codes that analyze routes. Right? But we always have to look at a map after we run the route to see if the route makes sense. And this was a case where, gee, you know, maybe we ought to try and bypass the mousetrap in favor of taking that nice non-interstate toll road that exists around. So really it was an idea of seeing what the route was and seeing that there's a deviation that could work in our favor.

MR. COLES: Steve, could I just interject a little bit?

MR. MAHERAS: Yeah.

MR. COLES: So from a PRA point of view and the point of view of the methodology, right, we view that as defense in-depth -- another defense in-depth measure, which is part of the approach.

MEMBER ROBERTS: Yeah. Now, you know, the only thing about that route would be that the state would have to approve the deviation. Right?

VICE CHAIR KIRCHNER: More importantly, it would reduce the number of people potentially at risk.

That's the --

MEMBER ROBERTS: Absolutely.

VICE CHAIR KIRCHNER: -- what you want to optimize on.

MEMBER ROBERTS: Yeah.

VICE CHAIR KIRCHNER: If you go right through the center of Denver and you get stuck of have an accident, you're going to maximize the potential exposure.

MEMBER ROBERTS: Yeah.

VICE CHAIR KIRCHNER: If you do a loop around Denver, you've got a low population zone --

MEMBER ROBERTS: Right.

VICE CHAIR KIRCHNER: -- versus a high population zone.

MEMBER ROBERTS: I absolutely agree 100 percent, but we're just the -- You're talking about the last bullet, it talks about variabilities. But back on the first bullet, there's a lot of variabilities. And maybe they're in the et cetera at the end, unexpected weather. The route may be flat going through Denver and hilly going around it. I don't know.

VICE CHAIR KIRCHNER: It's flat going around.

MEMBER ROBERTS: Either way, I mean just hypothetically.

MEMBER HALNON: At what point, I mean out of all those assessed in this, you know, that great idea of going on the pretty road may not be such a great idea because you're actually increasing the risk of an accident even though you may expose less people.

MEMBER ROBERTS: Correct. Correct. That's absolutely true. And so that's why in these kinds of cases when you actually ship fuel, first of all, you drive the route to make sure that it's acceptable.

MEMBER HALNON: You check the weather forecast.

MEMBER ROBERTS: Second of all, you work with your state that you're transporting through to make sure that they agree with what you're proposing for an alternate. Right? So this is not something that happens 100 percent on us. Right?

MEMBER HALNON: Okay. But the state doesn't have a PRA and an analyst or --

(simultaneous speaking)

MEMBER HALNON: -- sitting in the background.

MEMBER ROBERTS: The state has traffic

people though. And they know their roads.

MEMBER HALNON: All right. So I come from a state where I would not trust the traffic people.

MEMBER ROBERTS: What state is that?

MEMBER HALNON: Hawaii. No, I'm just kidding. But they're not -- They don't do with nuclear fuel all that often.

MEMBER ROBERTS: Oh, but they deal with HAZMAT every day. Right?

MEMBER HALNON: So that's where you're coming from. So it's extrapolating from their experience from other stuff.

MEMBER ROBERTS: So the routing rules for HAZMAT are similar to, but not exactly the same as for rad material.

MEMBER HALNON: Okay, so the same goal. Prevent the accidents.

MEMBER ROBERTS: Yeah, the same goal. Yeah.

(simultaneous speaking)

MEMBER ROBERTS: Right.

MEMBER HALNON: I get it.

MEMBER ROBERTS: Yeah.

MEMBER BIER: I have a question that is, I think not the presenters, but maybe for Ron or Joy, which is are we supposed to be assessing the adequacy of the methodology or assessing whether we think it's safe for Pele to ship? Because the two are kind of different things.

MEMBER BALLINGER: When we first started looking at this with Bernie, I think he thought we were nuts because in our opinion, that would be Chris and myself, we looked at it. And there was that one sentence in there that said, by the way, this methodology might apply to non-Pele. And so it was the methodology --

MEMBER BIER: Okay.

MEMBER BALLINGER: -- that we were thinking about. But as soon as that one sentence was in there, that opens up the flood gate to what we've been talking about all along. And I don't know if people have more than one epiphany, but I'm thinking that this is an important -- important evaluation. And if I was to vote for a letter, I would vote for a letter for sure. But not with the letter that we now have, my bad. But I think that a lot of the topics that we've been discussing may not impact Pele, but later on down the road, hopefully we will have to try to ship one of these things and it won't be Pele because it's a DoD thing. So there's some information here that I think needs to be pointed out, but that's one person's opinion.

CHAIR REMPE: In our subcommittee discussions when we were talking with the staff, I think one of the staff members had a good point back. He said you know when we were looking at this, we were thinking about something like Pele, but we didn't maybe perhaps think that our document would be construed as approving a methodology that would be used elsewhere. And I think that at least that staff member thought yeah, maybe we should be looking at it more carefully with what could happen from this evaluation thinking is kind of where I'm at it too.

MR. MAHERAS: So I think I'm still on deck. So after we get the accident rates, we combine the accident rates with probabilities of specific accidents to yield frequencies for the entire route. We talked about frequency maybe being per transport instead earlier. This is the same approach as we used in the -- in the repository EIS and other -- other Department of Energy and NRC environmental documents that deal with transportation.

If there is concern about specific areas of routes, those usually come out when someone actually drives the route to look at the infrastructure. So correlations between accident rate target hardness. And by that, I mean what could it hit and how hard is the thing you hit. Presence of streams, rivers, and other route hazards could be addressed in that survey and through the use of appropriate compensatory measures. All that being said, additional analyses could be useful to explore the impact of the variability in the accident rates. And with that, I'll turn it over to Harold if there's no other questions.

MR. ADKINS: I believe I'm next up. Next slide please. So one of the questions, I think the Committee had, Subcommittee, I guess previously was how would this be used? Right? How would it be a vehicle that leads to or is integrated into the process of developing a safety analysis report application that the NRC would review? And the one thing that immediately stood out to us that we wanted to make clear is, you know, we talked about the application of the methodology only applying to postulated hypothetical acts in a condition evaluation and being able to meet the dose and containment criteria. Right?

So ultimately we take a lot at the all influencing physical, chemical, and environmental loading conditions that would adversely affect the package performance in the first place in the exact same light that the NRC would expect an applicant to do. And taking a look at the configuration, applying all of the applicable consensus standards, ASME code standards, some of the NRC transportation regulatory guides -- reg guide 7.1 through 7.13, the NRC standard review plans, all of the process that currently exists right now to a tee from beginning to end.

And ultimately that would express that there's a need for the packaging to meet the deterministic demonstrate requirements -- the Demonstration Unit would meet, in this particular case, I guess that's kind of misleading, but that determinalistically would be found to meet all the normal conditions of transport, but then would apply to only let's say a suite or a handful of items that were presented challenges or maybe uncertainty as far as whether they're able to meet the metrics as part of the postulated hypothetical accident conditions. And then those would be exploited to determine, you know, how robust and what some of the propensity or uncertainty would be associated with that and develop the compensatory measures to accommodate and provide equivalent safety and leveraging DoD and safety margin and things of that nature that we previously discussed. And then applying for an application through 10 CFR 71.12 to leverage all of this culminating information as part of the application to get -- to approach the pathway of getting this certificate of compliance. Right? Just to give you a rundown.

Next slide. And I think I have to hand this over to one of my colleagues, Steve Maheras.

MR. MAHERAS: So I'm going to talk a little bit about how transport would actually be made if Pele were to actually be moved in the future at some point in time. So first of all, the transport would be made in compliance with the DOT rules. That is a given. Because of the size of the truck, we talked about Pele being a 150,000 pound load. We'd need to get state permits for each and every state along the route and that would include an evaluation of the proposed route that was going to be used and any alternative routes that an applicant proposed for transport. And this is to verify that the infrastructure can accommodate the vehicle and the load because if it doesn't fit, it doesn't ship.

Alternative routes are often times included in these analyses in case of bad weather, road closures, et cetera. The proposed route must meet the requirements of the DOT routing rules. These routes are chosen to minimize radiological risks. They typically will involve interstates and bypasses or beltways around a city, but states have also got the opportunity to designate preferred routes. You know, and this lets them based on their state-specific local knowledge, designate routes that they would prefer be used instead of interstates.

MEMBER BIER: I was questioned about -- I mean I understand all this stuff --

MR. MAHERAS: Right.

MEMBER BIER: -- that, you know, the states would still have to do their thing --

MR. MAHERAS: Right.

MEMBER BIER: -- like for the other shipment.

MR. MAHERAS: Yeah.

MEMBER BIER: But I have a question about how you envision your analysis method being used because if we end up in a mode of say nth of a kind and you know, there's some facility down the street from Greg's house in Ohio and they're shipping -- you know, they're shipping one reactor a month for the next eight years, but two different destinations. And are you envisioning that after they propose their route and get their state approval that you would go through the same laborious process you went through of where the wiggly parts in the road and are they are high elevation or whatever? Or are you envisioning the site next to Greg's house could get kind of a blanket approval to ship say anywhere that satisfies the various state and you know, some other generic form of requirements? You know, no dirt roads and you know, et cetera.

MR. MAHERAS: Okay. What you're describing is what we would call the run scenario.

MEMBER BIER: Yeah.

MR. MAHERAS: And we're very much in the crawl scenario.

MEMBER BIER: Okay.

MR. MAHERAS: We're very much in the crawl scenario right now.

MEMBER BIER: So your sense is it's not that you would propose reimplementing what you just did once a month for eight years, but just that this was a learning experience and we might see you back in a few years with a more generic proposal?

MR. MAHERAS: I think it's very much a discussion that applicants and the NRC will have to have if God willing --

MEMBER BIER: Yeah.

MR. MAHERAS: -- more of these transports are made.

CHAIR REMPE: So we interrupted you earlier. My take is that basically we can't get the data from the states because they just give you the total accident rate for their state. Well in PRA especially with these new designs, there's often a lack of data. So what we typically, I think do with PRA is we applying engineering judgements. So if I saw an elevated location near a high population area --

MR. MAHERAS: Right.

CHAIR REMPE: -- that's subject to black ice in the Winter in Idaho where the semis often go off, I might take that average accident rate and bump it up by a factor of ten just because of engineering judgement tells me that it could not only have higher frequencies, but I also know there's higher consequences.

MR. MAHERAS: Or I might choose not to ship when those conditions exist.

CHAIR REMPE: I just don't think you can go around on anything that's reasonable around

Pocatello. But you look for it, yeah, it would be better to go around and find a different place. But if there is no other place that you're estimating the risk, I think you've got to do something like that.

MR. MAHERAS: It's quite common to limit shipments to prescribed times of the year --

CHAIR REMPE: That would be good --

(simultaneous speaking)

MR. MAHERAS: And I'll give you an example of that. This is not Pele, but it's another site. Okay, so Big Rock Point, right, is a reactor that has a large tourist population in the Summer. So while we would dearly love to move the casks off of that site in the Summer, one of the things that we're going to have to consider is the tourists that inundate that area at that time. And that is part of the transportation planning process that occurs for every shipment every time fuel is moved.

CHAIR REMPE: So what I'm hearing is the methodology has some other backstops --

MR. MAHERAS: Right.

CHAIR REMPE: -- that are considered before it happens. But if I'm approving a methodology for estimating the risk, what I'm trying to say is use some engineering judgement with your limited data to give us a better estimate and not just throw it into the uncertainty analysis and sensitivity study analysis bit.

MR. COLES: Yeah, Joy. I think that's right. This is Garill again. And I know you know this, but in the report itself, we did examine a lot of these assumptions about the route. And we performed fairly extensive sensitivity assessment. And I think those kinds of observation hazards, they -- I think absolutely right. They need to be examined. And the way we propose to do that is with sensitivity and with uncertainty analysis.

CHAIR REMPE: But I'm just saying maybe the base case could also use some intellect --

MR. MAHERAS: Oh, absolutely.

CHAIR REMPE: If you drive the route -- It's really the people who are driving the routes should look for some of the more dangerous parts on the road. And use some engineering moment on the data --

MR. MAHERAS: Yeah.

CHAIR REMPE: -- and not just average the data.

MR. MAHERAS: We actually had a project this year where we took some young engineers and they built the equivalent of a Google car with a rotating camera on the roof to do the route survey. So those kinds of things, I think can be incredibly helpful. This is something that the Army does on a kind of standard practice basis also.

MEMBER BALLINGER: I need to make a comment that we should not be using the chat feature of Teams and apparently some people are. So please --

MR. MAHERAS: It's not us.

MEMBER BALLINGER: Well, somebody is. Whoever it is, please don't use the chat feature.

MEMBER BIER: One other question. In your experience, not necessarily in this report, have you done sensitivity analysis to see how much difference there is from one route to another, say for the same destination?

MR. MAHERAS: Yeah, we've done some examination of that on other projects. And I'll give you an example. When we did the repository EIS, we analyzed a case where we would use all trucks for transporting the waste to the repository. Those trucks according to the rules, right, would have gone right through downtime Vegas on their way to Yucca Mountain. Right? Right through the spaghetti bowl is what that intersection is called. Right? And so we said okay, so let's look at other things. And we looked at the back way into the site through Death Valley. We looked at alternatives that would even come all the way around the site. So we looked at about eight different -- eight different other routing strategies. Right? And they make some difference. The major difference that you will see is getting out of downtown. So if there is a bypass around the city, wicked good thing to use. Right? But you have to balance that in an EIS, especially with increasing the distance. Because increasing the distance increases the traffic deaths that you might calculate. The ones that aren't related to the cargo that are related to just the truck being on the road. Right? So, yeah.

MR. BLEY: Could I jump in? This is Dennis Bley. I really like everything you've been talking about. I like your discussion with Joy about bringing engineering or expert information or judgement into the analysis. And there are ways to do that might be better than doubling or multiplying by ten or something like that. But that makes sense.

There's two issues you haven't talked about much that at least a few years ago when I was involved in some of this, turned out to be pretty significant. And the one you touched on a little bit, which is local police or state police might encourage restricting access through very busy parts of cities at busy hours. And you touched on that. I think that's covered.

The other one though -- and maybe this has improved in the last ten years. It used to be pretty significant because as you move from one area to another, whether it's the state police at the state borders or maybe it gets turned over to local police in certain others, the turnover of the escort sometimes led to really big delays or problems. And you haven't talked much about that. Have you looked at that?

MR. MAHERAS: Yeah, that's an operational issue that we had given some thought to. It's not reflected in the PRA, but it's definitely the consideration in the transportation planning for an actual shipment. Right? So what happens is the shipment arrives at border A and the folks that are supposed to escort it into the next state don't arrive on time, they're late, whatever. Right? And so then they can't perform the escorting. Now that is ameliorated a little bit in the DOE world because people will track shipments with Transcon is what the tool is called. And so what that gives you is the state that's getting the shipment will see that shipment arrive on their screen roughly an hour before it gets to the border, so they're reminded that they need to -- that it's going to be arriving.

But it really all comes down to pre-transport coordination between law enforcement in all of those states along the entire route. And really communication is the key to that process. A lot of this is done through what the DOE has now, the National Transportation Stakeholders form. And so that's where people from each one of the states can get together. They know each other. So they're not getting cold calls. They all know each other. They work together on projects, et cetera. So it really does streamline the planning. And shipments in this venue typically start to be discussed two to three years before they're made. Right? So that everybody knows what's coming and what it's going to look like and who's involved and what the planning is going to look like, et cetera, et cetera, et cetera. Right?

MR. BLEY: So thank you. It sounds as if things have improved since I was touching on this some years ago. I recall some cases where shipments got stalled in less than optimal places for a fairly long time. And I'm glad that's no longer the issue it used to be.

MR. MAHERAS: Yeah. So one of the other things that happens on spent fuel transports is that they're required to have commercial vehicle safety alliance level 6 inspection of the load and the tractor and the trailer. And so what that inspection is designed to do is it's designed to show that, that vehicle and load are defect-free before departure. And that is a big help to us in making the transport because many states downstream will see the decal that we've put on the car that shows that they made the inspection and they will choose not to inspect, which is a good ALARA practice at times. Right? But this is a well-established process that's used for every shipment that's made. So we would rely upon that or the Army equivalent.

I'm taking up a lot of time here. This is the last slide, I promise. So we would also evaluate the route from the perspective of protection of that shipment. We would use likely NRC guidance of the Army equivalent. And what this means though is coordination with law enforcement agencies along the route, identification of safe parking in case of mechanical issues, bad weather, hazardous road conditions or unanticipated problems.

We would want to have all of our identified and specified compensatory measures in place. You know, time of day, day a week restrictions, rolling road closures, escorts. A shipment would only be conducted after it had been coordinated with all the effective states and tribes as part of the transportation planning process that includes notification of those states and tribes along the route, shipment tracking, shipment status, and emergency response plans and procedures are in place.

And then we would want to ensure that the shipments avoid bad weather. Black ice for example, hazardous roads through constant communication with drivers monitoring road conditions and restricting travel when adverse conditions pose a threat to the transport. So any delays would be coordinated with the downstream states and tribes. But nothing that I put on this slide is new. Right? This is what happens today. Right? Yeah.

MR. ADKINS: One last point. This is Harold Adkins. Unlike what we did on the last presentation, we went and populated the tail end of this presentation with all the applicable references so they're available to you that we've discussed today.

MEMBER HALNON: Are all the decisions to what you just mentioned is weather, road conditions getting worse or whatever? Are all those decisions on the drivers themselves or how does that work? I mean are they in communications with law enforcement that are escorting them?

MR. MAHERAS: They're in communications with the escorts and they're also in communication with the movement control centers used for the dispatcher, the home office --

MEMBER HALNON: Is there one person in charge?

MR. MAHERAS: Oh. I will have to check that and get back to you. I don't know off the top of my head if they have a duty officer who -- I don't know the answer to that.

MEMBER HALNON: Okay. I'd be curious because the communication is -- I mean you've got health effects, maybe the driver or someone else that could -- you know, other things that are outside the scope of road conditions. There's other things that can happen. I was just curious if there was one person in charge, you know, 24/7 or at least while it's on the road moving.

MR. MAHERAS: Yeah, there's a 24/7 number, but it rings the Control Center. And what I don't know the answer to is the precise staffing of the control center. I'll have to get back to you on that.

MEMBER HALNON: Yeah, I'd appreciate that definitely. Thank you.

MALE SPEAKER: I'd like to turn it over tO NRC.

MEMBER BALLINGER: We're about to have our discussion on this presentation. But may I suggest that before -- we take a break between this presentation and the NRC presentation. Is that appropriate?

CHAIR REMPE: That would be fine. I have one just comment about your backup slide about corrosion and oxidation. And I get it that, that's something typically considered. But as Jeff mentioned in his opening remarks, right now we're getting a lot of micro-reactor designers that are perhaps -- I think you used the phrase "hand waving some things".

MEMBER BALLINGER: Yeah.

CHAIR REMPE: And again, I think that's why it's important for the staff in their evaluation to make sure it's documented because it's something that is a guide for the staff when they're looking at these things, as well as applicants. And so I know it's a backup slide and you didn't present it, but I didn't buy that one, just that it's typical -- saying that on the transcript. Okay?

MR. WHITE: Bernie White, NRC staff. We added it to our evaluation.

CHAIR REMPE: Okay. And so your request for a break is -- Right now, I've got 26 after. If we came back at 40 or 20 til, is that fine? That gives you 14 minutes.

MEMBER BALLINGER: Say it again.

CHAIR REMPE: Let's get going so --

(simultaneous speaking)

CHAIR REMPE: Yes?

MEMBER BALLINGER: No. No, 2:40 unless we negotiate. 2:40.

CHAIR REMPE: Yes, okay. And we're going to take a break and come back and the staff can be ready for their presentations and I'm going to mute us.

(Whereupon, the foregoing matter went off the record at 2:26 p.m. and went back on the record at 2:40 p.m.)

CHAIR REMPE: Okay. It's 2:40 and I'm going to turn it back over to you, Ron.

MEMBER BALLINGER: Thank you. Mr. White

tells me that he can finish his talk in ten minutes. I can assure him that we'll just abuse it.

CHAIR REMPE: It's a challenge.

MEMBER BALLINGER: Take that as a challenge. Anyway, Bernie, go ahead.

(laughter)

MR. WHITE: Let me start by saying, I didn't say I could limit your questions to ten minutes, I can finish my talk in ten minutes. Thank you. Thank you.

So we're to talk to you a little bit about the methodology. We're not going to rehash what we did at the subcommittee meeting telling you why we think it's acceptable. We're going to talk about things that we heard at the subcommittee meeting and provide some information on things, you know, to help inform your decision. Some of those things will include overview of NRC requirements for spent fuel transport, limitations of the methodology, clarifications that we're making to the endorsement based on the subcommittee comments, and then an updated slide on the next steps.

So for package, the shipper would ensure that the package to be used has contents that are approved for shipment. If not, they would obtain an amendment to the NRC approval.

In the next slide, I'll provide level of review of NRC package review. If the shipper does not have an approved route -- you know, we heard about route approvals earlier --

(off record comments)

CHAIR REMPE: This is Joy Rempe. We have some interference from someone who needs to mute their phone out on the internet with someone named Kyle. Thank you.

(laughter)

MR. WHITE: So if the shipper does not have an approved route, the route approval -- a route approval would be required. Staff in our office of nuclear securities response reviews applications for route approvals. So more information on both route approvals and transport security requirements can be found in NUREG-0561 Rev 2, physical protection of shipments of a radiator reactor fuel. Some of the criteria used in route selection include minimizing transport time, availability of swift local law enforcement agency response, availability of locations for safe havens, availability of appropriate rest and refueling stops.

During its route reviews, the staff checks for the accuracy with respect to names of state and if appropriate for the route, tribal contacts, 24-hour state phone numbers, phone numbers for each local law enforcement agency along the route, and the path of route across each state. If contact is needed during shipment, it should not be delayed due to having an incorrect phone number. The route will be physically inspected -- The route should be physically inspected as well. One doesn't want to try and take a semitrailer under a bridge or tunnel that doesn't have sufficient height. You laugh. I've seen it.

In addition, route selection will need information related to weather, road closures, and events with large gatherings such as concerts, fairs, or sporting events that may be close to the route. I-95 goes right through Bolivar, not too far from the Orioles and Ravens stadium. You wouldn't want to take hazardous material up there this Sunday afternoon at 1 o'clock.

So the security requirements in Part 73 for spent fuel shipments have advanced notification requirements for radiated reactor fuel. No later than two weeks prior to the shipment or prior to the first shipment of a series of shipments, the licensee shall arrange for state law enforcement escorts. Positional information sharing when requested, coordinate with local law enforcement for response and assistance. Other security requirements include leading and trailing vehicles, armed escorts, and communication requirements.

The communication requirements for spent fuel shipments by road are to provide the escorts with capability to call for assistance if necessary, allow progress of the shipment to be tracked, provide the escorts with a way to quickly develop new local law enforcement contacts, and if needed, obtain new route information when unexpected detours become necessary, and coordinate the movement of and transport of escort vehicles when more than one vehicle is used in a shipment.

At a high level, the methodology endorsement is being limited to two road shipments and only for the tristructural isotropic or TRISO-based project Pele transported with micro-reactor. So why are we doing that? Well, for a couple of reasons. First, we've reached out to other micro-reactor vendors and nobody has indicated a need to use this. Secondly, opening it up for widespread use would bring in some complicating factors, which I'll get into in a couple of minutes.

Application of methodology would also be for a specific route that would be provided in the package application. While the methodology is generic and could be used for other transport of micro-reactors, we're limiting it to Pele. Endorsing the methodology for more widespread use could have policy issues for which commission direction may needed and potentially consideration of rule making.

In addition, more widespread use at the NRC -- For more widespread use, the NRC would have to consider co-located hazards for transport of multiple or large numbers of transportable micro-reactors along the same route or a similar route. Given the amount of uranium in the project Pele transportable micro-reactor, which is less than any single pressurized water reactor fuel assembly, any release due to an accident is not expected to be large when one compares it to a reactor accident.

The methodology is consistent with existing commission policy by limiting consequences to the maximum exposed individual to meet the quantitative health objectives. While we did not focus on the numbers used in the calculations performed by Pacific Northwest National Lab, we do note that in their sensitivity analysis, they showed that, you know -- for their demonstration that the dose to an individual is most sensitive to reactor cool time and drops off quickly with distance from the accident. It did not appear to be sensitive to exposure time as well.

Now I'll turn it over to Jonathan for the next few slides.

CHAIR REMPE: Just to try and make sure you don't make that ten minute thing, what are the other micro-reactor folks -- you said none of them are interested in using this methodology. Have they given you a clue on what they plan to use for methodology?

MR. WHITE: So the ones that have told us said one of two things. Either we're going meet Part 72 or we're going to use 71.41(c), which authorizes alternate test -- environmental test conditions. If you remember back to the subcommittee meeting, we talked briefly about the Trojan reactor vessel, that is something similar. While we did exemptions for that, it did use alternate environmental test conditions. The big difference between that approval and this is that for that type of approval, while you could do a lower test, you still have to meet the dose rate and containment criteria in Part 71. So there's no way of having an out for meeting those.

CHAIR REMPE: Thank you.

MEMBER MARCH-LEUBA: So I can think of what we're doing, what is the final product of (indiscernible due to accent)? Is it an SER? Is it NUREG? Is it a letter?

MR. WHITE: So we are issuing a letter that would endorse the methodology, you know, with certain caveats.

MEMBER MARCH-LEUBA: You sign it or it is it signed by --

MR. WHITE: It won't be signed by me. My pay grade's not high enough to use the euphemism.

MEMBER MARCH-LEUBA: (audio interference)

MR. WHITE: It will be from probably my branch chief, (inaudible). Okay? Along with that will be accompanied -- we don't call it a safety evaluation report. And the reason we don't is because typically SERs you compare with rules. You know, regulations. We're not doing that because there are no rules for this. You know, if we were to approve an exemption, you have to show that it doesn't endanger the public health and safety, which is fairly subjective.

MEMBER MARCH-LEUBA: So particularly, it's a letter of approval.

MR. WHITE: We call it a methodology evaluation.

MEMBER MARCH-LEUBA: We like this methodology and (indiscernible due to accent) because you're going to need my license anyway.

MR. WHITE: Right, for -- Right, for this specific use for two transports by road. Yep. Mmm hmm.

MEMBER MARCH-LEUBA: Thank you.

MR. WHITE: Mmm hmm.

MR. MARCANO: Thanks, Bernie. So this is Jonathan Marcano, NRC. So in these next two slides, I will be covering the topics for which the staff made additional clarifications to our draft methodology endorsement as a result of the discussions we had during our subcommittee meeting to ensure that we clearly described the scope of our endorsement.

The first topic for which the staff added language is with regards to the applicability of our endorsement to the approaches and that our endorsement does not extend to the basis and the (indiscernible due to accent) of numerical assumptions and estimated results. So we're focusing on that systematic approach as described by the methodology. And this is due because as we have been discussing, the PRA base the frequencies on a hypothetical route and the four doses they use in engineering adjustment to estimate package damage and the release of radioactive material rather than performing quantitative renewing evaluations.

We also added one new section to the draft methodology endorsement on the approaches to estimating likelihood of accidents. This was a topic that was brought up with regards to the application of conditional modifiers to the frequency of highway accidents. So in that, we -- For that specific section, the NRC considers in our endorsement that the estimates of likelihood of accidents scenarios are inputs to the methodology and not part of the methodology itself. So our review of the application -- the future application that utilizes the methodology, when we receive that, then our expectation -- our review will be no different on any review. Right? And our expectation is that the level of justification of the approaches and numerical assumptions will be commensurate as important to safety. And that includes the use of data, frequency estimate, conditional modifiers, among others.

MEMBER MARCH-LEUBA: Did you allow acceptance criteria, the frequency consequence (indiscernible due to accent) charts?

MR. MARCANO: We did. And our endorsement pretty much states that the development of the risk evaluation guidelines is consistent with existing commission policy and guidance.

MEMBER BIER: Excuse me.

MR. MARCANO: Yes.

MEMBER BIER: Can we either see a version of those charts here if you have them in backup or if not, I can probably talk about them.

MR. MARCANO: I'm now wondering whether or not there's been a substantial enough change as a result of the subcommittee meeting. I don't think we have the current version.

MEMBER BIER: Well, I think any version is --

MR. MARCANO: Well, we have a version.

MEMBER BIER: Yeah. I mean I can talk from what I have. I don't think I can display it because I'm not logged into Teams. But I'm wondering if this is probably something I should have asked the lab folks before and not you guys. But I'm pondering those frequency consequence charts. And there are places where there are like two events with very, very similar consequences and maybe one more likely than the other. And I think in the usual use of those charts, the dividing line would be compared against a complimentary cumulative in which case the likelihood of those two events with similar consequences would be added. You know, because like if I pick like 12 representative accident types or whatever and show them each as a little dot, I could subdivide them and get you know, a 1,000. And they would all be, you know, dots but very, very low.

MEMBER MARCH-LEUBA: When we start doing the LMP original discussions --

MEMBER BIER: Yeah.

MEMBER MARCH-LEUBA: -- the answer is that they group it into different types of accidents.

MEMBER BIER: Yeah, but still for a fission reactor, you would combine them all.

(simultaneous speaking)

MEMBER MARCH-LEUBA: -- in focus on Wednesday, focus on Thursday, focus on Friday.

MEMBER BIER: Yeah. Yeah. Yeah.

MEMBER MARCH-LEUBA: Right before it goes down. Right?

MEMBER BIER: Yeah, exactly.

MEMBER MARCH-LEUBA: It would make more sense. So the question is how did you group it?

MEMBER BIER: Yeah. Anyway, I mean if we can go over that more offline or whatever, but it's just something that didn't occur to me til now.

MR. MARCANO: This is Jonathan Marcano. And Brian, you might also want to jump in. That's something that we also discussed and we evaluated. We definitely don't want to see those events. Just seeing those -- Yeah, so we would definitely look at that and consider that.

MEMBER BIER: Because it's something I feel like I was slow to catch onto. It bothered me last time in subcommittee and I couldn't quite figure out why. And all of the sudden today, I figured out what it was that was bothering me, so okay.

MR. MARCANO: Yeah. Same for the data, same for the accident data. Right? I mean you don't want to see those just divided by 1,000, so definitely.

MR. MCCARTIN: Yeah. Tim McCartin, NRC staff. And this is that dividing line that we see between approving of the methodology and how it's used in an amendment 4 request. And you're absolutely -- any methodology can be used inappropriately. And so the review has to look at these types of things to see how the risks are calculated and what it means. But that's part of the review using the methodology, but it's a critical part of our review.

MEMBER BIER: But I think you're describing it accurately. It doesn't call into question all the zillion hours of work that the team did to generate that, but it could be plotted in maybe a more informative way or more expressive way.

MR. MARCANO: Bernie, we can go to the next slide. The next one, yep. Another topic we added clarifications was on consideration of (indiscernible due to accent). We already talked a little bit about this. The methodology does include consideration for (indiscernible due to accent) by retaining event sequences with extremely low frequencies. However, the staff added language to note that the application -- the future application that applies to this methodology should address doses to a worker and a member of the public to ensure that there are no (indiscernible due to accent).

And on this note, I also believe that it is important to note that as described in the methodology, the design of the package will address the elements for passive heat removal to ensure that the TRISO fuel will maintain its structural integrity necessary to retain fission products. And this will be another area the staff will be reviewing during our approval.

Finally, we included language to clarify that the applicant will need to use appropriate initial and boundary conditions to evaluate damage to the package, which will include any material degradation such as corrosion, oxidation, or radiation. Like we have been discussing, this is consistent with our reviews. And it is required by the regulations in 71.43 (d). And I'll turn it back to Bernie.

MR. WHITE: Thanks, Jonathan. So now I'll talk a little bit about our review, what we would expect for an exemption request. So an exemption request authorized transport of irradiated material, in this case, irradiated fuel, must show that the exemptions authorized by law will not endanger life of property, nor the common defense and security. Since it's NRC's practice not to use categoric exclusion in CFR 51.22(c)13 for approval of package designs for packages to be used for transport of licensed material when approving exemptions, the application should include an environmental report.

A safety review for Project Pele using the methodology would include evaluation of the probabilistic risk assessment and much of the same information that the NRC receives for routine package approval. The application for a package evaluated by the analyses would include structural materials and thermal analysis of the tests and conditions for normal conditions of transport to determine that the package meets the post-test criteria. In addition, the application should include structural materials and thermal analyses for hypothetical accident conditions. And depending upon whether the post-test criteria are met, the accidents determined by the probabilistic risk assessment.

The analyses for normal conditions of transport in hypothetical accident conditions are performed from material properties at the temperature of the test and would include any material degradation such as corrosion, oxidation, or radiation damage. These analyses are also benchmarked to known data. For example, impact limiter test or skill model drop tests.

The results of these analyses inform the containment shielding and criticality analyses to provide the input for the damaged state of the package. Typically the containment analysis determines whether the package meets the release rates for Type B packages. Using the methodology, the containment analysis would also provide the quantity of material released and the (inaudible) fraction that would be used to determine their portion of the dose consequences.

The shielding analysis typically would show that the package meets the regulatory dose rates after evaluation of the test for normal condition of transport and hypothetical accident conditions. However, the methodology analysis would go a step further to determine the total effect of dose equivalent to the maximally exposed individual if the containment and dose rate criteria after accident conditions cannot be met. The criticality review would ensure the package is subcritical. The NRC has never been requested to approve a package that would need an exemption from any of the subcriticality requirements.

For the sake of brevity, I haven't talked about the procedures except sensor maintenance program were also a part of a package application. In addition to the safety review, the application for an exemption must show that the shipment will not be -- will not endanger the common defense and security. Past exemptions have stated that the licensee will meet the appropriate security requirements, which for this would be for shipment of a radiated reactor fuel.

Finally, the package approval using exemption would need to be accompanied by an environmental report. The NRC would perform an environmental analysis to determine the potential for environmental impacts, which could result in either a finding of no significant impact or FONSI, which would be documented in environmental assessment or the need to perform an environmental impact assessment. As you heard stated earlier, there currently are no plans to move this off site.

If that's the case, staff could do a safety review of the application, but not approve the shipment -- the package for shipment. Which means that in order to approve the package for shipment, we would need an environmental report, which would specify the route and location for which the package would be going. So it would be a safety review. Here's our safety findings. Have a nice day.

MEMBER HALNON: Would that environmental review also include alternatives to the shipping? In other words, keeping it where it's at?

MR. WHITE: Yep, it would. Yep. And so you know, while PNL went over a sketch that it had for the Project Pele micro-reactor transport might look like, this is a drawing I received from NAC International for a package of similar weight to what Pele might be. This is what, you know, their proposed vehicle would look like for that one particular package.

MEMBER BROWN: Can I ask a question relative to this? This is pretty small. This is not a huge amount of irradiated fuel. And there's much larger quantities of irradiated fuel shipped throughout this country today with little, if any effect. And I presume you all have been involved -- somebody's been involved and I won't go into the details. And my curiosity here is this sounds like, you know, we've got a nat running around and we're going to kill it with a maximum hammer or pickaxe that we can get our hands on and smash it to pieces. I mean it's -- this is -- and it's separated from the whole package. I mean this is four packages that gets shipped, you know, with the prior four modules. And this is a smaller 20 x 8 x 8, whatever the dimensions were in the figures. And even within that package, it's a little bitty hunk of stuff.

And it seems the benefits of something like this application in terms of the country's electricity sources and various vital internal country, you know, Defense Department basis critical communications setups that you don't want to lose, that you can decouple from the existing grid and then use. It seems to me that we ought to be using our heads in terms of how this is -- I'm not saying be unsafe, but recognize that you've really got to compound a lot to make this little bitty trunk full of stuff be a real hazard to the safety of the population.

I'm just looking for some -- How do you apprise -- you're dancing around -- You're like doing a stork dance around all these issues with exemptions and everything else when as is, you've got to do this, then you've got to do this, then you've got to do this, then you've got to do this. And it just seems to me somewhere along the line, you ought to develop a way to look at this as something that could be pretty vital to the country. And how do we do this without literally squashing it before it ever gets off the ground?

I'm just -- I'm a skeptic sitting here. I can't believe I'm talking like this since I'm normally looking to shut everything down as fast as you can. But it seems to me -- and that's based on some past experience I've had, even though I didn't do it myself, but I was involved in it and knowing what was going on. So I'm just throwing that out to try to throw some common sense and everything else as opposed to trying to make -- buckling up your armor so nobody could stick any spears in your chest.

I'll stop right there. I just think this is a good idea when you look at how it can be applied throughout the country. It's very vital electrical we might need in the future. It's a small thing in a lot of these hot places, as well as some medical facilities that are critical that you have to keep powered in order to protect a lot of people. And nobody wants to use diesel generators. That's kind of crazy also, but that's another issue. Okay, I'll stop right there. Sorry about that.

MEMBER MARCH-LEUBA: In that line of though, I'm sure that (indiscernible due to accent) Pele, but I'm sure that the plan for DoD is to (indiscernible due to accent) this reactor to the PNL and keep it as museum in the Richland Desert. Richland, Washington. But in reality, if only one is built and it never gets needed, it will be a national security nuclear emergency. It's (indiscernible due to accent)in the desert, in the Sahara. So it wouldn't be a bad idea for whoever is above our pay rate to help plan for transportation in an emergency. Once you have 20 of them, that's a different issue. But only one and you keep it in the desert, there's nothing -- a significant chance that some guy at (indiscernible due to accent) says hey, it would be nice to have it in Germany -- based in Germany. So I will think ahead.

MR. WAKSMAN: So just for awareness, Jeff, the plan for the Pele prototype after it's done is to turn it over to the Department of Energy, so it will be in the Idaho Desert and they'll be able to signs whatever out of it until it's done. And then they'll probably take it apart.

MEMBER MARCH-LEUBA: That's right. (audio interference)

MR. MARCANO: But going back, this is Jonathan -- This is Jonathan Marcano, NRC. Going back to the comment made by Mr. Charles, the previous studies done on transportation, you know, have demonstrated that the doses are very low. And what obviously we're doing here, right, we are seeing an applicant -- a potential applicant that will potentially require -- request exemptions. Right? But what you can at least early on, derive from the report is that the doses are -- when you see the doses, they drop significantly low from 25 meters to 100 meters. So it kind of remains consistent with some of the previous conclusions that have been made in the safety of transportation.

MEMBER BROWN: I'm just making an observation that are responsible for hundreds of major systems to be delivered and sent -- and designed and built. And we always have specifications that are very constraining and everything else. It turns out when you start building them, you can't always meet your specifications. And everybody's ringing their hands and saying what do we do? And the way I used to manage the program is if you didn't have exceptions, you wouldn't need approvals. There's times to use your head and accept what you get. Don't change the spec, but just keep on going and do what you need to do to get it delivered.

And I just -- I'm just -- my only purpose in my comment is to use some common sense in systems like this that are obviously not really a hazard per se when you really get down to the nitty gritty. And there's a lot of ways to transport something like this with a lot of escort and get it there safely. So I just -- That's the only purpose of my -- Don't get wrapped in your -- Oh, my God, I can't do anything because the rule says. You've got the capability here. You make the rule. Say okay when it makes sense. That's all.

MR. MCCARTIN: Yes. And I think we're being appropriately cautious. But you're right, there isn't a lot of fuel compared to maybe a spent fuel shipment. But there is enough plutonium there that it does present a hazard. And it's a very significant hazard. The containment requirements for transportation are such that releases are maintained very low because they need to be. You can't release a lot of respirable plutonium. And so I think what's being done today is for this potential exemption, we're looking at the risks associated with it and doing an appropriate calculation that looks at well, what might happen -- what might be the releases so we can make a risk-informed decision.

I understand that, you know, the safety record in transportation is superb, but that doesn't mean you can relax things. You need to appropriately look at it. I'd like to think we're doing the appropriate amount of consideration for this risk-informed approach. But you know, the hazard is there. I mean, there is enough plutonium there to cause a serious problem should there be an accident that we would hope never would happen. And you're correct, there are many compensatory measures to transport this safely, but you don't want that accident to happen.

And so at least I think we're applying the appropriate level of resources and effort to this. But you know, we acknowledge, you know, there are -- we need to always look in the mirror and say are we doing the right resources for the right reasons? It's an appropriate caution.

MEMBER HALNON: You know, a few words and a lot of words over here. Really needs to be commensurate with the risk is what you're saying and have a process that allows you to do that. And the reason I say that is because when I see an environmental report, it scares the heck out of me. I've seen some two-page environmental reports in the PSDARs and I've seen 3,000 page environment reports and they still have an environmental report on it. So if we're talking a PSDAR level environmental report with maybe some stop over or, you know, bigger things, that's fine.

But if we're talking environmental reports that would cost, you know, hundreds of thousands of dollars for even -- even more than that probably for a vendor to do. And then you have to do one, you know, applicants will start doing them to get a heads up on what you might be doing. And before you know, you're ratcheted into, you know, a huge bureaucratic type thing. So that's what the comment, I think would be extrapolated to is be careful. Don't make it bigger than it has to be.

CHAIR REMPE: I have a different question. I do appreciate you've made a lot of changes to address comments from the subcommittee meeting. But like on Page 2 of your evaluation, it said, "The staff reported PNL's proposed approach to determine the risk of transporting the micro-reactor". And you heard this also during the subcommittee meeting expand upon the fact that they average the accidents over the road. You heard them today say hey, we don't have data. You're approving or endorsing an approach that doesn't try -- that may miss the fact that certain -- that accidents may be higher at certain locations. And I'm not sure again if you endorse this that it will be clear to the applicants and the staff reviewing it that they need to go into more depth, have some sensitivity studies and certainly consider higher frequency locations along the road that might be near high population zones.

MR. MCCARTIN: Tim McCartin, NRC staff. Point well taken. We had made changes as Jonathan talked to specifically the frequency approach, but --

CHAIR REMPE: I don't see it in the slides that were done. Did I miss it?

MR. MARCANO: That was on Slide -- I talked about it on Slide No. -- This is Jonathan Marcano, NRC, Slide No. 5 of today's presentation. And we added --

MR. MCCARTIN: Well, we added an exception. Now it doesn't say that on the slide. Jonathan mentioned it in talking --

CHAIR REMPE: Okay.

MR. MCCARTIN: -- and it might have --

CHAIR REMPE: It must have gone right past me.

(simultaneous speaking)

CHAIR REMPE: I don't see that and that's --

MR. MCCARTIN: Right. Yes. But --

CHAIR REMPE: That's good.

MR. MCCARTIN: Right. And once again, it's always informative to present the information to others. And I think -- you know, once again, I think we'll go back and re-read it again. There may be other additions to make this point clear because you're right, people will read some of those words. In the sentence you read, it might imply we've agreed with the risks.

CHAIR REMPE: Or the methodologies were calculated.

MR. MCCARTIN: Well, that's what we want to make clear. We agree with the methodology. There is a significant review. The methodology is relatively easy to review. Looking at how it's used and how they develop the inputs, that is a much more intensive review. And it will have to get to the -- as we have said, commensurate with the significance to safety, there's certain things that, you know, if that frequency averaged over the route has a large impact on the risk, then that's got to be looked at and it's got to be justified.

CHAIR REMPE: That will be clear in the text you've added, which we're not seeing (audio interference)

MR. MCCARTIN: I will say I hope it is, but I completely promise that I'm going to go back and re-read the document. And I think there are some of these points that we want to be perfectly clear, not only for the general public and others that might read it. But for a potential applicant when they apply things, you do understand that the methodology is this. All these other things are going to need careful review consistent with their significant safety. That is a critical part of the endorsement that I will say I'd like to think we are --

(simultaneous speaking)

MR. MCCARTIN: We will challenge ourselves to re-read again and make sure that it is.

CHAIR REMPE: Thank you.

MR. MCCARTIN: Yeah.

MR. WHITE: Sorry. Bernie White, NRC staff. I was making a note. So the next steps. Our initial plan is to issue the commission paper by the end of January and that's dependent upon, you know, the outcome of the full committee deliberation and any letter we might receive from it. Begin pre-application engagement with ANC in the first quarter of 2024. ANC has indicated we'll receive a package application to do a safety review in the fourth quarter of 2024. And we're looking about a year -- a year and change for us to issue our findings of that safety review. The endorsement for the framework would be dependent upon (a), when we issue the commission paper and (b), whether or not it maintains its status as an information commission paper.

MEMBER MARCH-LEUBA: So NRC is going to be asking for the license, not DoD?

MR. WHITE: No. NAC -- NAC -- NAC International --

MEMBER MARCH-LEUBA: Oh. They're the ones that we --

(simultaneous speaking)

MR. WHITE: Right. So SCO has a contract with BWXT to design and develop the reactor and build it. BWXT contracted with NAC International. Not NRC, NAC to do a package application.

VICE CHAIR KIRCHNER: Just for this particular case because again, you're limiting it to TRISO fuel design, AKA right now, the Pele. This is only to move it to Idaho.

MR. WHITE: No. No.

VICE CHAIR KIRCHNER: It's to take it away from Idaho?

MR. WHITE: Take it away from Idaho after it's been used.

VICE CHAIR KIRCHNER: Through the route that you showed us in the subcommittee or --

(simultaneous speaking)

VICE CHAIR KIRCHNER: So to get it to some decommissioning place?

MR. WHITE: Yeah. So the reactor is going to be designed and built by BWXT. The fuel is being built by BWXT. They will be shipped separately. The fuel will be shipped in an NRC-approved package. We're working on that review right now. Standard normal operating practice for package removal, right, will be operated in Idaho. And somebody from -- jump in if I make a mistake please. The intent is that the safety review we do would demonstrate that it can be done. Not the fact that they're going to move it from Idaho to a specific location.

VICE CHAIR KIRCHNER: Okay, yeah.

MR. WHITE: And that's the reason why we put in a safety review and not authorizing package approval. Because if we were authorizing package approval for an exemption, we would have to have an environmental report, which would look at the route -- the exact route that was being taken. Even if we didn't have a route-specific approach, it would look at that route that was being taken and the environmental consequences along that route for shipment. That's the end of the NRC presentation.

MEMBER BALLINGER: Thank you. Are there questions from the member before we go out for public comment? Okay. Now's the time to go out for public comment. If there are members of the public or in the room, I guess, that would like to make a -- provide a statement, please give us your name and your organization and then make your comment. Since there's no ground swell, I don't think we have any comments. So that concludes the presentation and the public comments. So we thank you very much for your presentation. Our next step is to basically talk amongst ourselves and decide our path forward.

CHAIR REMPE: So Ron, I think at this time, do we want to let the Court Reporter be done?

MEMBER BALLINGER: Yeah, that was my next thing was to decide what we want -- that was the next thing. I don't think we need the Court Reporter. I think we're done.

CHAIR REMPE: Yeah. So Court Reporter, at this point, we want to thank you for your services and you're done for this meeting.

(Whereupon, the proceedings went off the record at 3:21 p.m.)

Advanced Reactor Content of Application Project (ARCAP) Interim Staff Guidance (ISG) Documents and Technology Inclusive Content of Application Project (TICAP) Guidance Documents Status

ACRS Full Committee Meeting

December 6, 2023

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Purpose and Agenda

- Provide a high-level overview of the Technology Inclusive Content of Application Project (TICAP) Regulatory Guide 1.253 and the nine Advanced Reactor Content of Application Project (ARCAP) Interim Staff Guidance Documents
- Agenda
  - High-level overview of ARCAP and TICAP structure
  - Discussion of Licensing Modernization Project
  - Discussion of Regulatory Guide 1.253 (TICAP Guidance)
  - Discussion of ARCAP interim staff guidance documents

Background – How to Access Draft Documents and Comments

- Revision 0 of ten draft documents were reissued in May of 2023 (ADAMS Package No. ML23044A038).
- Revision 1 of the TICAP guidance was issued is September of 2023
- All of the documents are available in Table 2 of the public ARCAP/TICAP webpage https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html

ARCAP ISG Title	ADAMS Accession #	Regulations.gov Docket ID	# of Comments
Draft DANU-ISG-2022-01, Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap	ML22048B546	NRC-2022-0074	68
Draft DANU-ISG-2022-02, Chapter 2, "Site Information"	ML22048B541	NRC-2022-0075	12
Draft DANU-ISG-2022-03, Chapter 9, "Control of Routine Plant Radioactive Effluents, Plant Contamination and Solid Waste	ML22048B543	NRC-2022-0076	13
Draft DANU-ISG-2022-04, Chapter 10, "Control of Occupational Doses"	ML22048B544	NRC-2022-0077	2
Draft DANU-ISG-2022-05, Chapter 11, "Organization and Human-System Consideration"	ML22048B542	NRC-2022-0078	12
Draft DANU-ISG-2022-06, Chapter 12, "Post Construction Inspection, Testing and Analysis Program"	ML22048B545	NRC-2022-0079	9
Draft DANU-ISG-2022-07, "Risk-Informed ISI/IST Programs"	ML22048B549	NRC-2022-0080	43
Draft DANU-ISG-2022-08, "Licensing Modernization Project-based Approach for Developing Technical Specifications"	ML22048B548	NRC-2022-0081	8
Draft DANU-ISG-2022-09, "Risk-Informed, Performance-Based Fire Protection Program (for Operations)"	ML22048B547	NRC-2022-0082	23
Draft Regulatory Guide 1404, "Guidance for a Technology Inclusive Content of Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Advanced Reactors"	ML22076A003	NRC-2022-0073	73
Draft Regulatory Guide 1404, Revision 1 – added Appendix B to provide additional guidance for expectations for a probabilistic risk assessment (PRA) at the construction permit (CP) stage	ML23194A194	NRC-2022-0073	30

ARCAP/TICAP Background

- Material to support today's meeting available at: ML23283A092
  - Includes ten comment resolution tables and ten guidance documents
    - Guidance documents provide a comment identification that provides a reason for the change

- ARCAP/TICAP Public Webpage provides links to key meetings and documents associated with the development of these documents (see: https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html)

ARCAP/TICAP Background

- Guidance for developing and reviewing technology-inclusive, risk-informed, and performance-based non-light water (non-LWR) applications

- Being developed to support 10 CFR Part 50 and 10 CFR Part 52 applications
  - Needed to support expected near-term non-LWR Part 50/52 applications using the licensing modernization project (LMP) process in NEI 18-04, Revision 1

- The NRC staff intends to revise the guidance per the final Part 53 rulemaking language

ARCAP Background

- Broad in nature and intended to cover guidance for non-LWR applications for:
  - combined licenses
  - construction permits
  - operating licenses
  - design certifications
  - standard design approvals*
  - manufacturing licenses*
- Encompasses TICAP
  - TICAP is guidance for off-normal reactor states only.
    - ARCAP encompasses everything needed for a license application.

* RG 1.253 does not currently address MLs and SDAs. ML and SDA applicants are encouraged to discuss their plans to use the RG with the NRC during the preapplication phase

TICAP Background

- TICAP scope is governed by the LMP-based process
  - LMP uses risk-informed, performance-based approach to select licensing basis events, develop structures, systems, and components (SSC) categorization, and ensure that defense-in-depth is considered

- Industry developed key portions of TICAP guidance
  - See NEI 21-07, Revision 1, "Technology Inclusive Guidance for Non-Light Water Reactors Safety Analysis Report Content for Applicants Utilizing NEI 18-04 Methodology," (ADAMS Accession No. ML22060A190)

- RG 1.253 (issued as DG-1404) proposes to endorse NEI 21-07, Revision 1, with clarifications and additions
  - There are no proposed exceptions

Licensing Modernization Project Background

- LMP governing guidance documents:
  - NEI 18-04 Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," (ML19241A472)
  - Regulatory Guide 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors," (ML20091L698)
  - RG 1.247. "TRIAL - Acceptability of Probabilistic Risk Assessment Results for Non-Light Water Reactor Risk-Informed Activities," (ML21235A008)

Licensing Modernization Project Background

- LMP Process endorsed by the ACRS and the Commission

  - SECY 19-0117, "Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors," (ML18311A264)
    - Staff Requirement Memorandum ML20147A504

  - The ACRS issued a letter dated March 19, 2019 (ADAMS Accession No. ML 19078A240)
    - Observed that the SECY paper proposes the next evolution of a licensing approach that has been developed over the past 30 years, and recommended that the Commission adopt the proposed approach

Licensing Modernization Project Background

- LMP System Engineering Inputs

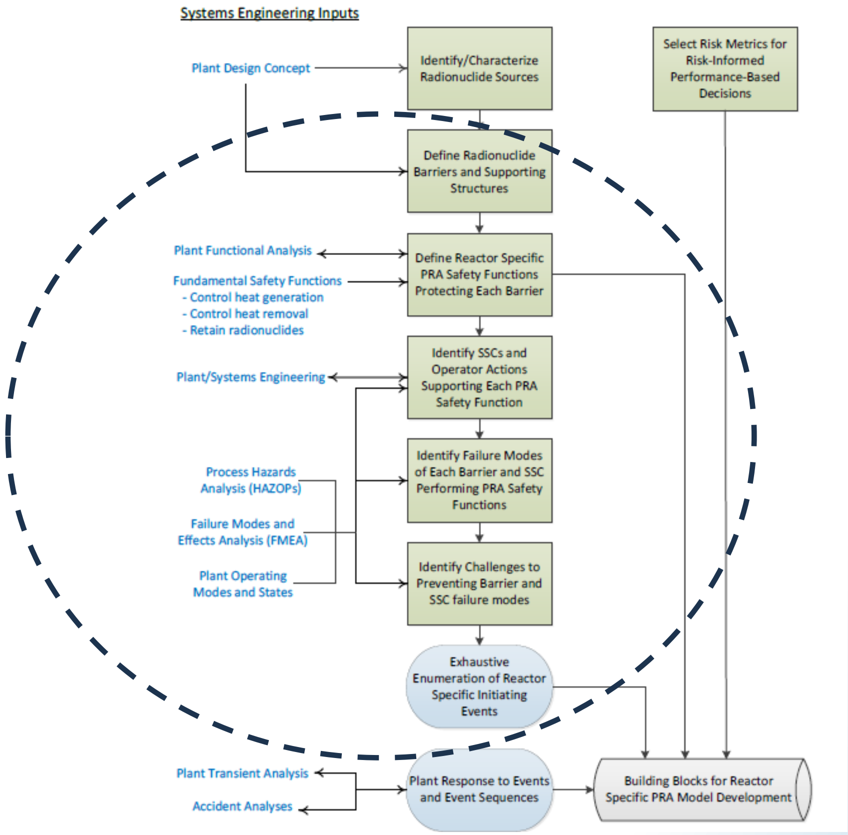
  - Fundamental Safety Functions*
    - Control heat generation
    - Control heat removal
    - Retain radionuclides

  * Event sequences involving chemical attack such as air and water intrusion in an HTGR are considered when addressing the FSFs.

  - Hazards Analyses
    - Process Hazards Analysis
    - Failure Modes and Effects Analysis
    - Reactor Specific Initiating Events

NEI 18-04 (LMP)

Figure 3-3. Flow Chart for Initial PRA Model Development



LMP Approach to Safety Functions

- *Fundamental Safety Functions:* Safety functions common to all reactor technologies and designs; includes (1) control heat generation (reactivity), (2) control heat removal and (3) confinement of radioactive material
- *Required Safety Function:* A PRA Safety Function that is required to be fulfilled to maintain the consequence of one or more DBEs or the frequency of one or more high-consequence BDBEs inside the F-C Target

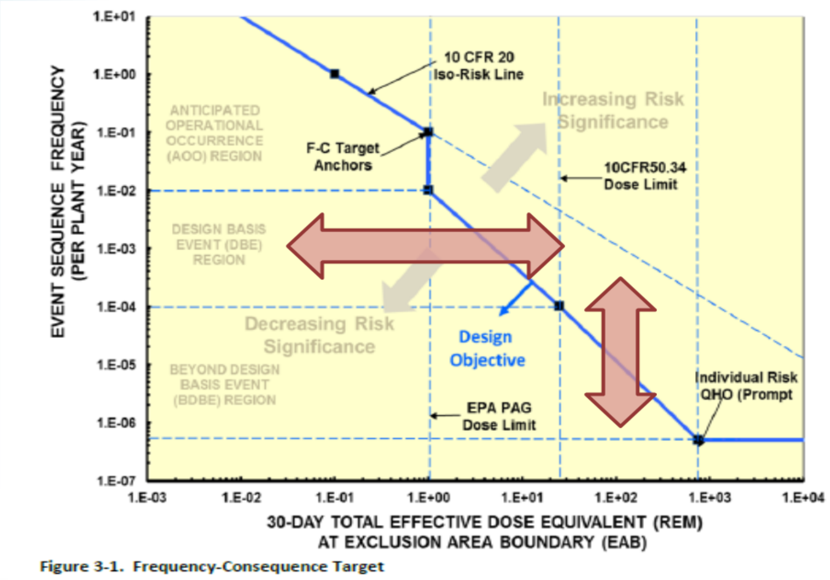
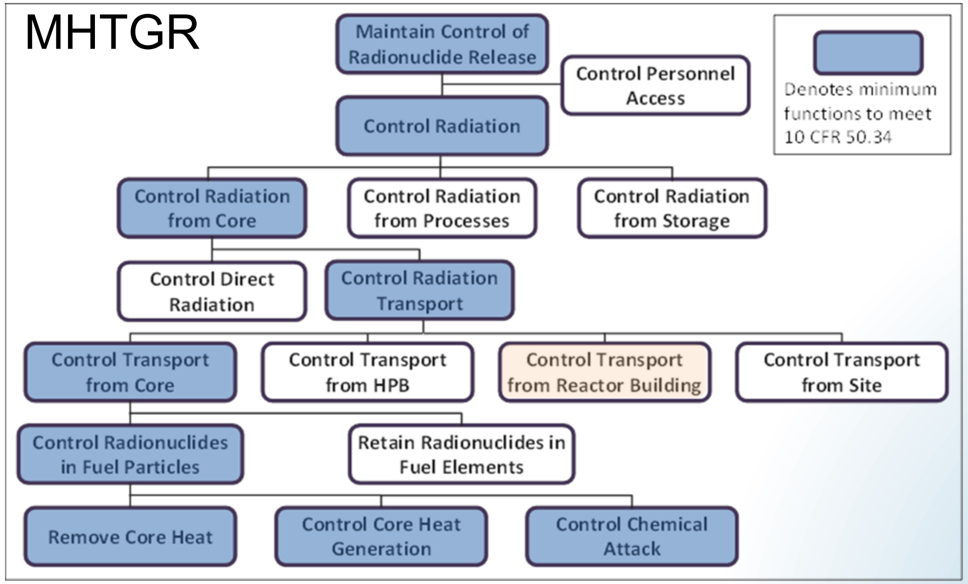


Figure 3-1. Frequency-Consequence Target



ARCAP and TICAP - Nexus

<u>Outline Safety Analysis Report (SAR) – Based on TICAP Guidance</u>

1. General Plant Information, Site Description, and Overview
2. Methodologies and Analyses and Site Information*
3. Licensing Basis Event (LBE) Analysis
4. Integrated Evaluations
5. Safety Functions, Design Criteria, and SSC Safety Classification
6. Safety Related SSC Criteria and Capabilities
7. Non-safety related with special treatment SSC Criteria and Capabilities
8. Plant Programs

Additional SAR Content –Outside the Scope of TICAP

9. Control of Routine Plant Radioactive Effluents, Plant Contamination, and Solid Waste
10. Control of Occupational Doses
11. Organization and Human-System Considerations
12. Post-construction Inspection, Testing and Analysis Programs

Audit/inspection of Applicant Records

- Calculations
- Analyses
- P&IDs
- System Descriptions
- Design Drawings
- Design Specs
- Procurement Specs
- Probabilistic Risk Assessment

<u>Additional Portions of Application</u>

- Technical Specifications
- Technical Requirements Manual
- Quality Assurance Plan (design)
- Fire Protection Program (design)
- Quality Assurance Plan (construction and operations)
- Emergency Plan
- Security Plan
- Cyber Security Plan
- SNM physical protection program
- SNM material control and accounting
- Fire Protection Program (operational)
- Radiation Protection Program
- Offsite Dose Calculation Manual
- Inservice inspection/Inservice testing (ISI/IST) Program
- Environmental Report and Site Redress Plan
- Financial Qualification and Insurance and Liability
- Fitness for Duty Program
- Aircraft Impact Assessment
- Performance Demonstration Requirements
- Nuclear Waste Policy Act
- Operational Programs
- Exemptions, Departures, and Variances)

* SAR Chapter 2 derived from TICAP guidance as supplemented by ARCAP interim staff guidance Chapter 2, "Site Information"

- Safety Analysis Report (SAR) structure based on clean sheet approach
- Additional contents of application may exist only in the SAR, may be in a separate document incorporated into the SAR, or may exist only outside the SAR.
- The above list is for illustration purposes only.

TICAP and ARCAP Roadmap Common Guidance

- Applicability is now only for non-LWRs
  - Recommends that light-water reactor applicants wanting to use ARCAP/TICAP guidance engage in pre-application discussions
- All ISGs provide applicant guidance and NRC staff review guidance in separate sections
- Removed references that did not have complete NRC staff review
  - Appendices added to several ISGs to list in-development guidance documents that could affect future revision of those ISGs

TICAP and ARCAP Roadmap Common Guidance

- Importance of Principal Design Criteria (PDC)
  - TICAP guidance covers PDCs associated with the licensing modernization project (i.e., those associated with off-normal conditions)
  - ARCAP Roadmap ISG and associated ISGs (e.g., ARCAP Chapter 9) contains PDC guidance for normal operations
  - RG 1.232, “Guidance For Developing Principal Design Criteria For Non-light-water Reactors,” (ML17325A611) provides additional guidance for reviewer consideration
  - ARCAP Roadmap ISG recommends discussion of PDC during preapplication phase

Technology Inclusive Content of Application Project and Staff Endorsement in RG 1.253

TICAP – High Level Overview

- Goal is to develop technology-inclusive guidance that proposes an optional formulation of advanced reactor application content that is based on a risk-informed, performance-based approach for demonstrating that plant safety meets the underlying intent of the current requirements

- Guidance is intended to increase efficiency of developing and reviewing an application

- Scope is governed by the LMP methodology to facilitate a systematic, technically acceptable, and predictable approach for developing key portions of a design's SAR
  - The LMP methodology provides processes for identifying LBEs, classifying and establishing special treatments for certain SSCs, and ensuring DID adequacy

- The LMP methodology is based on a full-scope probabilistic risk assessment (PRA)
  - All sources of radiological material,
  - all hazards,
  - all plant operating states,
  - full analysis of scenario progressions (i.e., analyzed from initiator to radiological consequence)

TICAP – High Level Overview

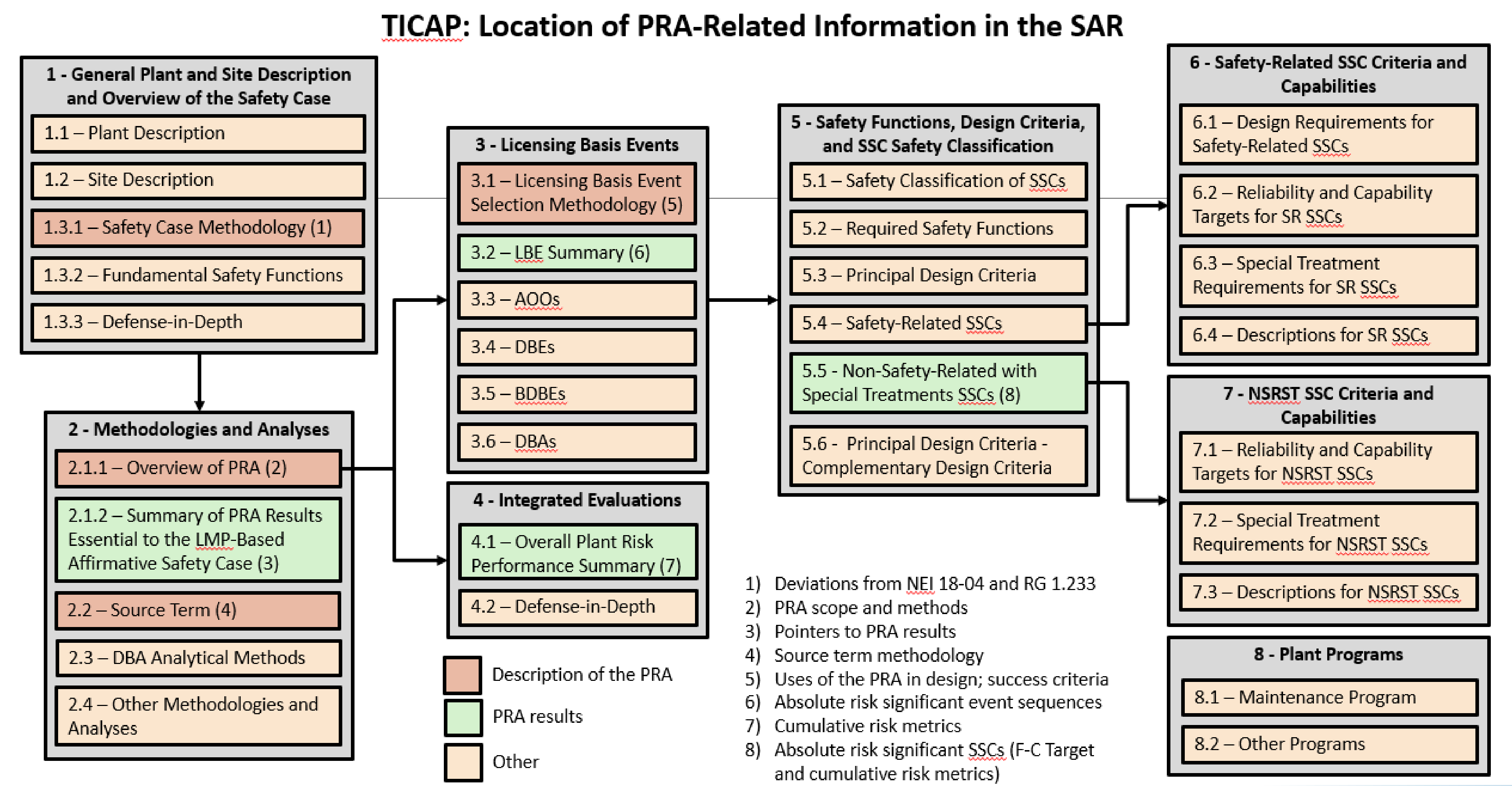
NEI 21-07 (TICAP) Safety Analysis Report Outline

1) General Plant/Site Description and Overview of Safety Case
2) Methodologies and Analyses
3) Licensing Basis Events
4) Integrated Evaluations
5) Safety Functions, Design Criteria and SSC Safety Classification
6) Safety-Related SSC Criteria and Capabilities
7) Non-Safety-Related with Special Treatment (NSRST) SSC Criteria and Capabilities
8) Plant Programs

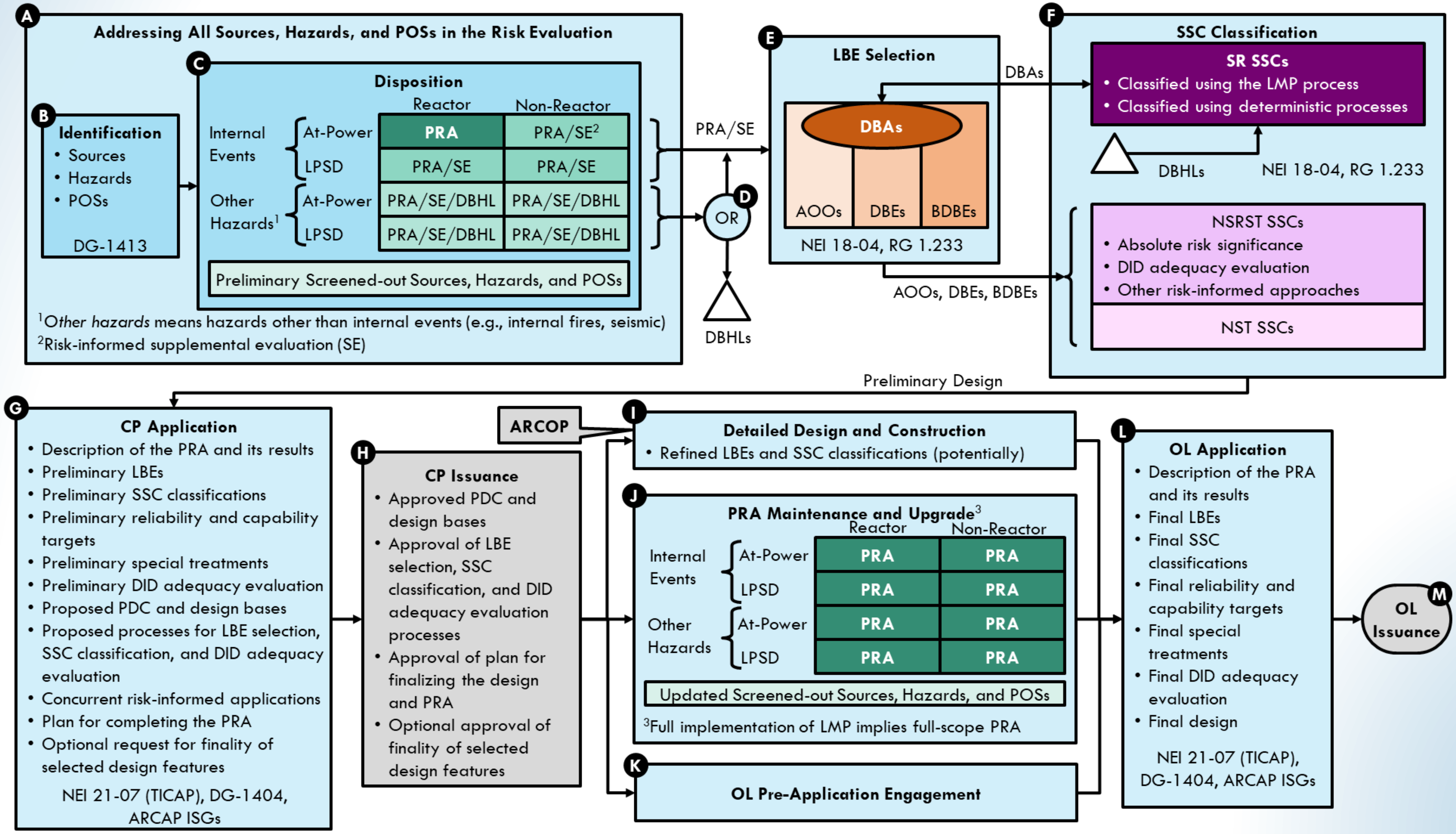
RG 1.253 (TICAP)

This RG endorses the methodology described in NEI 21-07, Revision 1, as one acceptable method for use in developing certain portions of the SAR for an application for a non-LWR CP or OL under 10 CFR Part 50, or a COL, or DC under 10 CFR Part 52. However, the NRC staff provides clarifications and additions to certain statements in NEI-21-07, Revision 1, as discussed below.

TICAP Guidance



TICAP Construction Permit/Operating License Guidance



Construction Permit PRA Acceptability

Key Points from RG 1.253, Appendix A:

- All sources, hazards, and plant operating states (POSs) should be addressed (i.e., identified and dispositioned) in the CP application, where *dispositioned* means each item is either:
  - Modeled in the PRA logic model,*
  - Screened out of the PRA logic model with justification,*
  - Accounted for using risk-informed supplemental evaluations, or
  - Accounted for using design-basis hazard levels (DBHLs) for hazards other than internal events

NOTE: Generally referring to *the PRA* implies these three items

- As a minimum, the LMP-based CP application should be supported by an internal events, at-power, reactor PRA logic model, which represents the fundamental plant response model that:
  - helps demonstrate the applicant's ability to develop an acceptable PRA logic model and
  - establishes an acceptable foundation for upgrading the PRA logic model as the design progresses
  - while acceptable for the CP stage of licensing, achieving only the minimum scope of the PRA logic model may not realize the full benefit of the LMP methodology

* The ASME/ANS non-LWR PRA consensus standard, ASME/ANS RA-S-1.4-2021, provides requirements and processes for defining the scope of the CP PRA logic model.

Construction Permit PRA Acceptability

Key Points from RG 1.253, Appendix A (continued):

- A self-assessment of the PRA logic model, screening analyses, and risk-informed supplementary evaluations helps reduce the need for in-depth NRC review
  - This could be a peer review but is not required as such

- The CP application should provide a preliminary, yet complete**, set of LBEs

- The CP application should provide a preliminary, yet complete**, SSC classifications

- Further expectations
  - The CP application should provide a plan for maintaining and upgrading the PRA during construction.
    - Example: Replacing a seismic DBHL with a seismic PRA
    - CP holders are encouraged to keep the staff advised of changes to the PRA completion plan that significantly affect the design.

** Consistent with the maturity of design information and relative to the scope of the PRA logic model, screening analyses, and risk-informed supplementary evaluations supporting the CP application.

Advanced Reactor Content of Application Project Interim Staff Guidance Documents – Overview

ARCAP Roadmap Overview

- Provides guidance for other portions of the application outside of ISGs including emergency plan, security, financial qualification and insurance and liability
- Includes four appendices
  - Appendix A – Preapplication Guidance
  - Appendix B – Applicability of Regulations to non-light water reactors
  - Appendix C – Construction Permit Guidance
  - Appendix D – Draft Documents Under Development

Additional Portions of Application

- Technical Specifications
- Technical Requirements Manual
- Quality Assurance Plan (design)
- Fire Protection Program (design)
- Quality Assurance Plan (construction and operations)
- Emergency Plan
- Security Plan
- Cyber Security Plan
- SNM physical protection program
- SNM material control and accounting
- Fire Protection Program (operational)
- Radiation Protection Program
- Offsite Dose Calculation Manual
- Inservice inspection/Inservice testing (ISI/IST) Program
- Environmental Report and Site Redress Plan
- Financial Qualification and Insurance and Liability
- Fitness for Duty Program
- Aircraft Impact Assessment
- Performance Demonstration Requirements
- Nuclear Waste Policy Act
- Operational Programs

Chapter 2 Overview

- Chapter 2 provides guidance on the scope and approach for selecting the external hazards which must be considered in the plant design.
- The selection of external hazards is to be informed by a probabilistic external hazards analysis, when supported by available methods, data, standards and guides.
- Chapter 2 limits the amount of information that needs to be provided in the SAR to that necessary to establish the design basis external hazards.
- Chapter 2 refers to existing site evaluation guidance (e.g., RGs) where appropriate.
- The guidance in Chapter 2 is based upon the requirements of 10 CFR Part 100, Subpart B.
- 12 comments received.

Chapter 9 Overview

- Applies a performance-based approach for level of detail of information provided in the SAR related to control of routine plant radioactive effluents, plant contamination and solid waste

Chapter 10 Overview

- Applies a performance-based approach for level of detail of information provided in the SAR regarding the control of occupational dose

Chapter 11 Overview

- Supports Part 50 and 52 non-LWR applications with relatively traditional concept of operations
  - Does not address remote or autonomous operations
- Guidance to applicants and NRC reviewers on:
  - Organizational staffing
  - Qualifications
  - Training
  - Operator Licensing: staffing exemptions, licensing during plant construction (i.e., cold licensing), considerations for new programs, other exemptions
- NRC staff also incorporated human factors engineering (HFE) guidance to supplement LMP and TICAP guidance

Chapter 12 Overview

- Intended to provide guidance to the NRC staff regarding application content that would support making the finding that the constructed plant has met the applicable Part 50 and Part 52 regulations to support issuance of an operating license or authorization to load fuel, respectively
- ISG differentiates between 10 CFR Part 52 applicants that must include inspections, tests, analyses and acceptance criteria (ITAAC) and 10 CFR Part 50 applications that are not required to include ITAAC.
- Requirements to describe preoperational testing and initial operations in OL and COL applications are contained in 50.34(b)(6)(iii) and 52.79(a)(28), respectively.
- Provides guidance for:
  - post-manufacturing and construction inspection, preoperational testing (i.e., tests conducted following construction and construction-related testing, but prior to initial fuel load), analysis verification, and
  - initial startup testing (i.e., tests conducted during and after initial fuel load, up to and including initial power ascension).

ARCAP ISI/IST Overview

- The ISG provides guidance for developing risk-informed, performance-based ISI/IST programs for non-LWRs.
- The ISG guidance is based upon the use of a plant-specific PRA to identify the SSCs to be included in the programs.
- The ISI guidance is based upon the use of:
  - ASME BPV Code, Section XI, Division 2, “Requirements for Reliability and Integrity Management (RIM) Programs for NPPs,” for developing the ISI program using risk information and an expert panel.
  - ASME BPV Code, Section III, Division 5, “High Temperature Reactors,” for designs using high temperature materials and notes that ASME is developing a flaw evaluation Code Case for high temperature materials.

ARCAP ISI/IST Overview (continued)

- The IST guidance is based upon:
  - Existing IST program approach, with additional guidance for passive components, and notes that ASME is developing a new OM-2 Code for inservice testing of components in new and advanced reactors, including non-LWRs.
  - Using plant-specific risk information to determine the scope of the IST program and proposed testing frequencies.

ARCAP Technical Specifications - Overview

- The text in the 10 CFR 50.36 regulations for TS content needs adaptation to correlate to the analysis and outputs of the risk-informed LMP approach described in NEI 18-04.

- Guidance addresses content for TS administrative controls section and recommended TS format

ARCAP Fire Protection for Operations- Overview

- 10 CFR 50.48(a) requires that each operating nuclear power plant have a fire protection plan that meets the requirements of either 10 CFR Part 50, Appendix A, Criterion 3 for LWRs or the applicant's proposed principal design criteria that have been deemed acceptable by the NRC.
  - Although 10 CFR 50.48(c) – NFPA 805 – does not apply to non-LWRs, concepts associated with this risk-informed approach are included in the draft ISG

- The scope of this ISG addresses the review of the application content regarding the fire protection program for operations including application descriptions of:
  - Management policy and program direction and the responsibilities of those individuals responsible for the program/plan's implementation.
  - The integrated combination of procedures and personnel that will implement fire protection program activities.

Acronyms and Initialisms

ADAMS	Agencywide Documents Access and Management System
ANS	American Nuclear Society
AOO	abnormal operating occurrence
ASME	American Society of Mechanical Engineers
ARCAP	Advanced Reactor Content of Applications
ARCOP	Advanced Reactor Construction Oversite Process
BDBE	beyond design-basis event
CDC	complementary design criteria
CFR	Code of Federal Regulations
COL	combined license
CP	construction permit
DBA	design-basis accident
DBE	design-basis event
DBEHL	design-basis event hazard level (NEI 18-04)
DBHL	design-basis hazard level (NEI 21-07)
DC	design certification
DG	draft regulatory guide
DID	defense in depth
EAB	exclusion area boundary
FOAK	first-of-a-kind
FR	Federal Register
FSAR	final safety analysis report
FSF	fundamental safety function
GSI	generic safety issue
HFE	human factors engineering
HTGR	high temperature gas cooled reactor
HPB	helium pressure boundary
ISG	interim staff guidance
ISI	inservice inspection
ISG	inservice testing
ITAAC	inspections, tests, analyses and acceptance criteria
LBE	licensing basis event
LCO	limiting condition for operation
LMP	Licensing Modernization Project
LPSD	low-power and shutdown

Acronyms and Initialisms (continued)

ML	manufacturing license
NEI	Nuclear Energy Institute
NEIMA	Nuclear Energy Innovation and Modernization Act
NFPA	National Fire Protection Association
NLWR	non-light-water reactor
NPUF	non-power utilization facility
NSRST	non-safety-related special treatment
NST	no special treatment
OL	operating license
PDC	principal design criteria
POS	plant operating state
PRA	probabilistic risk assessment
PSAR	preliminary safety analysis report
RFDC	required functional design criteria
RG	regulatory guide
RSF	required safety function
SAR	safety analysis report
SDA	standard design approval
SE	supplemental evaluation
SR	safety related
SRM	staff requirements memorandum
SSC	structure, system, and component
TEDE	total effective dose equivalent
TICAP	Technology-Inclusive Content of Applications
TIRICE	Technology-Inclusive, Risk Informed Change Evaluation
TIMaSC	Technology-Inclusive Management of Safety Case
TS	Technical Specification

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NRC REVIEW OF A RISK-INFORMED METHODOLOGY FOR A TRANSPORTABLE MICRO-REACTOR PACKAGE

Advisory Committee on Reactor Safeguards
December 6, 2023

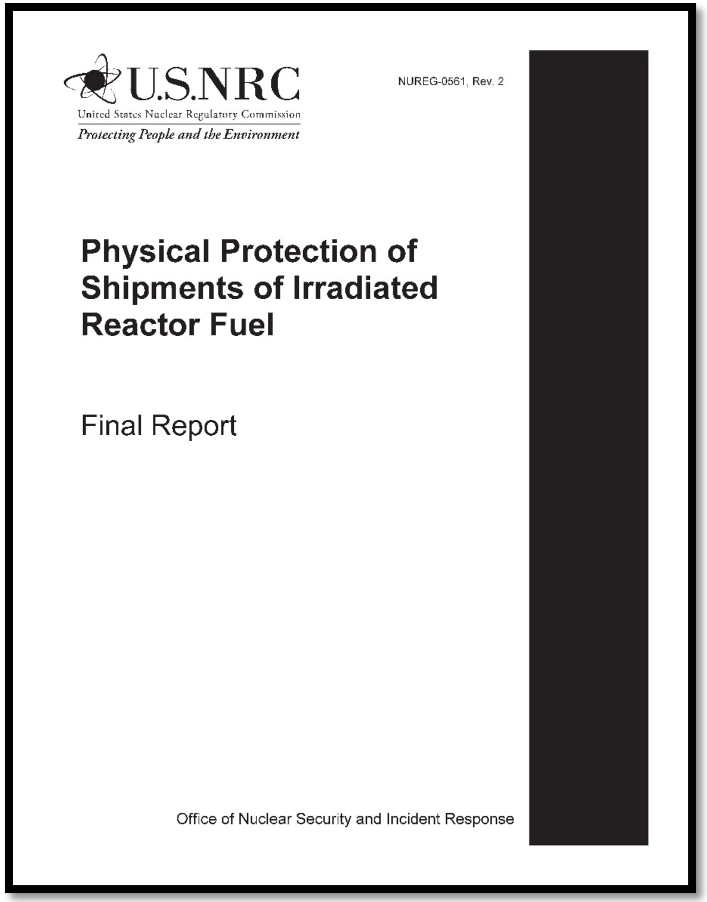
Bernard White, Senior Project Manager
Jonathan Marcano, Senior Risk and Reliability Analyst
Division of Fuel Management
Office of Nuclear Material Safety and Safeguards

Agenda

- Overview of NRC requirements for spent fuel transport
- Methodology limitations
- Endorsement clarifications from ACRS subcommittee meeting
- Next steps

NRC Requirements for Spent Fuel Shipments

- Package approval and benchmarking
- Route approval
  - Route selection criteria
  - Safe havens
  - Contact information
- Security
  - Pre-Plan & coordinate w/States & Tribes
  - Armed escorts
  - Monitor shipments
  - Advanced notifications


U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-0561, Rev. 2

Physical Protection of Shipments of Irradiated Reactor Fuel

Final Report

Office of Nuclear Security and Incident Response

Methodology Endorsement

- Scope limited to:
  - Two shipments by road only for Project Pele
  - Specific route
  - Tri-structural isotropic (TRISO) fuel only
- Widespread use would necessitate further discussion, such as
  - Generic applicability and rulemaking
  - Numerous (1 vs 100) shipments and co-located hazards
  - Societal risk

Clarifications as Result of ACRS Subcommittee

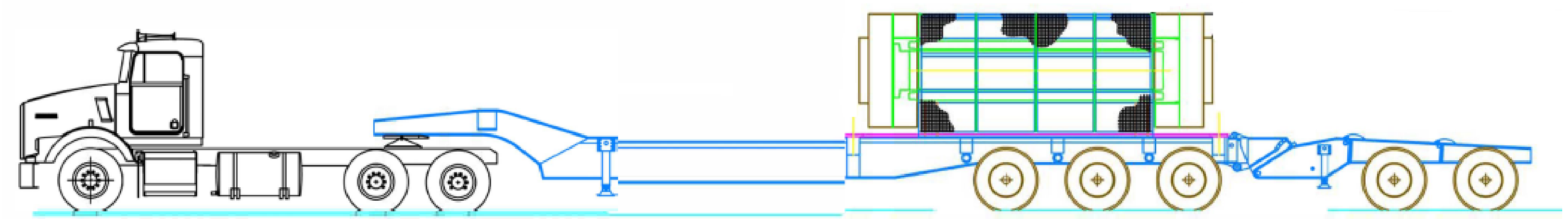
- NRC staff added additional language to sufficiently describe the scope of the Methodology Endorsement
  - Endorsement limited to approach and not the justification of numerical values (e.g., frequency estimates, dose calculations)
  - Justification of numerical values will be addressed during the review of an application

Clarifications as Result of ACRS Subcommittee

- Applicant should consider cliff-edge effects (e. g., Regulatory Guide 1.233)
- Revised to include for material degradation, such as corrosion, oxidation, or radiation, as required by Title 10 of the *Code of Federal Regulations* 71.43(d)

Exemption Request

- Safety review
  - PRA
  - Structural evaluation
    - Normal conditions of transport and
    - Hypothetical accident conditions ←Methodology
  - Thermal evaluation
    - Normal conditions of transport and
    - Hypothetical accident conditions ←Methodology
  - Containment evaluation
  - Shielding evaluation (dose consequences)
  - Criticality safety
  - Materials evaluation
- Protect the common defense and security
- Environmental review



Drawing courtesy of NAC International

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Next Steps

Issue Commission Paper (Information)
January 31, 2024

Pre-application Engagement with NAC
First Quarter 2024

Receive NAC Package Application
Fourth Quarter 2024

Issue Safety Review of Package Design
Early 2026

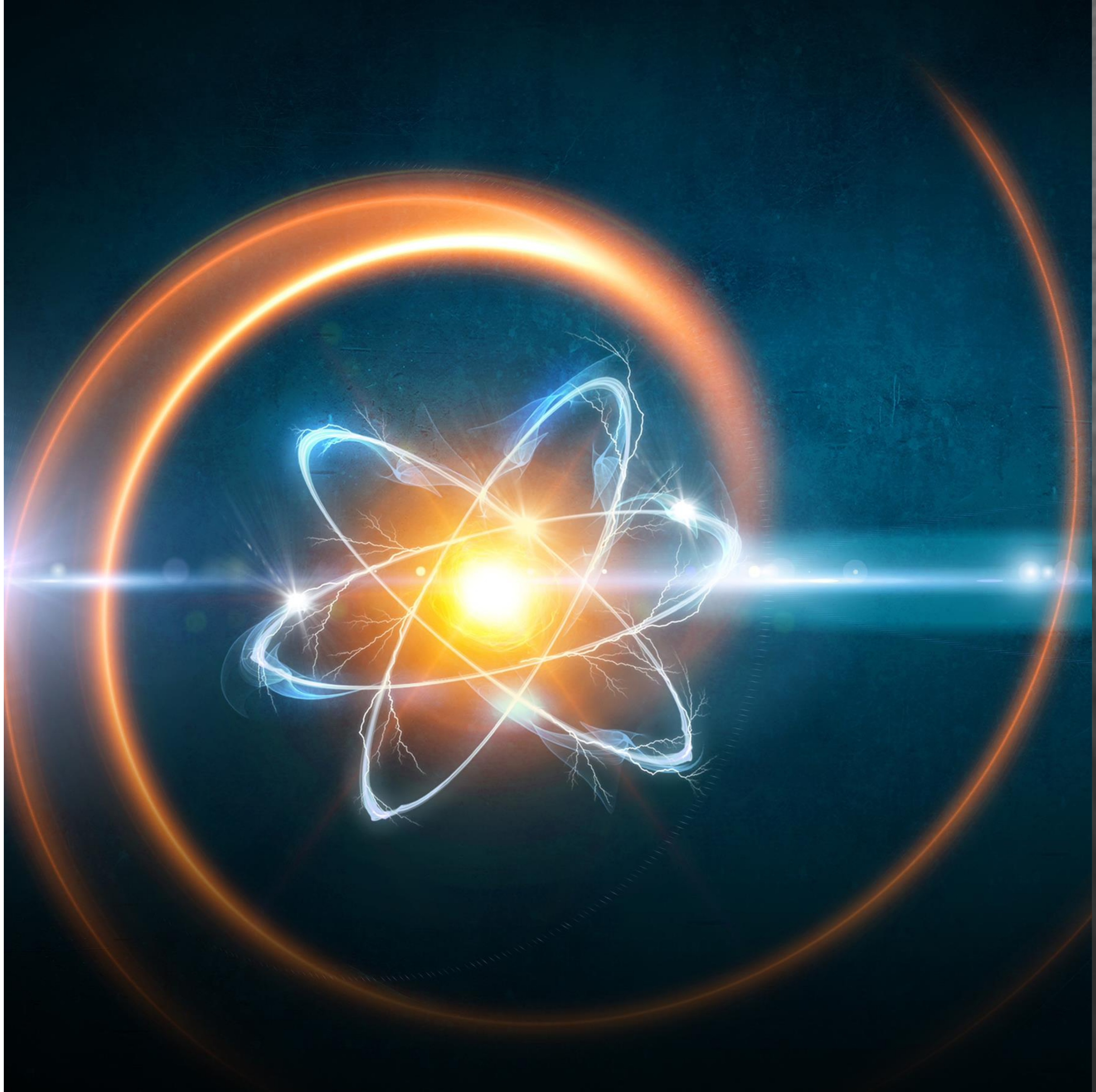
Methodology approval needed by NAC in January 2024

Pacific Northwest
NATIONAL LABORATORY

Development and Application of a Risk-Informed Approach for Regulatory Approval for Highway Shipment of a Microreactor

Harold Adkins
Garill Coles
Steve Maheras

Advisory Committee on Reactor Safeguards Meeting
December 6, 2023
Washington D.C.



U.S. DEPARTMENT OF ENERGY BATTELLE
PNNL is operated by Battelle for the U.S. Department of Energy

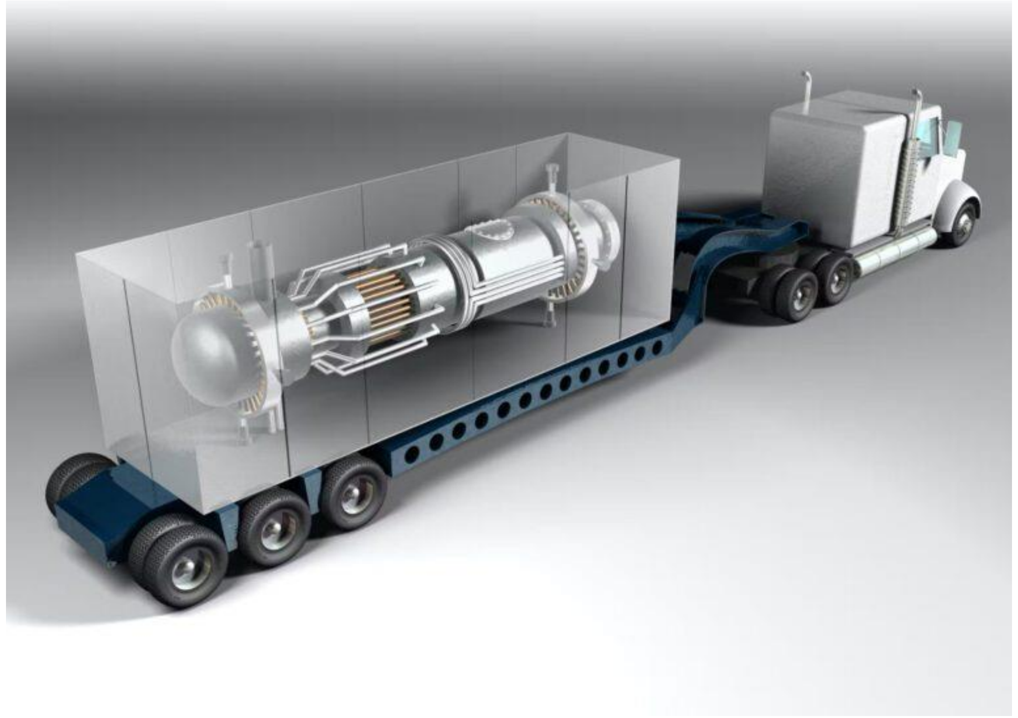
Purpose and Major Elements of Presentation

Purpose: Provide background information on proposed risk-informed regulatory approach for the transportation of a transportable nuclear power plant (TNPP) in support of NRC draft safety evaluation

1. Brief description of the demonstration TNPP
2. Description of the proposed risk-informed regulatory pathway for TNPP transport and why it is needed
3. Overview of proposed risk evaluation guidelines
4. Overview of quantitative risk assessment process using an integrated assessment process based on probabilistic risk assessment (PRA) methods which includes use of sensitivities and uncertainty analysis and consideration of defense in depth (DID) and Safety Margin (SM)
5. Example results of applying the proposed PRA and risk evaluations guidelines to the demonstration TNPP using proposed approach
6. Brief clarification in response to questions raised during the November 17 ACRS meeting.

Project Pele TNPP Package used to Demonstrate Risk-Informed Regulatory Pathway

- Many advanced reactor vendors are developing TNPPs to make higher density energy readily available for:
  - Department of Defense's (DOD's) domestic infrastructure resilient to electric grid attack
  - Enabling rapid response during Humanitarian Aid and Disaster Relief (HADR) operations
  - Clean, zero-carbon energy in a variety of austere conditions and off-grid locations
- These TNPP conventions would be factory produced, fueled, acceptance tested, and deployed as sealed units prepared for transport and retrieved for refueling and reapplication
- Project Pele is a HTGR using HALEU UCO TRISO fuel
  - 1 to 5 MWe, minimum of 3 years of full power operation
  - Comprised of a Reactor, IHX, Control, and Power Conversion Module
  - Reactor Module contains a vast majority of radioactivity at EOL (remainder in IHX Module)
  - Each module contained in and integral with separate ISO-compliant CONEX box-like containers



Semi-Tractor and Trailer Carrying Reactor Module

Photo courtesy of News & Technology for Global Energy Industry, April 21, 2022
https://www.powermag.com/green-light-for-project-pele-defense-departments-mobile-nuclear-microreactor-demonstration/

Acronyms: MWe – megawatt electric; HTGR – high temperature gas-cooled reactor, HALEU – high-assay low-enriched uranium; UCO – uranium oxycarbide; TRISO – tri-structural isotropic; IHX – intermediate heat exchanger; EOL – end of life; ISO- International Organization for Standardization; CONEX – container express

Need for Risk-Informed Regulatory Approach and Basis for Proposed Regulatory Approach

- A TNPP with its irradiated fuel contents prepared as a package for transport could be challenged to meet the entire suite of regulatory performance requirements in 10 CFR 71 as they are intended for thick-wall steel vessel for SNF transportation package
  - It is anticipated that the TNPP will be capable of being deterministically shown to comply with the Normal Conditions of Transport (NCT) as outlined in 10 CFR 71.71
  - However, it may be challenging to demonstrate that the level of robustness of current proposed TNPP technology can fully meet the dose rate and containment success criteria after Hypothetical Accident Conditions (HAC) tests as outlined in 10 CFR 71.73
    - ✓ E.g., Sequential 30 ft free drop, crush, puncture free drop, 30-minute engulfing hydrocarbon fire, and water immersion tests
- Leverage compensatory measures, defense-in-depth approaches, and philosophies to establish equivalent safety. Also leverage consideration of TRISO, compact, fuel sleeve, core, and reactor structure related inherent retention and protection boundaries
- If Fissile Material or Type B package postulated HAC requirements (10 CFR 71.73) cannot be directly met, then other options such as 10 CFR 71.41(c), 10 CFR 71.41(d), or 10 CFR 71.12 (Exemption) are possible
- Preferred initial pathway identified by PNNL is the Exemption process that allows compensatory actions to protect the basis of exemption if acceptable risk is demonstrated
  - Can apply to more than a single shipment unlike Special Package Authorization (10 CFR 71.41(d))
  - Flexibility in deviating from deterministic requirements compared to Alternative Environmental and Test Conditions

Reasoning Behind Selection of this Regulatory Approval Pathway

- Quantitative risk analysis approaches such as Probabilistic Risk Assessment (PRA) are used in risk-informed regulatory approaches for the NRC:
  - PRAs have been conducted since the 1970s for nuclear reactors starting with WASH-1400 and used since the 2000s for risk informed licensing applications.
  - PRA has also been used to assess:
    - ✓ Dry cask storage systems at a nuclear power plants (see NUREG-1864)
    - ✓ Transportation of spent nuclear fuel (SNF), most notably in NUREG/CR-4829, NUREG/CR-6672, and NUREG-2125
    - ✓ Risks of transporting SNF to the Yucca Mountain repository by truck and rail (DOE/EIS-0250)
- Proposed to NRC as an aid in developing a near-term approval pathway to drive Advanced Factory-Produced TNPP development and deployment
- Bridges the gap between the current regulatory framework (thick-wall steel vessel based) and the level of robustness of current proposed TNPP technology
- Provides buffer time for strategic regulatory considerations and possible rule making to accommodate advanced, transportable, microreactor conventions

Risk-Informed Regulatory Approval – Using Exemption Process

- Quantitative Risk Assessment - Demonstration of acceptable risk will require a quantitative assessment given (1) the complexities and uncertainties about package performance and (2) potential risk to public. PRA provides a rigorous quantitative approach
  - Unlike the approval pathways used in the past (e.g., Trojan Reactor Vessel), it is unlikely that all accident scenarios can be screened based on likelihood.
- Risk Evaluation Guidelines - Quantitative risk assessments work best when supported by guidelines about acceptable risk as a key basis for regulatory decisionmaking
- However – risk-informed regulatory guidelines using PRA do not exist for transportation packages like they do for nuclear power plants (NPPs)
- That said – The proposed risk evaluation guidelines are based on the risk-informed decision making (RIDM) guidance in NRC 2008 report for nuclear material and waste applications (ML080720238)
  - This guidance includes proposed quantitative health guidelines (QHGs) developed from the 1986 NRC Safety Policy Statement for the worker as well as the public
  - Challenges remain in its implementation and the approach has not been endorsed for use by NRC as that would be a policy decision

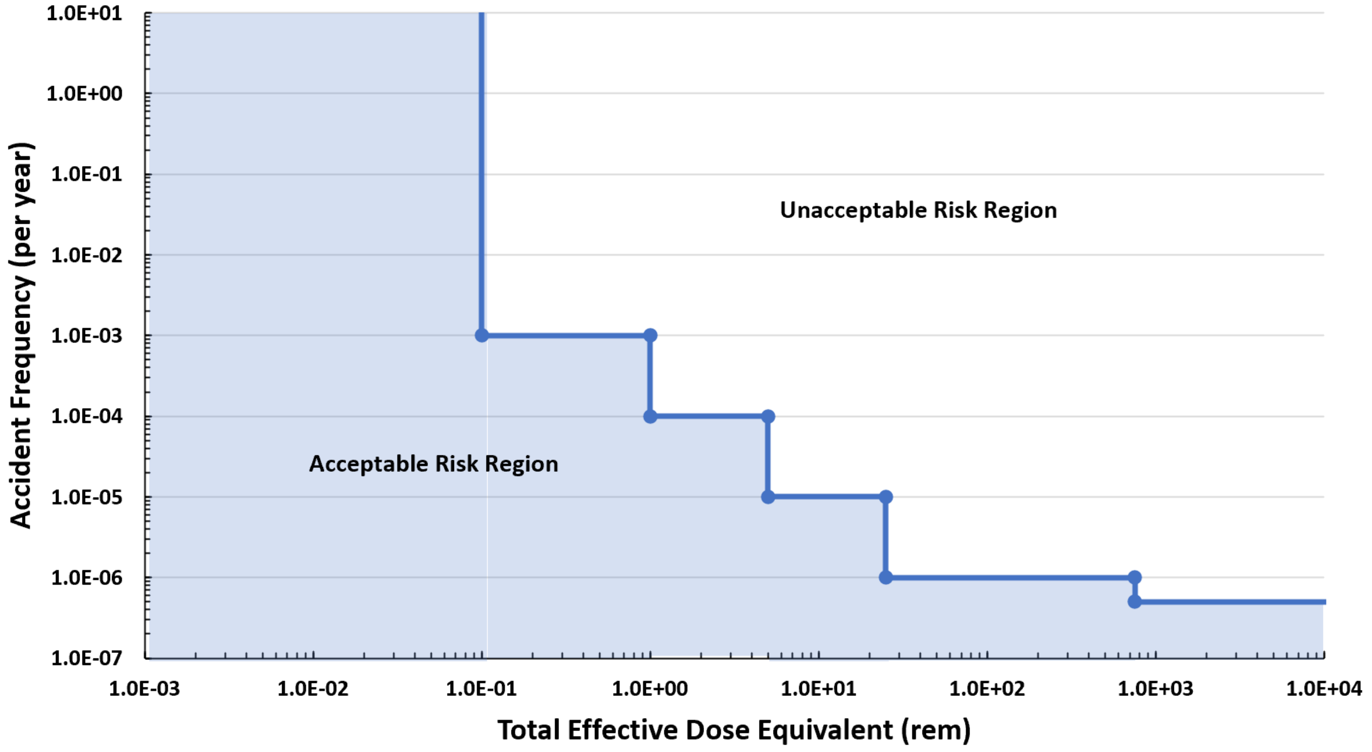
Justification for Using Surrogate Measures for QHGs

- However, PNNL proposes using surrogate measures for QHGs proposed in the NRC 2008 RIDM report
  - In the same way that Core Damage Frequency and Large Early Release Fraction are used instead of health effects for risk-informed applications for the current fleet as justified in NRC RG 1.200.
- Specifically, PNNL proposes formulating goals in terms of pairs of radiological dose and likelihood limits to an individual receptor which are more feasible to achieve:
  - Reduces calculational burden by eliminating determination of health effects
  - Dose limits can be compared to other federal/international dose limits used in related contexts
  - Determining likelihood and consequence as pairs provides added information for decisionmaking
- PNNL examined the use of dose consequence and likelihood from other applications
  - NEI 18-04 provides risk-informed licensing basis development for advanced non-light-water NPPs
  - DOE-STD-3009 applies risk ranking using dose and likelihood for nonreactor facility nuclear safety analysis
  - NUREG-1513, NUREG-1520, and 10 CFR Part 70 Subpart H provide guidance used in Integrated Safety Analysis (ISA) for determining performance requirements for nuclear fuel cycle facilities
  - The Q system in Appendix I of International Atomic Energy Agency (IAEA) Specific Safety Guide (SSG)-26 uses a reference dose to determine an upper quantity limit of radionuclides in Type A package (greater quantities require Type B)
    - ✓ Exposure time – 30 min

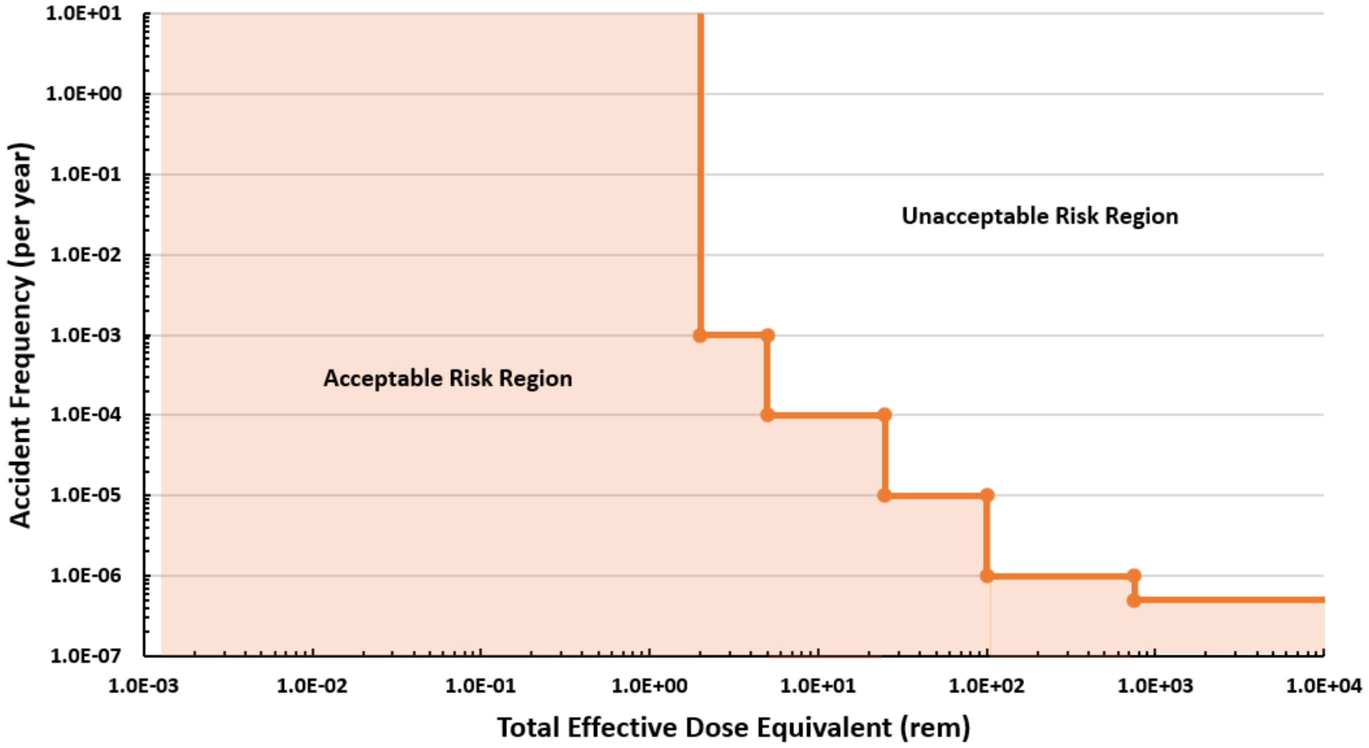
Proposed Risk Evaluation Guidelines

Proposed risk evaluation guidelines compatible with NRC nuclear safety goals, Qualitative Health Objectives, and NRC-proposed QHGs in the NRC 2008 RIDM report

For the Maximum Exposed Member of the Public

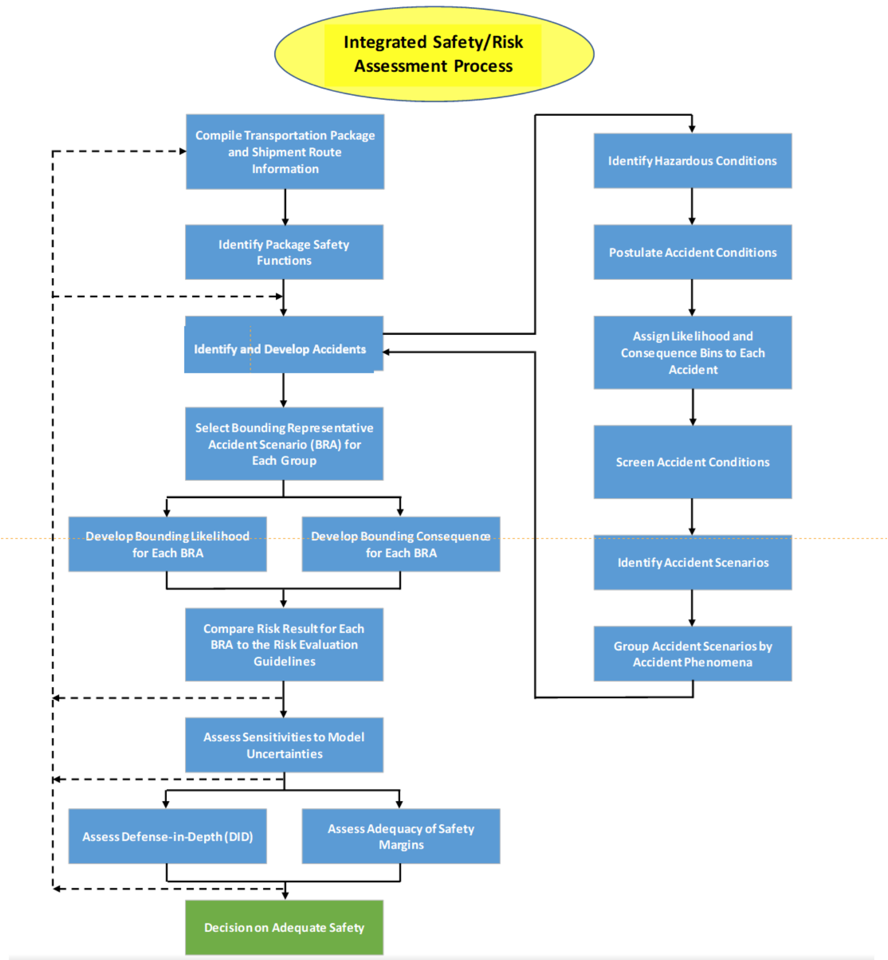


For the Worker



Integrated Risk Assessment Process

- Uses probabilistic risk assessment (PRA) approaches and methods to the level of Bounding Representative Accidents
- A transportation PRA on the Project Pele TNPP was performed as a demonstration of the approach, applying the following steps:
    1. Compilation of the TNPP design and Shipment Route Information – which is information intensive and should be started early
    2. Identification of the Package Safety Functions
    3. Identification and Development of Accidents Scenarios
    4. Definition of Bounding Representative Accidents
    5. Development of Likelihood for Bounding Representative Accidents
    6. Development Bounding Consequences for Bounding Representative Accidents
    7. Comparison of Risk Results to Proposed Risk Evaluation Guidelines
    8. Assessment of Sensitivities and Model Uncertainty
    9. Assessment of Defense-in-Depth and Safety Margin

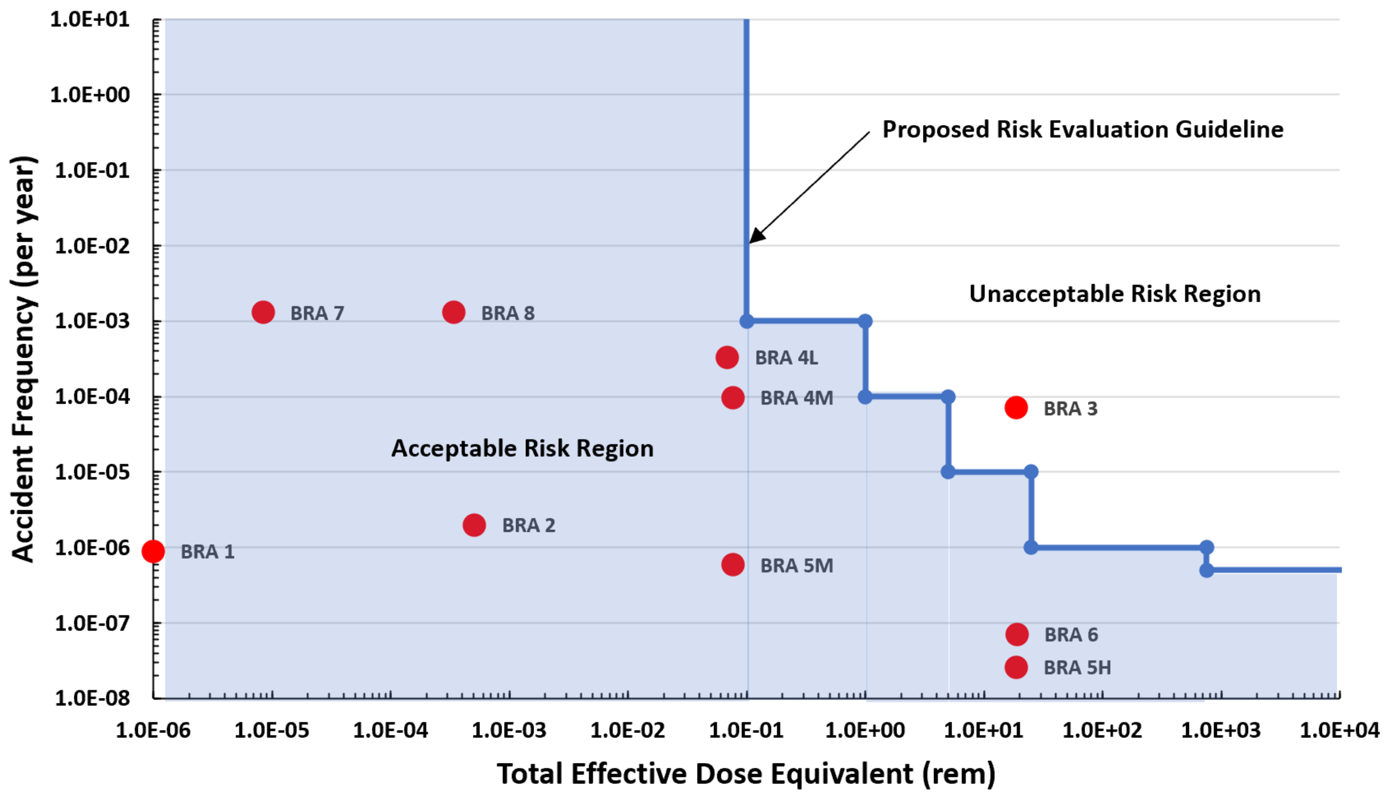


Probabilistic Risk Assessment Development Process

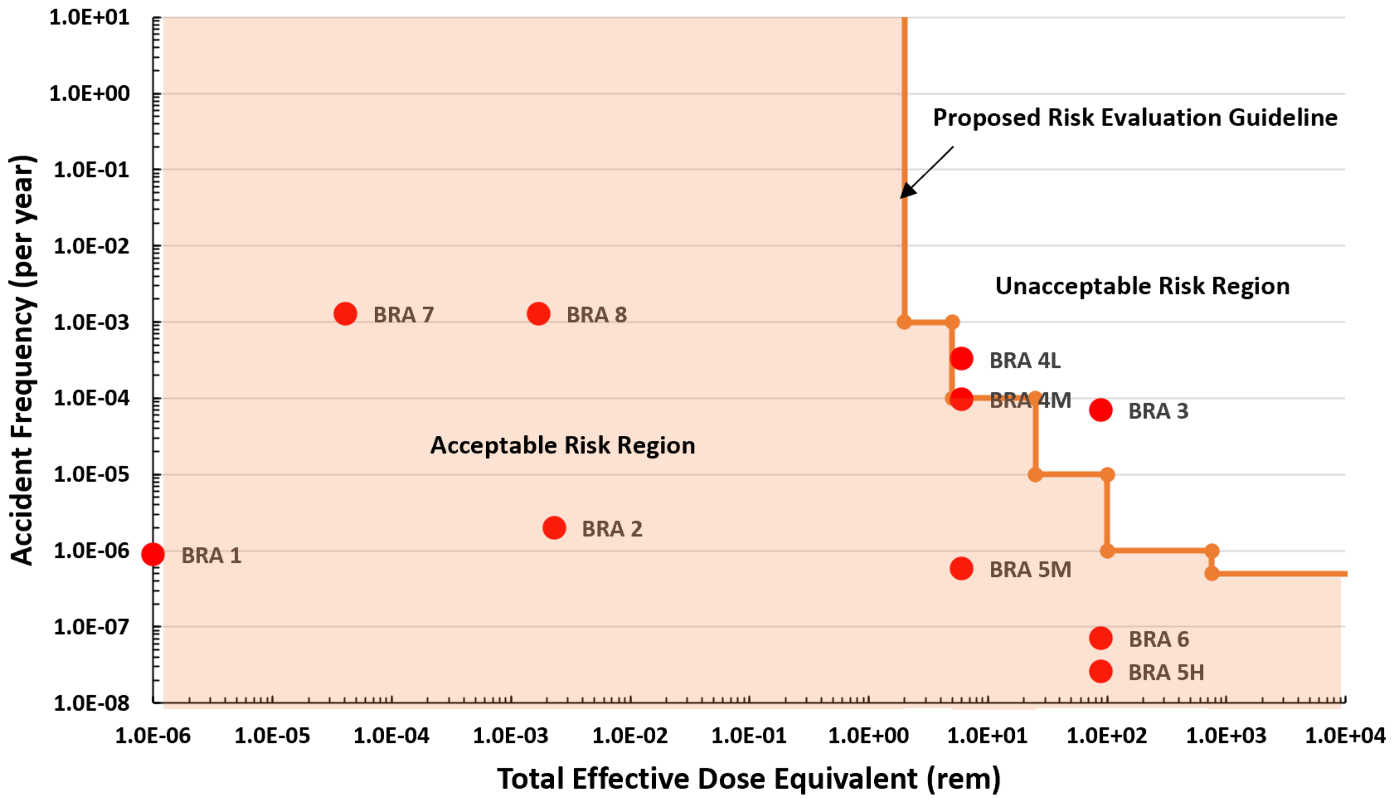
Summary of Demonstration TNPP PRA Risk Results

- Risk for the Bounding Representative Accident Results Shown Graphically

For the Maximum Exposed Member of the Public



For the Worker



Note: BRA 9A and 9B - two kinds of flooded criticality events - are not shown here because their consequences were not calculated given that their likelihoods were determined to be extremely low.

BRA 10 – reactivity insertion caused by crash impact leading to criticality was not developed because it was anticipated the demonstration design will preclude (or design against) this possibility (e.g., using locking mechanisms)

Follow-up Topics From the Last Meeting

1. Cliff edge effects
   - Criticality is an example because even though it occurs less than a frequency of 5E-07 per year it introduces a new phenomenon and might produce a dose greater than 750 rem dose.
   - Other factors that could impact risk are seen as having just incremental effects.
2. Modeling accident recovery
   - The purpose of recovery is to mitigate occupational exposure
   - Reduction of accident risk using recovery action (if possible) is not credited in the PRA
   - Recovery can involve increased occupational dose for radiation workers. However, this dose is managed by a recovery plan under a radiation protection program and not under the Risk Evaluation Guidelines
3. Risk Evaluation Guidelines for multiple shipments
   - The demonstration was done for a shipment in one year. It could be applied per TNNP for multiple shipments per year by increasing the accident frequencies proportionately.
4. Generic Applicability
   - PNNL believes that the approach has generic applicability and in fact used a similar approach for DOE National Nuclear Security Administration for a package not meeting the codified requirements.
   - However, the approach should be demonstrated for other modes of transport (e.g., barge, rail, maritime) and other types of packages,… because there would no doubt be differences and knowledge transfer.

Follow-up Topics From the Last Meeting

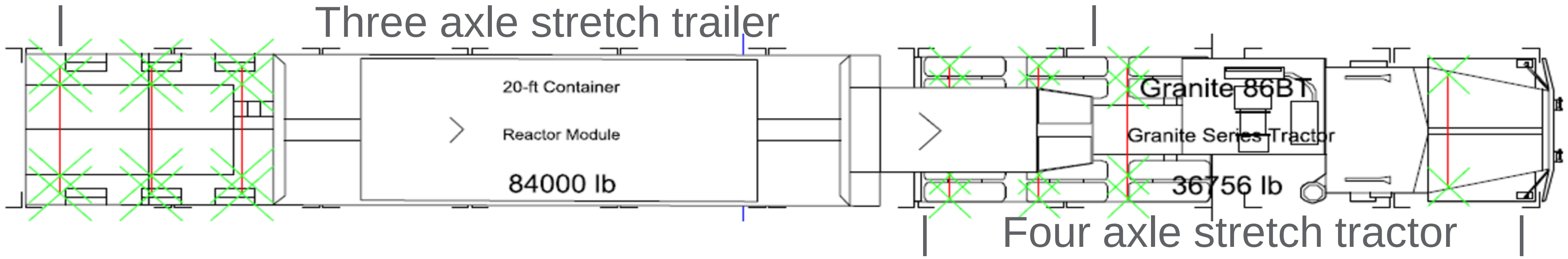
5. Use of state-level accident rates versus route segment-specific accident rates
   - Accident rate data are for trucks > 26,000 lbs. and legal weight trucks have a maximum weight of 80,000 lbs.
     - ✓ Trucks that would carry a Reactor Module would weigh approximately 150,000 lbs. and would require a state-issued permit to be operated on interstates, highways, and roads
     - ✓ These permits are issued by a state to provide permission for an oversize or overweight vehicle and load to travel on a specific route, and potential hazards are mitigated through permit conditions such as requiring route surveys, the time of day and day of week during which travel is allowed, the number or spacing of the vehicle's tires to distribute the weight of the load, the speed that the load can travel, the use of warning signs and lights, the use of escorts, etc.
   - Vehicle-mile data are not reported for specific locations
     - ✓ Reported at the functional system level (interstates, other freeways and expressways, etc.) for each state, for rural and urban areas (DOT Table VM-2)
     - ✓ Reported by vehicle type for road type level (interstates, other arterials, other roads), for each state, for urban and rural areas (DOT Table VM-4)
   - Existing analyses are not designed to estimate accident risks at specific locations along the routes; rather, they are designed to integrate the risk over the entire route in a probabilistic manner consistent with the Risk Evaluation Guidelines
     - ✓ SNF routing requirements in 49 CFR Part 397, Subpart D are specifically designed to minimize radiological risks, and consider available information on accident rates, transit time, population density and activities, and the time of day and the day of week during which transportation will occur to determine the level of radiological risk
     - ✓ Base vehicle accident rates are combined with conditional probabilities of specific accidents to yield annual frequencies for entire route
     - ✓ This is the same approach to accident frequency that was used in the Yucca Mountain EIS (DOE/EIS-0250), NUREG/CR-4829, NUREG/CR-6672, and NUREG-2125
     - ✓ Correlations between accident rate, target hardness, presence of rivers and streams, and other potential route hazards could be dealt with by a route survey and appropriate compensatory measures
   - That said, an uncertainty analysis or sensitivity study is needed to explore the impact of the variability in the base vehicle accident rate on the risk.

Applying the Proposed Risk Informed Licensing Methodology to a Draft NRC Safety Evaluation/Safety Analysis Report (SAR) Application

For an applicant to receive transportation package licensing approval, they must develop a complete transportation package safety basis as part of their application that demonstrates reasonable assurance of adequate safety to the public, worker, and environment is provided. This would involve:

- An assessment of all influencing physical, chemical, and environmental loading conditions that would adversely affect package performance when considering all disciplines (structural, thermal, containment, shielding, criticality, operations, and acceptance) to verify maintenance of subcriticality, retention of radionuclide inventory, and adequate shielding and thermal management
- Application of all applicable consensus standards (e.g., ASME Codes and Standards), NRC Transportation (Division 7) Regulatory Guides (e.g., Regulatory Guide 7.1 - 7.13), NRC Standard Review Plans (e.g., NUREG-2216), etc., and using Regulatory Guide 7.9 as standard format and content guidance of Part 71 applications to:
    - Deterministically demonstrate TNPP package compliance with dose rate and containment success criteria after Normal Conditions of Transport (NCT) as outlined in 10 CFR 71.71
    - Deterministically demonstrate TNPP package compliance with dose rate and containment success criteria after Hypothetical Accident Conditions (HAC) tests as outlined in 10 CFR 71.73 or fully exploit the design to determine the level of robustness and capacity to meet these requirements
    - Develop legitimate compensatory measures while employing quantitative risk assessment using an integrated assessment process based on PRA methods which includes use of sensitivities and uncertainty analysis and consideration of DID and SM to reestablish equivalent safety only for those challenges identified through a rigorous screening of HAC related assessments
    - Request that NRC consider an exemption following the process outlined in 10 CFR 71.12 and leverage the substantiating information from the previous step to protect the basis of exemption and demonstrate acceptable risk

How would a shipment of a TNPP be conducted?



A Reactor Module shipment would be conducted in a manner similar to current SNF shipments. This requires that:

1. The shipment is made in accordance with U.S. Department of Transportation Hazardous Materials Regulations (49 CFR Parts 171-180)
2. A state permit has been obtained for the oversize/overweight vehicle (about 150,000 lb.) that carries the reactor module
   - This includes an evaluation of the proposed route and any alternative routes to verify that the transportation infrastructure can accommodate the truck and its load
   - Alternative routes included in case of weather, road closures, etc.
3. The proposed transportation route and any alternative routes must meet the requirements of 49 CFR Part 397, Subpart D
   - These routes are chosen to minimize radiological risks
   - Interstates, and interstate bypasses or beltways around a city
   - States may also designate preferred routes as alternatives or in addition to interstates, and interstate bypasses or beltways
4. The vehicle and its load have received a Commercial Vehicle Safety Alliance (CVSA) Level VI inspection
   - This requires the vehicle and the load to be defect-free prior to departure.

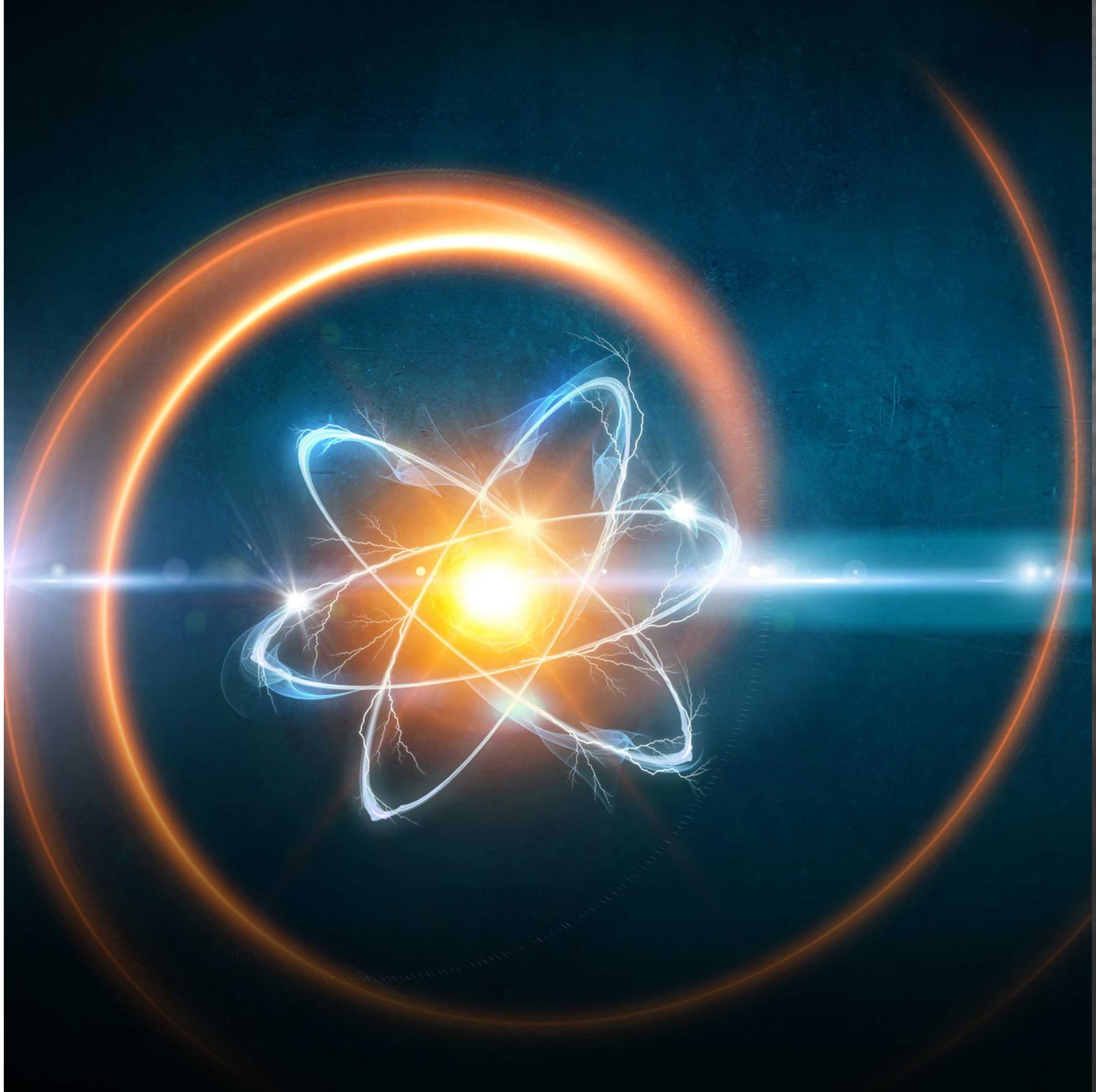
How would a shipment of a TNPP be conducted?

Also required are that:

5. The proposed transportation route and any alternative routes have been evaluated from a security perspective
   - NUREG-0561, Physical Protection of Shipments of Irradiated Reactor Fuel, or the Army equivalent
   - Includes coordination with local law enforcement agencies and identification of safe parking areas in case the shipment is delayed en route due to mechanical problems, bad weather or hazardous road conditions or other unanticipated problems
6. All identified and specified compensatory measures are in place
   - Time of day and day of week restrictions, rolling road closures, escorts fore and aft, etc.
7. Conducted only after the proposed shipment is coordinated with all affected States and Tribes as part of planning and communication
   - Advance notification of the States and Tribes along the route, shipment tracking, and shipment status
   - Emergency response plans and procedures in place
8. Ensuring that the shipment avoids bad weather and hazardous roads through constant communication with drivers and by carefully monitoring road and weather conditions and restricting travel when adverse conditions pose a threat to shipment safety
   - Any delays (traffic, weather, mechanical issues, etc.) are coordinated in real time with downstream States and Tribes.

Pacific Northwest
NATIONAL LABORATORY

Questions & Discussion



References

- 10 CFR Part 71. 2023. "Packaging and Transportation of Radioactive Material. Code of Federal Regulations," U.S. Nuclear Regulatory Commission. Available at https://www.govinfo.gov/app/collection/cfr/2023/
- 49 CFR Parts 171-180. 2023. Hazardous Materials Regulations. U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2022/
- 49 CFR Part 397. 2022. "Transportation of Hazardous Material; Driving and Parking Rules," U.S. Department of Transportation, Federal Motor Carrier Safety Administration. Available at https://www.govinfo.gov/app/collection/cfr/2022/
- IAEA. 2022. "Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition)," Specific Safety Guide No. SSG-26, Revision 1, International Atomic Energy Agency, Vienna, Austria, dated 2022
- NRC. 1975. Reactor Safety Study. "An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants." Report No. WASH-1400 (NUREG 75/014). U.S. Nuclear Regulatory Commission, Washington, DC. October.
- DOE. 2002. "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain," Nye County, Nevada. Report No. DOE/EIS-0250. U.S. Department of Energy, February.
- DOE. 2014. "DOE Standard – Preparation of Nonreactor Nuclear Facility Documented Safety Analysis," DOE-STD-3009-2014, U.S. Department of Energy, Washington, D.C., November.
- NRC. 2002. "Integrated Safety Analysis Guidance Document, NUREG-1513," U.S. Nuclear Regulatory Commission, Washington, D.C., May.
- NRC. 2007. "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant." Report No. NUREG-1864. U.S. Nuclear Regulatory Commission, Washington, DC. March.
- NRC. 2014. "Spent Fuel Transportation Risk Assessment." Report No. NUREG-2125. U.S. Nuclear Regulatory Commission, Washington, DC. January.

References

- NRC. 2015. “Standard Review Plan for Fuel Cycle Facilities License Applications,” NUREG-1520, Revision 2, U.S. Nuclear Regulatory Commission, Washington, D.C., February
- NRC. 2020. “Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material.” Report No. NUREG-2216. U.S. Nuclear Regulatory Commission, Washington, DC. August.
- NRC. 2020. “Acceptability of Probabilistic Risk Assessment Results for Risk Informed Activities, Regulatory Guide 1.200,” Revision 3, U.S. Nuclear Regulatory Commission, Washington, D.C., December.
- NEI. 2019. “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development.” NEI 18-04. Nuclear Energy Institute, Washington D.C. August.
- Sprung JL, DJ Ammerman, NL Breivik, RJ Dukart, FL Kanipe, JA Koski, GS Mills, KS Neuhauser, HD Radloff, RF Weiner, and HR Yoshimura. 2000. “Reexamination of Spent Fuel Shipment Risk Estimates.” Report No. NUREG/CR-6672. Sandia National Laboratories, Albuquerque, New Mexico. March.

Back Up Slides

Follow-up Issues From the Last Meeting

Consideration of corrosion and oxidation:

- Consideration of corrosion and oxidation and chemical interaction are typical concerns included in a hazard identification checklist and though these terms are not mentioned in the Hazardous Condition Evaluation worksheets in the Appendices of the report, these phenomena were considered when postulating ways that the containment could fail during transportation. Their impact is encompassed by random failures that might occur in containment (e.g., isolation devices).