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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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708TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THURSDAY

SEPTEMBER 7, 2023

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The Advisory Committee met via teleconference at 8:30 a.m., Joy L. Rempe, Chairman, presiding.

COMMITTEE MEMBERS:

JOY L. REMPE, Chairman

WALTER L. KIRCHNER, Vice Chairman

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MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

LARRY BURKHART

C-O-N-T-E-N-T-S

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

8:30 a.m.

CHAIRMAN REMPE: Good morning. The meeting will now come to order. This is the second day of the 708th meeting of the Advisory Committee on Reactor Safeguards.

I'm Joy Rempe, Chairman of the ACRS. Other members in attendance are Ron Ballinger, Vicki Bier, Charles Brown, Vesna Dimitrijevic, Greg Halnon, Walter Kirchner, Jose March-Leuba, Robert Martin, Dave Petti, Thomas Roberts, and Matthew Sunseri. I note we do have a quorum.

Similar to yesterday the Committee is meeting in person and virtually. The communications channel has been opened to allow members of the public to monitor the Committee discussion.

Mr. Larry Burkhart is the designated federal official for today's meeting.

During today's meeting the Committee will consider the following topics: NRC Reviews of Volcanic Hazards Assessments for New Reactor Licensing and Branch Technical Position BTP 7-19, Guidance for Evaluation of Defense-in-Depth and Diversity to Address Common-Cause Failure due to Latent Design Effects and Digital Safety Systems.

Portions of the sessions for today's topics may be closed as stated in the agenda. A transcript of the open portions of the meeting is being kept and it is requested that speakers identify themselves and speak with sufficient clarity and volume so they can be readily heard. Additionally, participants should mute themselves when not speaking.

So at this time I'd like to ask other members if they have any opening remarks.

(No audible response.)

CHAIRMAN REMPE: Not seeing any hands up on the internet or in the room, I will then move forward. And I'd like to ask Walter Kirchner to lead us in today's first topic.

Walt?

MEMBER KIRCHNER: Thank you, Madam Chairman.

So this morning we are going to have an informational briefing on volcanic hazards assessments for new reactor licensing. And just by way of background; and I'll keep my opening comments short, we had a previous presentation on the Reg Guide for volcanic hazards assessment; that's 4.26, and wrote a letter on the topic in April of 2021. Our conclusions in brief were that this was reasonable guidance that

the Reg Guides should be exercised through trial applications. And there were some interesting research topics there on the impact of the volcanic hazards on SSCs to look at, in particular ash falls, which we'll hear more about this morning.

There was a Rev 1 version issued to take care of some of the administrative matters in August of 2023. And as it turns out the trial applications are upon us. We have -- or more directly the NRC has a white paper from the clean carbon-free power plant proposal for the Idaho site, as well as a TR from TerraPower for the Natrium site in Wyoming. So the trial applications are upon us and -- and as the staff.

With that I'm going to turn to Eric Benner for opening comments from the NRC staff and then we will subsequently hear from Jenise Thompson who will take us through her presentation on the topic.

Eric?

MR. BENNER: Thank you, Chair Rempe, Member Kirchner, and all members.

I do note that I will be the SES -- NRR SES representative for both of these topics today, which might strike you as kind of unusual, but the external hazards function is in my division and I call

it the cool part of my division's work.

So I am as enthused probably as you are to hear this topic today. As Member Kirchner said, we did the Reg Guide and presented it before you. Today's presentation will build on that presentation as the ongoing activities and as mentioned Jenise Thompson, our expert in this area, will be leading the presentation.

She'll be discussing the ongoing activities, but will not be diving too deep into the site-specific details of the reviews because they're on their own track. So we certainly will have ongoing -- I expect we'll have ongoing discussion with the Committee on these issues moving forward. So with that I will just turn it over to Jenise.

MS. THOMPSON: Thank you, Eric.

I'm sure everyone can see the slides. I can see them up.

Thank you, Barb, for presenting the slides for us today.

I wanted to start with a little bit of geo-trivia suggested by my deputy division director who I believe is a Jimmy Buffett fan. And the song Volcano was written and recorded in a studio near the Soufriere Hills volcano in Montserrat, but the volcano

did not actually erupt on Jimmy Buffett. It did not erupt until 16 years after that album was issued. And the song Volcano is to my knowledge the only popular song that mentions both volcanos and Three Mile Island. So there's a nuclear and volcano connection to that. And I know Jimmy Buffett's been in the news lately. So I'll start with that small anecdote of geo-trivia to get us going.

Barb, the slides have disappeared. I'm not sure why that is.

But while we're waiting for those to come back, again my name is Jenise Thompson. I'm a geologist in the External Hazards Branch. I was the technical lead on Reg Guide 4.26, which as many of you members may recall, was a cross-agency team to develop that Reg Guide. We also had some --

MS. HAYES: (Audio interference) to get these slides back up.

MS. THOMPSON: Thanks, Barb.

And today I'll go into detail, kind of a where we started and where we're going, so what we have accomplished thus far and what we're going to go into the future.

I see we already have a hand up, so I'll pause and take that question.

CHAIRMAN REMPE: Dennis, I believe your hand is up. If you had a question?

DR. BLEY: It is. I had a little trouble getting my mic turned back on.

Jenise, back a couple years ago when you presented this we sent a letter, and Walt talked about that one, and in that letter the staff agreed with essentially all of our three major points and talked a bit about the issue of effects on SSCs of volcanic hazards and especially the issue of volcanic dust and its small size and how it can cause problems.

You said the staff was aware of a research project at the AEA. You were following that. I notice there's no mention of any new information in this Reg Guide. If you're planning to talk about that at some point, that would be great. If you weren't, I'd like to hear a little more about why we're not seeing anything yet.

MS. THOMPSON: Yes, so I can address that.

Barb, we're seeing your Teams chat right now.

But I'll address the comment first before getting back to the presentation.

We did go looking for some information on the effects of volcanic ash on nuclear SSCs. I know

that the Committee pointed us to some research on the effects of sandstorms and sand particles on a facility in UAE. We did not pursue that further at this time because the difference in -- basically the difference between a sand hazard versus a volcanic hazard, the material property differences that would be considered.

And also because looking ahead to the potential evaluation of the effect of whatever the screened in volcanic hazard may be for a selected site, the effect on SSCs is going to be very technology-specific and technology-dependent. So we didn't feel that we had enough information on the potentially affected SSCs, the magnitude of the hazard to pursue that line of inquiry at this time.

It is something that we're mindful of going forward, looking into how we're preparing for these reviews and what additional capabilities for staff expertise will be needed in the assessment of the effect of volcanic hazards on nuclear structure systems or components, but again we're taking more of a site-specific focus because it's a very broad scope of potentially impacted SSCs. If we were to look at every design that is potentially a future applicant that may need to consider volcanic hazards.

So that's something that we're still mindful of looking ahead to, but we don't feel that we have the full scope of information to make an informed research project of it right now.

DR. BLEY: Okay. Thank you. We look forward to hearing more in the future in this area.

We also pointed out that the Guide suggested that there was sufficient guidance on addressing the issue of volcanic hazards on equipment in an ANS document and in NEI 18-04. I see that the call out to NEI 18-04 has disappeared, but we pointed out back to the staff that those documents only warn analysts to consider the kind of problems that are there, but don't really give them any guidance on how to deal with it. I guess we'll see something in the two applications that Walt pointed out earlier, so we look forward to that.

And I had just a quick question in that area, because I don't think you'll be talking about those in any length. In one of those papers they make strong use of a paper on the Volcanic Explosivity Index, which I don't think you talk about much, especially a paper by Newhall and Self in '82, which came a couple years after Mount St. Helens and seems to have taken account of that.

Is that going to be an important document for you and are you likely to pull it into the guidance?

MS. THOMPSON: You're asking specifically about the Newhall paper?

DR. BLEY: I am.

MS. THOMPSON: So at this time we don't have plans to include that in the -- in a future revision to Reg Guide 4.26. And whether it becomes an important factor in these future reviews for the volcanic hazards assessments that are submitted in support of these license application reviews is going to be very dependent on the information that the applicants are providing and the resources and research papers that they're relying on to build the safety case for the adequacy of the volcanic hazards assessment that they have performed and whether or not those research papers would be included. I could only speculate.

DR. BLEY: Okay. Well, thank you. And I'll listen to what you have to say now. I think I'm still at the point of seeing this as a good general overview of how you approach the issue, but pretty light on exactly how you deal with it and what's the approved approach if you rely upon this Reg Guide.

But we'll look forward to your talk. Go ahead.

MS. THOMPSON: Yes, and you're keying off of something that is correct. This is really intended to be a more general overview of where we're at, what we've completed thus far, what we're currently doing and what we're expecting to do in the near term with respect to volcanic hazards for these future license reviews and -- or application reviews. So I purposely did not go into detail because again we don't have docketed information for one of the sites.

We have a topical report that is still under active review, so we don't have the staff's final conclusions to share at this point. So I'm really talking at a higher level of how we're anticipating Reg Guide 4.26 as being implemented based on our previous interactions and some of our pre-application engagement with some of these applicants in the last couple of years and what we're doing as a staff to prepare -- to provide the best review we can for those volcanic hazards assessments.

So I'll get into the presentation now unless there are some additional questions. This is meant to be kind of an overview slide of some of the topics that I'll be touching on in today's presentation including the issuance of Reg Guide 4.26.

We've also been involved in the review of the Carbon Free Power Project, or CFPP, volcanic hazards white paper, which was outlining the planned approach that CFPP is taking in the performance of their volcanic hazards assessment. So we didn't get into technical discussions of what are the specific hazards and sources of volcanic hazards that are being considered for that particular application. So I want to make sure that that's clear as well.

So that review was completed by the staff, and I'll get into that a couple more slides.

We've also been observers to a Department of Energy project at the Idaho National Laboratory. They are undertaking a Level 3 SSHAC to consider volcanic hazards at the entire INL location, and the NRC staff has been observers to that ongoing activity. And we've also in the course of supporting pre-application engagement with the Carbon Free Power Project and as observers to the INL SSHAC been out to the Eastern Snake River Plain in Idaho to visit and see some of these volcanic features directly in the field as part of these activities.

And then looking ahead to some of our ongoing and upcoming activities, we do have the TerraPower Volcanic Hazards Topical Report review

which is ongoing. So again we won't be going into detail of that specific application or that topical report right now, but we will I suspect be back before you before too long to discuss what the staff's conclusions were with respect to that topical report. And all of this is building up to the staff supporting the licensing reviews for the CFPP and TerraPower applications which we're expecting in the not-too-distant future.

So we'll go to the third slide, please, Barb.

And we'll start with the regulatory requirements. For many of you this is going to be a rehashing of the intro to Reg Guide 4.26, but I did kind of want to give an overview because I know that there may be some new people at the table on the Committee or some members of the public who were not involved or participants or attending the previous briefings on Reg Guide 2.46.

So the regulatory requirements are listed here, specifically 10 CFR Part 50, Appendix A, 52.17 for early site permits, and 52.79 for combined licenses. And the only specific mention of volcanic activity in the applicable regulations is in Reactor Site Criteria 102.3 where volcanic hazards or volcanic

activity should be considered as one of the geologic or seismic factors that may impact the design and operation of these nuclear power facilities.

We'll go onto the next slide, please, and talk about Reg Guide 4.26. That was a great summary of the activities related to 4.26. This is outlining a method to assess volcanic hazards for new nuclear power reactor sites. You recall I was up before the Committee twice before in February of 2020 and in April of 2021. I promise -- there shouldn't be a ton of overlap between those presentations and this one, but it may be useful to go back and look at some of those slides if there are some additional questions that I don't cover.

Rev 0 was issued in June of 2021. You can pull it up at the ML here. As they mentioned just last month we processed Revision 1 as an administrative change. Something I want to emphasize about that administrative change is we earlier this year became aware of two paragraphs and two bullet points that were inadvertently deleted during the final document processing of Reg Guide 4.26 in its Rev 0 form.

So the version that was shared and distributed for public comment in the summer of 2020

and the version that was shared to this Committee in April of 2021 had those two paragraphs and two bullet points. So the only changes from Rev 0 to Rev 1 are the restoration of the text that should have been included initially in that Rev 0 but was omitted. So that's the key difference there. There have been no other substantive changes to the guide in that Rev 1.

And then finally I'll walk through in the next couple of slides the flow chart we provide in Reg Guide 4.26, which if you recall it has options for an applicant. So an applicant may choose to perform a more detailed assessment of the specific volcanic hazard or they can do what we call the engineering analysis option which allows them to perform basically a screening to determine a maximum magnitude hazard and then move forward in the process to consider the effect of that maximum magnitude hazard on the structure, systems, and components for their selected design.

So we'll go to the next slide, please, and we'll walk first through the hazard analysis. And I'll do this much more briefly than in previous presentations, but something to keep in mind is we built in a lot of flexibility to this volcanic hazards analysis approach. And that's intended to give the

applicants the ability to leverage these off-ramps so that it's not intended to be a start-to-finish, you must do all of these steps to have an adequate volcanic hazards assessment. You can use the information that you have. You can use the hazard information, the engineering information, risk information and leverage those off-ramps once you've reached an acceptable conclusion or an acceptable result.

So it starts at step 1, which is leveraging the geologic history and geological site characterization information. This is information that's going to be required in the application anyway, so looking whether there are quaternary volcanos in the site region or quaternary volcanic deposits in the site vicinity, the quaternary period being the most recent roughly 2.6 million years of earth history and the site region being a 200-mile radius or 320-kilometer radius from the site and the site vicinity being that 25-mile or 40-mile radius.

And if either of those questions are answered in the affirmative, then an applicant would proceed into the next step of the volcanic hazards assessments. So this information should be readily available to most application -- or most applicants as

part of their application development for these permits and licenses that they'd be applying for.

Another important component here which isn't reflected in the flow chart but is reflected in the text of Reg Guide 4.26 is the development of the tectonomagmatic model. And I know we went into a little bit more detail of that in the April 2021 presentation. And that is just a consideration of what are the driving forces for volcanism in the region of interest or for this time period of interest.

It's not a numerical model. It's really a conceptual model looking at the processes driving volcanism to understand what they are, what's controlling volcanism in that area, to look at what's the potential for a future event in that site that would be consistent with the current conditions of that volcanic system. Because volcanic systems are dynamic. We're not going to see static systems for some of these locations and recognizing that not all volcanos may result in being a potentially -- a potential source of hazards given the current environment in which their system is existing. So allowing for that flexibility of using that geologic information to inform that decision as well becomes an

important factor in the early steps of this hazard analysis or volcanic hazards assessment process in Reg Guide 4.26.

But we're going to assume that they're moving forward, that an applicant would move into screening volcanic hazards. And again you can see this is where another off-ramp exists where if those hazards can reasonably be screened out for whatever information is available then that would end the assessment. If not, they would move into developing initial insights. And if those risk insights are considered acceptable, then that would also allow an applicant to end the assessment.

We're going to skip ahead from the engineering analysis option and assume that an applicant would move forward into step 4. And this is where they would evaluate the eruption potential and/or hazard potential. You'll note that in Reg Guide 4.26 the NRC does not endorse the use of one particular model or code to consider those -- or to evaluate those eruption potentials or hazard potentials. I feel like I'm going to -- you may think I'm a broken record by the end of the presentation today, but that's going to be a site-specific decision and an applicant decision to be made.

We've also in Reg Guide 4.26, particularly in the explanation of step 4 -- this is where those two paragraphs and two bullet points were inadvertently omitted. And those are two important paragraphs and some important bullet points that provide guidance to an applicant on what the appropriate level of model support would be. So providing the justification for why the selected numerical model is appropriate for the source volcano and the potential hazards that are being considered for that source volcano and giving the applicant the flexibility to choose the method that they believe is best applicable to their site-specific circumstances and their selected design.

And then once that is completed an applicant would move into step 5 and looking at developing some risk insights, which if acceptable would end the assessment. And I know there was a comment earlier about NEI 18-04. And I can confirm that in the development of risk insights here in step 5 Reg Guide 4.26 does address the use of NEI 18-04, referring back to Reg Guide 1.233 which endorses that NEI document. So if there were some additional questions on that, I would point to that section and also back to Reg Guide 1.23.

But also note that when talking about risk-insights and PRA information, particularly looking at uncertainties in volcanic hazards and volcanic systems, we're talking about uncertainties that can be on the order of several orders of magnitude. So here in the risk-insights consideration it may need to include non-PRA information for that particular hazard assessment.

And if an applicant is still within the process they would proceed to steps 6 and 7, which are also some of the key steps in the engineering and analysis option. So we'll go to the next slide.

And the next slide is -- the red boxes are showing what the engineering analysis option would look like. And the focus here on this engineering analysis is to determine a maximum magnitude hazard for those volcanic hazards that have screened in step 2 and then use that maximum magnitude hazard to evaluate the SSC performance and potentially evaluating mitigating actions.

And the iteration between step 6 and step 7 as shown by the double-pointed arrow here is to allow an applicant to implement mitigating actions if needed to augment or ensure the continued performance of that SSC under the maximum magnitude volcanic

hazard that needs to be considered based on that initial screening up in step 2, so allowing for that iteration so that if the SSC performance under the maximum magnitude hazard is not acceptable without some kind of augmented action or implemented action to support that SSC through the volcanic hazard event at the site to allow for that in the process.

And also as we're looking ahead this is where -- as we plan for these future licensing reviews of volcanic hazards assessments this is where our tie-in with the nuclear engineers and systems engineers would be potentially very important in providing that maximum magnitude hazard for those engineers to then assess the performance of the SSC and then working together to determine are those mitigating actions reasonable to be implemented in the amount of time you have between the notification of the impending event and the arrival of the hazard at the site and if those mitigating actions are going to improve the SSC performance to a level that would be considered acceptable?

So that is essentially Reg Guide 4.26 in a nutshell. We'll go onto the next slide and just talk about some of the key inputs --

MEMBER KIRCHNER: Jenise?

MS. THOMPSON: Yes?

MEMBER KIRCHNER: This is Walt Kirchner just briefly on that last slide. Just an observation that depending on the analysis of the vulnerability to volcanic events an option is changing the site or relocating to a higher elevation. I think we'll see that for the two applications that are coming your way.

MS. THOMPSON: So --

MEMBER KIRCHNER: (Audio interference) and actually choosing a site at a higher elevation to avoid lava flows or debris flows or flooding, et cetera, et cetera. So it's more of a macro iteration rather than an SSC by SSC consideration.

MS. THOMPSON: So it could be a macro iteration. I think in general the approach we've taken in 4.26 is with the hope that an applicant would not get down into step 6 or step 7 and then realize that they would need to consider a different location for their site. And maybe some of that information looking at local topography and where past hazards have been mapped or observed in the site area or site vicinity -- that may be something for an applicant to consider earlier in the process closer to step 1 when looking at initial siting determinations.

But if it comes down to it and step 7 -- 6 and 7 can't iterate an acceptable performance of the SSCs, then a change in site may be necessary.

Were there any other questions before I move onto the next slide?

(No audible response.)

MS. THOMPSON: All right. So we'll go onto slide 7. So as we take this approach to reviewing volcanic hazards assessments it's a multifaceted approach. We're gathering -- we expect that the applicants will be gathering a fair amount of information. This is what we'll be looking at as part of our review. Again not just the geologic history or the site characterization information, but how all of that information is informing the tectonomagmatic model for an applicant to determine which sources of volcanic hazards, if any, would need to be considered because they are considered consistent with the tectonomagmatic model for their selected site location.

We're also looking at numerical modeling. We know that in step 4 -- that's generally where we talked about it in Reg Guide 4.26, but we also know that some applicants are choosing to use numerical modeling to inform their screening decisions earlier

in the process, which is a completely acceptable use of numerical modeling in this context. And we're also looking internally at our own expertise so that we're prepared to not just review those numerical models, but have an understanding of their development so that we can better review the justification for the acceptability of that model for that selected site and if necessary to perform any confirmatory calculations.

And this is where we're working as a wider external hazards team because we do have -- some of our meteorology team have been providing -- have been doing numerical modeling in support of atmospheric dispersion for many years. And so using some of that expertise as we prepare to review tephra dispersion modeling and also working with our seismology and geophysics team in both NRR and the Office of Research who have extensive modeling experience as it relates to seismic hazards and seeing where we can learn from and work with each other to have this capability in house.

And then finally looking at are there any other engineering considerations that need to be brought to mind as we look at these volcanic hazards assessments both from the effect on SSCs that are going to be relied upon to operate at their intended

safety function during these events and also looking at are there any structure or geotechnical engineering considerations that we need to be mindful of looking at the early construction process and foundation interfaces looking at whether there needs to be any concerns about fractured rock encountered in the sub-surface or vesicular rocks encountered. You can see the photo here on the right is showing some pipe vesicles in a volcanic rock in Eastern Idaho.

So what are some of those engineering considerations? And these are conversations that we'd be having as part of any license review with counterparts, but looking at whether there are any unique engineering considerations that we need to be mindful of going forward with these volcanic hazards assessments and associated license reviews.

So we'll go to the next slide, please. We do have some completed and ongoing activities that have already been mentioned briefly, and I'll talk to them again on this slide here. The Carbon Free Power Project white paper came in, as I mentioned before. This was really focused on the planned approach that they're taking to performing their volcanic hazards assessment and asking for a determination of whether that was considered acceptable and consistent with Reg

Guide 4.26.

Notably for the Carbon Free Power Project they expanded the site vicinity from a 25-mile radius to a 35-mile radius. And the justification they provided for that is that allows them to include two additional quaternary volcanic fields in the Eastern Snake River Plain. And so that was one of the changes that they have taken from Reg Guide 4.26.

This is also the applicant that is planning to use numerical modeling to inform the screening decision in step 2 and also to allow them to better refine their maximum magnitude hazard for using an engineering analysis option. So using that numerical modeling that is described in step 4 of the flow chart earlier in the process is something that we determined as a staff was considered consistent with Reg Guide 4.26. And if you're interested, you can read the full staff assessment from last fall at the ML listed here.

I also mentioned at the start that the Idaho National Laboratory is undertaking a Level 3 SSHAC. That's the Senior Seismic Hazard Analysis Committee process. This is a process that's endorsed in Reg Guide 4.26 as one way to conduct an expert elicitation in part of -- as a performance of the

volcanic hazards assessment. This is a process that we've used extensively to assess seismic hazards in the past at nuclear facilities. And the staff are very familiar with this process considering it allows an applicant to consider the center body and range of technically defensible information.

So we've had an observing team in all three of the workshops being conducted for this site-wide PVHA at the Idaho National Laboratory. We've also were included in the field visit in which the SSHAC participants were observing features in the field that may play into the final report for this particular project.

The final report has not yet been issued, but we do expect that future applicants considering sites at the Idaho National Laboratory may use that report as the basis for their future volcanic hazards assessment, which is why we've been following this project relatively closely over the last few years, because it would be an important input to those potential future applicants.

DR. BLEY: Jenise?

MS. THOMPSON: I see another hand has gone up, so I'll pause.

DR. BLEY: Yes, it's Dennis again. These

models -- I wonder if you can say anything about where the staff stands and how they've review the -- I'll call it the reliability of such models. It strikes me -- as opposed to the atmospheric modeling where we get lots of chances to look at -- to see how they perform under various conditions. Here, unless we have a really good record before a volcanic event, once it's happened some of the evidence that you would use in your model before that has been destroyed.

How do we have confidence in these models?

MS. THOMPSON: So I actually have a slide later in the presentation that talks a little bit to the numerical models that we know applicants are using --

DR. BLEY: Okay. That's good.

MS. THOMPSON: -- but I will say that the justification for the use of one model over another is something that is a case that the applicant is going to need to make, which is why we've provided that explanation of adequate model support in Reg Guide 4.26. And like I said, we're doing some background work right now to have a better understanding of the use of these models in the past so that when we see those models being used in a future application we're not starting from zero. We've already built up some

internal knowledge and workability with those particular models. But I do have a numerical modeling slide later where I'll talk a little bit to it.

But in general the NRC -- there are many different models that could be used and it wouldn't be efficient for us to go through any kind of validation or verification for every single model that is available, which is why the burden for that and the justification for that has fallen to the applicants here to justify their use of a selected model.

DR. BLEY: Okay. I'll wait for that next slide.

MS. THOMPSON: Okay. It's towards the end of the presentation. It's not immediate, but we will get there.

So I think I was on the last bullet here, which is the TerraPower volcanic hazards assessment. This is the topical report that was submitted earlier this year. This is a report that is still under active review. The staff are still working through their review and documenting their findings, so I won't go into detail on this, but this is on our radar. It's an ongoing activity that we have a team put together who are actively engaged in that review at this time.

We'll go onto our next slide, please.

DR. SCHULTZ: Excuse me, Jenise. This is Steve Schultz. Jenise, on the previous slide --

MS. THOMPSON: Okay.

DR. SCHULTZ: -- you mentioned that the Idaho National Laboratory is following the Senior Seismic Hazard Analysis. And in your review of the Carbon Free Power Project you note that that work is not following the Senior Seismic Hazards Analysis Committee work exactly, but you referred in the white paper review that they're leveraging the concepts of that work and they're focusing on -- as a result on some of the issues associated with uncertainty.

Could you just expand on that statement? It's only a brief statement in your review of the white paper and I wanted to better understand why they're not using more work that's ongoing at Idaho National Laboratory and what it really means when you say that they're leveraging that work.

MS. THOMPSON: So essentially it boils down to schedule. So based on our interactions for both the INL V-SSHAC and the Carbon Free Power Project pre-op engagement the INL V-SSHAC is on a different completion schedule than the Carbon Free Power Project. So by the time the INL report is finalized

the CFPP project intends to be further along in their application development process. But there is a fair amount of overlap in supporting staff to both the INL PVHA work and the people who are assisting the Carbon Free Power Project in doing the volcanic hazards assessment for that.

So that's essentially what I mean. It's just a schedule difference, but there is a number of overlap in technical experts that are involved in both of those particular projects.

DR. SCHULTZ: What's the relative schedule for those projects? When you say they don't quite sync up, does that mean one is not going to be done for three or four years and the other needs to be done in one year, or what does that really mean? How long or what's the time frame of these? Are we into seismic hazard evaluation that goes on for decades?

MS. THOMPSON: We're not definitely in the years standpoint, but I don't think the -- and I don't own -- I'm not responsible for either of these two projects, but I believe that --

DR. SCHULTZ: Sure.

MS. THOMPSON: -- the INL final report is expected sometime towards the middle of next calendar year. And I believe that CFPP was looking for an

earlier date than that to submit their application. But I would also defer to Omid, the safety PM for CFPP if he wanted to chime in with any other calendar information, because that's I think the best I have at this point.

MR. TABATABAI: Good morning. Yes --

MS. THOMPSON: But it's not years; it's definitely months.

MR. TABATABAI: Yes, thank you, Jenise.

This is Omid Tabatabai. CFPP will submit the application in January of 2024. So Jenise is right.

DR. SCHULTZ: That helps. Thank you very much.

MS. THOMPSON: Were there any other questions on this slide?

(No audible response.)

MS. THOMPSON: Okay. So moving ahead, I'm going to speak a little bit towards the prospective site locations and some of the regional volcanic -- or sources of volcanic hazards of interest in previous briefings. So again, I'm not going to speak to specific hazard levels or magnitudes of hazards or probabilities today because that would be premature since we don't have these application. They're under

review or the application -- the topical report that we do have under review is still in the review process.

But showing here the -- this is a map from the Yellowstone Volcano Observatory at the U.S. Geological Survey. It has the statutory role for monitoring volcanic hazards in the United States and issuing alerts if they determine that an event may be forthcoming.

The orange line is just showing the boundary for the Yellowstone Volcano Observatory, so we don't really need to pay attention to that.

The two purple stars, the one in Central Idaho or Eastern Idaho is the INL location and the one is Southwestern Wyoming is the TerraPower site. These are just rough estimates of the location.

And the green triangles are showing the actively monitored volcanos under the observatory system. So obviously Yellowstone in Northwestern Wyoming is I know a source of interest from previous briefings that we've given on volcanic hazards and along the West Coast of the U.S. You can see a lot of green triangles and those are the volcanos of the Cascade Observatory. And then further into Northern California the California Observatory.

The white triangles are what are termed unassigned sources, or volcanic features. So these are sources that the USGS in looking at the current state of the system; remember that tectonomagmatic model, do not warrant as active monitoring as these green triangles. I don't want to say that they're not monitored because a lot of these areas still have installed instrumentation that can inform smaller scale monitoring, but they don't rise to the level of the USGS feels that they need to take a more active monitoring role for those particular sources.

And then in Eastern Idaho kind of this oval shape in the center is representative of the Eastern Snake River Plain, which is a quaternary distributive volcanic field in which the INL location is located. And you can see there's three unassigned volcanic sources here. And I'll talk a little bit about each of those in a subsequent slide looking at the Eastern Snake River Plain, but I wanted to give kind of a regional perspective of where these two sites that we know that we need to be prepared to review these volcanic hazards assessments are located and what some of those volcanic sources of past interest may have been.

So we'll go to the next slide and look

specifically at the Eastern Snake River Plain. And this is from a paper from Gallant et al, from about five years ago showing the age of the basalts on the Eastern Snake River Plain. And I hope you can visualize how this is truly a distributed volcanic field. The youngest age of basalts are spread out across a wide area within the Eastern Snake River Plain. This isn't just a source of volcanic hazards because it's going to be a pinpoint source one GPS coordinate on the map. This is going to be a wider scale potential source of hazards here.

You can see the -- kind of in the upper right quadrant the outline of the INL property in that thick black line and then these darker blue basalts are the youngest of the basalts here. Just to the east of the INL property is the Hell's Half Acre lava field, which is just over 5,000 years old. I think it's 5,200 plus or minus. The smaller flow in the center, the only one -- the youngest flow that comes onto the INL property proper is the Cerro Grande, which is just under 11,000 years. The largest by area just to the west of the INL is the Craters of the Moon lava field, which is just over 2,000 years old. And then to the south is the Wapi Field, which is also about the same age as the Craters of the Moon.

So looking at the approach that CFPP has taken in their white paper that expanded their site vicinity to include both the Hell's Half Acre source and Craters of the Moon. And we expect that when looking at the Eastern Snake River Plain -- I know we talked about siting considerations and whether you would need to move your site.

And then looking at the plain, it's -- there's a fair amount of topography that is sometimes unexpected, so a lot of localized topographic highs and lows and the effective topography in looking at volcanic hazards. Particularly those from lava flows is potentially going to be an important factor when looking at hazards for the Eastern Snake River Plain that may screen in for these sites. But again we'll talk more in detail about what those specific hazards would be, what the probabilities would be, and what the potential hazard magnitudes would be once we have that information submitted by an applicant. But I did want to touch on the Eastern Snake River Plain because I know we've had some questions from it in the past.

But before I go on are there any questions for this slide?

(No audible response.)

MS. THOMPSON: Okay. Then we'll go on --

MEMBER KIRCHNER: No, don't go on yet, Jenise.

MS. THOMPSON: Okay.

MEMBER KIRCHNER: This is Walt. I'm sorry. Just calibrate us who are not geologists -- and you're speaking in a different language. So it's less than 15,000 years for the dark blue on this particular slide. Should that be of concern and what concerns -- what's the take-away from this? It seems like this is a very active site area, this Eastern Snake River Plain, so for the general public what does a geologist -- what's the take-away from this slide?

MS. THOMPSON: So I think one of the key take-aways here is that in looking at a source like the Eastern Snake River Plain it's not going to come down to just looking at what the most recent age of the basalt is. It's also going to be looking at the current conditions within this system, the tectonomagmatic model, understanding what if anything is driving volcanism in this particular area and are the conditions still in existence for this particular source for there to be another eruption comparable to what we see in the geologic record that's been preserved for this location.

So it's not a matter of it's a 2,000-year-

old lava flow time to panic. It's a matter of yes, there's a 2,000-year-old lava flow. There are also very old -- over 100,000-year-old lava flows out here and looking at the specific conditions in which there could be the potential for a future eruption in that particular location or a future vent opening with an associated lava flow or other volcanic hazard associated with it.

But it's something to be aware of, but it's also something that's going to require some additional information to understand the conditions for the specific site and also looking at the specific location of the site. So a site that's going to be located -- and I can't remember who provided the comment earlier, but looking at moving up slope. That is one consideration that can be made in looking at sites in this particular area because in general we're not going to see lava flows overtopping large topographic barriers.

They're not going to be flowing uphill for the most part. That would be highly irregular. So looking at where there are areas where selecting a site on a localized topographic high may be a very prudent decision to make early in the siting process. But again it's going to be very location-specific out

here and it's going to depend on those site-specific conditions and the selected location of that site and the basis for the tectonomagmatic model that's informing those hazard decisions for the applicant as they develop their volcanic hazards assessment.

CHAIRMAN REMPE: Jenise, this Joy. And I think this is a question I brought a while ago when you first presented to us, but in the case of the Idaho site -- there are a lot of facilities that are within, I would think -- or at least more than one within that 35-mile radius, not only existing, that were built many years ago, but also ones that are being proposed.

And so when you look at the hazards associated with such an event -- even by the time the Carbon Free nuclear power plant is built there might be other facilities affected. So you're kind of looking at not only the multiple units within the Carbon Free plant, but there are also facilities that that might be affected. And is that considered? I kind of scanned through the Reg Guide and it didn't explicitly call that out and I'm just wondering -- maybe I missed it, or how will the staff -- what will trigger everybody thinking about don't just look at this particular reactor or plant?

MS. THOMPSON: So within the safety reviews for new reactor licensing we do have consideration of other nearby facilities, and that's accomplished by our Manmade Hazards Team. And so the concerns related to events that would impact other nearby facilities would fall under their review. And this is maybe a place where looking at the final INL site-wide PVHA report can give our manmade hazard reviewers some additional information of potential hazards at those other locations that may then impact the site that's coming in for review in a license application, but that's something that would be accomplished by Manmade Hazards Team.

CHAIRMAN REMPE: Okay. And the fact that they may have not followed the latest guidance on volcanic hazards because they were built a lot of years ago and the response team was responding to all of the common-cause failures associated with a seismic event might be something that needs to be considered more carefully at that site. Anyway, thank you.

MS. THOMPSON: You're welcome.

MEMBER MARTIN: Well, also to add the CFPP is pretty unique, right, because it's a case where a performance period is being sited on a DOE site and the NRC has the authority. And again that's been

negotiated between DOE and NRC. I'm not sure I've heard of another situation where that has occurred. So I would imagine at this point DOE's kind of hands-off. They've managed their situation. And if there's any new hazard created by CFPP I'm sure they'll be assessing their reactors.

CHAIRMAN REMPE: The reality of the event is there's a response team of the site that will have to deal with all of it before anything can come from other communities if you had to do something.

MEMBER MARTIN: (Audio interference) to speak from my experience on DOE, a DOE -- a planned DOE framework and not a reactor. Volcanic hazards is part of hazards, the broader holistic hazards analysis. And DOE's framework probably doesn't go to the extent that's being presented here today, but it's certainly within the safety basis of what they do and how they review safety basis -- safety cases on the site.

So what I find particularly useful is this interaction between NRC and DOE making some effort to get on the same page. Because clearly at Idaho they've been thinking about this for quite some time. And most commercial sites aren't impact, but I think this is -- in my estimation with experience with DOE,

I like DOE's approach to hazard analysis in general. And when I see you all talking to each other and finding some common ground and working together and shaping your analysis I think that's really the best approach.

But I just wanted to really throw out the fact that the CFPP is a unique scenario where DOE has obviously stepped off and just said, okay, all the work NRC's done for the last decade, we recognize that and accept that and authority to (audio interference), things like this.

MR. BENNER: Yes, I think I'm going to partition that a little bit, Chair Rempe. So we have -- we will have an application before us for an NRC license. So we'll -- I think (audio interference) the benefit here -- the downside here is yes, there might be some additional hazard here. The benefit is we have a federal partner who we can leverage their experience and their information, but we'll have to make the decision about CFPP and make -- render judgment about the hazards.

And like Jenise said, there are two parts: There's the pure volcanic hazards on that site and then there's another part of there's a bunch of other facilities there that could present hazards. I think

what you're asking is what I would call sort of the second order effect of you have the volcanic hazard, it has an impact on those other facilities, how is that factored in our hazard analysis? And I can't speak definitively about that, but I think we likely -- (audio interference) experience we do do some bounding assessment of those manmade hazards.

Now I don't know if we (audio interference) it back to what was the cause of say a train car exploding, right? We just say okay, a train car could explode. What would be the hazard on the facility? So that's one piece.

Now the other piece of -- is DOE looking at the existing facility such that once this plant is licensed it presents a manmade external hazard to those facilities? I can't speak to that. I would tend to think they would do some amount of assessment on that, but I can't speak to their process for those facilities.

CHAIRMAN REMPE: Again, I just wanted to (audio interference) on the record again and you guys could think about it, but one could have a vision of a lava flow and a lot of dust that affects a lot of facilities at once and everybody's trying to respond to it. But of course it's very a low frequency of

that. I'm not worried about it and all that, but I just think people need to think about it.

MR. BENNER: Right. And our license, they'll have to demonstrate both from a safety standpoint and from an emergency preparedness standpoint how they're going to do things. Now how much they would intend to leverage some close-by DOE resources, that I'm not sure of, and we might not see that until we get the application.

CHAIRMAN REMPE: Something to think about. Anyway I raise the point.

(Laughter.)

MEMBER MARTIN: Since you bring up the subject, DOE's hazard analysis approaches begin very holistically with hazardous materials and energy sources from everywhere. To your specific question about hazards from other facilities, whether they are the consequence of the first hazard, whether volcanic or earthquake or plane, that is addressed in their framework.

Now I guess what I have yet to see; and I wasn't expecting this in this presentation, is what is the NRC's approach to -- really to entry into hazard analysis, whether it's this or looking at flooding or earthquake? Is there a holistic hazards analysis that

at least at a high level reviews the site, the environment, and looks at what are the hazardous materials, what are the energy sources, what are you neighbors doing, and incorporate it into a singular document, and then from that initial assessment potentially enters into volcanic or whatever type hazards.

I think that's more of a question for you, Eric.

MR. BENNER: Yes, and when you say a singular document, all of those analyses are contained in our SER for a particular site, so it should integrate that (audio interference).

MEMBER MARTIN: But not necessarily a -- like it's a high-level document. I see it scatters --

MR. BENNER: Yes.

MEMBER MARTIN: -- with the detail, but it definitely seems to be that there is an entry-level exercise that maybe they screened out -- if you're somewhere (audio interference) volcanos, what would be the process to screen out (audio interference) this exercise? If you had a holistic hazards analysis you could go through and go, well, okay, I've considered all these possibilities. I know (audio interference) an earlier slide to (audio interference) numerical

values and likelihoods and such into it. At some point you would want to say, all right, that hazard isn't significant in this particular region, so would not go down this path. How does that --

MR. BENNER: Well, we do in the Reg Guide. There are some screening kick-outs, so I think you have to at least start, right? And this is some of the discussion we've had with industry of can you just start by say the NRC screening out lots of things and then the applicant's leveraging that?

And I think we took the approach that you at least have to start looking at all these hazards and then you might be able to quickly screen out -- but we do -- some of might -- well if we're talking like the semantics of -- yes, you still have to look at -- at least take the first step for each of the hazards. But then you maybe quickly exit instead of -- right, your first step is what hazards are applicable to my site? And then only look at those. I think we get to the same place. It's just -- right, particularly when you look --

MEMBER MARTIN: Particularly a letter -- I think a letter approach --

MR. BENNER: Yes.

MEMBER MARTIN: -- where you (audio

interference) --

MR. BENNER: Yes.

MEMBER MARTIN: -- with energy sources and materials. And then you go, all right, that works me into these other ones. But that's obviously not the way the framework --

MR. BENNER: Yes, I just think the construct is that -- I think -- like I said, I think you get to the same place. I just think it's sort of the order of the (audio interference).

MEMBER MARTIN: I (audio interference), but I think you do, but I think it's a little bit harder to understand from an applicant standpoint --

MR. BENNER: Okay.

MEMBER MARTIN: -- because the entry is --

(Simultaneous speaking.)

MEMBER MARTIN: And it would be nice if there was one overarching type process that then gets you into the level --

(Simultaneous speaking.)

(Laughter.)

MR. BENNER: I'm going to link to the topic I'll be talking about this afternoon because the Committee gave us similar feedback on something from Digital I&C. And basically I'm going to paraphrase.

So like how does all this fit together, right? We don't understand how the -- okay. So we ended up doing a presentation for the Committee that had a graphic that showed how it all fit together, and it was interactive, right, the road map. And part of the driver for that was, I think the Committee said, hey, you're going to have a bunch of new applicants. How do you make this clearer for them?

So I'm going to take from this meeting that we would consider a similar approach for our external and manmade hazards activities. Not necessarily to make the presentation, but can we look at ways that we can come up with tools to communicate and make it clearer for potential applicants?

MEMBER BROWN: It's nice to see that the I&C world is --

MR. BENNER: Having an influence on the rest of society?

(Laughter.)

MEMBER BROWN: (Audio interference) make clear what they're doing.

MR. BENNER: Okay. Good.

(Simultaneous speaking.)

CHAIRMAN REMPE: We both got it. Probably we're off topic, but thank you for considering it.

(Laughter.)

MR. BENNER: Hey, let's go back to Geneva on that.

CHAIRMAN REMPE: Scott, do you need a question, sir?

MR. MOORE: Yeah, just a point of information. I don't know what --

(Audio interference.)

CHAIRMAN REMPE: Scott, we have -- you need to get up closer to the places that are around the room. I didn't try your spot, I tried other spots. Sorry.

MR. MOORE: This is just a point of information. And I don't know what hazards analysis or risk analysis was done for these. But DOE has two NRC licenses at INL. One of them's active, one of them's not active.

The active one is -- they're both for waste -- one of them is the TMI-2 fuel debris license, and it's a specific NRC license. And the other is called a license but it's not built. It's the Idaho Spent Fuel Facility.

So, NRC has licenses just for that item.

CHAIRMAN REMPE: Well, actually, I think Lawrence Berkeley, there was an effort years ago where

NRC would license DOE facilities. And there's one at Lawrence Berkeley and one other place that I can't remember. But it's not typical. Yeah, it's not typical.

(Simultaneous speaking.)

CHAIRMAN REMPE: Yeah, it's not.

MEMBER MARCH-LEUBA: Also, for example, is Columbia Power Station is an example.

MR. MOORE: Yes.

MEMBER MARCH-LEUBA: But that one is 100 percent privately owned, whereas the CFPP has a lot of relations with DOE for starters.

PARTICIPANT: Is that actually onsite?

MEMBER MARCH-LEUBA: Yes.

(Simultaneous speaking.)

CHAIRMAN REMPE: Jose, you can actually, I tried your spot. It works and you don't need to move. It was Scott that was so far away.

But, yeah, for those out on the internet we've had some IT issues today. Actually, it was working great today thanks to Comcast, whoever is on it now.

Anyway, go ahead, please.

MS. THOMPSON: Are we ready to -- I heard talking in the background.

MEMBER BROWN: It's Charlie Brown.

Am I not loud enough?

MS. THOMPSON: No. I can barely hear you.

MEMBER BROWN: Okay. That's unusual.

CHAIRMAN REMPE: Just speak louder.

MEMBER BROWN: Am I closer now?

MS. THOMPSON: Yes.

MEMBER BROWN: Okay. No, I guess my question is TerraPower is a new advanced reactor design. Why, why do they have a topical report and they're going to put a new reactor like this?

Does this complicate NRC's ability to evaluate that, all the rest of this stuff that they're bringing to the table as well as now have to deal with the volcanic location that they seem to be evaluating?

MR. BENNER: Well, I'll give the general answer and Jenise can supplement.

I mean, any, any applicant can come to us. I'll partition this into two parts.

Regarding the siting, they can propose any site they wish. And then we just have to work with that applicant to see if the hazards, you know, indicative to that site can be managed.

The idea of a topical in the, in the advanced reactor framework a lot of advanced reactors,

because we don't have -- we've, we've been asked, hey, can you spec measure these so applicants can get certainty on certain things? And we don't overall segment for these. We have our licensing processes. But, you can use topical to get some level of certainty in a specific area that what you're doing seems to be appropriate to the staff.

So, again, that's a choice on their part. They put all this in the application. I think it's pretty common for all the advanced reactors applicants that for certain parts of the review that they either want to try a new approach or know we're going to be challenging.

They oftentimes lead with a topical to sort of get a head-start and get the feedback from the staff on, on, you know, the staff's position. It does make it somewhat challenging for many of these reviews. So, those aspects are going on in parallel.

We have reviews where the topical report is being reviewed at the same time as the actual licensing review. We have to work hard to make sure there's the appropriate intersection of those two reviews.

So, but I'll, I'll hand it over to Jenise if she has any specifics on the hazards that she wants

to mention.

MS. THOMPSON: No. I think you covered it.

It's just a different approach to providing their volcanic hazards assessment information. And it's an approach that's allowed within the regulatory process. And so, we'll review that topical report just as we would if that information had been included in the license application directly.

So, it doesn't really change our review approach, it just changes a little bit the, the timeline for it, and the interactions or the interface between that topical report review and the license application review.

All right. So, we'll move a little bit to the east, so move to the Eastern Snake River Plain. I know the other source of volcanic hazards that we've had a lot of questions and inquiry about in the past has been the Yellowstone Caldera.

So, we'll go to the next slide, please, Barb.

And I'm showing this picture not to be alarmist. This is not -- the shaded areas are not reflective of a continuous ash layer across the United

States. These are just showing the shapes that encompass the mappable or the maps deposits for these three past historical Yellowstone eruptive events.

So, we have the largest event is the most recent at a 630,000 year old eruption from Yellowstone that resulted in the Lava Creek tephra ash bed. The teardrop shape in the middle is the smallest volume or the smallest area. It's a 1.3 million year old eruption. And then that intermediate shape in the middle is the Huckleberry Ridge at 2.1 million years.

And what I wanted to emphasize with respect to Yellowstone, I know there's been a lot of question about it. I know there has been, you know, T.V. specials, things like that about the Yellowstone Caldera and super eruption. And in looking at potential sources like Yellowstone, this is where something like the tectonomagmatic model and looking at the wide amount of research and information on the current state of these volcanic, these forces of volcanic hazards, these volcanoes, these calderas, becomes a very important component to both the development of the volcanic hazards assessment for a site that may need to consider a hazard originating from Yellowstone. And it's also going to inform the staff's review of these potential hazards.

So, looking at this, it's not a you must consider hazards from Yellowstone ash deposits, it is a future Yellowstone, or is the current state of the Yellowstone system consistent with this type of eruption that we see preserved in the geologic record.

So, that's the key thing that I want to emphasize with particularly tephra hazards coming from Yellowstone.

And I'm going to go to the next slide which is also still going to talking about Yellowstone.

And considering the tectonomagmatic model and how -- what are the driving factors that are influencing the potential for volcanism in these active systems, and a lot of that is going to come down to monitoring of these volcanoes and these volcanic forces.

So, this is, again, a map from the Yellowstone Volcano Observatory. Each of the symbols on the map is showing a different type of instrumentation that that volcano observatory is using to actively monitor this particular volcanic source.

And so, this is something that the USGS does an exceptional job of with respect to monitoring of these volcanoes within their observatory system.

And some of the instrumentation that's installed just here at the Yellowstone system is these seismometers. They are literally taking the temperature of this caldera, GPS, SCAT, cameras.

If you'd like to go online to the observatory site you can get online and see their webcams and they'll show you the current state of the calderas on a webcam for you, and also tiltmeters.

So, these are heavily monitored systems so that if in these volcanic hazards assessments there is a need to consider a volcanic hazard originating from one of these closely-monitored systems and/or to implement a mitigating action in the event of a volcanic hazard emanating from this particular resource there's going to be a fair amount of information available.

The USGS would be responsible for issuing that alert, and then considering whether there's adequate warning time, could potentially all be factors that we'll be looking at in the reviews of these volcanic hazards assessments.

And so, that's kind of what I wanted to emphasize with looking at both of these two systems here with the Eastern Snake River Plain and Yellowstone. And we'll see the information as we come

to it. But in looking at the volcanic hazards assessments that are being performed, understanding the tectonomagmatic model what is currently driving volcanism is going to be a very important component of our review and of the development of the volcanic hazards assessment.

And so, looking at some of these potential sources we'll go to the next slide. And now I'm going to talk a little bit about the potential hazards and what those potential hazards may be in looking at effects on a nuclear facility.

So, this is kind of an exhaustive list of potential hazards. You can refer to the write-up in Reg Guide 4.26 or the February 2020 presentation where I went into a lot of different volcanic hazards in much more detail. But I'm very briefly going to touch on three specific hazards.

And those are tephra fall, lava flow, and new vent opening. And with new vent opening would come proximal hazards. And those are hazards that are going to be spatially limited to a very close proximity around that particular vent opening.

So, going on to tephra fall, you saw the map of the Yellowstone ash spreads. The tephra is a volcanic hazard that can be both a very localized

phenomenon, or it can travel very long distances. And with that there can be a wide range in spherical sizes, can be a wide range in thicknesses, and also looking at deposit density.

So, the picture shown here, this lighter-colored material on the surface of the earth, this is a tephra blanket of the two full features. This is, oh, just over a 2,000 year old tephra blanket. And you can see that it's not, this is not a thick sequence of volcanic ash. This is, you know, within probably 100 yards of the feature itself. But this is not a very thick sequence, but it is still prevalent out on the plains. And it almost looks to me like somebody spilled glitter sometimes.

What we're looking at in terms of what this would mean as a hazard to a nuclear facility, there may be potential for issues with air intakes on related structures.

Also, looking at if there is tephra deposition or accumulation in the switchyard. Is there any potential or need to address removing that tephra before there are concerns with things like arcing, because things like volcanic ash, this is rock material so it's not, you know, like paper or something you get in your fireplace.

So, we're looking at things that have a wide range of particle sizes. And with that comes a wide range of potential impacts on the nuclear asset at the particular site.

So, as we look ahead to how are we going to review not just what the hazard is going to be at that site, or what the applicant has determined the hazard from that ash fall to be at the site, you know, looking at things like deposit density, thickness of that deposit, we're also going to be looking at for that particular design of reactor what are the potentially affected SSEs from that volcanic ash?

Is this an enclosed system that doesn't have air intakes that would be impacted by tephra?

Or, are there safety-related SSEs that rely on air intake to perform their safety functions?

And, again, this is where working with our systems engineering counterparts is going to play an important role in the review, not just to the volcanic hazards but the effect on the facility as well. And if there is a potential effect on those SSEs, ensuring that there is adequate warning time to implement whatever mitigating action is necessary to ensure the continued performance of that SSE will also fall within the scope of the licensing review that we're

expecting to perform.

Moving on to the next slide and lava flow hazards.

We looked at the map from the Eastern Snake River Plain that is from the Hell's Half Acre lava field. So, this is just to the east of the INL property boundary. Hopefully, everyone can see the person up on this low lobe.

And lava flows, when we're talking about these we're looking at dense, hot, these have a very high heat capacity comparable to metals. So, these in terms of hazard could, if they reach a nuclear facility, could pose a massive problem.

But in looking at the volcanic hazards assessments and preparing for these reviews, some of the things that are going to factor into that review and the determination of whether this hazard is going to impact the site are going to be things like the distance traveled from the source to the site.

And it is the volume of flow and the viscosity of that flow. Does that flow have the right properties and the right topography to reach that particular site when erupted from a specific source.

And so, we're going to be looking at a lot of very local, locally dependent conditions that could

impact where that flow could travel and whether that flow could result in some kind of adverse effect on a nuclear facility. But in general, as I said before, we're going to see that flow is generally going to be governed by topography.

You can imagine, I took this picture standing kind of in the lower basin area, and this flow is the end of that particular lobe. So, that's kind of the toe of it where it stops.

But you could imagine that if there was a flow of sufficient volume that flowed into this lower, you know, localized basin where I took this photo, that if there is a continued influx of lava flow it, it could have the potential to overtop this more localized high point where the person is standing. But, again, that's going to be a very site-specific decision looking at site topography, looking at location of the vent from which the lava is erupting, and looking also at the conditions of the lava as well.

So, looking at flow hazards there's, again, just like tephra, there are a lot of different components that will come into play when considering lava flow. But in general, on the Eastern Snake River Plain you'll see that topography is likely to be king.

And then we'll move into our, the last example hazard for today which is the new vent opening and the associated proximal hazards. We'll go on to slide 16.

This, there we go.

So, the photo here is showing the Kings Bowl feature, which is a just over 2,000 year old new vent. It opened just north of the Wapi lava field in the southern part of the Eastern Snake River Plain, so it's out of the INL property here.

You can see some people on the left side of the feature right up on the ridge line there. It gives you a feel for the size of this particular feature.

The photo is taken looking to the north. So, to the right side or the east, that's where that tephra blanket picture was taken, which is consistent with the prevailing winds on the Eastern Snake River Plain, coming from west to east or, in this photo, left to right. So, you see the tephra blanket on the eastern side of the feature here, which would be one of those proximal hazards to be considered.

This new vent opening also had a lava lake that formed just to the western side, so past where the people are standing. And those low, very low

hills along the horizon are roughly representative of the end of that, the extent of that lava lake.

And that lava lake, that surface, that now hardened lava surface preserves some evidence of these proximal hazards that we see.

But what I want you to take away from this is that new vent opening is not going to be a surprise. These are going to be events that are preceded by increased activity because, as you can imagine, as a magma body comes up from the depths in the surface of the earth towards the surface it's a very disruptive process. And all of the overlying rock is going to have to accommodate that magma body flowing up towards the surface.

And what we may see is surface deformation along with that increased seismic activity. And it's also important to note that it's possible for these magma bodies, these erupted sites to eventually stall in the subsurface and not become a surface, a new vent opening on the surface. But if that were to occur, you would still see that increase in seismic activity, and potentially see also surface deformation, depending on the depth at which that magma body stalls in the subsurface.

So, we'll go the next slide.

As I mentioned before, the lava lake still shows some evidence of volcanic ballistics.

So, it hasn't changed on my screen yet. Maybe it will change.

There we go.

So, on the left-hand size -- and I apologize, there's no scale on this slide, but I could stick my, the toe of my boot in this hole here on the left-hand side. And what happens here is you have the lava lake essentially starting to pool and form a crust along that surface. And as continued eruption occurs, lava is erupted and those smaller globs of material break through that surface and results in the small hole in the center of this photo on the left.

And as I mentioned before, also with this another proximal hazard is going to be looking at things like tension cracks or fissures. And these are going to be features that open up generally on either side of the new vents to accommodate that magma body rising towards the surface. And this is how the earth is accommodating that additional volume coming up and potentially erupting to the surface.

And you can see a person kind of in the top center of the photos here. This is roughly about a meter wide. And then it's very, very deep. And it

runs several kilometers north to south. And it runs parallel to that new vent opening, both on the east side and the west side, and accommodating that volume of magma rising to the surface and then erupting actually itself.

So, those are just three of the hazards that may need to be considered in the course of these volcanic assessments that we're starting to review. Like I said, it's not exhaustive, so if other volcanic hazards are streaming in from other volcanic sources, we are also prepared to review these. But these, I think, are realistic, realistic hazards that we may be expected to review in the course of these volcanic hazards assessments.

So, we'll continue on to slide 18, please.

So, I had promised that we would talk about numerical modeling. So, here we are.

And in looking at what would be the magnitude of the hazard or the probability of those hazards erupting or reaching a site, what we are expecting to see from most of these applicants performing volcanic hazards assessments is a reliance on numerical modeling.

Again, looking at Reg Guide 4.26, we've not endorsed a specific program or another because

there are many different programs out there, each with their own merit and each with their own applicability to certain sites and what your desired outcome will be.

So, our focus has been on the programs that we know applicants are planning to use, and focusing on understanding those models, and the development of those models, and how those models are being applied for these particular sites, so that when those models are presented as part of either a topical report or a license application that we have built an understanding of them so that we can better fulfill our review role in looking at the model support that's being provided, and the justification for the use one code for this particular license application.

So, for TerraPower we know that they're using AshPlume and PVHA_YM. Both of these were developed through CNWRA as part of the Yucca Mountain licensing review. AshPlume is a code that's modeling atmospheric dispersion and deposition of tephra. And PVHA_YM is estimating the probability of a volcanic event occurring within an affected area using a kernel density, or using kernel density estimates.

So, those are the two codes we know that TerraPower is using.

And for the INL PVHA and the Carbon Free Power Project, the CFPP application, we know that they're choosing to use Tephra2 and MOLASSES as part of their numerical modeling. And Tephra2 and MOLASSES are both open-source codes developed by a team of researchers and faculty from the University of South Florida.

Tephra2 models tephra accumulation at locations around a source volcano.

And MOLASSES is used to estimate the area inundated by lava flows for a pre-loaded digital elevation model.

And so, this is where our primary skills focus on volcanic hazard modeling has been to support these models. Again, it's going to be up to the applicant to provide the justification for the use of those models and the applicability for their use at their selected sites, because we just can't consider every single model that's available and out there and build capability for the staff to functionally use each of those models, or determine which one is better than another. Because it is, to some level, going to be a very site-specific consideration.

And also looking at what the applicant and their consultants or contractors are most familiar

with using in the performance of their volcanic hazards assessment.

So, I'll pause because I'm expecting maybe a question or two here.

MEMBER KIRCHNER: Jenise, this is Walt Kirchner.

Could you talk a little further about the D&D of these codes? Are they actively -- have they been benchmarked in any way against Mount St. Helens, or in the case of MOLASSES, against lava flows in Hawaii, et cetera?

Is there any, it is all based on historic evidence or are they actually using active volcanic activity for benchmarking?

MS. THOMPSON: So, I know that AshPlume and PVHA_YM both went through the nuclear validation and verification in support of the Yucca Mountain Review.

And I know just based on the literature that we have seen a lot of literature published in using Tephra2 and MOLASSES against known eruptions, and looking at those.

I would refer you back to -- I'm trying to think -- I think it was the February 2020 presentation I gave. I think we went through an example from one

of these. I don't remember exactly what I had before that.

But that, that's an excellent question. And that's something that we're seeing these codes being used in the literature. And that's something that will be important in our review for the justification for the use of those particular codes.

MEMBER KIRCHNER: Okay. Thank you. I'll go back and look at your --

MS. THOMPSON: I'm just looking back at --

MEMBER KIRCHNER: -- your 2020 presentation.

Okay, thank you.

MS. THOMPSON: Yeah. I would particularly look at, I would particularly look at slides 31 and 32 from that presentation which, how appropriate, the example we used was from -- was three different codes used to model the 1997 eruption at Soufriere Hills on Montserrat. So, we've come full circle today.

MEMBER KIRCHNER: Okay.

MS. THOMPSON: All right. If there's no other questions on this slide, I've just I think two or three more slides to go.

So, we talked about, I talked about a lot today of not just the Reg Guide and the process for

the outlines, but the ongoing activity action we have, the potential forces of inputs that we talked about, volcanic hazards, how they would be modeled to determine what those maximum magnitude hazards would be. And it's all to inform these future licensing reviews.

So, we know that applicants in general are following Reg Guide 4.26. There's been some minor alterations, but I do think that the publication of Reg Guide 4.26 was very timely, and that we're seeing three different projects that are proceeding with the process outlined in 4.26 for the performance of volcanic hazards assessments.

So, that's giving us some confidence that we were on the right track with issuing that Reg Guide when we did. And now we're getting some important lessons learned from the application of those Reg Guides to actual projects over the last few years and into the next couple years as we move into license reviews for those, the uses of that approach for performing a volcanic hazards assessment.

We're also, as I said, we're preparing for the review of those numerical models, including being ready to perform confirmatory calculations. But that's something that we, as a staff, during the

course of our licensing reviews decide is necessary or prudent to perform.

And we've also completed several site visits. We've been out to the Eastern Snake River Plain in support of INL PVHA work. And we've also been out there for pre-app engagement with the CFPP applicant. So, we've seen a lot of these features in the field directly observable for us.

So that's, that's an important factor when we're performing our review as well is having a clear understanding of the scale, and scope, and proximity of these features to other locations around the site region and site vicinity.

And we expect as part of our licensing review that we'll get out to the TerraPower site as well in the future.

So, moving on to the next slide.

We're also, just to reiterate, as we look toward particularly the effects of volcanic hazards on SSEs at these, for these particular designs, whether there is a need or a case need for mitigating actions to improve that SSE performance. And with that, looking at things like criteria for initiation.

Is there a need for monitoring or additional monitoring if these systems are already

monitored?

What would be considered the practical demonstration of these actions and activities as this is where we may be looking to our hydrology counterpart to have a lot of experience of looking at the implementation of flood protection measures and the possible implementation of those between the notification of an impending event and the arrival of the hazard at the site. So, we do have some experience in the review of other hazards that may be informing how we approach those volcanic hazards assessments and those, the efficacy of those mitigating actions in the future.

And then, also just to reiterate, we're also looking at foundation and excavation plans and how that may relate to foundation stability with our geotechnical instructional engineering counterparts. And also looking ahead for that geologic mapping permit condition piece put into our, our staff evaluation or our safety evaluation reports for these permit or license applications, and how, if there are any considerations beyond the normal considerations that may need to be considered for siting in volcanic terrains.

For example, the photos here on the right

you can kind of see that middle fractured layer in the center. If that becomes your foundation level what, if any, additional measures or actions need to be taken to ensure foundation stability or excavation stability?

So, we have a lot of cross-pollination between not just our hazards staff but also the engineering staff at the NRC so that we're prepared to take a very holistic approach to these reviews, not just looking at it from a geologic perspective, but also incorporating all of these other engineering considerations that we need to be aware in performing these future licensing reviews.

So, we'll go the last slide here and just kind of give you a snapshot of what's ahead for us.

As I mentioned before, the TerraPower topical report review is ongoing. So, we'll be completing that review in the next couple of months, I believe.

We also are getting ready for the acceptance and detailed technical reviews of both the CFPP and TerraPower applications. So, we'll have those on our plate as well.

And what we're planning to do as we move forward with these licensing reviews and activities is

documenting our lessons learned. Because really what we're, in addition to performing these licensing reviews, we want to ensure that in the future Reg Guide 4.26 continues to be a useful tool for applicants considering siting in volcanic terrain, or needing to consider volcanic hazards as part of their license application process.

And so, making sure that what we learned in our experiences, and what the applicants have learned from using Reg Guide 4.26 to guide their volcanic hazards assessments is something that we're capturing and improving on in the future.

So, I'll just leave you a photo from Craters of the Moon, this very steep slope called Blue Dragon Flow, if you hit the light just right sometimes it iridesces a little blue for you. And this is just to, again, emphasize for some of these locations topography will be king. Because this flow came in from the horizon area, went around the local topographic highs, and into the path of least resistance, this lower basin here.

So, with that, I think I've left a half hour for questions. So, I will stop talking now.

Thank you.

DR. BLEY: Jenise, Dennis Bley.

MS. THOMPSON: Yes.

DR. BLEY: Will you be bringing the TerraPower topical to the committee?

And if so, when do you expect that to come to the committee?

MS. THOMPSON: I will defer that to the project manager. I believe one of them might be online, and they would be able to speak to the schedule better than I am. Or, yeah.

So, Stephanie just raised her hand. She's the PM for that topical report.

MEMBER KIRCHNER: Jenise, this is Walt Kirchner. I have some information on this.

And I suspect, Dennis, -- well, first I want to tell everyone on the committee that the White Paper from CFPP and the staff's review of that approach are both on our SharePoint site for today's meeting, as well as the TerraPower topical report's there.

So, you, if you want to start taking a look at it, it's available.

Second, I believe from my scholarly information I have is we may be looking at the TerraPower topical report in the May time frame of next calendar year.

MS. THOMPSON: Yeah. And I see that Stephanie Devlin-Gill, she's the PM for the TerraPower topical report, has her hand raised.

So, Stephanie, did you want to chime in with more?

MEMBER KIRCHNER: Yeah.

MS. DEVLIN-GILL: So, well, I don't actually -- Hello, everyone. Stephanie Devlin-Gill, senior project manager for TerraPower.

I don't have anything more to add. That's right now on our schedule, yes. We think subcommittee in something of the May time frame. But we are in the early stages of the review. So, that may change with time, but that's the current schedule.

So, thank you.

MEMBER KIRCHNER: Members, further questions?

Go ahead, Vicki.

MEMBER BIER: First, can you hear me from where I am?

DR. BLEY: You're a little soft, but yes.

MEMBER BIER: I'll come around to a microphone. Sorry.

Hi. Can you hear me now?

MS. THOMPSON: Yes.

MEMBER BIER: Okay, thank you.

I was curious about what is the state of the art on forecasting of volcanoes?

And would we expect something similar to what's done for hurricanes where if there's a significant risk identified we might shut the plant down preventably?

And has anybody thought about that or looked into it?

MS. THOMPSON: So, I don't know if you would call it forecasting. But the U.S. Geological Survey does keep a very close watch on all of the volcanoes that are included in their Volcano Observatory Program. They operate I believe it's five Volcano Observatories around the U.S. And that would be the authority that would issue any kind of notification of an impending volcanic event.

Whether that would rise to the level of needing to shut down the facility, I think it's going to depend on what the potential hazard would be for that particular location, and not something that we would review as part of the application. But it's not something that we would -- it's not something I want to speculate on right now because I wouldn't know what the justification would be or what the particular

hazard would be from a hypothetical volcanic feature that's going to result in a hazard impacting a nuclear site.

So, that's something that we'll consider going forward. But I don't believe that there's a -- it's not a forecast per se, but there is active monitoring of these volcanoes in the United States by the USGS.

MEMBER BIER: Okay. And just have an additional comment.

I know that there has been a method to go up, like, on small island nations, or whatever, where you have to worry about when people evacuate, to kind of -- it's essentially a formal expert opinion method, you know, similar in a way to the seismic hazard assessment but much less voluminous and elaborate, something that you can do quickly.

And they have used that to decide on evacuations in some circumstances. So, if people are interested, I could forward links to that, or whatever. But it's just something to consider going forward how would those decisions be made.

DR. BLEY: Hey, Vicki, this is Dennis.

MEMBER BIER: Yes.

DR. BLEY: I don't know if you remember,

but back when Mount St. Helens erupted, for about a month before that there was a lot of very public communications of the activity and changes and kind of swelling of the earth under -- above that area. And it was very thoroughly tracked and publicized.

MEMBER BIER: Yes. Thank you.

That's the extent of my comments.

MS. THOMPSON: Thank you.

MEMBER KIRCHNER: Members, other comments or questions?

MEMBER DIMITRIJEVIC: Jenise.

MS. THOMPSON: Yes?

MEMBER KIRCHNER: Vesna, do you have any questions?

MEMBER DIMITRIJEVIC: Yes.

Actually, I would like to ask, Jenise, do you have a feeling, you know, because as a PRA person I'm mostly interested in these numerical estimates, and I have a feeling that those will be, you know, very hard to come with any reasonable certainty.

So, do you have any feeling how work, elaborate work is needed to come with this numerical estimate for any applicant? How much work, you know, has to be invested in get those numerical estimates?

MS. THOMPSON: So, do you mean in terms of

computational time for their modeling or?

MEMBER DIMITRIJEVIC: No, no. It means what kind of basis that you collect. I mean, are we talking here very work-intensive or, you know, because that would -- that's not something that will be available for the different areas; right? So, the applicant will have to do that, his own study to cover those numerical estimates.

MS. THOMPSON: So, I'm going to preface this by saying that I think it's going to be up to the individual applicant to determine the extent of the numerical modeling they would like to perform.

There's no requirement in the Reg Guide that an applicant needs to take a modeling-intensive approach to determining their hazards. An applicant could just as easily assume a maximum magnitude hazard in their screening steps, and take a much more deterministic approach of, okay, the thickest ash layer that I've found is X number of meters. And they can link it, assuming that will be the hazard at their particular site without the need to do any additional modeling.

And that would probably be the least amount of effort to complete that. Whether it's the most accurate reflection of the volcanic hazard for

that particular source and that particular site is probably debatable. And that's where using a, using an approach that would rely more on modeling may be useful for, particularly if you're looking at SSE performance and you don't want to be considering the performance of SSEs under, you know, a 5-meter load of ash. I'm just picking a number out of thin air there.

So, it can be as computationally time consuming as an applicant desires it to be. There's, I assume, my gut is telling me, that we'll probably see somewhat of a middle ground where there is some deterministic looking, screening of certain hazards and then taking a modeling approach to determine, to refine that hazard level for other hazards or other potential -- or other sources of volcanic hazards.

But I, I wouldn't want to guess how much time and effort it's taking.

MEMBER DIMITRIJEVIC: You said exactly what I was, you know, hoping you would say. Because you actually said a couple of times you guys support numerical approach. But that's, you know, a lot of times would be, you know, the much more productive to combine with the deterministic approach, you know.

MS. THOMPSON: Yeah. And that's a good clarification is in the development of Reg Guide 4.26

we wanted there to be flexibility. So, the option of using numerical modeling is available. It's not a requirement though.

So that having that flexibility I think is important for applicants to be able to choose what's best for the conditions at their site and their selected design. And that's something that we're seeing play out in these volcanic hazards assessments that we expect to be reviewing.

MEMBER DIMITRIJEVIC: And so, basically in your diagram that's acceptable, the condition is, you know, flexible, right, what is acceptable?

MS. THOMPSON: Well, that's, that's acceptable to the applicant to complete their assessment. Acceptable to the NRC staff is something that we would determine in the course of our review.

So that it's up to the applicant, if they believe that their results should be earlier in the volcanic hazards assessments process in that flow chart is acceptable to take that off ramp and complete their assessment, then it would be up to the applicant to make the case for why that stopping the assessment at that point is acceptable, and to justify that conclusion and not proceeding further in the analysis.

MEMBER DIMITRIJEVIC: Right. And this is

where they can introduce risk-informed, you know, principles like --

MS. THOMPSON: Exactly.

MEMBER DIMITRIJEVIC: -- like, for that part of a -- if they determine that that's the only hazard that can get to the site, then the only impact would be on, let's say, switchyard, then, you know, you don't need really volcano to use offsite power, things like that. You know, you can do some comparison with current risk and things like that, and make a risk-informed decision.

That's how I always visualize this can be done.

MS. THOMPSON: Exactly.

And that's correct, the intent of the Reg Guide because in looking at volcanic hazards there's a wide range of physical demands that could result on the affected facility. And it would be impractical to not consider a risk-informed approach to considering such a wide range of potential effects on a facility.

It's not a one-size-fits-all approach for volcanic hazards by any stretch because there are just so many different physical characteristics that need to be considered. And then potentially so many different SSEs that may be impacted by whatever the

hazard may be.

MEMBER DIMITRIJEVIC: Okay, thank you.

MS. THOMPSON: Thank you.

MEMBER KIRCHNER: Members, I need to leave time for public comment. And maybe this is a good juncture to ask.

Anyone out there on the line, unmute yourself, identify yourself, affiliation if appropriate, and make your comment.

(No response.)

MEMBER KIRCHNER: Hearing no comments from the public. One last time amongst the members, any further comment?

MEMBER MARTIN: One more administrative.

Other hazards, external hazards, flooding and earthquake, appear in the Reg Guide under power losses. And now we have an external hazard, volcano, and environment and site.

Did they get lost there? Or, I mean, you could flip the question, why are earthquake, and flooding, and power losses are not in siting?

Those decision-based go a little different here because much of the basis for discussion is because it's CFPP and TerraPower factors. Why here?

MR. BENNER: I'm going to defer to Jenise.

MS. THOMPSON: Yeah. I was going to say, I can chime in with a little bit of a history on that. And then I don't know if Ed O'Donnell is on the call or in the room, but he may have some -- he's the project manager from Research, the Reg Guide project manager for Reg Guide 4.26.

But initially the Reg Guide didn't start off in Section 1 of the Reg Guides or in 1, I don't know what it's called exactly. And it was moved to Section 4 for Category 4 because at the time we were still discussing the applicability of the Reg Guide and whether this was something that could be expanded to include non-power reactor facilities.

So, it was moved into siting instead. So, that if at some point in the future the scope or applicability of the Reg Guide were to expand, that we would already be in that siting space rather than in a reactor space only.

But I don't know if Ed has more to add on that.

MR. O'DONNELL: No. No, well said. Well said, Jenise.

MEMBER KIRCHNER: Go ahead.

MR. O'DONNELL: No further comment. Jenise expressed it very, very well.

MEMBER KIRCHNER: Yeah.

And I was just saying to Bob, the other thought in the public meeting back in 2021 was although it had power reactors in the titles, it could apply equally well to a radiological production facility.

MEMBER MARTIN: -- and come to the same conclusion that those belong in 4?

Is it just, like, scattering around not the best way to design, you know, the framework issue? Not a safety issue, seems like it's lost in this situation.

CHAIRMAN REMPE: Sounds like another reason to think about another website.

MEMBER KIRCHNER: Yes, Dennis, go ahead.

DR. BLEY: Yeah. On this same line, I understand and appreciate where you've moved it. I don't understand why you keep nuclear power reactor sites in the title, you know, instead of something like nuclear facilities which seems is equally appropriate for either of them.

MS. THOMPSON: That's a good point. And I think it's about the point for us to consider in the future in another revision to the Reg Guide. Because I agree with you, I do think this would be applicable

to other nuclear facilities that would need to consider volcanic hazards in their license applications.

So, that's something we can take back and when we're looking to revise the guide in the future we can take a very hard, close look at the applicability section and see if we can change the title and alter the applicability to more widely cover all of the NRC licensed facilities.

CHAIRMAN REMPE: This is Joy. Then I have a question.

I've heard some really simple suggestions. And this is, this could be an information briefing. But the committee can always decide to write a letter at any time. That's a risk that you're well aware of.

Walt's shaking his head again.

A simple one-page memo saying, hey, we were briefed on this, and during the meeting we proffered a couple of suggestions. I don't know if it's worth it or not, but it's something I'd bring up, but.

MEMBER KIRCHNER: In my opinion I would not recommend writing a letter now. Let's see it put to the test. We have applications coming in. We could -- I don't think we have any major comments to

offer that weren't offered in our letter back in April of 2021.

For example, this very last topic of the title was suggested that I don't think that rises to the level of writing a letter that the title should say nuclear facilities.

CHAIRMAN REMPE: No, I'm thinking more about the global approach for applicants, another change to a website like what happened if Charlie does a license step.

But, anyway, that's just something to think about. And I'm not looking or pushing for another letter. But I hope the thoughts don't get lost because they're just individual comments now, they're not a committee position.

Anyway.

MEMBER KIRCHNER: Members, further comments?

With that, I want to thank both Jenise and Eric. Thank you for your informative presentation.

I'd just make one comment. I can't let this one go.

Jenise, I think I heard you say something to one of the questions that in your gut -- and maybe I misheard you, I'll go back and look at the record --

but to what extent, maybe lead with this, to what extent when you screen in using 4.26 would you prefer the applicant do with the volcanic hazards, particularly those that could be kept on the ash side, because that can be fairly widespread, but if you screen in, to what extent -- and I was the one who made the comment about macro decisions, look for the high ground, for example, to avoid lava flows, and avoid flooding as a result of lava flows, et cetera -- to what extent should the guidance in 4.26 suggest to the applicant don't necessarily try and calculate your way out of the problem given the large uncertainties but take the high ground -- pardon my metaphor -- at what point do you practically, you know, are you looking for the applicant to, as I said, take the high ground to avoid extensive calculations along the lines of Vesna's questioning, how do you risk inform something that has huge uncertainty?

Maybe I'll just leave that as a thought for the future because one would, in my gut reaction to this, is one would hope that the applicants aren't, you know, parking a site on a vent and then trying to calculate their way out of the problem.

Is that a rational expectation?

MR. BENNER: I'll add a generic -- this is

Eric Benner -- I'll add a generic piece and then Jenise can go deeper.

We actually just had a knowledge management session with the staff and NRR on the topic of clarity versus consulting. And because there, you know, we're cautioned to not consult. So, regarding sort of, you know, directing an applicant to both physically and metaphorically take the high ground, we wouldn't do that.

But what we could do and should do is if they are, you know, going down a path that's going to rely on calculational, you know, for methodology, and particularly if they are picking a site that is on the low ground, we can point out the challenges of that approach.

And should point out how much of a risk it's going to be for them to get an acceptable regulatory finding.

So, that's sort of the generic case. And I'll turn it over to Jenise for, again, specifics on these hazards.

MS. THOMPSON: Yeah. And I appreciate Eric's point. Because it really isn't our place to redirect them to change their site. We don't have essentially what amounts to a site exclusion criteria.

And if you recall back in I think the February 2020 presentation, maybe April of 2021 as well, that's one of the reasons we did not endorse the IAEA safety guide on volcanic hazards because they, they do have site exclusion criteria for volcanic hazards that if that hazard would impact the site, that site should not be considered for construction.

And that doesn't -- that's not consistent with the NRC's risk-informed approach to regulation.

So, I think there, as Eric said, there would be the opportunity for a lot of early discussions on how those initial siting decisions were being made, and also looking to all of -- and if numerical modeling is being relied upon to demonstrate the safety of the site, then looking very, very closely at that safety case being made by the applicant is in their specific application.

But, again, taking that, that approach where it's not our position to direct the prospective applicant one way or another but to provide clarity on the regulatory requirements and the regulatory basis and justification that should be provided in their application. And that would be, I think, a lot of early discuss -- early and often discussions in that pre-application.

MEMBER KIRCHNER: Thank you, Jenise. Jenise, thank you.

Stephen.

DR. SCHULTZ: Walt, this is Steve Schultz.

MEMBER KIRCHNER: Yes.

DR. SCHULTZ: Jenise, a follow-up question there.

That is, as you do the reviews of TerraPower and the NuScale, I mentioned NuScale as part of the facility process because that's the design I want to get to that, you know, for the design side you're going to get a lot of information about the capabilities that the designers believe they have with regards to the hazards that you've gone through today.

You know, when a designer puts forward their seismic design, they have a particular deterministic valuation of what the design capability of the facility is for seismic hazard. And the same will come out with regard to the design capability for the ash, for the capabilities associated with flooding, and so forth.

And so, there's, as you mentioned earlier, there's certain design aspects that will be available for decision making associated with the overall evaluation. There's that side of it, too.

MS. THOMPSON: Yes. And that's something that we're planning to support the reviews of these volcanic hazards assessments, recognizing that I, I'm a geologist and the characterization of the hazard is my wheelhouse. And once we get into looking at the effects of those hazards on these structures, the different components for that specific design, that's when we will be passing the baton, if you will, on to the various systems engineers for the potentially-impacted systems, and relying on their expertise in support of that licensing review.

So, this is where we're, we're anticipating additional overlap in review areas where volcanic hazards may now be passing over not just to structural or geotechnical engineering, but also looking at nuclear systems engineering and passing that information on to them to do the PRA review. So, it's going to be a much wider scope of review, not just looking at the hazard, but where those pass-off points are between the hazard staff and the engineering analysis staff.

So, that that's a review that's going to follow the normal course of review for the nuclear systems engineers as their, part of their safety review. And we're just providing an input to that

review for them.

DR. SCHULTZ: Yes. And --

MS. THOMPSON: So, lots of, lots of review interfaces here to be mindful of as we move forward, not just the geologic hazard components.

DR. SCHULTZ: That's good.

And on that side, there's a lot of features and evaluations that will be done. And they can be done on a one time basis. They can be used for other evaluations and don't need to be repeated by every applicant or every designer. It can be established what their design capabilities are.

MS. THOMPSON: Yeah. And that's part of why we're really focused, even though we haven't completed the review yet, why we're focused on documenting those lessons learned to inform any future revisions to Reg Guide 4.26 so that we're capturing those, those interfaces and those conclusions that have already been made.

I know we started off with a question about the capability of SSEs to withstand various volcanic hazard loads. So, this is going to give us the firsthand experience and knowledge to start documenting that and using that learned experienced in future license reviews as well.

DR. SCHULTZ: Excellent. Thank you.

MEMBER KIRCHNER: Okay. With that, thank you to everyone. Thank you again to Jenise Thompson and Eric for being here with us today.

And I yield back a couple minutes of our time.

CHAIRMAN REMPE: Thank you very much.

Okay. At this point I want to go off the record, okay, Jim. And we'd like to request that you, along with Eric, return at 1:00 p.m. this afternoon.

(Whereupon, the above-entitled matter went off the record at 10:27 a.m. and resumed at 1:00 p.m.)

CHAIRMAN REMPE: Okay, it's 1:00 p.m. on the East Coast, and we're back in session. And at this time I'd first like (audio interference) to ask -- hold on.

And now I'd like to ask Member Brown to lead us through our first topic for today.

MEMBER BROWN: Okay. Just, I'm going to make some kind of a game plan, opening comments, since we're kind of out of sorts on the way we normally do stuff.

Because of the Commission's desire to get something out within a year of the SRM, the normal process of scheduling a Subcommittee, and then another

meeting with several of us, kind of out of sorts. So we requested to combine it with this full Committee meeting so that we can get ahead of the ball game. And hopefully help you meet your goals. And it also will allow you to at least hear our comments in the transcript on the (audio interference) BTP.

I intend to try to get through this, the slides, in an expeditious manner. But you know how it works with the Committee people, they undoubtedly have questions. I will probably save mine until later, but at the end. And then Tom and I probably both will give some additional ones if we don't cover them all. But my object here is to get all of our, the two people who probably did the most review on it, give our comments and thoughts and more inconsistencies in the transcript so you would have them.

And the objective of all of this is to try to get a letter which documents those. Hopefully we can do it this Committee meeting, if the Committee agrees. But I'm just proposing it. There will be the comments and stuff in it. If not, we would get it out in the October meeting. That will still get it, but you would already have the comments.

The other object would be that we don't have to have the comments resolved prior to the issue

of public comments on the 19th. You can obviously do it if you want to, if we don't get to the letter until October. But they can be done in conjunction with the public comments. If the Committee agrees with me at the end of this whole shooting match.

So that's kind of, did I miss anything, Joy, or did I kind of get it, that's still in line with your game plan, right?

CHAIRMAN REMPE: Sounds good. I hope --

MEMBER BROWN: Okay.

CHAIRMAN REMPE: Court reporter, could you get --

MEMBER BROWN: Can you hear me? Can you hear me, court reporter? Uh-huh.

(Off-microphone comments.)

MEMBER BROWN: All right.

CHAIRMAN REMPE: But is it enough to put on the transcript --

MEMBER BROWN: Were you able to get me on the transcripts?

(Off-microphone comments.)

MEMBER BROWN: Okay. Well, I'm fundamentally done. I was going to pass off to -- oh, one other thing. For the Committee's purposes I had Christiana, since the old SRM was 93-087 that had all

the points that's been, and we had a BTP, we had a subcommittee meeting, a full Committee when we did Rev 8, that's based on the old SRM.

Gave you a copy of the, and there are all, the changes that the Commission made on the original SRM are in red so you can see what was done back in '93. What the Committee Commission did on the 222-0076 is also, what the Commission changed, also is in red. You've got a copy so you can see what the differences are as they progress through the discussion to make sure everything is there.

Mine understanding of the Staff's object was to leave all the stuff relative to diverse best estimate systems the same. Only do what was necessary to get the risk-informed guidance direction that the Commission did. And they will address that, and how they did that, and didn't mess up anything else. And that's where, maybe, where some of the comments come in.

So with that, go ahead.

CHAIRMAN REMPE: Just one clarification, just because this is a public meeting, I think it's great that you and Tom have got your comments together, but, and, you know, it's great that you're going to put it on the record and the Staff can see

it, but of course, we all know that there are two individual --

MEMBER BROWN: Yes.

CHAIRMAN REMPE: -- respondents in the letter --

MEMBER BROWN: No, absolutely. Those are --

CHAIRMAN REMPE: So, just wanted to make sure. I know that the Staff knows, I know --

MEMBER BROWN: Yes, I apologize for that.

(Simultaneously speaking.)

MEMBER BROWN: I should have, I know you know that's clear, but nothing is ever official until the Full Committee puts it Betty Crocker Housekeeping seal of approval on it.

(Laughter.)

MEMBER BROWN: With that, I will turn it over to Eric for some opening comments.

MR. BENNER: Thank you, Chair Rempe, Member Brown. My name is Eric Benner, I'm the Director of the Division of Engineering and External Hazards. And the I&C technical review is conducted within my division.

We both very much appreciate the Committee's flexibility on this issue, as because

Member Brown said, once we got, we had made the proposal for our risk-informed alternative for diversity and the Commission paper, the reference number that Member Brown gave, SECY-222-0076, when the Commission gave us their direction back, which essentially approved the Staff's proposal with some changes, they gave us a year to promulgate it in implementing guidance.

So that significantly challenged the Staff, setup a schedule to achieve the Commission's direction. And so again, we appreciate the Committee's flexibility in working with us on the scheduling.

We also very much appreciate getting the Committee's feedback as soon as possible. So we do understand that it would come in the form officially of a letter. That being said, we'll be listening to any input we hear, and will be looking at ways to either incorporate it for the version that goes out for the public comment or as part of our comment, public comment period, and issue resolutions.

So I do applaud you taking the time to give us the feedback now, because I think were we to go through the public comment period and then get significant feedback from the Committee after that,

that could likely result in another public comment period, so we would not be able to achieve the schedule the Commission had given us. So this at least gives us an opportunity to meet that schedule, so we appreciate that opportunity.

We have three main presenters, which I'll introduce. Samir Darbali and Norbert Carte are both I&C reviewers within my division.

Steven Alferink is a risk and reliability analyst. And he is in our office, the Office of the NRR's Commission of Risk Assessment. And this is testament of that, that the I&C Staff and the Risk Staff did work closely, both in developing the proposal to the Commission and in the implementing guidance.

So with that, I'll turn it over to Samir Darbali.

MEMBER BROWN: One more observation is that when you get to, the further comments are extensive and/or make very, your dramatic type changes that you all did, that we would, not a necessity, needing another meeting afterwards. That wouldn't be driven by us, it's largely driven by what the public come through and what you all have to deal with it.

MR. DARBALI: Yes.

MEMBER BROWN: So just wanted to make sure that was, you understood that is the final thing on the table if necessary.

MR. DARBALI: Okay.

MEMBER BROWN: Not intending to do that. Gives you a way with it a little.

MR. DARBALI: All right. So thank you and good afternoon. So today we'll provide some background information by going through the original four points, as Charlie mentioned.

MEMBER BROWN: And can we, want to check to see if the court reporter can hear you?

MR. DARBALI: Can you hear me?

CHAIRMAN REMPE: Court reporter, can you hear Samir?

(Off-microphone comments.)

MR. DARBALI: Okay, thank you. All right, so --

MEMBER BROWN: He asked you to speak louder.

MR. DARBALI: Yes.

MEMBER BROWN: You should be able to do a high resonant voice.

MR. DARBALI: Okay. So we're going to be going through the original four points from SRM-SECY-

93-087 and the new points in SRM-SECY-222-0076. We'll then talk about the Commission direction from the SRM and the Staff's proposed response before we go into detail with substantive changes to BTP 7-19. Well finish with the next steps for revising the BTP.

Now we'll go through the next slide for Point 1 of SRM-SECY-93-087. So Point 1 requires a D3 assessment to demonstrate that common cause failures have adequately been addressed. The language in this original first point places the focus on the D3 assessment of the proposed I&C system rather than on the facility install in the proposed system.

This point also uses the term, common mode failures, instead of common cause failures. And these were things that we were looking to clarify in the revised point, which we'll look at later.

Next slide please. So Point 2 requires that the D3 assessment analyze each postulated CCF for each event evaluated in the accident analysis using best estimate methods to demonstrate adequate diversity. As you see in red, the addition that the Commission made to this point back in 1993 for the use of best estimate method.

Next slide. Point 3 requires a diverse means of accusation if a CCF could disable a safety

function. And the Commission added that the diverse function can be performed by a system that is not safety related.

Next slide. For Point 4 it requires diverse maintenance for a room display and manual controls for actuation of critical safety functions. The Commission edited this point to allow for the diverse display of the manual controls to be performed by equipment that is not safety related.

And now we'll go to the four points in SRM-SECY-222-0076, which can be found in the enclosure to the SRM. So for Point 1 the first paragraph is similar to that of the original point. But we've clarified that the focus of the D3 assessment is the facility in following the proposed system. And we also replaced the term, common mode failure, with common cause failure.

MEMBER KIRCHNER: Could you tell us, in your own words, why shall has been changed to do not.

MR. DARBALI: The Commission made that change, but did not provide a specific reason why.

MR. BENNER: We interpret it to mean the same.

MEMBER KIRCHNER: Okay. So, effectively -- because most of your regulatory language is shall

--

(Simultaneous speaking.)

MEMBER BROWN: Shall is more legalistic, and must is must. Shall is legalistic language, and the must fundamentally means figure it out for yourself. They have choices. It flows in the, a bit of what I would call, I don't want to call it a risk, but engineering judgment thought process is how you proceed. That's my thoughts on it.

MEMBER KIRCHNER: Thank you, Samir.

MEMBER BROWN: Must is not legalistic.

MR. DARBALI: Now, thank you for the question. So for Point 1 we also added a new sentence to explain that a D3 assessment must be commensurate with the risk-significant of the proposed I&C D3.

Next slide for Point 2. Thank you. So the original Point 2 only covered best estimate methods. And we're keeping that here. The new Point 2 covers best estimate methods and risk-informed approaches.

For the new Point 2, a new first paragraph was added to explain that the D3 assessment must be performed with either best estimate assessments, a risk-informed approach or both. The second paragraph is essentially the same as that of the original Point

2, referring to what is required when using best estimate method.

Next slide. Thank you. So this is the third paragraph of the revised Point 2. And it was added for the use of a risk-informed approach. And explains that the Staff will review applications for consistency would establish NRC practices and guidance for risk-informed decision making.

For example, Regulatory Guide 1.174 and reg, for operating light water reactors. And Regulatory Guide 1.233 for non-light water reactors.

Next slide.

MEMBER ROBERTS: This is Tom Roberts.

MR. DARBALI: Yes.

MEMBER ROBERTS: The Commission added the Reg Guide 1.233, if I understand your markup.

MR. DARBALI: Yes.

MEMBER ROBERTS: That was the only reference I could find in the revised BTP to that Reg Guide. Do you know why the Commission added that or do you think there is a need to provide guidance to the applicants or the licenses of how they apply Reg Guide 1.123 to this scenario?

MR. DARBALI: So the intention, when we wrote the SECY-22-0076 we intended it to cover all

reactor types. And so, I believe the Commission's intent, so we provided an example of 1.174. I believe the Commission's intent with 1.233 was to also show an example guidance for non-light water reactors.

MEMBER ROBERTS: Right. But the BTP doesn't further expand on that?

MR. DARBALI: Correct. So the BTP, Branch Technical Position 7-19, is part of a vendor review plan for operating in light water reactors. And so, the guidance for non-light water reactors really wouldn't fit within BTP 7-19. So the guidance in BTP 7-19, again, covers light water reactors, guidance for non-light water reactors is founded elsewhere.

MEMBER BROWN: I'll amplify that because that was one of my observations was that the regulatory guidance list that you all list does not even list 1.233, yet it is referenced in the SRM. And this really applies to both light water and non-light water based on the general language. So it just seems, to us, that if it's in the SRM and the Commission edited it, it seems like it ought to be in addition to just the Point 3 or Point 2 phraseology, it really ought to be in the list of identified regulatory, I forgot what section it is. It's right up in the front --

MEMBER ROBERTS: Yes.

MEMBER BROWN: -- where all the regulatory guidance is sitting. That was just an observation that we would be making. I think Tom is --

MEMBER ROBERTS: Sure. And perhaps the BTP should explain why it's not further described. Okay.

MEMBER BROWN: Yes. That would be an alternative approach.

MEMBER ROBERTS: Which would then lead to wonder, okay, what document applies for new advance non-light water reactors when they're figuring out how to apply the (audio interference)? Tom, what's your answer that question?

(Off-microphone comments.)

CHAIRMAN REMPE: Okay, so let's try and not move the microphone anymore. And use your command voice, Charlie, I know you've got it.

(Laughter.)

MEMBER BROWN: I will do that.

CHAIRMAN REMPE: Okay.

MEMBER BROWN: It's present most of the time.

MEMBER ROBERTS: So I'll repeat the question. If BTP 7-19 is not applicable to advance

the non-light water reactor, what --

MR. DARBALI: So --

MEMBER ROBERTS: -- is?

MR. DARBALI: So the design review guide, or DRG, provides the I&C review guidance for advance non-light water reactors. And that would be the document, that document goes together with Reg Guide 1.233. That document is performance based and risk-informed (audio interference) inception. But again, that's a separate document, separate activity from BTP.

MEMBER ROBERTS: Okay. So is your intent to revise that document consistent with the BTP revision?

MR. DARBALI: So currently the folks in the division of advance reactors, DANU, in NRR are looking at what updates are needed, if any, to meet the SRM.

MEMBER ROBERTS: Okay, thank you.

MEMBER BIER: If I can follow-up with a related question.

(Off-microphone comments.)

MEMBER BIER: That's all right, I'll come around. Thank you.

If I can follow-up with a related

question. From the existing document it looks like the definitions of what counts as risk-significant are geared to traditional LWR criteria like, I forget exactly what the numbers are, but there was a number for core melt and another number for LERF as frequencies, but those may not apply to some reactor designs. Like if there is no solid core or whatever, and has there been thought about how the definition of risk-significant would apply to other designs?

MR. DARBALI: I'm going to turn it over to Steven Alferink.

MR. ALFERINK: So the answer is, yes, we're certainly thinking about it. But specifically because the BTP 7-19 is for light water reactors. That is why we kept (audio interference).

CHAIRMAN REMPE: So now I'm getting confused. I thought you were expanding it to non-LWRs, right?

MR. DARBALI: No. The BTP is still for light water reactors.

CHAIRMAN REMPE: Only?

MR. DARBALI: Only. Yes.

CHAIRMAN REMPE: But it could go to the advance light water reactors, like the small modular light water reactors for example?

MR. DARBALI: Correct. Yes.

CHAIRMAN REMPE: Okay. So then the question would be still relevant, and I'd elaborate that there is, the definition of the CCF is not risk-significant if the following criteria are met for the sensitivity analysis, and the increase in CCF or the increase in LERF is less than in both of those cases.

And I would think that, we wrote a letter years ago about, eventually you're going to get to say that these criteria, you know, it's really easy to meet those, and it could be significant really is where I was going with it too because I had the same thought for it.

MR. DARBALI: So I believe we do have some slides when we get to the discussion of risk-significance. So we could explain in some detail --

CHAIRMAN REMPE: Sure.

MR. DARBALI: -- later. Okay. So we could go to the next slide.

MEMBER BROWN: I just can't help myself. And I probably lost -- this is light water versus non-light.

Why isn't the BTP applicable in non-light water reactors? I mean, you got systems and protection systems, why don't those same defense-in-

depth issues apply to non-light water reactors? Or are they just so safe that nobody has to worry about them?

MEMBER BROWN: No, it's not, it's not really a technical issue regarding the applicability, it's that fact that the BTP is part of the standard review plan for light water reactors.

MEMBER BROWN: But why does that make any difference? I mean, if BTP is a NRC document it should be able to be used. Can you hear me?

(Off-microphone comments.)

MR. DARBALI: Dinesh Taneja, would you like me to provide some additional insights?

MR. TANEJA: Yes. This is Dinesh Taneja. So, Member Brown, to answer your question, standard review plan is one of the NUREG-0800. And when you look at the NUREG-0800 it specifically states in our regulation that that guidance applies to light water reactors, okay?

So when we developed the DRG, and Reg Guide 1.233, it was named different for that very reason that we wanted to distinguish it from the SRP. Okay? When we presented our DRG to the Committee here, I think we came to an agreement that the guidance can be used for light water reactors, but it

was intended to be developed for non-light water reactors.

Now that guidance, you know, I believe is already in conformance, or at least the intent of the SRM already. So we are looking at, to see if we can modify our revisement, but the intent is already being met because it's already risk-informed and performance based.

So that's guidance is what's going to serve the Staff very well in looking at all these non-light water designs in combination with the Reg Guide 1.233.

MEMBER BROWN: But as I reviewed that it was also a spinoff of the original efforts on the design specific review guidance that we built for --

MR. TANEJA: That is true.

MEMBER BROWN: -- one of the early light water reactors, okay, that was being proposed by B&W, I believe, at the time.

MR. TANEJA: Correct.

MEMBER BROWN: And then we applied it to the NuScale and others. So I'm just saying, these things are so vanilla --

MR. TANEJA: They are. I agree with you.

MEMBER BROWN: For some reason that just

doesn't make sense to divorce 7-19 which has got a plethora of information on what to do on overall defense-in-depth type perspective. And I suspect it's not all duplicated in the DRG, okay, relative to what's, I mean, this is 38 or 39, 40 pages worth of stuff. This is pretty detailed.

MR. TANEJA: Correct.

MEMBER BROWN: So anyway, it's an open, it's just a question. We --

MR. TANEJA: Yes, it is. And the other point is that, you know, Staff really has all these tools available. So it doesn't limit us to not use these tools when we are reviewing an application regardless of whether it's for advance non-light water reactor or an SMR or a design mod. So these are the set of tools that we do have available. We have to just, you know, legally distinguish them in certain buckets.

MEMBER BROWN: Yes, again, after you all do your review, applicants need to know what you're reviewing too. And if you're going to invest using it in a way that "this perception is not," then it kind of surprises the applicants as to, oh, you're making comments that are relative to guidance that's just not in the other, the non-light water side.

MR. TANEJA: Yes.

MEMBER BROWN: We're just trying to make the point that this doesn't seem to connect the dots very well. And it might be useful in this document now to at least provide a little more of expansive consideration of its application because it's very generic.

MR. TANEJA: Yes.

MEMBER BROWN: It doesn't matter. You can make this thing out of chewing gum, reactors out of chewing gum, and it would still apply. That's sarcasm, but then there is something. Okay?

MR. TANEJA: Understood.

MEMBER BROWN: Okay. Ought to have some humor in there.

(Laughter.)

MEMBER BROWN: All right, Committee, can we, Tom, are you finished?

MEMBER ROBERTS: Yes.

MEMBER BROWN: Okay.

MR. DARBALI: Okay, thank you. Next slide. So the original Point 3 only discussed the need for a diverse means with a CSF, critical safety function. The new Point 3 now also covers designed technics and mitigation measures, other than

diversity. And the first paragraph was added to explain that if technics or measures, other than diversity, are credited in the assessment, that they must be adequately justified commensurate with the risk significance of the CCF.

Next slide. The second paragraph of the new Point 3 is essentially the same as the original Point 3 as it explains that, what is required when a diverse means is credited in the assessment. Fr example, the diverse means could be manual or automatic or performed by a system that is not safety related.

Next slide. And this third paragraph in the new Point 3 was added to explain that if design technics or measures, other than diversity, are not demonstrated to be adequate with a risk-significant CCF, than a diverse means is required.

Next slide. For Point 4, the language in SECY-22-0076 was essentially the same as the original Point 4. The Commission in the SRM added the words "risk-informed" to clarify that the identification of critical safety functions could be performed using risk information. The Commission also added that last sentence to allow applicants to propose a different approach if the plants design passes the commensurate

level of safety.

CHAIRMAN REMPE: I have a question.

MR. DARBALI: Yes.

CHAIRMAN REMPE: In our recent reviews of some of the advance non-LWRs, and we issued that when, and how they, while they define their critical safety functions has come up. For example, Part 53 Framework A has a certain way of doing it. It's a little bit more fussy with Framework B, which now go, are combined or whatever.

But in the regulations the critical safety functions appears differently in the guidance in the current NRC regulations. Does the operating fleet have some document that says, okay, for this plant our critical safety functions are?

Are they going to have to submit something?

How does that work, do you know what their critical safety functions are when they come in?

MR. DARBALI: So the original SECY-93-087 provided an example of critical safety functions. And those could be, those examples could be tied back to, I believe IEEE 497 and then ANS standard from 1980, I believe ANSI-ANS 4.5.

Those really, after Three Mile Island,

where the documents that identified, for post-accident monitoring, what those critical safety functions are. But again, those are examples for light water reactors. There is no regulation to say those are specifically the only critical safety functions.

And so, when an application comes in, they identify the controls and display to meet the critical safety functions. But for a typical digital I&C upgrade licensing review, we're not evaluating the licensees determination of what those critical safety functions are. So they provide those functions and the controls and displays for those functions.

CHAIRMAN REMPE: You think with an LWR there wouldn't be variability.

MR. DARBALI: Correct.

CHAIRMAN REMPE: But if someone were to try and use this for an advanced small modular light water reactor, or a non-LWR, you know, it would be very important to have agreement with the staff what those critical safety functions are, is why I'm kind of bringing this up.

MR. DARBALI: Right. And we do have, we did clarify the section of the BTP that talked about critical safety functions. We do have a slide on that. And so to explain, at a very high level, what

the importance of those critical safety functions are. And based on that licensing can make their determination. But we have a slide on that.

CHAIRMAN REMPE: Yeah, I didn't see chemical, control chemicals (coughing) and things like that.

MR. DARBALI: Right. Right.

CHAIRMAN REMPE: So that's why I'm kind of thinking that it may be something --

MR. DARBALI: Yes

CHAIRMAN REMPE: -- that may come up. Anyway, go ahead.

MR. DARBALI: Okay, thank you.

MEMBER DIMITRIJEVIC: And I have a like comment. The column, the risk-informed critical safety function, that's not the thing, so, I mean, it's a critical safety function which are selected using risk-informed principles. But there is not such a thing as risk-informed critical safety functions.

MR. DARBALI: We agree.

(Laughter.)

MR. DARBALI: No, we agree with that statement. Okay.

So, as we just saw, the Commission approved, with some edit, the Staff's recommendation

to expand the policy to allow the use of risk-informed approaches to demonstrate the appropriate level of defense-in-depth. The Commission also provided direction to the Staff to clarify, in the implementing guidance, that the new policy is independent of the licensing pathway and to complete the final implementing guidance within a year, which is May 24th of next year.

MEMBER BROWN: I take it that means, I'm speaking loud enough, that means Part 53 applies, as well as the licensing pathways, even though it's not official yet?

MR. DARBALI: So if, right. When we talk about --

MEMBER BROWN: It's intent.

MR. DARBALI: The intent, right.

MEMBER BROWN: Yes.

MR. DARBALI: But without having a final Part 53 we can't --

MEMBER BROWN: I got that --

MR. DARBALI: -- really --

MEMBER BROWN: -- I just wanted to make sure that we had the same --

MR. DARBALI: Right. Right.

MEMBER ROBERTS: And not to beat a dead

horse, but you had raised a point earlier that BTP 7-19 is not a complete response to the Commission direction, and so I assume you got other parts of this process also laid out, like design review guide, if that's the appropriate document to change?

Because you come here with just the BTP, so I'm wondering if there is a public interface plan and a schedule to go through all the other documents that are required in a year?

MR. DARBALI: Dinesh, could you provide some insights on the DRG?

MR. TANEJA: Right. So we looked at the Reg Guide 1.233 and we looked at the DRG. The intent of the SRM is already being met by those two set of documents.

So the Reg Guide provides the guidance to the applicant, and the DRG is the Staff review guide. Now, if you look at the framework of performing the LMP type of a licensing basis determination, the risk-informing it and having built into the process. So it really meets the intent of it.

So at this time we are just evaluating to see, you know, do we need to just revise it to add the word SRM in it or do we want to take a lesson learned on actual use of those guidance documents and wait

till we get some of the feedback?

In the meantime what we intend to do is, with all future applicants and designers we are going to share the SRM information with them and pre-application engagements. And we are having workshops on digital I&C review with the DRG.

We've had a few workshops already with the industry, and we intend to have some more. So it's one of the topics that we are covering in that one.

That's, I think that's the way we are proceeding with addressing the concern of, that this SRM is applicable to all design types regardless of, that's why we are taking care of that very thing. So we will be evaluating, you know, the future revision to those documents.

MEMBER ROBERTS: So if we have an applicant who is not using Reg Guide 1.233 or the applicant chose some other approach, they have guidance today, I don't even know?

MR. TANEJA: No.

(Simultaneously speaking.)

MR. TANEJA: They, you know, they will have to propose what they are doing in our pre-application engagements. You know, it's like, for example I think we have an SR, you know, BWRX-300

design. That they are coming in with an alternate approach that doesn't meet, you know, the Reg Guide 1.233 approach, but they want to use the DRG to view guidance. It doesn't really meet the SRM. But they are using the IAEA framework. So we are dealing with that separate. On a case-by-case basis they're working.

MEMBER ROBERTS: Okay. And then on the SMR it exists --

MR. TANEJA: Yes. Yes. We are making that available. You know, I mean, we, you know, we're just looking at a topical report from GEH on the SMR, you know, the BWRX-300. And we provided a comment back to them, hey, look at this SECY-22-0076 SRM as well. So it's being communicated to them. Yes.

MEMBER ROBERTS: And I'm kind of stuck on the point Charlie made a few minute ago which is, that the DTP is mostly generic.

MR. TANEJA: Yes.

MEMBER ROBERTS: And it seemed like the non --

MR. TANEJA: They could benefit from looking at it too.

MEMBER ROBERTS: Right. The non-light water reactor, non-LMP applicant, which seemed to be

very well suited --

MR. TANEJA: Right.

MEMBER ROBERTS: -- BTP and then, you know, start with this guidance.

MR. TANEJA: The licensing framework using the LMP framework, I think it requires you to really model the CCFs early on in the design process, right?

MEMBER ROBERTS: Yes.

MR. TANEJA: And whereas, when we are looking at these digital upgrades to operating reactors, the part is after the fact part. So it's kind of, you know, how we treat that information. And how the Staff looks at it is kind of different.

MEMBER ROBERTS: Yes. Okay.

MEMBER BROWN: Let me make a query, can we walk away from this one and get on --

MEMBER ROBERTS: Yes.

MEMBER BROWN: -- want to make the point that I guess that it doesn't come out, come out, I hope I'm yelling loud enough, that the BTP is generic and should not be, that someone it should be identified as being useable across the type of reactors.

Whether you -- to me that would be something we would put up in the preamble or the lead

in or something in the initial DMT to, the general purpose is to provide defense-in-depth, et cetera, and risk-informed information for doing certain things. And the applicants have the ability to evaluate this for their applications without restraints. However you want to phrase that.

I don't want to mess with this one anymore, I think we've made the point. Tom, is that okay with you?

MEMBER ROBERTS: Sure. I don't want to hijack this meeting, but I'm wondering why it's not in the Reg Guide (audio interference) --

(Whereupon, the above-entitled matter went off the record at 1:38 p.m. and resumed at 1:43 p.m.)

CHAIRMAN REMPE: Wherever we were, please continue.

MR. DARBALI: So on slide 16, we just looked at the information direction. So the staff's proposed response (audio interference) --

(Simultaneous speaking.)

MR. DARBALI: Can you hear me now? So like I said, the staff's proposed response to meet Commission direction is to revise BTP 7-19. So we are working on Revision 9 which provides guidance for the review of risk informed approaches which may result in

the use of design techniques other than diversity.

Because of the one-year metric to issue the final implementing guidance, the staff has focused the edits to the BTP to be mostly toward incorporating the expanded policy. So here are the substantive changes made in Revision 9 of the BTP. For Section B.1.1, this was revised to update the language of the four points.

Section B.1.2 was revised to clarify the term, critical safety function. Section B.3.4 was added for the evaluation of a risk informed pre-assessment. Section B.3.1.3 was revised to support the evaluation of alternative approaches.

Section B.4 was revised to include guidance for the evaluation of approaches (audio interference). We've also added four flow charts to facilitate the use of the BTP. And we also added language from Reg Guide 1.152 regarding communication independence and control of access.

And we'll go into the details of all of these changes in the following slides. Next slide, please. So like I said, we updated the language to reflect the points in SR Section 22.76 as well as updated the explanation of the four points. We also added some bullets to help identify the applicable BTP

sections when performing a safety evaluation.

CHAIRMAN REMPE: We hear it in the room too. So I think it's better now. Thank you. Go ahead.

MR. DARBALI: Next slide. So on Section B.1.2, we clarified that critical safety functions are those most important safety functions to be accomplished or maintained to prevent a direct and immediate threat to the health and safety of the public. So that kind of addresses what's the overall criteria of a critical safety function. We also clarify the critical safety functions that are in SECY 93-087, samples representative of operating light-water reactors and that other types of reactors may have different critical safety functions based on the reactor design safety analysis.

Also that the identification of such critical safety functions may be risk informed. Again, no such thing as risk informed critical safety functions. Risk information can be used based on the side of the facility to determine those critical safety functions. And the intention is that they meet that first rule (audio interference) to the health and safety of the public. And now I will turn it over to Steve Alferink who's going to cover the risk informed

D3 assessment process.

MR. ALFERINK: Thank you, sir. Can everyone hear me?

MEMBER MARCH-LEUBA: Yeah.

MR. ALFERINK: My name is Steven Alferink, and I will discuss the review guidance for risk informed D3 assessment. So this slide illustrates how the staff envisions the risk informed approach getting into the overall D3 assessment process. The D3 assessment process starts by identifying each postulated CCF.

Once the CCF is identified, it can be addressed deterministically or by just defining alternative approaches. These options are shown in two boxes. If the CCF is not addressed using either of these two options, then it can be addressed using our risk informed approach which is shown in colored box. A review of our risk informed approach is broken down into four steps which is covered in corresponding subsections in Section D3.

MEMBER MARCH-LEUBA: Try to speak louder.

MR. ALFERINK: I will try to speak louder.

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: I understand quite a bit, but slower.

MR. ALFERINK: I will cover each of these steps in more detail in the following slides. Next slide, please. The first step in reviewing --

CHAIRMAN REMPE: Do you have a trade map for us, please? And be really close to where the microphone is. Thank you, sorry.

MEMBER MARCH-LEUBA: I can hear him. But if you speak more -- if you don't speak like me but more eloquently.

MR. ALFERINK: Hopefully this will be a little bit better now. We'll try this. Let me know if you still have difficulty hearing me, please. The first step in reviewing your risk informed approach is to determine consistency with NRC --

MEMBER BROWN: You got interrupted. Why don't you go back (audio interference) --

MR. ALFERINK: Sure.

MEMBER BROWN: -- so we know where we are.

MR. ALFERINK: Okay. So I'm on slide 20. Okay. So this slide illustrates how the staff envisions a risk informed approach getting into the overall D3 assessment process. The D3 assessment process starts by identifying each postulated CCF.

Once the CCF is identified, it can get addressed deterministically or by justifying

alternative approaches. These options are shown in the two boxes in the middle. If the CCF is not addressed using either of these two options, then it can be addressed using a risk informed approach which is shown in the colored box on the right.

The review of a risk informed approach is broken down into four steps, each of which is covered in the corresponding subsections of the new Section B.3.4. I will cover each of these steps in more detail in the following slides. Next slide. The first step in reviewing a risk informed approach is to determine consistency with NRC policy and guidance on risk informed decision making as described in Section B.3.4.1.

This step is provided because 0.2 of the policy explicitly states that the staff will review applications that use risk informed approaches for consistency with established NRC policy and guidance on risk informed decision making. 0.2 of the policy provides Regulatory Guides 1.174 and 1.233 as examples. Reg Guide 1.174 describes an approach that is acceptable to the staff for developing risk informed applications for a licensing basis change.

Reg Guide 1.174 also references Reg Guide 1.200 which describes an approach for determining

whether a base PRA is acceptable for use in regulatory decision making. As stated in SECY 22-76 is the staff's goal is that the acceptance criteria for risk informed approaches for Digital I&C CCF will be consistent with the NRC's broader practices and guidance for risk informed decision making and not specific to Digital I&C. The staff intends to leverage existing practices and guidance rather than develop an entirely new paradigm for Digital I&C.

As such, the review guidance for determining consistency with NRC policy and guidance on risk informed decision making points to current staff review guidance elsewhere, including SRP Chapter 19 and DC/COL-ISG-028. Now I will note that SRP Chapter 19 provides review guidance for addressing the principles of risk informed decision making, including defense in depth. Next slide. Now we are on slide 22.

The second step in reviewing a risk informed approach is to evaluate how the CCF is modeled in the PRA as described in Section B.3.4.2. The reviewer will first determine whether the application is based on the base PRA that meets the PRA acceptability guidance in Reg Guide 1.200 or for guidance from the reactors and reports the plant for

design at the time of application. As part of this activity, the reviewer will evaluate the justification for excluding any hazard or operating mode from the risk informed B.3 assessment as well as any changes made to the PRA model to support the application.

The reviewer will then evaluate how the CCF is modeled is in the PRA and the justification that the modeling adequately captures the impact of the CCF on the plant. Because the CCF could affect multiple plant systems or functions, this section specifically notes that the I&C technical reviewer and the risk analyst should coordinate their review to ensure that the application sufficiently addresses the impact of the CCF on plant systems and functions. In general, a CCF can be modeled in the PRA through detailed modeling of the Digital I&C system or the use of surrogate events.

MEMBER MARCH-LEUBA: So this is Jose March-Leuba. What is a surrogate event? You assume that the scram fails?

MR. ALFERINK: Give me one second.

MEMBER BROWN: What did you say?

MEMBER MARCH-LEUBA: What is a surrogate event?

MEMBER BROWN: Thank you.

MEMBER PETTI: I had a question. Typical PRAs, do they actually go into detailed modeling of the DI&C system?

MR. ALFERINK: I'm not aware of operating light-water reactors or models that have that detailed modeling. We wrote this to be general enough to account for it if they do.

MEMBER PETTI: But the history today is that no one goes into this level of detail.

(Simultaneous speaking.)

MEMBER PETTI: Although PRAs are the most advanced we have out there.

MR. ALFERINK: We tried to write this in general. So should somebody model it in the future, we don't need to rewrite the guidance.

MEMBER BROWN: Let me amplify. Can you hear me, Jose? Paragraph 1 and paragraph 3.B.3.4.2 says modeling of hardware software components.

One limitation is that some PRA models which means all do not include details of various hardware or software components of DI&C systems or all of the interdependencies across all different SSCs. And my observation that modeling software based digital I&C systems is an effort that I can use strong words or softer words and you'll never get there.

It's extremely difficult when you've got 500,000 lines of code and other data sources that gets pulled in whether it's (audio interference) driven or whether semi-deterministic.

In other words, straight through a routine programming all have a little bit of (audio interference). And I guess one of my concerns by emphasizing the modeling as much and recognizing that I am not a fan of risk informing these designs. I think everybody knows where I'm coming from. I'm worried that people trying to model and then they will be less likely to do it to dampen their enthusiasm to adopt a risk informed process because they really don't know how to model an I&C system in the PRA world (audio interference). Yes, Vesna? Is that Vesna?

MEMBER DIMITRIJEVIC: So I'd like to add a few things here. First step, in this slide, the CCF means I&C CCF. The PRA models cause failures and he has a very well developed model.

So those models are complicated and include multiple failures, double, triple, quarter, the alpha, beta, gamma factors. In my experience with the advanced reactors and that's connected with VPR. In order to model instrumentation that common caused factors, we have included that in the model.

But it is included through the mostly pseudo-guide events which are explained the host of questions that you don't go in this standard, like, four pumps common cause models. But instead of that, you replace the -- you don't have doubles, triples. You just replace common cause digital failure as a non-event. And sometimes that has a specific platform name and you name it. But actually models common cause failure of DI&C.

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: So you model the common cause failure by assuming the output fails.

MEMBER DIMITRIJEVIC: Yes, assuming.

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: -- giving to that event specific name instead of going through the common cause approach from the PRA. And what we saw in the EPR that those failures actually strongly dominate the risk. So --

MEMBER MARCH-LEUBA: Yeah, my question, I was going to have a follow-up question before we go into details of how implementing is. How can you have a critical safety function that is not risk significant? I mean, it's a famous oxymoron.

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: This retelling is not just related to that. It's related to control of the various systems and components in the plant. It's not always related to critical safety functions. You know, it's dependent on the --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: You only do the CCF analysis for the critical safety functions.

(Simultaneous speaking.)

MR. CARTE: So the displays and controls are with respect to the critical safety functions. This is Norbert Carte. CCF is with respect to all functions. It's just the displays and controls for diverse manual action are where we think about critical safety functions.

MEMBER MARCH-LEUBA: Can you say your name?

MR. CARTE: Norbert Carte, I&C.

MEMBER MARCH-LEUBA: I don't really understand the logic. I mean, if something is not risk significant, why do you want to formalize it? It's not critical.

MEMBER DIMITRIJEVIC: But you don't really know, Jose, before you really run the models, what is risk significant or not risk significant. And often

some things you don't expect to be risk significant could be risk significant. I am not sure actually also what was said, I mean, because this common cause includes all other functions.

Okay. So first -- how can I summarize that? It's definitely not easy and PRA lacks a lot of approaches to model DI&C. I mean, especially, like, say, for operator actions and things like that.

But the things being developed and the status of being built and maybe this will improve with time. But that includes to every activation of every system. It's not just a protection system. It's activation of every system and automatically when demanded, safety, non-safety. So it includes every SSC.

MEMBER MARCH-LEUBA: So will you explain to me and I know when we were passing, you were having a member of this cache. What's the difference between you seeing these surrogate events where you don't model the digital I&C and you assume it fail. And the deterministic analysis of the same problem, I mean, what is different between the two? Because assuming it fails, so that's the deterministic approach.

MEMBER DIMITRIJEVIC: You get it a probability to fail. And then you see how much it

contributes to the total risk. I mean, that's the difference between deterministic and probabilistic. So I mean, I don't know. I'm not sure I understand your questions.

MR. CARTE: Norbert Carte. Let me summarize it a little different. So typically when we think of a deterministic analysis, we think of the Chapter 15 accident analysis. And that only looks at the worst events and the most conservative analysis factor.

We don't look at all of the events. And based on the outcome of the worst events and analyze in accordance to the criteria if that's acceptable the facility to say. A PRA looks at all events and looks at consequences and likelihoods and does a tabulation across all events.

So it looks at beyond design basis accidents. It looks like design basis accidents, AOOs. It looks at everything and considers both consequences and likelihood to arrive at a number where a deterministic analysis basically makes a likelihood determination beforehand and says these are accidents. These are AOOs.

And then applies the criteria to that type of event. AOOs shall not cause fuel damage. An

accident shall not exceed certain dose limits, right?

So the likelihood is categorical in a deterministic analysis. And then the acceptability is then done deterministically based, so based on consequences. The PRA looks at all the events, likelihood, and consequences.

MEMBER MARCH-LEUBA: So let me give you the example of the small break LOCA. You don't run the worst small break LOCA. You run a spectrum of LOCAs. You run them all and pick the worst.

MR. CARTE: Yes.

MEMBER MARCH-LEUBA: Now from doing this risk analysis, you're saying you're going to look at a likelihood. That means you're going to run the spectrum of possible accidents from the unicycle to the end of cycle with different control patterns, with different loadings, with different -- is it raining or not. And I explain that you don't do that either.

MR. ALFERINK: This is Steven Alferink. You would normally just look at one initiating event for the small break LOCA. You don't look through every possible --

MEMBER MARCH-LEUBA: Yeah, you do.

MR. ALFERINK: -- configuration.

MEMBER MARCH-LEUBA: You do a spectrum of

breaks.

MR. ALFERINK: You have, like, a small break LOCA, large break LOCA. So you have a spectrum of different initiating events.

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: And you have different success criteria for each of them, each system, very quiet to operate in timing and things like that. Those are different scenarios in PRA.

MEMBER MARCH-LEUBA: Let me check your sound. Say something.

MEMBER BIER: Hi, Jose.

MEMBER MARCH-LEUBA: No.

MEMBER BIER: Okay. Should I come over here?

MEMBER MARCH-LEUBA: Come closer.

MEMBER BIER: I'm going to take a stab at a slightly different answer. Okay. I'm going to take a stab at a slightly different answer to Jose's question and see whether I'm understanding it right and whether it helps. I think the deterministic part would be deterministically saying this I&C system fails with probability 1.

And the probabilistic part would be all the rest of the plant PRA model. What happens if you

don't have the I&C model and what's this I&C system and what's the chance that would lead to core melt? Is that close?

MR. CARTE: Yes. So we essentially envisioned a sensitivity analysis. Calculate your CDF or whatever your risk metrics are. Postulate a failure with a probability of one. And then determine how much your risk metric changes. And that's a sensitive analysis to determine the risk to gauge the risk of the CCF.

MEMBER BIER: Okay.

MEMBER ROBERTS: I had a question similar to Jose's. Let me try an example and see if this captures Jose's question and maybe to answer it. So you have a reactor scram system, and so if you have no diversity because you're looking for alternatives to diversity, and your PRA would assume with a probability of one that there's no scram to run your plan events. And if your change in CDF were large which I would think it probably would be, if the scram failed, then you wouldn't be able to use the risk informed approach. But now you're stuck with adding diversity or coming up with some other explanation.

MR. ALFERINK: I'll get to that in a few slides.

MEMBER BROWN: That's assuming -- what you're saying is you assume all four channels don't work. And therefore, you don't scram.

MEMBER ROBERTS: Right. You assume a common cause failure. You assume you can't model.

MEMBER BROWN: You don't have any diversity.

(Simultaneous speaking.)

MEMBER ROBERTS: You can't model the details, so you have to assume there's no scram. But I would imagine someplace you could run through the risk model and say, well, if I don't scram, I'll still have a satisfactory low CDF. But then you wouldn't have metric critical safety function. Now you're starting to cross the line into deterministic space which you find a critical safety function because you thought that was important. But is that a potential outcome that you conclude fails to scram is okay as a consequence?

MR. CARTE: It's hard -- Norbert Carte. So it's hard to imagine for a light-water reactor. I have heard some molten salt reactor designs where the Doppler coefficient is large enough that you don't need a short scram, a postulated scram in two hours.

So it is possible for some designs. There

is that possibility, yes. But I don't see it for light-water designs yet.

MEMBER ROBERTS: That was a question I plan to ask in a couple of slides. It probably comes into play if you conclude at the critical safety function of scram that's not risk significant. Then that would require you to go through the five principles in the Reg Guide 1.174 which talks about safety margins and the defense in depth and regulation, those kinds of things.

And I would think it would be hard to come through that screen with a fail to scram. And then conclude that it really was risk informed to have that as an acceptable consequence. Is that right?

MEMBER MARCH-LEUBA: We've seen some designs on the new reactors where the control rods are not safety grade.

MEMBER ROBERTS: But then would the scram be a critical safety function?

MEMBER MARCH-LEUBA: It's not. It's because there is either expansion in the sodium reactors or the temperature coefficient in the silicon carbide. And you just don't need to scram.

MEMBER ROBERTS: But I read the BTP. I end up wondering just like Jose is asking how you

would ever use risk informed option because either you could've gone through the deterministic approach and your best estimate analysis would show that you have adequate diversity. Or you'd have to show that the consequence didn't warrant diversity or you wouldn't pass the risk informed. Didn't seem like there was any path that you could actually get to the end using the risk informed doc.

MEMBER MARCH-LEUBA: My concern is that the risk informed would be misused. It will not be done thoroughly and scientifically. And somebody would conclude that, hey, I don't need diversity.

MEMBER PETTI: But that's on the staff for them to view.

MEMBER MARCH-LEUBA: Yeah, but once -- I wouldn't say it on the record. Well, let's say once something is submitted is very rare it gets rejected.

MEMBER BROWN: What did you just say?

MEMBER MARCH-LEUBA: Once something is submitted for review, it very rarely it gets rejected. Sometimes it gets tweaked. But rejected --

MR. DARBALI: Well, I could add. So as we -- this is Samir Darbali. We were developing the SECY and later working on the BTP, we're looking at real examples of how this could be applied.

If you go back to the Oconee design, there were two functions that required a diverse automatic systems, the high and low safety injection. At the time, this was in 2003, 2005, the applicant actually wanted to use risk information to say why manual actions could be taken later than the minimum required that would trigger a DATS (phonetic). At the time, the staff did not accept that risk informed argument.

So the licensee ended up installing to DATS. That's an example of where this, a risk information could say, well, if manual action was taken much later than was required by the game attackers analysis, would the plan be still safe? We're not talking about reactor shutdowns. We're talking about safety injection. And maybe a risk argument could be used to justify a manual action be taken later rather than -- it's still a diverse means. But they're not installing a diverse automatic system.

MEMBER MARCH-LEUBA: I'm not a big fan of PRA. But for you to do a risk informed analysis like this, you will need to evaluate every single day in the site. Every single possible scenario and then figure out what is the bell distribution and peak theorem, you can tell.

You're not doing that. I've never seen

anybody do that. When you put in the PRA, the PRA takes us the input to Chapter 15 results which is the worst case.

MEMBER BROWN: We are digressing into the general benefits or non-benefits of PRAs in general. The fundamental point we were talking about, we were talking about (audio interference) to the modeling of CCF of these Digital I&C systems. Modeling the CCF with the Digital I&C systems, and we haven't really come to a conclusion on how you really model them other than Vesna's comment on the surrogate approach. You just assume it doesn't work. The end product (audio interference) does not work.

MEMBER MARCH-LEUBA: Yeah, we're kind of missing you, Charlie.

MEMBER DIMITRIJEVIC: To explain to this would take a long time and is much more complicated to that. Jose, I wouldn't really worry because those events are extremely important in the PRA. So I would really worry more about the deterministic principles like if we look in the 1.883 which we are looking at this that I would miss things. So just don't worry. The PRA will cover this if it's modeled right.

MEMBER BROWN: Okay, Vesna. We need to be getting off of the PRA in general, the goodness of the

PRAs. I got that. I think we need to proceed on. The issue is roughly on the modeling.

MEMBER ROBERTS: Can I have one follow-up question to Samir? The Oconee example, did the Section 3.2.2 in the BTP apply that? Because there's a whole provision for crediting manual operator action in the existing BTP.

MR. ALFERINK: Right. And I wasn't involved in that. But I believe --

MEMBER BROWN: Neither were we.

MR. ALFERINK: So the issue with manual (audio interference), it has to be performed in a timely manner. So Oconee for all of their other functions, they credited diverse manual actions that could be performed in a timely manner. Those two that require a diverse automatic system would be they cannot do it in a timely manner before we begin the packers analysis.

That automatically triggered you needed that. They wanted to provide a risk argument why they didn't need to. But at the time, the staff did not accept that.

MEMBER ROBERTS: So (audio interference). So the scenario, best estimate methods couldn't show that it was okay. But the probability of going down

that branch was low enough to screen it out essentially what would happen.

MR. ALFERINK: Right. That would've been --

(Simultaneous speaking.)

MEMBER ROBERTS: Okay. I understand. So that would've been less than the delta CCF, ten to the minus six, whatever the criterion is in delta LERF. Okay. That makes sense.

MR. CARTE: Norbert Carte, I want to parse a little bit best estimate and risk informed. So one approach to best estimate is that leak before break. So that's not necessarily risk informed. But it's a best estimate argument.

So some people argue you'll get leak before break. And therefore, you have time to for manual action. So that's a different way that a best estimate might come in, and it's not just an issue about risk informed.

MEMBER MARCH-LEUBA: I apologize for having taken us on a branch. So please continue.

MR. ALFERINK: I was actually worried about to answer your question. So I was going to note that certain events can be existing basic events in the PRA or new basic events added to the PRA that

capture the impact of the CCF on the plant. That's it. Now we're on slide 23.

The third step in reviewing a risk informed approach is to determine the risk significance of the CCF as described in Section B.3.4.3. This section provides guidance on reviewing the risk significance of a CCF obtained using either a bounding sensitivity analysis that assumes that CCF occurs or a sensitivity analysis that uses a conservative value less than one for the probability of the CCF. Since this is a rather long description, I use the term conservative within quotation marks on the slides to refer to the second type of sensitivity analysis.

When a risk informed approach uses a bounding sensitivity analysis, the reviewer will evaluate the baseline risk that was used to determine the increase in risk that does not need to evaluate the justification of the probability of the CCF. As we have stated in previous ACRS meetings, the staff is open to considering values less than one for the probability of the CCF with appropriate justification. And these values may vary from system to system depending on the design.

The staff does not currently have a

technical basis for a value less than one for the probability of the CCF and is applicable to all designs. So an application that uses a value less than one needs to provide additional justification. When a risk informed approach uses a conservative sensitivity analysis, the reviewer will evaluate the technical basis of the conservative probability of the CCF which demonstrates that defense in depth is addressed. As part of this activity, the reviewer will evaluate the impact of this assumption on PRA uncertainty, including a determination of whether this assumption is the assumption.

MEMBER ROBERTS: Yeah, this is where I planned to ask a question about the five principles in Reg Guide 1.174. And one of the principles is defense in depth, right? So any risk informed change has to be justified with the defense in depth.

I wasn't clear why you addressed defense in depth for this one specific exactly which in light of the follow-up question is there's also requirements for safety margins and maintaining consistency with regulations and having a monitoring program and all those things that show more than just Reg Guide 1.174 but pretty much any principle in risk informing. So I guess it's two questions. One is why is defense in

depth in here when it should always be. And then what about the other principles?

MR. ALFERINK: You're correct. So that's why a few slides back I talked about 1.174 and the principles. Yes, we always address those (audio interference). Here I would argue that this has additional emphasis.

There is a note in the SECY. Let me find the exact wording here. But essentially it says the staff does not intend to (audio interference). It's just based on reducing the probability. So this is added emphasis that you need to consider defense in depth, not just it has a low probability. So it argues additional emphasis on that point.

(Simultaneous speaking.)

MR. ALFERINK: That's right. It goes in the SECY.

MEMBER BROWN: (Audio interference).

MEMBER ROBERTS: Just a suggestion to think about covering principles, in the BTP just to make clear what you mean when you reference 1.174.

MR. ALFERINK: Next slide, again, slide 24. Both type of sensitivity analyses, the reviewer will evaluate if the quantification accounts for any dependents that are introduced by the CCF --

dependencies that are introduced by the CCF, including the ability for operators to perform main watches. An example of this situation for operating reactors, there's a CCF associated with the upgrade from analog to digital control room annunciators where the CCF may not disable protective function.

But it could impact the operator's ability to respond. It is important to note that the purpose of the sensitivity analysis is to determine the risk significance and the importance of the CCF, not the baseline risk with a digital I&C system. For the example of an operating reactor that is replacing an analog I&C system with a digital I&C system, the sensitivity analysis does not calculate the change in risk between the (audio interference).

With that said, a reviewer will evaluate the sensitivity analysis to determine if the CCF is risk significant or not. The CCF is not risk significant if the increase in CDF in the sensitivity analysis is less than one times ten to the negative six per year and the increase in LERF from the sensitivity analysis is less than one times ten to the negative seven per year. The increase in CDF and LERF are used in Reg Guide 1.174 for licensing basis changes. So their selection satisfies the staff's

goal that the acceptance criteria for risk informed approaches or Digital I&C CCF will be consistent with the NRC's broader practices and guidance for risk informed decisions.

MEMBER PETTI: So just a comment. You've been discussing about why whether or not this BTP (audio interference). That metric makes it (audio interference) because LERF and CDF may not be applicable (audio interference).

CHAIRMAN REMPE: But I would go further as I mentioned earlier saying that some of the advanced small modular LWRs increase core damage frequency less than one times ten to the minus six if they're down to ten to the minus eight. That could be a problem. This was -- again, we elaborated on this years ago. But there was a little plot we included in the letter that talked about that we were advocating --

(Simultaneous speaking.)

CHAIRMAN REMPE: So I hesitate to have something like that in there.

MEMBER ROBERTS: Yeah, I suggest the other core principles in the Reg Guide are important there in degradation safety margins because you increase your CDF by a factor of 100. And that will seem to come out of the principles.

CHAIRMAN REMPE: Yeah, you'd hope so.

MEMBER ROBERTS: Not to beat that. But that probably belongs in a slide like this. It's not risk significant if the five criteria are met, including the other four principles.

CHAIRMAN REMPE: Yeah.

MEMBER ROBERTS: So these are no sufficient. These are necessary maybe, but not sufficient to call it not risk significant.

MR. ALFERINK: And in order to get this point, you would already --

(Simultaneous speaking.)

MEMBER ROBERTS: We've had defense in depth, safety margins, either regulations or have an exemption, those types of things.

MEMBER MARCH-LEUBA: Okay. Going back to my favorite topic, I need to repeat again. Let's assume we are talking about the protection system. And you're trying to protect something that if it fail we have a CDF greater than ten to the minus six.

The only way you're going to have a risk informed evaluation and determine that the CCF doesn't cause a CDF greater than ten to the minus six is because the probability of the CCF, the frequency is very small. Ten to minus three, ten to minus four,

ten to minus five. But you don't want to do a PRA of the control system.

So how do you know what is the frequency of the CCF? I'll take one, yes. That's conservative. You take a number lower than that, you need to justify it. You justify, you have to have a detailed PRA of the system.

And nobody has the PRA of software common cause failures. You need to come closer. I can't hear you from there.

MEMBER BIER: I didn't say anything yet. I can just stand here, I think. I don't think you need necessarily a PRA of this system to justify an estimated CCF probability less than one. There might be grounds to say based on expensive testing and operating experience under a wide variety of circumstances. We think it's less than 0.2 or something but it's not high.

MEMBER MARCH-LEUBA: And that's my --

MEMBER BIER: So it's subjective.

MEMBER MARCH-LEUBA: And that's my general objection to PRA because when I look at the fault trees, almost everything has a failure probability of ten percent. But you don't know what it is. I mean, if you look underneath the PRA, the result always has

four significant entries. But you look at the input, 90 percent of the input is 10 percent.

DR. BLEY: You're making stuff up now, Jose.

(Simultaneous speaking.)

MEMBER PETTI: Let's keep moving, please.

MEMBER DIMITRIJEVIC: Yeah, let's not make this about Jose. And if we add Charlie, then we are really in trouble. 74 is applicable for you here. It's really for operating fee. It's for the plant change.

And here we are sort of also very liberal on defining what the change is. And so therefore you should be using something which even advanced reactors will be using something which, for example, 10 CFR 50.69 rely of the ranking of the SSCs. And not to be based on the Reg Guide 1.174.

This is not -- I don't think that this is a good application for this guide. So I think you should consider the different documents on the -- I'm just trying to think. I think it's NEI document of determining the importance of SCCs. But I don't remember at this moment that number.

(Simultaneous speaking.)

DR. BLEY: This is Dennis. And I think

we've talked about this before. But you're absolutely correct about the purpose 1.174. But the principles on which it's based are applicable in other cases, and I think that's what they're suggesting here. Maybe they could say a little bit more about that.

MEMBER DIMITRIJEVIC: Dennis, it was never -- like, for example, some of the advanced plans changed this criteria based on the CDF. This is so specific for the coolant experience on the CDF which we saw. So that's why I will try. I'm not sure actually that the Zenith C (phonetic) have the better document for that. But it has to be somewhere because 10 CFR 50.69 is based on (audio interference).

MR. WEERAKKODY: This is Sunil Weerakkody, senior level advisor for PRA in NRR. So first off, I want to agree with Vesna, her statement that 1.174 appears to be not applicable here because we use it to review and approve those changes. But I'm going to say a couple of things.

I'm sure Vesna would understand she's been in the PRA as long as I have. What we did here was we recognized that the more appropriate parameter to find the significance of this common post-failure is something called risk achievement work which you see in 50.69. However, for a couple of reasons, we found

we can correlate that to the change in CDF.

If you think about how that parameter is computed, risk achievement work, it's very much related to the change in CDF. And we prefer that approach because we have to come up with a greater approach to make decisions and going with the delta CDF approach using Reg Guide 1.174 is more amenable. And that's why we chose it. But I do agree with you, Vesna, that in terms of starting out with assessing the significance, the risk achievement work is the better parameter.

MEMBER DIMITRIJEVIC: Yeah, you know this risk achievement, the problem is there between absolute and relative. And this is the PRA discussion. That has not been so for the new fleet.

So I don't really know. Is it going to be new document or maybe new version of 1.174 or maybe a general one which can be applied for advanced reactors? I mean, I don't know. But I think it's like in this moment, it's sort of the -- putting it here is not going to work for advanced reactors.

MR. WEERAKKODY: Again, this is Sunil. I do agree. This may not work for advanced reactors which will have other risk metrics other than CDF, yes.

MEMBER DIMITRIJEVIC: You mean if they have a CDF of ten to minus nine. If you are allowed an increase of ten to minus six, then you're talking about a factor of thousand. And then is that acceptable or not? I mean, that's what I said, relative and absolute. So I mean, it doesn't have to be just non-light water reactor. But light-water reactor with very small core damage.

MR. WEERAKKODY: This is Sunil Weerakkody again. I'll be like a politician. I don't answer speculating those questions. So I don't know what would happen with the advanced light-water reactors.

But definitely this will, for the light-water reactors and even the advanced light-water reactors -- one of the things I will clarify is that even with the advanced light-water reactors whose core damage frequencies are low like ten to minus eight. When you fail a system like RPS, it's going to make a big jump up.

So I think we will catch that with some of the exceptions. So again, we haven't done those calculations. But I know we have done a number of calculations actually offering the number of calculations using our models to get at -- to look at how the different systems would fare if we fail the

CCF.

CHAIRMAN REMPE: But you may be relying on non-safety related equipment --

MR. WEERAKKODY: Yes.

CHAIRMAN REMPE: -- if you had a failure --

(Simultaneous speaking.)

MR. WEERAKKODY: Correct, yes, yes.

MEMBER BROWN: Why in the world do you think -- why in the world don't you think that -- why do we design the systems the way we do? I mean, we got four channels. You can incorporate some diversity. I don't do great big analysis. It's going to cost me three or four or five million dollars to get finished in several years. Okay?

And I've got four channels in. Now I have got a design that has been proven for 70 years to work kind of just fine. And now we want to risk inform the design of these systems for whether it's not light-water or light-water.

I mean, your point is correct. If the whole RPS fails, that's why we have the (audio interference) independence, the control of access, predictable, repeatable performance out of it, the five principles. I mean, we argue and promote those,

and they work well.

So I mean, I'm going to default early that I was a manager in a plant and we were going to upgrade to a Digital I&C system. The last section I would use would be 3.4. I would use -- and I put the processors in there, two FPGAs or have a couple just to make everybody happy, even if I didn't believe it was necessary.

It just -- it boggles my mind a little bit about where we're going. I mean, I totally agree with Jose and I agree with Vesna. I mean, I don't know all the details of 1.174. I'm a total neophyte when it comes to between she and Vicki.

But from building -- for spending 35 years building stuff and actually putting it in shifts, it doesn't get any easier (audio interference). And those are engineering judgments. The reason we have four vice three.

We actually had plants that only had three channels. We had plants for some functions we only did two. We found out reliability wasn't very good if you wanted to do a startup and you only had two intermediate range channels.

So we made four. So the ships, they're out at sea. They got to operate. Commercial plants

are on the land. They're different. So you have a different strategy that you use when you approach how you implement redundant systems.

But for the major critical safety systems which RPS safeguards systems and, well, that's about it. I mean, you cover those with these principles, you've covered them. You can't have redundant reactor control systems.

You can't have them fighting each other. One has to control or the other. So you can't have two voltage regulators governing a generator. You got to have one or the other (audio interference).

MEMBER BIER: I have another question for staff that might clarify at least my thinking, maybe some other people's thinking. We're talking a lot about I&C for scram and what if you got scram failure. There's a ton of I&C out there, everything from tiny test lines that probably don't appear in the PRA anywhere because they're only used in maintenance to actuation of an individual pump or whatever. So what is the scope of applicability of this? And maybe there's a lot of cases where it might be more applicable than just for scram.

MR. CARTE: Norbert Carte, I&C. So we're focusing mostly on RPS and ESFAS. And the reason is

because the concern is that there's not enough time to do things manually. And you have certain automatic actions for RPS and ESFAS. And you evaluate those automatic actions.

And presumably, you have those automatic actions because there is not time to do a reliably by hand. And in those cases, their failure would be a problem. And that's why you evaluate the failure of those automatic protective actions. The other actions, presumably you have more time to do them manually and therefore -- and there's more diverse ways to do that. But the CCF was really a concern always for the automatic protective actions rather than all the actions.

MEMBER MARCH-LEUBA: Before you get discussion, let me put something on the record. If you have an action that from the deterministic analysis, you find out you can't survive. And you decide to go risk informed. In my mind what you're telling me is trust me CCF is not going to happen.

Because if it were to happen, it would be bad. That's what risk informed does. Trust me CCF will happen. And that's not under discussion. Charlie, speak loudly.

MEMBER BROWN: Yes. Excuse me, but we are

going to have to move on because we need to wrap this -- we've got a few more slides to go. We're not going to resolve this PRA, non-PRA risk 1.174 in this. It has raised some issues, but I'm going to suggest that we move on.

And then because I know Tom wants to make a few other comments he wants to at least read in and I've got a few I want to just bring up. They're not as broad and expansive and heart throbbing as these are. Just some questions of why here is not there type things. So why don't you go ahead and finish the slides. We've only got seven or eight more slides (audio interference) 32, something like that.

MR. ALFERINK: Samir already covered the rest of what I was going to cover on this slide. So it you go to slide 25, please. So slide 25 now. The fourth step in reviewing your risk informed approach is to determine appropriate means to address the CCF as described in Section D.3.4.4.

This slide illustrates a graded approach for the review based on the risk significance of the CCF. The risk significance of the CCF is characterized by mapping its increasing risk to the regions in Reg Guide 1.174. This figure illustrates this process based on CDF.

A similar figure would illustrate this process based on (audio interference). If the CCF is not risk significant meaning the increase in risk falls in Region 3, the reviewer should conclude that standard design and verification and validation processes are sufficient to address the CCF. If the CCF is risk significant meaning that the increase in risk falls in Regions I or II, the reviewer will evaluate the CCF against the acceptance criteria in Section B.3.1.3 commensurate with the risk significance of the CCF.

MEMBER ROBERTS: I want to ask you about that. The diagram shows a bubble in Region I. And the text you just read out of the BTP also talked about Region I. Reg Guide 1.174 says applications that result in an increase in CDF above ten to the minus five per year, i.e., the increase of Region I would not normally be considered. So --

MEMBER BROWN: Will not normally --

MEMBER ROBERTS: Will not normally be considered. So basically, Reg Guide 1.174 is saying if you're in Region I, you're really not risk informed. I guess you could try anything. But the NRC staff says you normally won't consider changes in Region I. So I was trying to figure out why the BTP

is kind of encouraging changes from Region I.

MR. ALFERINK: So it's a different -- you're really measuring two different things. So for 1.174 you're looking at licensing basis change. That will be the change in risk associated with that licensing basis change.

Here we are using this figure and we're looking at the risk to the CCF. How much will risk change if the CCF -- if you put the Digital I&C system in. Digital I&C system is in there. If the CCF occurs, how much does this risk change?

MEMBER ROBERTS: So you're trying to justify an alternative to diversity which seems to me like the same thing as what Reg Guide 1.174 is going after for any change.

MR. ALFERINK: 1.174 doesn't assume that the failure occurs. That would be here's your current plan. You have this licensing basis change. How much of the risk change from where you are now to what you're proposing?

The intent here is you put your Digital I&C system in with risk significance if the CCF occurs. What is the change in (audio interference)? So, we use the same graph. It's really two different things that you are looking at.

MR. VASAVADA: This is Shilp Vasavada. I'm with the NRC.

MEMBER BROWN: Can you hear him, recorder?

MEMBER MARCH-LEUBA: Yeah.

(Simultaneous speaking.)

MR. VASAVADA: Shilp Vasavada with the NRC. So I think what Steve said to put it differently, 1.174 usually is used for licensing basis changes where you have the (audio interference) PRA, both for the baseline and for the change. You would have a failure probability which is mostly coming from operating experience of the data to use in the base PRA as well as the change.

And then you make the decision accordingly. And Region I, the guidance over there would apply. Over here, we are using this as a sensitivity.

You're using a bounding (audio interference) probability of one to say, okay, what's the worst case that can happen in the CCF -- Digital I&C (audio interference). It's different. You can say mindset because that's not how the (audio interference) operator plant will continue to function even after the Digital I&C changed.

We don't expect guaranteed failures. So

because of that different approach, the sensitivity that we are using with gauge what's the maximum worst case risk that can occur. And also the desire to have -- to put, in other words, a performance-based approach where we can grade how much the Digital I&C design techniques can be used.

We use this type of guidance. We are proposing this type of guidance. Region I, the Digital I&C techniques would have to be stronger. But we are using sensitivity rather than the way 1.174 usually does it.

MEMBER ROBERTS: You're saying you're not really in Region I because the CCF probability is not as bad as your modeling? That's what I thought I heard.

MR. VASAVADA: So in reality, you don't expect obviously guaranteed failures. So this is trying to, like, what's your upper bound. What's the worst that can happen, because we don't know the actual numbers. And yes, that's the concept, the (audio interference) operator plant would not have a failure probability of one. Or it's not expected to have failure.

MEMBER BROWN: The non-PRA CDF guide black is bad and you shouldn't do risk approaches. And the

other white is where CDF is such and such that a risk means you're good --

(Simultaneous speaking.)

MR. ALFERINK: For that figure, that is the change in risk associated with the licensing basis change. So the actually figure from Reg Guide 1.174. So yes, if you're actual risk increase is in the black area, then yes, we would generally not approve that. What we're trying to do here is (audio interference).

MEMBER BROWN: (Audio interference) CDF below like in black you're using above to --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: It's ten to the minus.

MR. ALFERINK: Black is bad.

MEMBER BROWN: That's what I thought. So I got it right the first time. I'm back designing systems.

MEMBER DIMITRIJEVIC: Let's make an attempt in this. This is why I thought that this Reg Guide is not good. The Reg Guide calculates if you want to change something in your licensing basis.

Let's say instead of taking this (audio interference) out for seven days, you want to take it for two weeks. And then you calculate the change in

the CDF. How they're using it here is to determine is the common cause of that specific thing important.

So let's say that I can totally neglect diversity and I'm not trying to eliminate the common cause. So that common cause become a very high probability. What's the change in the risk?

And the change in the risk is high. It says, oh, make sure we have a diversity. Make sure that's not going to happen.

So there they're using it to determine the importance of that common cause. That's how it is used. But because the original use is different, it's confusing.

MEMBER ROBERTS: Yeah, Ryan. That kind of goes to the question I was guessing on the next slide which is 3.1.3 which (audio interference) what you do. It basically says, go concoct an argument and try to sell it. That's what I read of 3.1.3.

It doesn't really say anything about the risk information. Oh, I guess that's a factor in the case you put together. But will that make 3.1.3 wrong? That's what it seemed to say is come up with a case and we'll see if we like it (audio interference).

MR. CARTE: Norbert Carte, essentially

correct.

MEMBER ROBERTS: I'm not sure with the risk information. Really it's just it's another tool in their tool kit to try to convince you that they brought you a good (audio interference)?

MR. CARTE: Yes.

MEMBER BROWN: Can we go to slide 26?

MEMBER MARCH-LEUBA: Yes.

MR. ALFERINK: With that, I'll turn to Norbert.

MR. CARTE: So next slide, please. So essentially there are two pathways. So if they submit a topical report and it gets approved, then they would need to follow the topical report. And you would have to make sure it's applicable, that it's followed and any deviations are justified.

But the approval of the topical report would be in the topical report. But if they propose a new application, yes, they have to justify it. So the is essentially, yes, a performance, they state their goals.

For this risk category, these are our measures and this is why those measures are added. And yes, they act to develop them. We had considered alternatives.

And so if you look at standards like IEC 61.508 and its derivatives are 513. What you have is you have measures applied based on reliability because the standard doesn't really know the risk associated with a particular application. And the higher the reliability, the more measures you need to apply.

So we could adopt something like that. But those standards are all very prescriptive in the sense of particular measures and particular reliability. And so it's not as flexible as this approach.

And yes, it's kicking the can down the road a little bit because you have to explain what you're doing and why. Now one argument I would have with some of the ways the PRA discussions are framed is we would hope that the PRA would be used to evaluate the risk of various designs, not to justify not installing diversity based on risk, right? So if you look at segmentation, independence, and things like that, the more you break a design up in the independent redundant pieces, the less risk significant each individual piece is.

And therefore, you can reduce risk simply by partitioning and segmentation and use of independence. And there are various ideas that have

been proposed. For instance, in the EPR design which was never approved but it was done on -- one, it's the standard (audio interference) approach is there's already functional diversity in the light-water reactor designs or for trip functions and for some ESF functions.

So their choice was to have two separate safety -- partition the reactor trip system into two separate safety-related boxes. And each box has either a primary or an alternate trip, either anticipatory or a backup trip. And in that way, they had them connected which we had an issue with.

But if they were truly independent, then that would be -- you could argue that the risk of one box failing is less because the other box would catch the event. So our hope -- bad word -- is that you use the PRA to evaluate the designs and improve the design and argue that this design is more effective rather than justifying not having diversity based on a risk number. And that is always the risk that you run into, that someone just says, well, it's low risk. Therefore, we don't need to do anything.

No, use the PRA as it was originally intended to, to evaluate the relative worth of different design techniques. If you do this, this is

the risk. If you do that, this is the risk. So this is a better approach.

MEMBER BROWN: I'll just interrupt you because we're going to need to move on some more. But the segmentation partitioning is almost, like, redundancy having independent channels (audio interference). And then your segmentation is suspect or your partitioning is suspect. So there's a bunch of regular rules you have to follow that have nothing to do with anything other than maintaining independence.

MEMBER MARCH-LEUBA: Yeah, I thought we were talking about common cause failure. So when one fails, the other does too.

MR. CARTE: Well, common cause still has a vector in some sort if you have different functions. So the question is that's where you have to justify what are the vectors. Do you believe that the real time operating system on your PLC is going to fail at the same time as both systems?

Do you believe that the platform software, whatever it is, AC 160 or whatever, is going to fail? Do you believe it's the application program that's going to fail? So what is the source of the CCF and have you adequately addressed that as a source?

MEMBER MARCH-LEUBA: Let me start by agreeing with you with your previous statement that PRA should be used for (audio interference). I disagree with your former statement or the latter statement in the sense that if you're telling me trust me, CCF is not going to happen. And you're not willing to do the full PRA to prove that.

You're saying, trust me. Obviously, it's not going to happen. Come on, guys. How is it going to happen? That's what I'm hearing.

MEMBER BROWN: Yes, but there's a bunch of different arguments. If you look at a four channel system. Say you had the same software, the same processed. Independent data coming into all of them.

But if you run it asynchronously means that data is not arriving. If you're getting bad data, the bad data is not arriving at the same place all at the same time. You may never even see the bad data.

And so that would be an argument. Potentially, if you could evaluate that, no diversity is required. But yet what do we do? Even though we fill that type of independence into it, one of the many independences, you still have the probability of something.

Maybe you have it and we do something else. We put diversity into it. Just somewhere we got to move past this part of the slides. I'm not quite sure what to do with this, but we've got to move on. Okay. Next slide, 28.

(Simultaneous speaking.)

MEMBER BROWN: Excuse me for interrupting, Norbert.

MR. CARTE: Michael, slide 27. Thank you.

MR. DARBALI: So now we're going to discuss the changes made in Section B.4 regarding (audio interference). So like you see in the first column of the table, it's a summary of the six acceptance criteria from Section B.4 and their applicability based on how 0.4 is addressed.

So going back to 0.4, 0.4 requires that independent and diverse main control room displays and controls be provided for manual system level actuation of risk informed critical safety functions. All of the six acceptance criteria are applicable as shown in the second column titled 0.4 approach. And these are the six acceptance criteria that you can find in Division 8 of the BTP.

So when you've seen the first two columns, it's basically Revision 8. As we noted earlier, the

SRN added a sentence at the end that says that an applicant may alternately propose a different approach to the requirements in 0.4 if the plan has the commensurate level of safety. So what we did in the BTP as identified in the last column to the right titled different approach is we identified which of the existing six acceptance criteria would apply to a different proposed approach.

So as you can see in the last column, we determined that the acceptance criteria items A, C, E and F would still apply to a proposed approach. But when it comes to the acceptance criteria items Bravo and Delta, the reviewer should determine that the application contains appropriate certification based on the commensurate level of safety in the planned site. Next slide.

So we recognize that now we've added all this new guidance for reviewing the risk informed 3D assessment. It can be a bit more confusing to figure out how to use the BTP and identify what sections apply and when. So we've added four flow charts. Each one is centered around each of the four points. And this should help the reviewers understand what are the conceptual steps in performing the review and identify which sections of the BTP contained the

guidance for performing that review. Next slide.

And finally, to address a prior comment made to the ACRS, we've added language from Regulatory Guide 1.152 regarding communication independence and control of access to prevent unauthorized access to a safety-related system. And we provided an example indicating that the use of forward base unidirectional communication is an approach that staff consider successful. And this can be done with a hardware base unidirectional device.

MEMBER MARCH-LEUBA: Sorry, Charlie. I know we're late. But number one bullet, so you only have to prevent an authorized access if the licensee is nice enough to consider cybersecurity? If they don't consider cybersecurity, they're even more susceptible to it. They can have a path.

(Simultaneous speaking.)

MR. DARBALI: Right. That's not the intention. The language we use in the BTP is the same language we use in Reg Guide 1.152 which the committee had looked at.

MEMBER MARCH-LEUBA: There's a shall in there. The licensee shall ensure there is no unauthorized access.

MR. DARBALI: Right.

MEMBER MARCH-LEUBA: I mean, it's not in here. There's a should and it's considered only when it's considered --

MR. DARBALI: Well, right. And again, we do have control of access guidance in IEEE 7432 as endorsed in Reg Guide 1.152. It does say shall not have --

MEMBER MARCH-LEUBA: I place my concern. That's important. And in my opinion, forget about CCF. Forget about all the other PRA results. That is going to cause a problem in the reactor in the next ten years. That should be considered. Unauthorized access by a bad actor is the most likely -- if you risk -- and everybody just laughs when I say it.

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: No, you're not.

MR. DARBALI: We agree. Our position is that the regulatory guides that include these requirements as well as the cybersecurity program.

CHAIRMAN REMPE: You make it real short. You want them to say measurers shall be included or must be included instead of should is the comment you're trying to make.

MEMBER MARCH-LEUBA: Only if they're nice enough to consider cybersecurity.

CHAIRMAN REMPE: (Audio interference) Reg Guide. But anyway, go ahead.

MR. CARTE: Norbert Carte, we to look at those words a little better. But the basic idea is we would prefer to have no difficult communication into a safety system and have the safety system as simple as possible. And if that is the case, then you don't need cybersecurity to actually control measures in the protection system, right?

MEMBER MARCH-LEUBA: I better disagree.

MR. CARTE: But that's the concept.

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: The trend is to have micro-reactors that are parachute dropped into Alaska and controlled from Chicago. That's the trend. And second, I will email you a link of an Israeli research paper in which they hijacked a camera in the corner of the room and pointed it to the LEV on the computer -- the power LEV of the computer.

And just by looking at that were able to get the draft keys they were using for the HDPS. So the fact that you don't have a cable doesn't mean they can't get it. But keep going.

MR. CARTE: That's the concept behind that statement.

DR. BLEY: Before you keep going, this is Dennis. I just searched the document for these words. I don't think the slide has the same words that's in the Reg Guide. If they do, I agree with Jose. But I'm not sure they're in there anywhere.

MR. DARBALI: If you go to Section 2 titled Relevant Guidance, we have an item there for Reg Guide 1.152.

MEMBER BROWN: On page 8?

DR. BLEY: And it has these same words. Okay.

MEMBER BROWN: I had a little bit of difficulty with that just being in the Reg Guide. That's the only place the word cyber is used I remember. So the idea of cyber and the basic defense in depth functionality of the document is not listed. It's only a related -- what do you call this section? I forgot --

(Simultaneous speaking.)

MR. DARBALI: Relevant guidance.

MEMBER BROWN: Relevant guidance. So that's not really part of the fundamental defense in depth evaluation where cyber really if they're going to consider it, it ought to be considered as part of the defense in depth design of the system regardless

of how it comes out, whether you like it if it's done the way I do or not. But somebody has to look at that.

And I agree. I understand Norbert's point and that if you have no communications, there's no lines. But if you look at all the RPS systems we've looked at, plant data comes out of that system. It goes to the main control room.

That should be (audio interference). But it's only addressed through this part of the (audio interference). So it made cyber really have a defense in depth issue associated with it. And it's really not covered explicitly other than it's related guidance.

And I think (audio interference) should be incorporated as part of the -- and I don't know which section it goes in. But it's in the diversity section, not at the risk informed section. So I mean, if you want to risk inform it, you can say cybersecurity is a piece of cake because everybody knows we've got wonderful software that will protect it forever. And if you an figure that one out, then I don't what your system. But that's another point.

MR. DARBALI: But to clarify, the inclusion of this language in the relevant guidance

section, completely separate from a risk informed (audio interference).

MEMBER BROWN: I know. Okay. Although we could argue if you're doing a risk informed analysis, why don't you have similar words that if cyber is being evaluated via the design. I don't know why we say if it's being considered. But I know all of the political kerfuffle that we have to go through this to get to this point.

MR. DARBALI: Right.

DR. BLEY: If you think where Jose started, if you just get rid of that first phrase, if licensees and applications consider the cybersecurity design features, delete that. Measures should be included. That's the point, I believe.

MEMBER BROWN: Yes, but it ought to be --

(Simultaneous speaking.)

DR. BLEY: If you don't do cyber and don't do this, it's worse than just (audio interference).

MEMBER BROWN: No, I agree with you. But we've fought that battle trying to get words into -- it was a battle just getting considered into 1.152 as opposed to --

DR. BLEY: Yeah, but that was a little different. But okay.

CHAIRMAN REMPE: But I agree with what Dennis is saying because there's context by the prior sentence. And then I might say measures must be included instead of should. But that's all up to you guys.

MEMBER BROWN: Yeah, we can't tell you what to do. The addressing of the cyber issue ought to be both under the first (audio interference), the best estimate sections, 1 up to 3.4. And then it ought to be covered independently under the risk informed. But I mean, it's applicable to both, although to me cyber ought to be separate. It shouldn't be under risk informed at all.

MEMBER MARCH-LEUBA: Yeah. And well, since you took time, let me put my 20 seconds to the always, my marketing, when you get home, google Casino Aquarium cyber. And you will get -- you probably already know it. So that somebody can rob a casino. I get into the aquarium in the lounge.

The bad guys are not going attack the protection system. They're going to attack the aquarium. So when you do cyber, you need to be looking at the aquarium, not the protection system.

CHAIRMAN REMPE: How many aquariums?

(Simultaneous speaking.)

MEMBER BROWN: This part obviously needs to be (audio interference).

MR. DARBALI: So just the next steps for completing the draft, so we're looking to (audio interference) public for public commenting in October. Hoping to close the public comment period in November. And this will keep us on track to the final Revision 9 in (audio interference).

CHAIRMAN REMPE: So although I know Member Brown said something about we're not planning to have you come back. But if things were to change, I assume we'll have adequate time. Sometimes these things will come to us without adequate time to schedule a subcommittee meeting and a full committee meeting. And there's been a lot of comments today. And please, please give us adequate time. Then I won't be chairman by that time. Go ahead.

MEMBER BROWN: Thanks. Tom, did you want to read your other questions (audio interference)?

MEMBER ROBERTS: My major comments are covered. I think I probably summarized them by having a better alignment between either Reg Guide 1.174 or the appropriate risk informed standard. And through here I think a couple of examples we talked about are the definition of not risk significant doesn't include

the core principles that aren't risk calculation.

So that's one aspect. The other aspect is the cases where you are risk significant. It seems like there's really no change from the existing practice. You can use 1.3 and just going ahead and make your case.

So it's really up to you whether that's very risk informed by that whole section. It doesn't hold a lot of value. But it may be that when you go try and use it with industry, you might get somebody who uses the risk information. So I guess I would have a major objection to it.

It just seems like the way it fits together, it's either not risk significant for Reg Guide 1.174 or there's no real change to the way it's being treated. But let's see. What else? Charlie, do you want to go through the more minor comments, or --

MEMBER BROWN: Yeah, I was going to get -- I had Reg Guide 1.233 was only in the references section, not in the related guidance. You deleted the ISGO 4 (audio interference). But it's not obvious of why he did that. I mean, that --

MR. CARTE: The prioritization information from Reg Guide 1.152 supersedes --

MEMBER BROWN: It did supersede? Okay. So that was incorporated?

MR. CARTE: That's why we took (audio interference).

MEMBER BROWN: That's fine (audio interference).

MR. CARTE: Right, you see that's (audio interference).

MEMBER BROWN: That's all taken out.

MR. CARTE: (Audio interference).

MEMBER BROWN: Yeah, but I didn't say one superseded the other. That next one was B.1, Item 2.1A. You talked about highly safety significance, safety-related SSCs that perform safety significant functions. The last sentence says -- this is early in the document -- for SSCs in this category, GDC 22 requires functional diversity to the extent practical and (audio interference).

And the GDC is fairly clear if you go back for all applications of (audio interference) generally in their licensing basis. So I don't see how we can really override that in this particular guidance. And functional diversity is part of the overall diversity evaluation.

MR. CARTE: Right. So what we're doing is

we're defining categories. And how the category is treated is not necessarily --

MEMBER BROWN: We don't have to resolve this right now.

MR. CARTE: But that was our reasoning.

MEMBER BROWN: Okay. Just we may need a little bit more discussion, and I want to get on with it. Oh, yeah. You (audio interference) the risk informed D3 assessment (audio interference) NUREG 2122 (audio interference). And I couldn't find that regulatory basis (audio interference). Maybe I read too fast. I don't remember seeing that one.

We've had enough discussions (audio interference) paragraph 3 (audio interference) should evaluate Digital I&C system interconnectivity. And by the time you walked your way through, it almost leads you to the point where you can have some if you evaluate it property when in reality (audio interference) the interconnectivity (audio interference).

That seemed to leave an opening for people to start connecting (audio interference) really evaluating what the (audio interference) paragraph 3 of B.3.4.2. That (audio interference) modeling (audio interference). Under manuals B.4, this is back in the

diversity (audio interference).

Paragraph 2 stated, for example, the point at which the (audio interference) downstream of the equipment. That could be adversely affected by (audio interference). But it's not included in A.3.2.2 under the diversity (audio interference).

So downstream, manual operations should not (audio interference). After that, the rest of the comments were Tom's. If he wants to -- and I'll give you a copy of this (audio interference). Tom, do you have anything else or are you happy?

MEMBER ROBERTS: More minor comments. Did you give them a copy of this?

MEMBER BROWN: I'll just give them a copy of this.

(Simultaneous speaking.)

MEMBER ROBERTS: The one that might be worth mentioning is we went through the effort to define what risk significant means in the risk section. It was in the context of comparing to safety significant. But the argument seems to stop halfway through.

It doesn't define safety significant and why you talk about risk significant. I'm trying to find that right now. It's in the definition section.

It might've been the NUREG that Charlie referenced.

MEMBER DIMITRIJEVIC: I notice that too. And that was one of my comments too, Tom. I think the discussion of the risk where the safety should be removed from that because it's not really, like, a PRA in Europe is called PSA, probabilistic safety assessment. I think that's a philosophical discussion and it shouldn't be in this.

MEMBER ROBERTS: So that's for your consideration, deleting it or finishing it. I would suggest one or the other. Just to know where I am, it says, risk significance and safety significance are different concepts. And it says NUREG 2122 defines risk as and then it stops talking.

And so it started an argument it didn't finish. So it's not to suggest that just deleting the start of the argument (audio interference), or if you had a reason for putting that in there, then finish the argument.

MEMBER BROWN: He explains that (audio interference).

MEMBER ROBERTS: I called the rest of mine editorial (audio interference).

CHAIRMAN REMPE: There's one thing I'm worried about backup. And I went and talked to Larry.

Are either of you opposed -- if you're going to be passing this to staff, the public meeting that it get added to the official record and just kind of title on there saying Member Roberts or Member Brown comments and stuff and we can be added?

MEMBER BROWN: Yeah, that's fine.

CHAIRMAN REMPE: Just wanted to make sure we discuss that here in the open. Because if there's a document going --

(Simultaneous speaking.)

MEMBER BROWN: No, I totally understand. I just copied the last part.

(Simultaneous speaking.)

CHAIRMAN REMPE: Yeah, this is a little different than normal. But I've done it. I've seen it done in subcommittee.

MEMBER BROWN: You're trying to get (audio interference) make sure we stay within the rules. (Audio interference) public comment now. Is there anybody on the lines that we're going to make a comment? Not hearing any --

MEMBER MARCH-LEUBA: No, I want to say I hear Charlie asking for public comments.

MEMBER BROWN: You did hear me? Okay. Are there any other member comments without getting

back into the PRA business and spending the next half an hour (audio interference)? I don't see -- oh, Walt. Okay.

MEMBER KIRCHNER: Yes, this may seem odd coming from me. But I think the idea has been formed decision making (audio interference).

MEMBER MARCH-LEUBA: Walt, speak up.

MEMBER KIRCHNER: Okay. I think today when we were talking about risk informed decision making, the context (audio interference). We kicked around some examples. I would submit that the risk informed decision making takes the PRA in the broader context of the NRC's regulatory (audio interference).

So I would submit that some of the rhetorical examples that we kicked around today would be a very heavy lift for (audio interference) that they wouldn't have an independent means to scram the reactor. I would just (audio interference) Criteria 27. So it's just not --

MEMBER BROWN: What you mean is it would be difficult to apply a risk informed approach.

MEMBER KIRCHNER: No, I think the risk informed would help you explore the vulnerabilities of the system.

(Simultaneous speaking.)

MEMBER KIRCHNER: -- regulatory, like, action, it's a system in its entirety acceptable. It's not just the delta PRA results. It's in the context of regulatory framework. And there are other considerations.

I just felt that the tenor of the discussion about risk informed decision making came in for some hard knocks today. But it's not just the delta CDFs and LERFs and such that the staff would use when they made the decision (audio interference) or reactor application. I'll stop there.

MEMBER BROWN: No, I agree with you. I think there's a way -- we're going to have the ability to be risk informing somehow within the defense in depth (audio interference). You got to start with something.

I may not like everything that's in there. But while I think (audio interference) PRA, the risk informed process -- thought process of looking at whether I need or don't need certain things or some diversity or not gets applied. I just have a hard spot relative to trying to put numbers and CDFs and deltas in little boxes. I think there's a way to use it in a more qualitative manner which gives you a feel for I can go this way or not.

I don't know (audio interference) or whether there will be subsequent revisions. But the Commission has asked for it, and I think we need to try to get it (audio interference) as we can. It's not for us to tell them no. No more. That's it.

CHAIRMAN REMPE: Okay. So at this point, I'm going to tell the court reporter we're going off the record.

(Whereupon, the above-entitled matter went off the record at 3:17 p.m.)

ATTACHMENT – Member Charles Brown and Member Thomas Roberts Comments on Inconsistencies of Proposed Rev.9 to BTP 7-19 (ML23222A237), their review presented at the end of the Full Committee Meeting, September 7, 2023 (Item 9 of the Agenda)

1. Section A.1 Regulatory Basis

    a. RG 1.233 is not included in this section even though it is referenced in the SRM and in the text.

2. Section B.1 Safety-Significance Determination

    a. Item 2.1.a. high safety significance: safety-related SSCs that perform safety-significant functions – The last sentence “For SSCs in this category, GDC 22 requires functional diversity, to the extent practical.” has been deleted. Why?

3. Section B.3.4 Risk-Informed D3 Assessment– A quote from NUREG-2122 is called out as a principal focus for determining risk significance, but NUREG-2122 is not listed in the Regulatory Basis section.

4. Section B.3.4.2 Modeling the CCF

    a. Paragraph 1 – Modeling of hardware or software components. “One limitation is that some PRA models do not include details of various hardware or software components of DI&C systems or all the interdependencies across different SSCs.”

Comment - Modeling of software based digital systems is extremely difficult if not impossible with any confidence. Is this likely to dampen licensee willingness to adopt a risk informed process to negate the need for diversity?

b. Paragraph 3 - In providing the justification, the application should evaluate **DI&C system interconnectivity** and address DI&C system spatial separation that could significantly influence the risk due to fires, earthquakes, and other hazards. This can be accomplished through detailed modeling of the DI&C system in the PRA or the use of surrogate events, which can be existing basic events in the PRA or new basic events added to the PRA that capture the impact of the CCF on the plant.

Comment - The interconnectivity within RPS reactor trip system divisions and within ESFAS trip system divisions should be ZERO with the exception of final voting modules. The statement in this paragraph leads one to believe that routine interconnections between divisions and systems are acceptable under some circumstances not identified.

5. Section B.4 - Manual System-Level Actuation and Indications to Address Point 4

a. Paragraph 2 – The sentence “For example, the point at which the credited manual controls are connected to the safety equipment should be downstream of the equipment that can be adversely affected by a CCF.” is addressed here when addressing Point 4 but not similarly under Section B.3.2.2 Crediting Manual Operator Action as a diverse means when addressing Point 3.

6. It is not clear how the risk-informed acceptance criteria are consistent with other risk-informed methods such as RG 1.174. It is suggested the alignment with other such methods be explained or improved. Examples include:

a. RG 1.174 lists five principles that must be addressed: (1) is the change consistent with regulation; (2) does the change affect defense-in-depth; (3) does the change affect safety margins; (4) are changes in risk small; and (5) performance metrics should be employed to monitor change. The discussion in section B3.4.3 (Determining the Risk Significance of the CCF) of the draft BTP 7-19 revision addresses only item (4) from this list under the sub-heading "For CCFs determined to be not risk significant". There is an earlier reference in the section to defense-in-depth, but it applies only for cases where CCF likelihood was assumed to be less than 1.0; it is not clear why this would not always apply. No other discussion of principles (1), (3), or (5) from the above RG 1.174-derived list is included in the BTP 7-19 revision.

b. Section B 3.4.3 of the BTP revision clearly states acceptance limits that would require the increase in risk to fall within Region III from Figures 4 and 5 of RG 1.174. However, section B 3.4.4 allows for larger changes in risk that would fall within Regions I or II of the RG 1.174 figures. No explanation is provided on why such a higher risk would be acceptable for a risk-informed evaluation using the guidance of BTP 7-19. for example, the following RG 1.174 statement is not addressed: "Applications that result in increases to CDF above 10-5 per reactor year (i.e., the increase in CDF falls within Region I of Figure 4) would not normally be considered." The draft BTP sends the reader to section B 3.1.3 for further clarification, but this section ("Use of Alternative Approaches Other Than Diversity and Testing to Eliminate the Potential for Common-Cause Failure

from Further Consideration") applies to deterministic evaluations of CCFs and how it applies to risk-informed evaluations is not clear.

c. Section B.1.1, in its quoting of the revised Commission-approved principles, lists both RG 1.174 and 1.233 as providing risk-informed principles. While the BTP revision addresses consistency with RG 1.174, it does not explain why the Commission policy statement cited RG 1.233. Instead, it provides a reference to SRP section 19.0. It is suggested that the reason for also citing RG 1.233 in the Commission-approved principle be explained, including how it either differs from or adds to the RG 1.174 reference.

7. The differences between the existing "deterministic" methods in section B 3.1 through B.3.3 and the risk-informed methods in section B 3.4 are not clear in all cases and further clarification is suggested. Section B.3.4 makes a point that safety-significant and risk-significant are different concepts, and then provides a definition of risk-significant. No similar definition of safety-significant is provided in the section, nor does the section explain why the difference between these terms is important to the BTP. The intended point might have been to explain why the deterministic methods of B 3.1 through B 3.3 cannot be mixed with the risk-informed methods of B 3.4, but this point is not made in the text. It is suggested that this discussion be completed.

8. The following comments are editorial or questions regarding proposed word changes:

a. Front matter, background: "Latent design defects are errors in the design of the DI&C system or component that can remain undetected

despite rigorous design-basis development, verification, validation, and testing processes." It is not clear why this change was made. The deleted phrase at the end of the sentence explains how hard it is to preclude CCFs in a DI&C system, and deleting that phrase removes information that would appear to be useful for a first-time reader of the BTP. It is suggested this phrase be restored or its deletion justified.

This comment applies also to Section B 3.1.2, where the following sentence is being deleted: "However, even a high-quality development process cannot completely eliminate latent design defects introduced during the design and integration process."

b. Section B 2.1, System Interconnectivity" Discussion - After revision, includes a sentence which states, "If the reactor trip or engineered safety feature (ESF) initiation signal in such a system reaches the final actuation device only through the equipment that performs control functions, then the reviewer should determine whether all the SSCs in that pathway have been assigned to the highest safety significant SSC category." GDC 24 requires separation of protection and control functions, such that this sentence appears to describe a system architecture that would not be permitted per GDC-24. Prior to deletions made to this paragraph, it was clear that the term "control functions" in this sentence did not refer to the plant control system, but after deletions it's not as clear. Clarification is suggested.

c. Section B 3.1.1 – This section ends with a Revision 8 example, which the proposed revision 9 deletes. “For example, a proposed digital protection system could implement each credited safety function in two or more independent divisions of the system, each using a different type of digital technology. In this case, the reviewer should determine whether the application includes an analysis reflecting the guidance of NUREG/CR-6303 and NUREG/CR-7007 to demonstrate that the diversity of these independent divisions is sufficient to eliminate a CCF from further consideration.”

It is not clear why this example is being deleted. It not only can be helpful to the first-time reader of this document but sets a basis for a satisfactory design and is currently used in installed approved replacement DI&C applications.

Clarification is suggested.

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

SRM-SECY-22-0076 Implementation: Branch Technical Position 7-19, Draft Revision 9

Advisory Committee on Reactor Safeguards
Digital Instrumentation & Controls Briefing
September 7, 2023

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

Opening Remarks

Presentation Outline

- Background
  - SRM-SECY-93-087 and SRM-SECY-22-0076 Points
  - SRM-SECY-22-0076 Direction and Staff Proposed Response
- Substantive Changes to BTP 7-19
- Next Steps
- Closing Remarks

SRM-SECY-93-087 Point 1

The applicant shall assess the defense-in-depth and diversity of the proposed instrumentation and control system to demonstrate that vulnerabilities to common-mode failures have adequately been addressed.

SRM-SECY-93-087 Point 2

In performing the assessment, the vendor or applicant shall analyze each postulated common-mode failure for each event that is evaluated in the accident analysis section of the safety analysis report (SAR) using best-estimate methods. The vendor or applicant shall demonstrate adequate diversity within the design for each of these events.

SRM-SECY-93-087 Point 3

If a postulated common-mode failure could disable a safety function, then a diverse means, with a documented basis that the diverse means is unlikely to be subject to the same common-mode failure, shall be required to perform either the same function or a different function. The diverse or different function may be performed by a non-safety system if the system is of sufficient quality to perform the necessary function under the associated event conditions.

SRM-SECY-93-087 Point 4

A set of ~~safety grade~~ displays and controls located in the main control room shall be provided for manual, system-level actuation of critical safety functions and monitoring of parameters that support the safety functions. The displays and controls shall be independent and diverse from the safety computer system identified in items 1 and 3 above.

SRM-SECY-22-0076 Point 1

The applicant ~~shall~~ must assess the defense in depth and diversity of the facility incorporating the proposed digital I&C system to demonstrate that vulnerabilities to digital CCFs have been adequately identified and addressed.

The defense-in-depth and diversity assessment ~~shall~~ must be commensurate with the risk significance of the proposed digital I&C system.

SRM-SECY-22-0076 Point 2

In performing the defense-in-depth and diversity assessment, the applicant ~~shall~~ must analyze each postulated CCF~~. This assessment may use~~ using either best-estimate methods or a risk-informed approach or both.

When using best-estimate methods, the applicant ~~shall~~ must demonstrate adequate defense in depth and diversity within the facility's design for each event evaluated in the accident analysis section of the safety analysis report.

SRM-SECY-22-0076 Point 2 (Continued)

When using a risk-informed approach, the applicant ~~shall~~ must include an evaluation of the approach against the Commission's policy and guidance, including any applicable regulations, for risk-informed decision-making. The NRC staff will review applications that use risk-informed approaches for consistency with established NRC policy and guidance on risk-informed decision-making (e.g., Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," RG 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).

SRM-SECY-22-0076 Point 3

The defense-in-depth and diversity assessment ~~may~~ must demonstrate that a postulated CCF can be reasonably prevented or mitigated or is not risk significant. The applicant ~~shall~~ must demonstrate the adequacy of any design techniques, prevention measures, or mitigation measures, other than diversity, that are credited in the assessment. The level of technical justification demonstrating the adequacy of these techniques or measures, other than diversity, to address potential CCFs ~~shall~~ must be commensurate with the risk significance of each postulated CCF.

SRM-SECY-22-0076 Point 3 (Continued)

A diverse means that performs either the same function or a different function is acceptable to address a postulated CCF, provided that the assessment includes a documented basis showing that the diverse means is unlikely to be subject to the same CCF. The diverse means may be performed by a system that is not safety-related if the system is of sufficient quality to reliably perform the necessary function under the associated event conditions. Either automatic or manual actuation within an acceptable timeframe is an acceptable means of diverse actuation.

SRM-SECY-22-0076 Point 3 (Continued)

If a postulated CCF is risk significant and the assessment does not demonstrate the adequacy of other design techniques, prevention measures, or mitigation measures, then a diverse means ~~shall~~ must be provided.

SRM-SECY-22-0076 Point 4

Main control room displays and controls that are independent and diverse from the proposed digital I&C system (i.e., unlikely to be subject to the same CCF) ~~shall~~ must be provided for manual, system-level actuation of risk-informed critical safety functions and monitoring of parameters that support the safety functions. These main control room displays and controls may be used to address point 3, above. The applicant may alternatively propose a different approach to this point in the policy if the plant design has a commensurate level of safety.

SRM-SECY-22-0076

- The Commission approved the staff's recommendation to expand the existing policy for digital I&C CCFs to allow the use of risk-informed approaches to demonstrate the appropriate level of defense-in-depth, subject to the edits provided
- The staff should clarify in the implementing guidance that the new policy is independent of the licensing pathway selected by reactor licensees and applicants
- The staff should complete the final implementing guidance within a year from the date of the SRM

Staff Proposed Response to Meet the SRM

Drafted Rev. 9 to SRP BTP 7-19

- Allows the staff to review risk-informed applications
- May result in use of design techniques other than diversity
- Focused the edits on the expanded policy

Substantive Changes to BTP 7-19

- Revised Section B.1.1 to reflect the updated four points in SRM-SECY-22-0076
- Revised Section B.1.2 for clarification of critical safety functions
- Added Section B.3.4 for evaluation of risk-informed D3 assessment
- Revised Section B.3.1.3 to support Section B.3.4 for evaluation of alternative approaches
- Revised Section B.4 for evaluation of different approaches for meeting Point 4
- Added four flowcharts to facilitate the review
- Added language from RG 1.152 to address a prior commitment to ACRS regarding communication independence and control of access

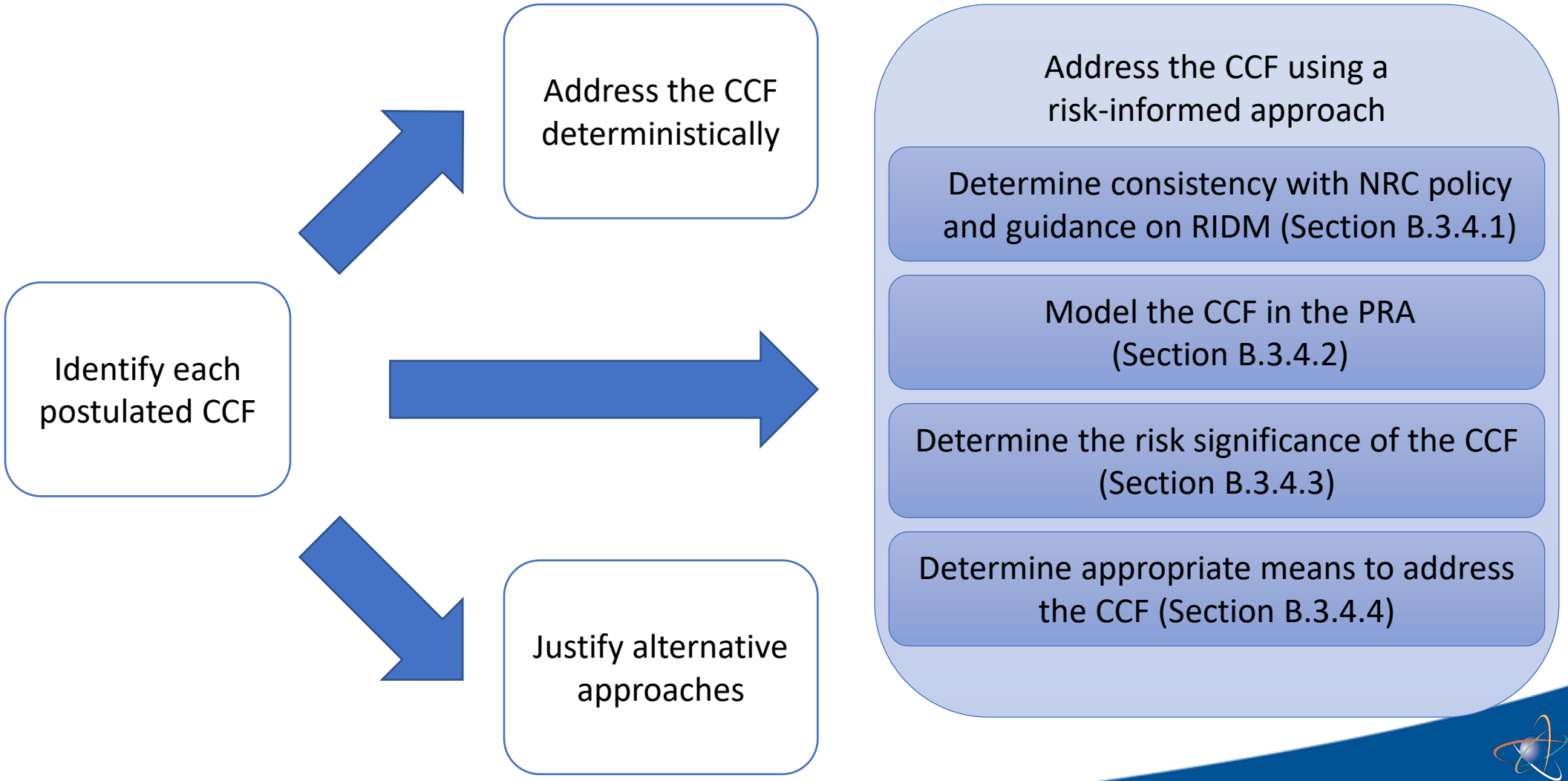
Updated Four Points of the Policy (Section B.1.1)

- Replaced the four SRM-SECY-93-087 points with the SRM-SECY-22-0076 points
- Updated the explanation of the four points to reflect the language in the SRM-SECY-22-0076 points
- Identified the applicable BTP sections for the evaluation of an application against these four points

Critical Safety Functions (Section B.1.2)

- Clarified that critical safety functions are those most important safety functions to be accomplished or maintained to prevent a direct and immediate threat to the health and safety of the public
- Clarified that the critical safety functions identified in SECY-93-087 are examples representative of operating light water reactors
- Clarified that other types of reactors may have different critical safety functions based on the reactor design safety analysis
  - the identification of such functions may be risk-informed

Risk-Informed D3 Assessment Process



Risk-Informed D3 Assessment (Section B.3.4.1)

Determine Consistency with NRC Policy and Guidance on RIDM

- Review applications that use risk-informed approaches for consistency with established NRC policy and guidance on RIDM
  - RG 1.174
  - RG 1.200
- Current staff review guidance includes:
  - SRP Chapter 19
  - DC/COL-ISG-028
- SRP Chapter 19 provides review guidance for addressing the principles of risk-informed decision-making, including defense in depth

Risk-Informed D3 Assessment (Section B.3.4.2)

Model the CCF in the PRA

- Determine if the base PRA meets PRA acceptability guidance
- Evaluate how the CCF is modeled in the PRA and the justification that the modeling adequately captures the impact of the CCF on the plant
- Options for modeling the CCF in the PRA include:
  - Detailed modeling of the DI&C system
  - Use of surrogate events

Risk-Informed D3 Assessment (Section B.3.4.3)

Determine the Risk Significance of the CCF

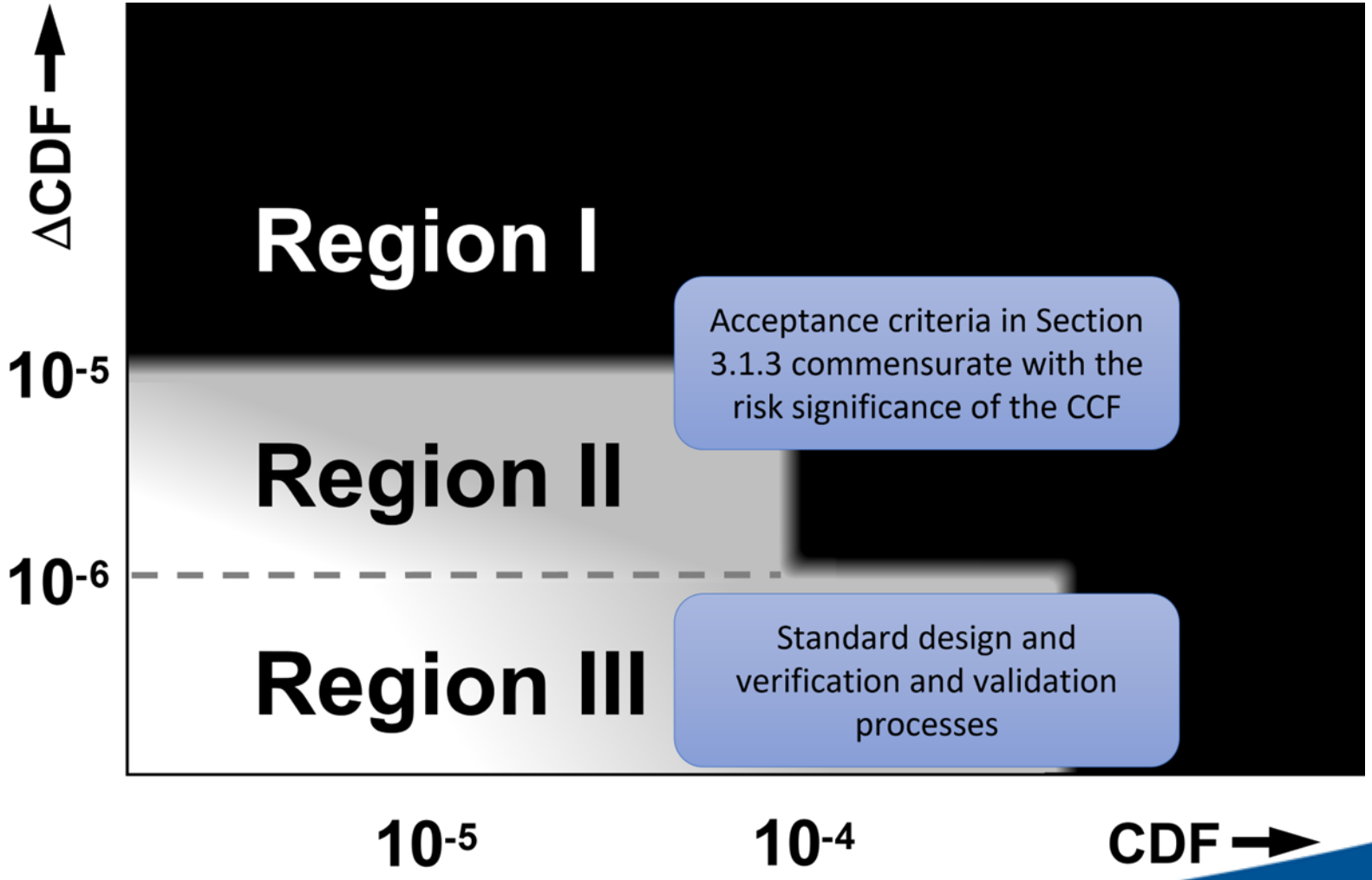
- The risk significance of a CCF can be determined using a bounding sensitivity analysis or a “conservative” sensitivity analysis
- A bounding sensitivity analysis:
  - Assumes the CCF occurs
  - Provides a description of the baseline risk
- A “conservative” sensitivity analysis:
  - Provides a technical basis for a conservative probability (less than 1) of the CCF demonstrating that defense in depth is addressed
  - Addresses the impact of this assumption on PRA uncertainty

Risk-Informed D3 Assessment (Section B.3.4.3)

Determine the Risk Significance of the CCF

- The quantification accounts for any dependencies introduced by the CCF, including the ability for operators to perform manual actions
- A CCF is not risk significant if the following criteria are met for the sensitivity analysis:
  - The increase in CDF is less than 1×10^{-6} per year
  - The increase in LERF is less than 1×10^{-7} per year

Risk-Informed D3 Assessment (Section B.3.4.4)



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Alternatives to Diversity (Section B.3.1.3)

Two Pathways

- Previous endorsement (e.g., RG) or approval (e.g., precedent or Topical Report)
  - Ensure it is applicable
  - Ensure it is followed
  - Justify any deviations
- A new approach proposed as part of an application
  - Use the acceptance criteria in BTP 7-19
  - Review description of vulnerability being addressed
  - Review description of alternative approach and justification (commensurate with the risk significance of the CCF per Section B.3.4.4)

Different Approaches for Meeting Point 4

Summary of Acceptance Criteria in Section B.4	Point 4 Approach	Different Approach
a. Proposed manual actions credited are both feasible and reliable, as demonstrated through an HFE analysis and assessment process	Applies	
b. Application identifies the minimum inventory of displays and controls in the MCR that allows the operator to effectively initiate, monitor and control the critical safety function parameters	Applies	If justified*
c. Manual operator actions are prescribed by procedures and subject to training	Applies	
d. Manual controls are at the system or division level and located within the MCR	Applies	If justified*
e. Quality and reliability of any equipment that is not safety-related is adequate	Applies	
f. Displays and controls are independent and diverse (not affected by the same postulated CCFs that could disable the corresponding functions within the proposed DI&C systems)	Applies	

* The application contains appropriate justification based on the commensurate level of safety in the plant design to ensure operators' ability to monitor, initiate and control the applicable critical safety function parameters is maintained.

Flowcharts to Facilitate the Use of the BTP

- Added four flowcharts at the end of the BTP:
  - Figure 7-19-1. Point 1 – Need for a Detailed D3 Assessment
  - Figure 7-19-2. Point 2 – Detailed Assessment
  - Figure 7-19-3. Point 3 – Addressing, Mitigating or Accepting the Consequences of Each CCF
  - Figure 7-19-4. Point 4 – Independent and Diverse Displays and Manual Controls
- The flowcharts provide a visual aid to the reviewers when reviewing an application against the four points
  - identify the conceptual steps for performing the review
  - identify the applicable BTP sections

Communication Independence

Added language from RG 1.152 to address a prior commitment to the ACRS concerning inclusion of communication independence and control of access

- Added a statement that, if licensees and applicants consider the cybersecurity design features, measures should be included to ensure that safety-related I&C systems do not present an electronic path that could enable unauthorized access to the plant's safety-related system
- e.g., the use of a hardware-based unidirectional device is one approach the NRC staff would consider acceptable for implementing such measures

Next Steps

- The staff is planning to issue the draft BTP 7-19, Rev. 9 for public comment in October 2023
- The public comment period is expected to end in November 2023
- The staff is planning to issue the final BTP 7-19, Rev. 9 in May 2024

Closing Remarks

Acronyms

ACRS	Advisory Committee on Reactor Safeguards
BTP	Branch Technical Position
CCF	Common Cause Failure
CDF	Core Damage Frequency
D3	Defense-in-Depth and Diversity
DAS	Diverse Actuation System
DI&C	Digital Instrumentation and Control
DRG	Design Review Guide
ESFAS	Engineered Safety Features Actuation System
GDC	General Design Criteria
I&C	Instrumentation and Control
ISG	Interim Staff Guidance
LERF	Large Early Release Frequency
LMP	Licensing Modernization Project
LWR	Light-Water Reactor
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
RG	Regulatory Guide
RIDM	Risk-Informed Decision-Making
RPS	Reactor Protection System
SECY	Commission Paper
SRM	Staff Requirements Memorandum
SRP	Standard Review Plan

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NRC Reviews of Volcanic Hazards Assessments for New Reactor Licensing

September 7, 2023

Jenise Thompson
NRR/DEX/EXHB

Where we're at and where we're going

Completed Actions

- Issued Regulatory Guide 4.26
- Reviewed Carbon Free Power Project (CFPP) Volcanic Hazards White Paper
- Observers to INL volcanic hazards assessment
- Visited Eastern Snake River Plain in support of INL and CFPP activities

Upcoming Activities

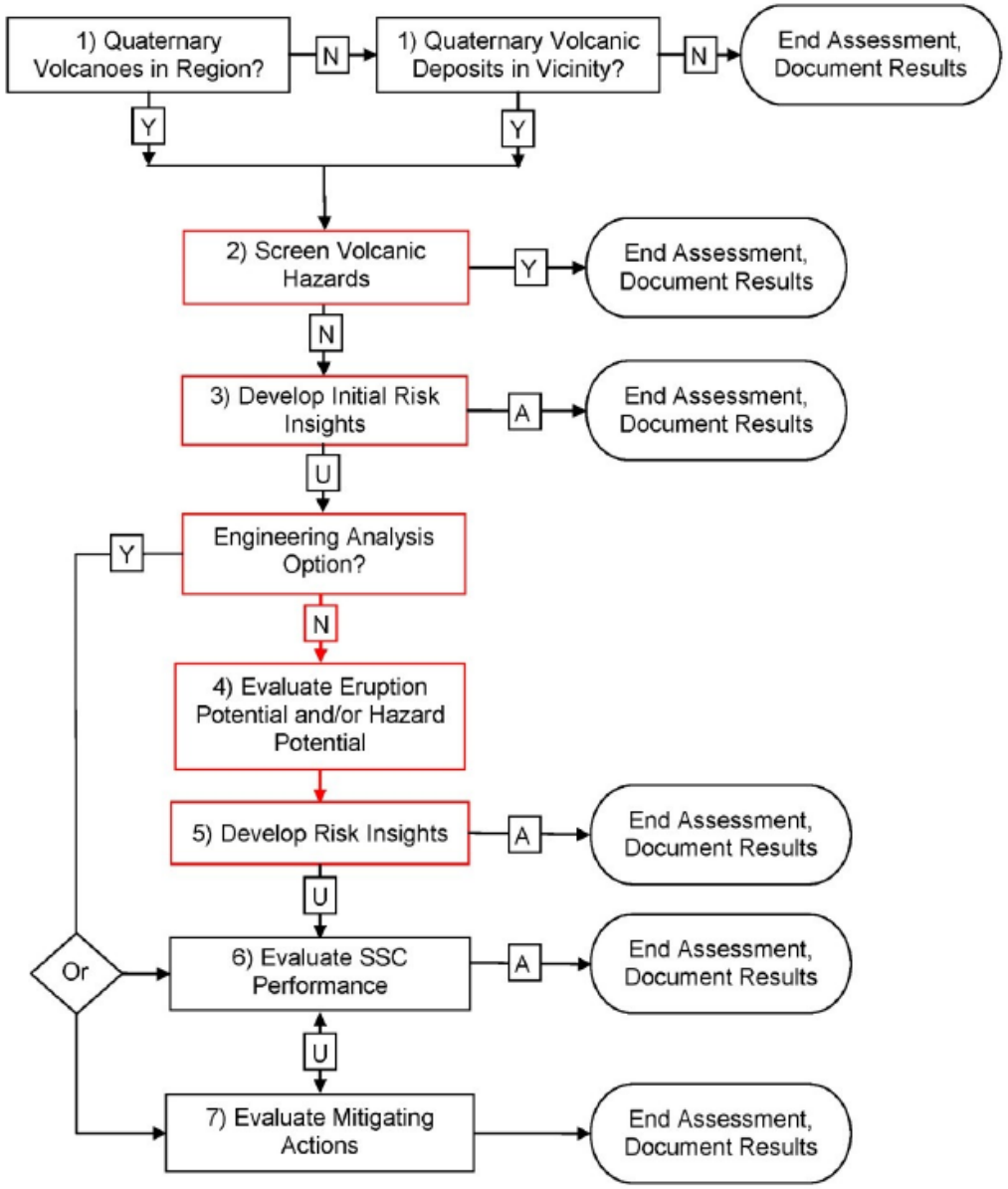
- TerraPower Volcanic Hazards topical report review
- CFPP and TerraPower permit/license applications

Regulatory Requirements

- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 2
- 10 CFR 52.17(a)(1)(vi) for an early site permit and 10 CFR 52.79(a)(1)(iii) for a combined license
- 10 CFR 100.23, “Reactor Site Criteria”

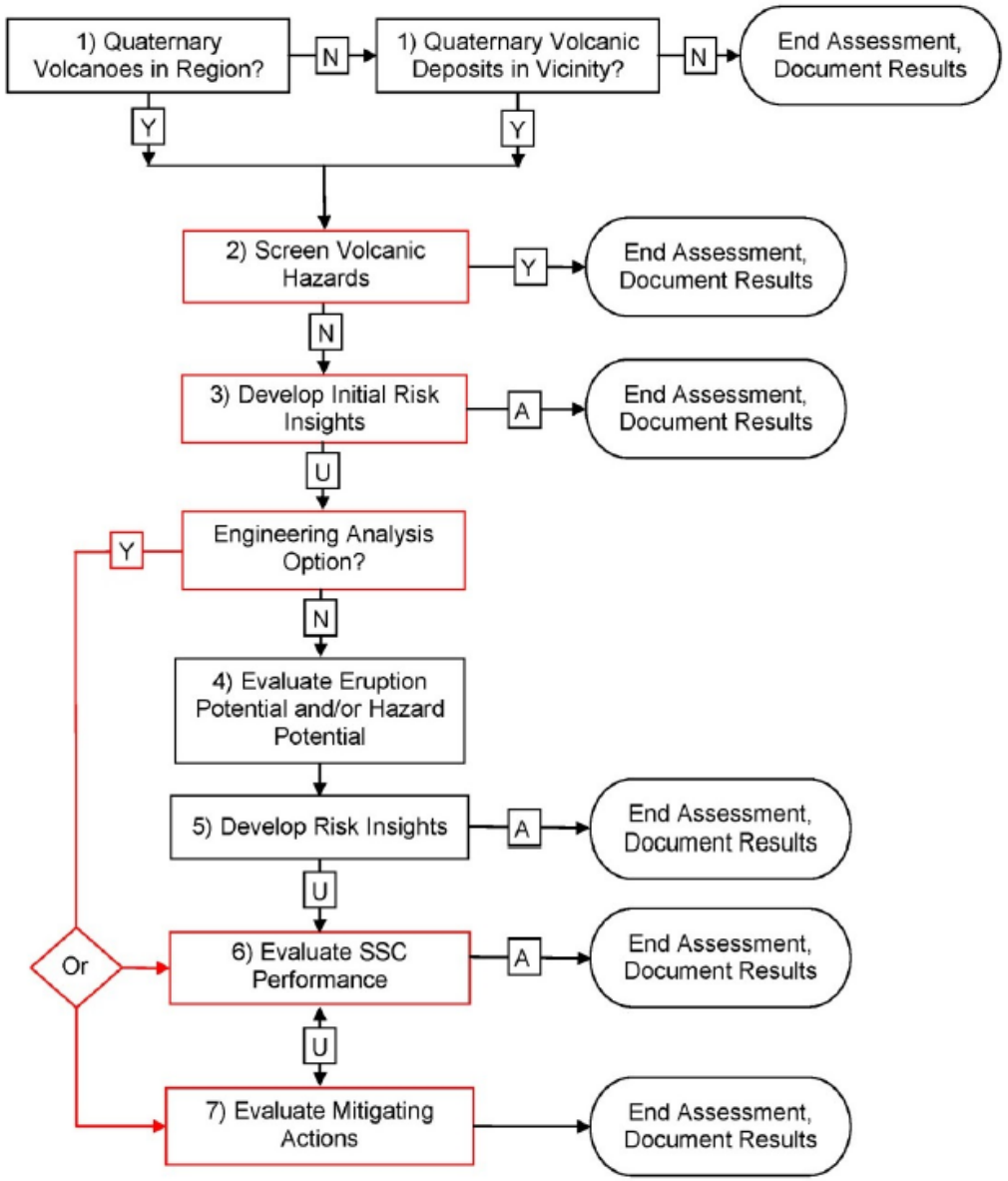
Regulatory Background

- RG 4.26 Volcanic Hazards Assessment for New Nuclear Power Reactor Sites
  - Briefed to ACRS February 2020 and April 2021
  - Revision 0 issued June 2021 (ML20272A168)
  - Revision 1 administrative change August 2023 (ML23167A078)
- Options to assess volcanic hazard or pursue engineering analysis based on maximum screened-in hazard



RG 4.26 – Hazard Analysis

- Multiple off-ramps
  - Acceptable (A) results can use the off ramp
  - Unacceptable results (U) continue process
- Quaternary Period (<2.6 Ma)
- Site region within 200 mi (320 km) and site vicinity within 25 mi (40 km)



RG 4.26 – Engineering Analysis

- Determine maximum magnitude for screened in hazards
- Iterate between evaluating SSC performance and mitigating actions, if desired

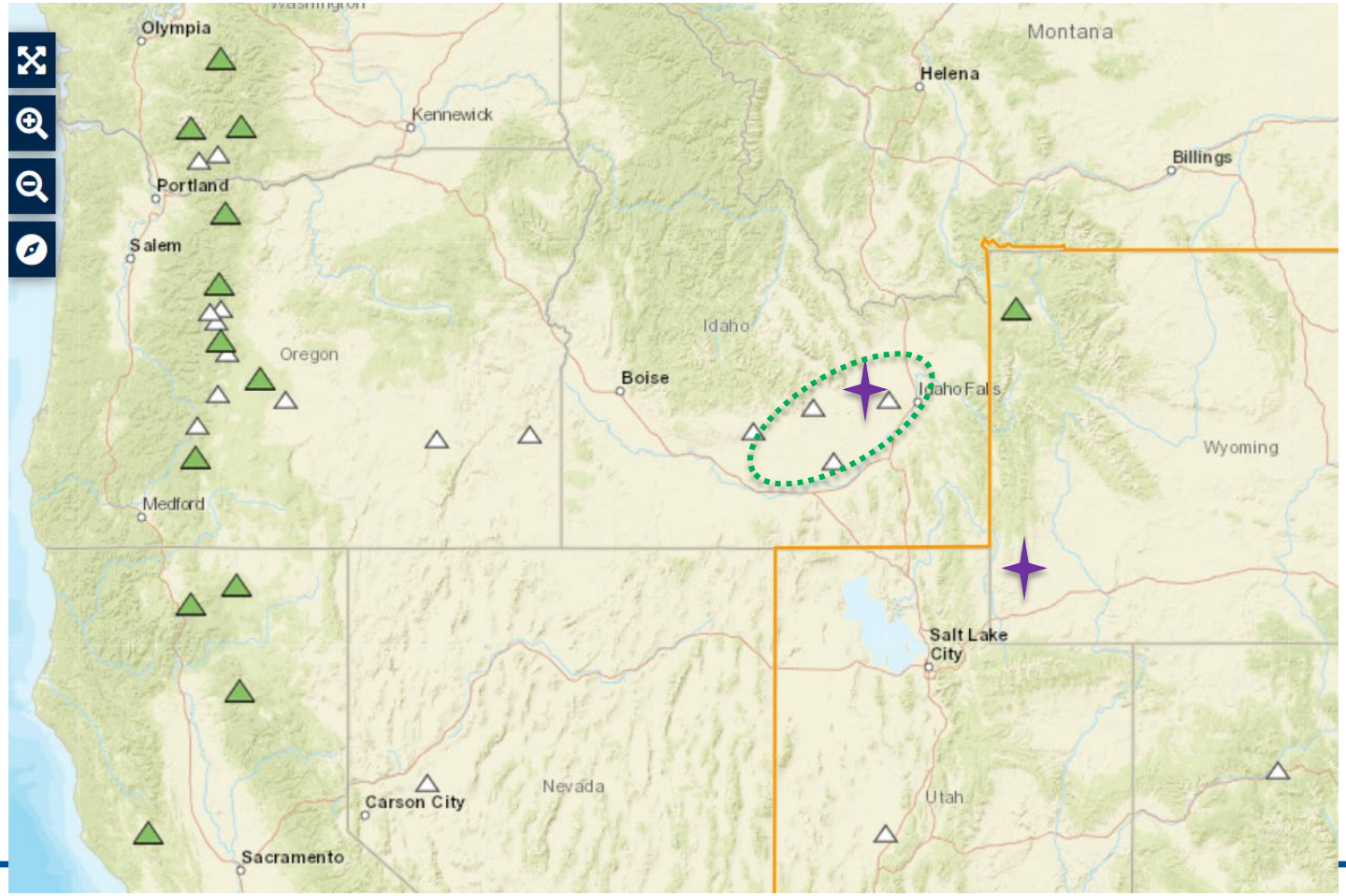
Reviewing Volcanic Hazards Assessments

- Geologic History
- Site Characterization
- Tectono-magmatic Model
- Numerical Modeling
- Engineering Considerations

Ongoing Activities

- Carbon Free Power Project White Paper (ML22224A196)
  - Staff assessment completed (ML22279A897)
- Idaho National Laboratory Probabilistic Volcanic Hazards Assessment
  - Following Senior Seismic Hazard Analysis Committee (SSHAC) process
  - NRC observers at all workshops and field visit
- TerraPower Volcanic Hazards Assessment Topical Report (ML23115A387)

Prospective Sites and Regional Volcanic Sources



From [USGS Yellowstone Volcano Observatory]

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

Eastern Snake River Plain (ESRP)

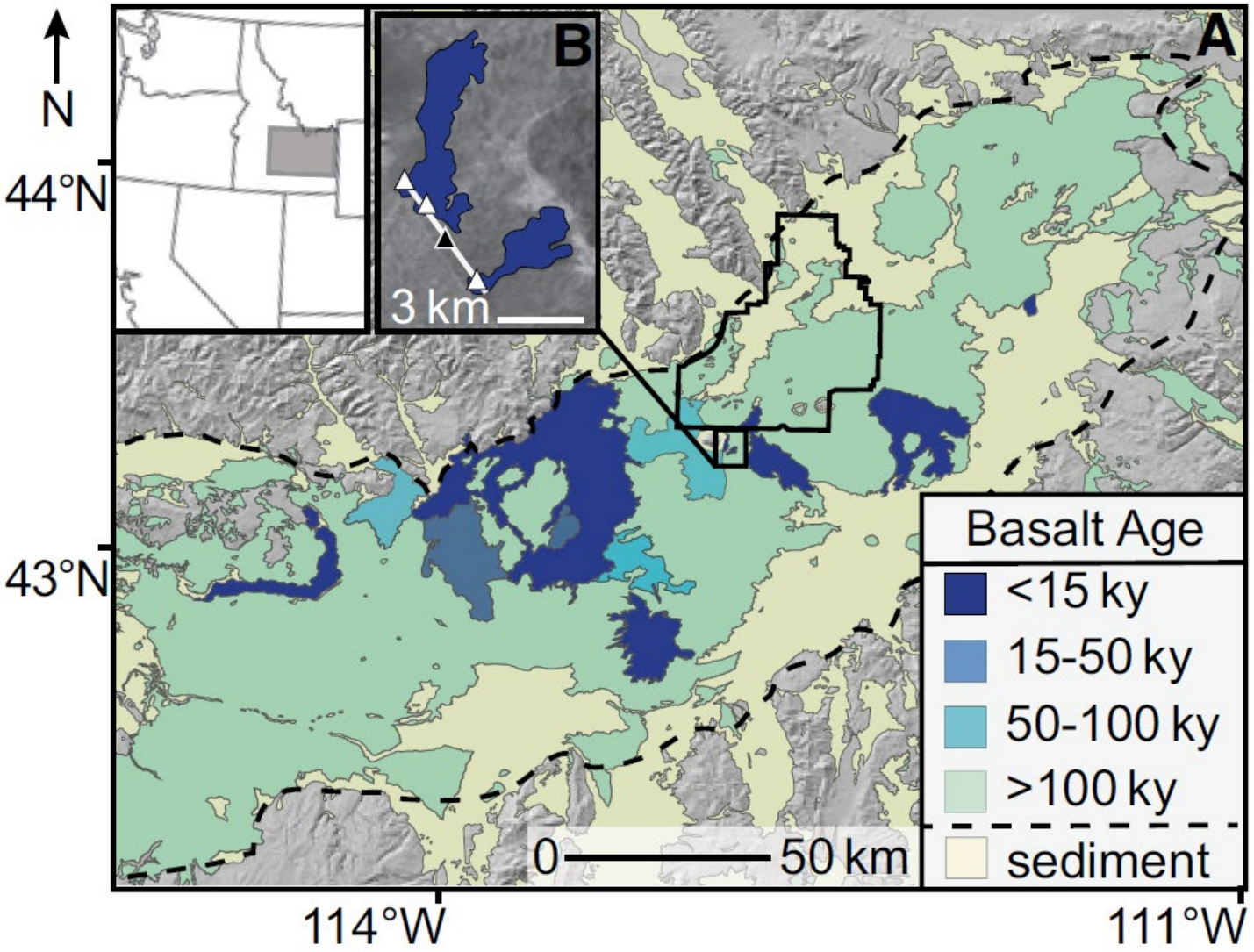
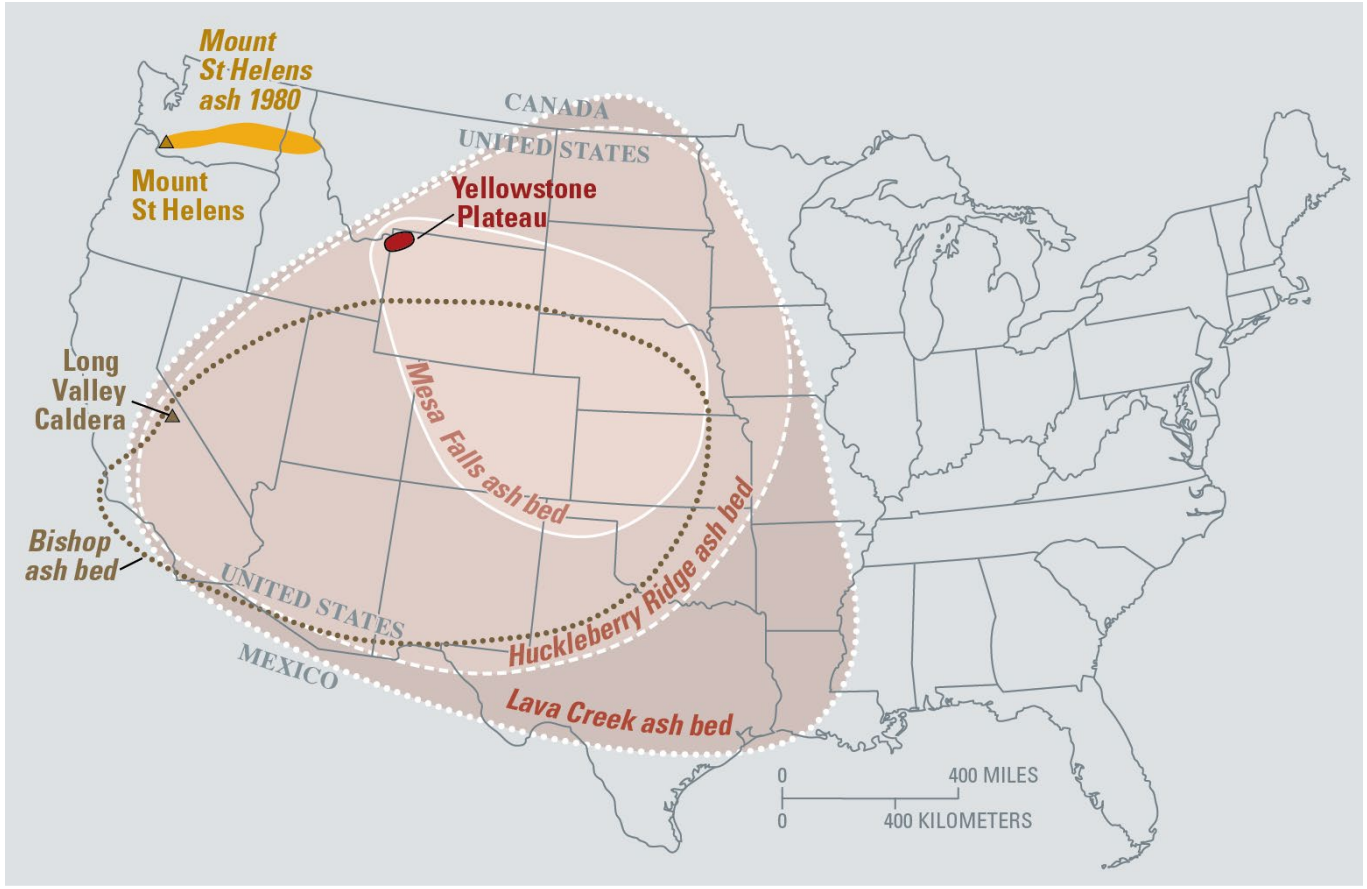


Figure from Gallant et al. 2018

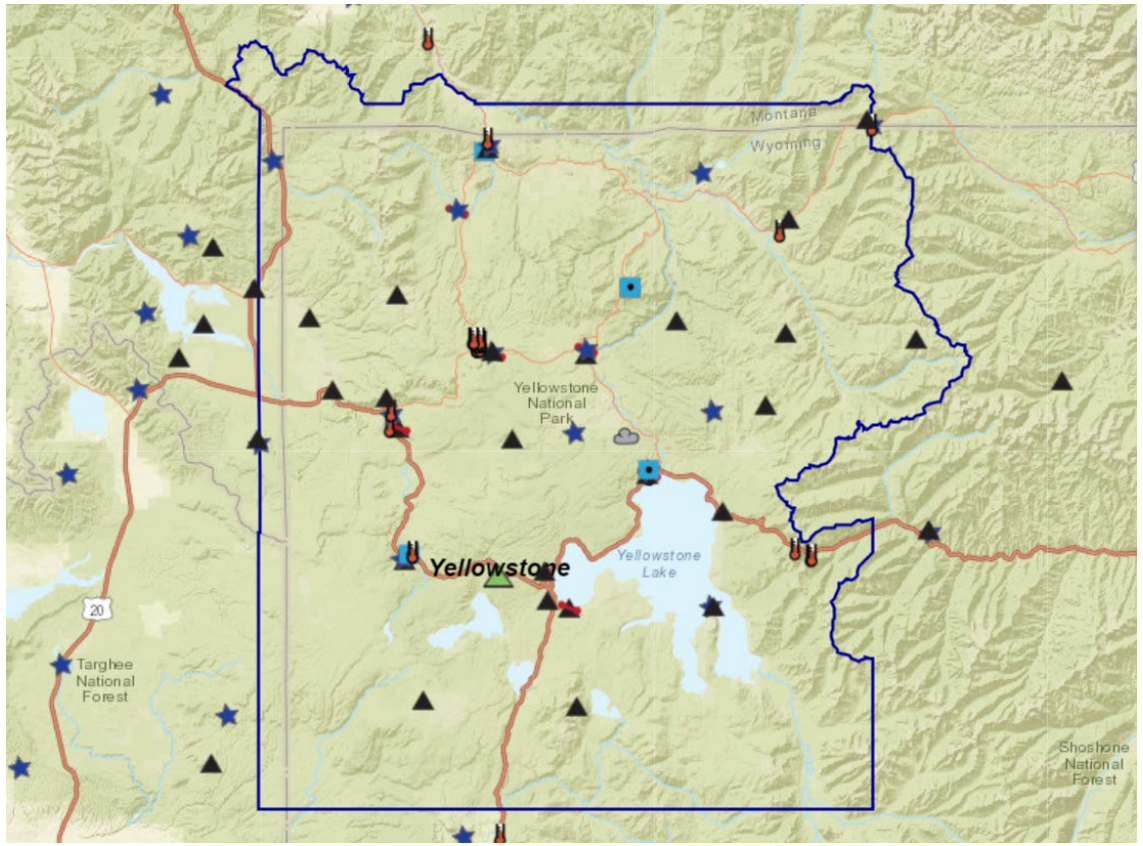
Yellowstone Caldera Deposits



- Lava Creek Tuff ~630,000 years
- Mesa Falls Tuff ~ 1.3 Ma
- Huckleberry Ridge ~ 2.1 Ma

From USGS Fact Sheet 2005-3024

Yellowstone Caldera



- Constant monitoring
  - Seismometer
  - Temperature
  - GPS
  - Gas
  - Camera
  - Tiltmeter

From [USGS Yellowstone Volcano Observatory]

Volcanic Hazards

- Tephra Fall
- Lava Flow
- New Vent Opening
  - Proximal Hazards

Tephra (Ash) Hazards

- Can travel long distances
- Wide range in particle size and deposit density
- Hazards to air intakes and switchyards
- Thickness of deposit, potentially affected SSCs and warning time are important to assessing impact of hazard on site

Lava Flow

- Dense, hot, with heat capacity comparable to metals
- Distance traveled from source to site will depend on local conditions
- Flow direction generally follows topography

New Vent Opening and Proximal Hazards

- Generally preceded by increased seismic activity and surface deformation
  - Eruptive dike may not reach the surface but effects will be noticeable

Proximal Hazards

Ballistics

Tension Crack

Numerical Modeling

- Several programs available
  - TerraPower
    - AshPlume – developed through NRC contract to CNWRA to support tephra hazard modeling at Yucca Mountain, models atmospheric dispersion and deposition of tephra
    - PVHA_YM – developed through NRC contract with CNWRA to support volcanic hazard modeling at Yucca Mountain, estimates the probability of a volcanic event occurring within an effective area using kernel density estimators
  - INL/CFPP
    - Tephra2 – open-source code developed by team at University of South Florida, models tephra accumulation at locations around a source volcano
    - MOLASSES – open-source code developed by team at University of South Florida, estimates area inundated by lava flows for pre-loaded digital elevation model.

Future Licensing Reviews

- Applicants are following RG 4.26 with minor alterations
- Staff preparing for confirmatory calculations of numerical modeling
- Site visits
  - Staff already visited INL to observe important features
  - Expect to visit TerraPower site as part of licensing review

Future Licensing Reviews

- Mitigating Actions and Monitoring
  - Criteria for initiation
  - Early warning of impending hazard
  - Demonstrate practicality of actions between warning and arrival of hazard
- Permit/License Condition(s)
  - Geologic mapping permit/license condition

What comes next

- Ongoing review of TerraPower Topical Report
- Reviews for CFPP and TerraPower CP/COLs
- Lessons learned from CFPP white paper, TerraPower Topical Report and licensing reviews
- Revise RG 4.26