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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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NuSCALE SUBCOMMITTEE

OPEN SESSION

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TUESDAY

MARCH 3, 2020

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2D10, 11545 Rockville Pike, at 3:05 p.m., Walter L. Kirchner, Chair, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chair

RONALD G. BALLINGER, Member

DENNIS BLEY, Member

CHARLES H. BROWN, JR., Member

VESNA B. DIMITRIJEVIC, Member

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JOY L. REMPE, Member

PETER RICCARDELLA, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

MICHAEL L. CORRADINI

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

MIKE SNODDERLY

P R O C E E D I N G S

3:04 p.m.

CHAIR KIRCHNER: Okay, we're back in session. For members of the public, we are turning now to the staff for their presentation on NuScale design certification application, the PRA. And with that, I'll turn to you first, Tony.

MR. NAKANISHI: Well, good afternoon, my name is Tony Nakanishi, and I'm with the Division of Risk Assessment. I'm here with Maria Pohida, also with the Division of Risk Assessment.

So today we'd like to provide a briefing that focuses on PRA and its, we tried to structure our briefing to be responsive to some of the feedback that we received from the ACRS members relative to the PRA focus areas. So if we could go to the next -- oh, I guess I'll have to. Yeah, I'm driving also.

So what we thought might be useful is to start out with a bit of a discussion relative to the design PRA and its context in terms of the Part 52 regulatory framework in terms of its uses, limitations, and the staff review associated with the DC PRA. And then get into some of the topics that were identified by the members. And so that includes the ECCS model, the sensitivity and uncertainty

analyses, and the reactor building crane operations.

So under the Part 52 process, consistent with Commission policy and direction, the primary focus of the PRA is to identify risk insights to inform the design, identify insights that could support things like the reliability assurance program that we were talking about, RTNSS, risk-significant human actions, things like that.

Obviously part of the PRA is to show that the new design is an improvement in terms of severe accident performance relative to the operating reactors. So from a quantitative standpoint, there's one use with respect to compliance or consistency with the Commission goals relative to CDF and LRF.

And I guess the emphasis that I, the emphasis here is that while we rely upon numbers that, you know, risk insights are really what we're trying to go after here at the DC stage. And our staff review of the PRA acceptability is really to support the PRA uses at the DC stage.

I also want to just highlight the progression of the PRA under Part 52. At the DC application stage and also at the COL application stage, there's a lot of unknowns that have to be addressed through assumptions. And over time, you

know, there are regulatory provisions to ensure that the PRA improves and the level of detail, the scope of the PRA. And just overall capability of the PRA.

And that's, sometimes we refer to the fuel load PRA at, right before operations, and that's, you know, that'll be developed or updated by the COL holder. And then, but even at that stage, you know, the plant hasn't been operated. So you're still lacking in plant-specific operating experience.

You'll have procedures by that time, but certainly there's still a lot of unknowns that have to be addressed via assumptions. And any risk-informed decisions will require the evaluation of those assumptions for impact on any decisions.

And just to, in terms of the guidance at the DC stage, we have a PRA acceptability regulatory guide that we apply primarily in the operating reactors space. Obviously, plant is in the design phase and there's no, there's many things that are unavailable.

And so Reg Guide 1.200 can't be applied directly, and so we do have a interim staff guide instead that sort of provides guidance to staff in terms of how we review the PRA for DC and COL applications.

So just to provide a summary in terms of the DC PRA for NuScale, we want to mention that the PRA acceptability is to be commensurate with its intended use. And the primary findings that we're making at this stage is relative to ensuring the Commission objectives relative to PRA use in design are satisfied.

I want to clarify that findings are not made on specific numerical results. We found that PRA acceptability is sufficient to support PRA uses in the design certification. And, you know, as a previous slide tried to highlight, there's established regulatory frameworks that will ensure that PRA will reflect an as-built and as-operated condition for operational phases.

And we also want to highlight that we applied a focus review approach for the Chapter 19 review, and we, you know, we focused on the information needed to reach the safety findings that we, that I mentioned.

So getting more specific into some of the topics that were raised, so for the ECCS model, there's certainly recognition that there's a lot of uncertainty in our view that, you know, there's obviously no operating experience. And you took a

look at the model, I guess, at the closed session. But we believe that for the purposes that we indicated earlier, that the model is sufficient.

And that, you know, there are assumptions that are used to model the ECCS with respect to the level of detail, completeness, and, you know, data. But we evaluated those assumptions for impact on the findings made at this stage and found them acceptable.

DR. SCHULTZ: Tony, when you say you evaluated those, could you describe basically how you did that, what's your approach.

MR. NAKANISHI: Sure, so yeah, it's a really a good segue to the next slide, which is, you know, sensitivity and uncertainty analyses. So the applicant provided some sensitivity studies addressing things like common cause failure, of human failure, operator action.

And we sort of applied the common cause failure sensitivity study as sort of a surrogate for, you know, evaluating the impact of less reliable ECCS system. And you know, the applicant showed that they still, the design is still, you know, consistent with the Commission goals and things like that.

MEMBER DIMITRIJEVIC: That's one of my main issues.

MR. NAKANISHI: Okay.

MEMBER DIMITRIJEVIC: This sensitivity uncertainty only supported conclusion that they meet safety goal. No any other. Am I right?

MR. NAKANISHI: So there's, so in terms of the CCF, the common cause failure sensitivity analysis, so the applicant --

MEMBER DIMITRIJEVIC: Let me add that all of these, they just show you that you're always meeting safety goals. But you never evaluate the implication on the input would be the up to human factors to anything. You just say, oh, we make safety goal so we are fine.

MR. NAKANISHI: So the DRAP process we -- so I guess I'll first of all mention I wasn't the reviewer that looked at the DRAP process. But I believe we, it was a kind of a integrated look at the design. So certainly the risk significance, yeah, methodology is one aspect.

MEMBER DIMITRIJEVIC: I didn't want to put you on the spot because you did not do it, and nobody does it. So it's all right. If you did it, it would be revolutionary thing. But you specifically say in SER, that's a not true statement, you specifically say the sensitivity uncertainty were used to evaluate

insight. They're only used to evaluate safety goal, not the insight.

So that statement is not true, and if you did not do it, nobody did it during the, you know, EPR review. Nobody's, this is advanced step to say, oh, okay, if you change this how does this imply insight.

So therefore I will note clearly, you can say the uncertainty and sensitivities are done to support the design meets safety goal, that's perfectly true and it's perfectly fine. But don't say they use that to support all other regulatory findings. Because they're not really used, they're just done, they illustrate that we meet safety goal for all these cases, but nobody looks at the implications, you know.

Like for example, the ECCS valves are not as reliable, obviously you really want to have a charging, and you know, containment and things because that's your only other level of defense. So that's what I was trying to say with the sensitivity uncertainty.

MR. NAKANISHI: Right, I think there could have been a more explicit --

MEMBER DIMITRIJEVIC: This is what you say in SER. You say that we can't appropriately consider uncertainty sensitivity a traditional relation

regulation defense in depth, blah, blah, blah, blah, to, in addition to risk insight to determine it is significant for DRAP, as discussed in Section 1744. That's not a true statement. If you can prove me, show me how uncertainty sensitivities are used there, I will be impressed.

MR. NAKANISHI: Yeah, I would say the focus was more on the, you know, the qualitative aspects, like the defense in depth and --

MEMBER DIMITRIJEVIC: But there is no defense in depth they also face, because you're only defending on ECCS valves, your next defense is that is charging, I mean, you know. So it's not, definitely not defense in depth.

MR. NAKANISHI: Well, right, so defense in depth meaning sort of the design, considering the design itself. I think there was some discussion earlier about, you know, the level of redundancy with respect to CVCS.

And you know, also the fact that it's a, you know, it's in a protected, you know, aircraft impact-proof reactor building. We think, you know, putting it on the DRAP may or may not necessarily add so much. It's already, you know, it's a normally operating system.

So I think things like that, we looked at it, you know, more of a, in holistic manner. We sort of went back and forth with the applicant regarding expert panel process. I think expert panel process is very important.

MEMBER DIMITRIJEVIC: That's true.

MR. NAKANISHI: I think the numbers, like I said, you know, you could sort of play around with the assumptions and, you know, get where you want.

MEMBER DIMITRIJEVIC: But, and I don't think you need to do anything more, don't get me wrong. I'm just saying it should be stated truthfully here and say when the PRA is completed in this spaces, you know, then that this insight should be evaluated because sensitivity, the sensitivity only addresses your safety goal.

MR. NAKANISHI: Right, so we'll look at that and consider rewording.

MEMBER DIMITRIJEVIC: That was my main concern, whenever I brought uncertainty sensitivity. Not just safety goal.

MR. NAKANISHI: Right, understood.

DR. SCHULTZ: Tony, just to amplify that, on the slide 3 in your last bullet, for the DC PRA uses, you have a number of things in the last bullet

that could be done. And the question is were they done for the passive design here.

MR. NAKANISHI: So they have been. So RTNSS evaluation has been done. From a probabilistic standpoint it's what we call the focus scope -- focus PRA where you assume that the non-safety systems are unavailable and you evaluate the CDF and LRF. The applicant evaluated that process and determined and we accepted that there's no written SSCs.

ITAAC is, you know, per our guidance it's supposed to be a risk-informed process. And so we tried to incorporate risk insights, I believe the crane, ITAAC on crane.

MS. POHIDA: The review of the crane resulted in additional ITAACs.

DR. SCHULTZ: In particular, yes.

MS. POHIDA: Thank you.

DR. SCHULTZ: And we'll talk about that later.

MR. NAKANISHI: And we talked about RAP, and tech spec I think it's a little, you know, there's this, I think it's primarily deterministic in terms of how we, you know, 5036 is written, so.

DR. SCHULTZ: There's some of that done but not --

MR. NAKANISHI: Right.

DR. SCHULTZ: Not a lot now.

MR. NAKANISHI: Right. And --

DR. SCHULTZ: Same with the COL action.

MR. NAKANISHI: COL action items, certainly.

DR. SCHULTZ: Well, the action items are there, so right.

MR. NAKANISHI: And then the interface requirements is really more relative to the specific site, site-specific features, how the design interfaces with like the ultimate heat sink and things like -- for NuScale it's a little different because their ultimate heat sink is, you know, within the design.

DR. SCHULTZ: Good, I appreciate the extra information. Thank you.

MEMBER DIMITRIJEVIC: I have additional questions. I found that in SER, but I thought I saw in slide, but I cannot. You said that you think that the applicant adequately addressed multi-module risk. That's within SER, I thought it was in some slide, but. How is multi-module risk defined, how does staff define multi-module risk?

MR. NAKANISHI: So the staff guidance for

multi-module risk is not quantitative. Like, the SRP 19 doesn't require the applicant to do a quantitative multi-module risk analysis. Really, the, what we were looking for and what we reviewed was did the applicant do a systematic analysis of multi-module scenarios and did they identify, you know, potential risk-significant issues associated with that.

And I believe the crane --

MS. POHIDA: We can discuss this with the crane, but there is no requirement for an applicant to quantify multi-module risk. The requirement is to look for potential system interactions. And that's what the applicant has done, and those are described in Chapter 19.

MEMBER DIMITRIJEVIC: Okay, because see they calculate multi-module risk in Chapter 19 as a risk to fail two modules, more than one module, right? Is that how you define multi-module risk?

MR. NAKANISHI: So the applicant decided to quantify the multi-module risk. Our finding is really of a, based on a qualitative assessment. Correct me if I'm wrong.

MEMBER DIMITRIJEVIC: Because there is a different aspect of this. Multi-module risk would be more than one module failing, or it could be increased

risk because you have multiple modules on the same side.

MR. NAKANISHI: It's the former, former.

MEMBER DIMITRIJEVIC: For --

MR. NAKANISHI: Simultaneous core damage events.

MEMBER DIMITRIJEVIC: So why wouldn't you look in increase the reason, or the presence of multi-module where we can start moving one module, heating that, as you know, have explosion of hydrogen above all of them. You know, whenever one event happens, affect all modules. Why was not staff interested that type of multi-module?

MR. NAKANISHI: So no, that is the, that's the multi-module --

MEMBER DIMITRIJEVIC: Because you said the former, which was more than one module failing, but.

MR. NAKANISHI: Yeah, maybe I misunderstood you, so --

MEMBER DIMITRIJEVIC: That's what they quantify in the Chapter 19, just the common cause within different systems and things like that.

MR. NAKANISHI: Right.

MEMBER DIMITRIJEVIC: But there is not any, like nobody even look in the, nobody even discuss

the, for example, operator will have to do multiple -- but multiple modules in the same time because they're exposed to the same external event and things like that. And even there is a section, don't we have a multi-module?

Joy, I think you were in charge when they only identify common systems but not never common risk contributions, right?

MEMBER REMPE: You're talking about in Chapter 19?

MEMBER DIMITRIJEVIC: No, I'm talking about --

MEMBER REMPE: In 20, Chapter 20.

MEMBER DIMITRIJEVIC: So that's why I sort of think that maybe there is some missed opportunity here to talk about the some risk impact from presence of multi-modules on the same site.

MS. POHIDA: May I provide a clarification? Regarding, and if I misspeak I'll defer to NuScale on this one, but in multi-module risk for full power conditions, multi-module risk was quantified by the use of module adjustment factors.

MEMBER DIMITRIJEVIC: Right.

MS. POHIDA: To look at the potential commonalities of operator actions and shared systems.

So that was done for full power. Multi-module risk in terms of a drop a module impacting another module, that is evaluated in DC Section 19.1.7, and that was done qualitatively.

In terms of multi-module risk regarding external events, as I recall, that was also done, you know, qualitatively, Chapter 19.

MEMBER DIMITRIJEVIC: This is where I have to say I disagree. What is done in Chapter 19 is calculate frequency or core damage frequency of failing two modules.

MS. POHIDA: Yes.

MEMBER DIMITRIJEVIC: This wasn't done is calculating crease of core damage frequency for single module due to presence of other modules. And that's what I would define as one aspect to multi-module.

MS. POHIDA: That's one aspect of several.

MEMBER DIMITRIJEVIC: Because let's say I agree that we are only we're looking in one module and that's what we are worried. But that module has increase in risk because of setup of these multiple modules. Because the operators could be, you know, distracted with a million or doing different things because eventually we move each of those modules around each other. They have some common spatial

things.

So I think that this was a failed opportunity to identify this type of increase in multi-module risk. That's in my opinion.

MEMBER REMPE: But just to clarify, it is in Chapter 19, but remember, I had to recuse myself. So I think we need to look at Steve.

MEMBER DIMITRIJEVIC: What was the, when you were addressing all these common system, that was some chapter you --

MS. POHIDA: Chapter 20.

MEMBER REMPE: But that was mitigation of beyond design-basis events. But there is, as Marie, said a multi-module risk in Chapter 19.

MEMBER DIMITRIJEVIC: But that's a different, that's what I know am I discussing. But what was the chapter where they say this is new bad concern or how about they connect the modules?

PARTICIPANT: System interactions.

MEMBER DIMITRIJEVIC: System interaction.

MEMBER REMPE: That was where we were talking about buildup, and that was back in Chapter 9. But that wasn't like a risk assessment, it was just how they would build up. I just was confused a bit on where you're going.

MEMBER DIMITRIJEVIC: I'm not talking about risk assessment because it wasn't in that chapter but I thought it should be.

MEMBER REMPE: Okay.

MEMBER DIMITRIJEVIC: That was what, whatever chapter that was. All right, did you understand my point?

MR. NAKANISHI: I think so, yes.

MEMBER DIMITRIJEVIC: All right.

MS. POHIDA: Thank you.

MR. NAKANISHI: So I think I'm going to turn it over to Marie at this point to talk about the crane operations.

MS. POHIDA: Yeah, as I presented in the phase 3 ACRS discussion, the calculated drop probability is dominated by operator errors. You know, overspeed, over-raise, over-travel. And failures of instrumentation that's, interlocks or switches to provide a safety stop. And that was based on the reactor building crane PRA, which we understand that reactor building crane design is evolving.

During that period since our last briefing, key assumptions was added for the low power and shutdown PRA in DC table 19.1-71 to state that movement of the reactor building crane is modeled as

being operator controlled. And you know, administrative controls will ensure that reactor building safety features, those limit switches and interlocks to prevent undesired movement, are functional during module movement.

We do have a COL action item, 19.1-8, where the validity of these reactor building crane assumptions and the crane data will be confirmed by the COL applicant.

MEMBER BLEY: Before you leave that--

MS. POHIDA: Sure.

MEMBER BLEY: NuScale and you said, and you folks agreed, as I recall, I don't remember if it's in the SER or somewhere else, that their crane vendor would do an analysis of human-related failures of the crane. And I would assume then the COL applicant would present that and you folks would review it. Is that your understanding?

MS. POHIDA: My understanding, if there are changes that impact the crane data or the crane assumptions in the DCA, that we would keep format --

MEMBER BLEY: They don't even have a crane now.

MS. POHIDA: I beg your pardon?

MEMBER BLEY: They don't have a crane yet.

They're laying out a specification, and you agreed that was a reasonable way to do it in Chapter 18. And then their vendor will, is being tasked with doing the human reliability analysis to support the crane. And I would assume that makes its way back to the PRA eventually in the COL stage. And you look like this is news.

MS. POHIDA: No, my -- I apologize. My understanding is is that we would be looking at that at COL stage.

MEMBER BLEY: Okay, that's fine.

MS. POHIDA: Thank you.

CHAIR KIRCHNER: Just an observation, Dennis and Vesna, and I think, and Joy, this rises to the level it's on of note.

PARTICIPANT: Yeah, it's already flagged.

CHAIR KIRCHNER: Yeah, we flagged it before, and I think this is one of the items that should find its way into our final letter on this. Thank you.

MEMBER DIMITRIJEVIC: But I just want to note that everybody that has that in mind, this core damage frequency through the cane is not part of core damage frequency consider safety goal. Because it cannot result in release.

So therefore it's irrelevant, it just hangs there like -- they decided that this, when new report core damage frequency and large release frequency, this core damage frequency is not included. And it's not used in importance measure, it's a separate chapter. Because it doesn't lead to releases. Because if they drop the module then, you know, they made the argument that there's not going to be releases from the pool.

MS. POHIDA: May I make a clarification on that?

MEMBER DIMITRIJEVIC: Sure.

MS. POHIDA: Okay. In the module drop analysis in the SER, we do do a comparison of NuScale's module drop probability and the resultant CDF against the Commission goals. And what we also used was a drop probability from the EPRI report on spent fuel casks, which was on the order of 5E minus 6. And what we recognize is that the use of either drop probability yields a core damage frequency that meets the Commission goals, okay.

And as we say in the SER, if we drop a single module, it does not result in a large release. So we do do a comparison of the drop probability and resultant CDF against the Commission CDF goal. Does

that help?

MEMBER DIMITRIJEVIC: Yeah, I know you do that, but it's not part of the, you know, any risk insights because it just fends for itself with large number of existing things, so. I'm not sure, actually, how to treat that, it's the first time I saw something like this happening, so.

MS. POHIDA: Well, the risk significance of the reactor building crane, and it's actually on this slide, the risk significance of the crane is inclusion of DRAP. That was used to initiate a deeper look into ITAACs and see, you know, what additional ITAACs could be performed to give a little bit more, for lack of a better term, infrastructure to the drop probability that was assumed in the PRA. And that was done.

Does that help? Okay. All right, getting back to bullet number one, in DC table Chapter 9.1.5-1, that does document the max speeds and lists heights for the reactor building crane. The reactor building crane is to be constructed single failure proof consistent with operating plants. I forgot the NUREG number and the supplemented by guidance in NOG-1.

The applicant, the COL applicant will describe the process for handling and the receipt of

heavy loads, including the nuclear power module per a COL action item, 19.1-5. Since phase 3, the reactor building is included within the scope of the human factors process during COL, according to the human factors designing implementation plan.

And as I stated earlier, the risk significance of the reactor building crane did result in additional ITAACs. And that's for, you know, rated low tests of the module lifting fixture and the module lifting adapter. And inspection of the, you know, as-built welds for the module lifting adapter and the module -- module-lifting fixture, excuse me, and the module-lifting adapter.

And as I stated previously, a postulated single module drop does not result in a large release.

So this concludes my presentation. I'll be happy to address any questions.

CHAIR KIRCHNER: Did you go beyond that, Marie and the staff, did you look at the build-out of the plant and any, are there any limitations on operating other modules while you're building out? You know, the nominal concept of operations has the, I believe it's unfueled, the nuclear power module comes in on a special trolley, it's positioned, if it's fueled, it's moving.

Are there any limitations on operations of any other modules that are pre-existing or installed while those operations are ongoing?

MS. POHIDA: That, those conditions were not evaluated in 19. I'm questioning whether they were addressed in Chapter 9, but I'm not the proper reviewer for that.

CHAIR KIRCHNER: I don't think so, nor is 20, to my knowledge.

MS. POHIDA: Yeah, that was not addressed.

CHAIR KIRCHNER: This is one of the rather unique features of this plant. And does that set of operations introduce risk significance to how the plant is built out?

MS. POHIDA: What was discussed in Chapter 19 was the postulated drop of a module being removed -- being moved for refueling on top of another, on an operating module. Whether it strikes the top and could result in breaks of CVCS piping, or if it's struck, you know, it hits the module at the bottom, at the pedestal, that is described in Chapter 19.

MEMBER REMPE: So what Vesna's mentioning is slowly coming back to me, that there are, and I'm having trouble remembering what chapter --

MEMBER DIMITRIJEVIC: Chapter 21, it was

actually.

MEMBER REMPE: Yeah, okay, there is a chapter that has some requirements about when they even start building, how many modules have to be supported by how many systems. I've not seen any assessment of when they're bringing in another module, but they do have some requirements. I just, you were puzzling me when you brought it up because I hadn't thought about it for a while.

MEMBER DIMITRIJEVIC: Twenty-one is called multi-module consideration. But it is very bare, this only identifies systems which are common for all the modules and nothing else. There is not any other multi-module consideration there. It is a pity, it could be fantastic and very informative section.

CHAIR KIRCHNER: Yeah. For example, although each module will have its own CVCS system, there's common supply of boron addition as one example of potential multi-module --

MEMBER REMPE: And so they do consider that one, as I recall, and it helped me remember. But isn't it like one boron addition a system for six or something like that. And so I would assume the risk assessment would have done like a one out of six or something or other.

It would have considered that. Because again, even though you had two for 12, you would have been thinking about those kind of relationships as a way to kind of think about this right now and what you're required to do. Does that make sense, what I'm trying to say?

MS. POHIDA: Yes, I understand. I would have to go back and look at the full power, you know, multi-module risk assessment that was done and see how those module adjustment factors, in other words the impacts, the conditional impacts in the other modules was done. But I would have to go back and look at that. I can take that back, though.

CHAIR KIRCHNER: The reason I bring it up is because I, from looking at like Chapter 21, it looks like it's really deferred to the COL to develop a conduct of operations plan for build-out. And hence a risk assessment, and a in-depth look at where they're reliant -- they are, as I mentioned just one example, the CVCS, there's one system for each module.

That sounds good, but they do share a common heating system, a common foreign injection system, and so on. So one starts to think, well, we got something operating and we're bringing something else in. What's the implications of that?

MS. POHIDA: We can take that back as an item to look at.

MEMBER REMPE: Yeah, I think we actually documented that concern in our letter. It's been awhile.

CHAIR KIRCHNER: I think so, because Chapter 21 is rather thin.

MS. POHIDA: It is very.

MEMBER DIMITRIJEVIC: And a factor is very simple, the system is common, they will just fail it for both modules. So the factors will not help if with this concern is.

MS. POHIDA: With this type of, this new, this consideration of the build-up of the modules as they're being brought online.

MEMBER DIMITRIJEVIC: Or be the common challenges were also not addressed in this, you know, two different modules. And the same operator's action affecting human. Probably not big deal, but it's very, it should be somewhere, you know. Now it's too late, but things.

DR. CORRADINI: Just to remind people, this was the June meeting letter, and it's a common letter between 19 and 21 where we did not have any specific recommendations for multi-module design

considerations. Most of it was --

MEMBER DIMITRIJEVIC: There was a common letter. Why would they be common --

DR. CORRADINI: It was the same letter, June.

MEMBER DIMITRIJEVIC: Oh, you mean in the same letter, but there is --

DR. CORRADINI: It's in the same letter.

MEMBER DIMITRIJEVIC: There was not --

DR. CORRADINI: But there was no recommendation specifically for multi-module design considerations, but there was a discussion in the discussion, most of what you've talked about is in the letter from June.

CHAIR KIRCHNER: I just brought it up because following on with Vesna's comments on -- you know, I think for the existing fleet, when they talk about multi-module, their concerns were much more limited. Here we have multi-modules within the same reactor building, different states of operation and so on.

Whereas most multi-module plants, even if they share control rooms adjacent or something, don't have the commonality of support systems that the NuScale design will have. Including the ultimate heat

sink, etc.

MEMBER REMPE: I want to --

MEMBER BLEY: They don't, but this committee has a history of recommending that people consider site risk in its entirety.

MEMBER REMPE: On kind of a different topic, I'm thinking aloud here, and I think we have time for hypothetical, but we've commented throughout several meetings about the COL applicant will develop the procedures. And this table that documents assumptions would be a good place for the staff to evaluate those COL applicant procedures at some point in the future.

And perhaps, you know, it's a good repository of a lot of such assumptions to help. Because I think this, because of the newness of and the uniqueness of the design, that the procedures that are used are going to be more important than maybe if we just had an evolutionary LWR coming through.

And is that kind of the best place for looking at this? And like right now in the earlier discussions on other topics this week, we're going to be pointing to more things the COL applicant procedures need to consider.

And maybe they don't fall into Chapter 19,

but is there a better place other than to look at the whole SE, all these assumptions? It just, I know the applicant has said we've got a list of assumptions, but I thought it was always in Chapter 19 context. What are your thoughts about this? Because I think it's going to be a difficult situation in the future.

MR. NAKANISHI: So I personally, and I think from a staff standpoint, we agree. I think the Chapter 19 has a list of key assumptions that have to be reevaluated for, you know, future phases, you know, COL application and beyond. So and then the COL item that we have, there's a COL item specifically, you know, identified to go back and evaluate those assumptions.

So, and COL you know, action items are something that, yeah, COL applicant has to address. Whether, you know, they'll, there may be other justification for doing, you know, proposed approaches, but they certainly need to address those. And so that provides some assurance from the staff standpoint that, you know, issues, design or operational issues, procedural issues, may be addressed in the COL stage.

MEMBER DIMITRIJEVIC: And I want to action this very much, even this is not called COE applicant

the COL holder who will deal with the procedures. When I look at this PRA, this PRA was done as a most PWR PRA side. It concentrates on things which we know, not on the things which we don't know.

So the thing is what we notice here in our review, there are some things which don't show in other PWRs suddenly become a issue here, like this boron dilution, steam generators, maybe even this containment bypass. But that's maybe issue in others, I'm not sure.

So we are discovering through this review some things which we review of the PRA has a very small chance to discover because they're used to reviewing PWR, not the new design. So while we are reviewing this design, we are discovering very valuable things they should keep in mind. How to keep this documented, that's the question, so somebody will see it in the future, before the full load, which is the main thing.

MR. NAKANISHI: Right, I think we agree. And there's a lot of lesson learned potentially here for future even non-light-water reactor PRAs, you know. I think there's, you know, when you have to recover from a otherwise a safe, stable state, you know, that could get into some potential issues. So

I think the point's well taken. I think we probably need to align, you know, internally and --

MEMBER DIMITRIJEVIC: You know when the -- brings, why didn't, why is this scenario not in the PRA? Well, I have never seen this in the PRA. It's a part of this design. So they haven't seen that in PRA, so they didn't even consider it, see. The people who will review it also didn't see that in the PRA, so they would not consider it. So that's a thing which we have to try to bridge somehow to keep this valuable information mean some.

DR. SCHULTZ: Leads to a followup question, Tony, and that, and Marie as well, is that does the staff have a good process to capture those things that you've learned from this experience, which is in fact somewhat different than what the staff has reviewed previously with LWRs?

It's certainly going to come up again, perhaps in more difficult evaluations with other designs, since this one is somewhat similar to light-water reactors.

MR. NAKANISHI: Right, I agree. I think we have some, you know, internal communities of practice, if you will, for, you know, risk type of activities. I think this is something that's probably

worth sharing in that group. And --

DR. SCHULTZ: Yeah, I'd certainly recommend it.

MS. POHIDA: We appreciate the comment, because it's, when you go through a review, it's not what's in the PRA, it's not -- it's what's not in the PRA. And should it be in scope.

MEMBER REMPE: Dennis brought up an example with the sampling system from the hydrogen. And Jose's brought up an example with respect to situations where you might have some sort of increased instability. Where do we catch those?

We can't tell the applicant to add it to table whatever. Do we just have to put it wherever? It would be nice if it were in a single location, you know, just to make it easier for the future. Thoughts on those ideas?

MR. NAKANISHI: So I think we need to go back, get back within, you know, kind of discuss among the staff and just kind of decide what we need to do, if anything, relative to, you know, from a licensing standpoint and documentation standpoint. I think we probably need to, you know, think about how to best do that.

MEMBER REMPE: Maybe our letter could

reflect that concern somehow.

CHAIR KIRCHNER: Tony, I don't have the hard copy view graphs in front of me. How many more view graphs have you?

MR. NAKANISHI: That's it.

CHAIR KIRCHNER: This is it. That's what I thought. Okay, so at this point then, members, further comments, questions?

MEMBER MARCH-LEUBA: Since my name was just in vain a couple of times, well, it was used -- I'm glad to be useful. One concern I have is as we're going doing the design certification, we are making risk-informed decisions that are called risk-informed based on a admittedly incomplete PRA.

So when we have the before logging fuel PRA, which that will go through a very thorough review and it will have much more completeness, because by that time we'll know how the operating procedures work, we'll know how the stimulator is designed, we'll know who'll build the crane.

Yeah, so is there a step when we reconsider those risk-informed decisions that were appropriate? Or what would trigger that decision? Or is it already been decided and forget it?

MR. NAKANISHI: Right, so I think, you

know, we would go back to some of the points I was trying to make relative to how you use the PRA. I think we're sort of trying to make sure we don't -- we don't make risk-informed decisions that are not supported by the current PRA.

So whenever you make certain decisions, we would make sure that the PRA adequately supports it, and things like completeness issues and, you know, various assumptions will be evaluated for the impact on decisions. So I guess what I'm saying right, I think we have to be careful right now with the current PRA how we use it.

MEMBER MARCH-LEUBA: And for future plans that are going to make even higher claims for risk-informed, like get rid of containment because I don't need it, how do we -- I mean, something like that we will not miss. But how do we ensure that as we know more about the plant --

MR. NAKANISHI: So the non-light-water, yeah, the non-light-water reactor process has a lot more rigorous approach. You know, the licensing modernization project and, you know, the associated used of PRA. So I think that process has to sort of address that.

MEMBER MARCH-LEUBA: It's a kind of a

chicken and the egg in the sense that you used the PRA to define your design participants, which defined the PRA. And somebody has to step in there and decide --

MR. NAKANISHI: There will be, yeah, a lot more rigor in terms of review against the standard, the non-light-water reactor standard. You know, peer review requirements, you know, looking at uncertainties and assumptions. I think that'll be a lot more rigorous.

MEMBER MARCH-LEUBA: Thanks, Tony.

CHAIR KIRCHNER: Other comments?

MEMBER BROWN: I'm not sure. I'm kind of responding to an email that Joy sent me, and I think you brought it up a minute ago, but I didn't realize something when you brought it up. You were talking about the RPV riser level sensor, the issue on the sensors.

And you made, and it triggers SFAS functions. And so your last sentence said so it was always just one sensor. Did you mean one sensor per division, or one --

MEMBER REMPE: No, there's multiple ones. But the, what I was trying to say was the pressurizer sensor and the RPV riser, it's the same --

MEMBER BROWN: Well, it's containment

level high and RP level low --

MEMBER REMPE: Containment levels are different --

MEMBER BROWN: Are triggers for actuation of ECCS.

PARTICIPANT: No.

MEMBER BROWN: Well, that's what --

MEMBER REMPE: No, the containment-level one is a different one.

MEMBER BROWN: I understand that.

CHAIR KIRCHNER: The letter is probably out of date.

MEMBER BROWN: But the RPV riser level sensor --

MEMBER BLEY: And pressurizer level.

MEMBER BROWN: And pressurizer level, those both trigger, or one of them the sensors.

CHAIR KIRCHNER: No, no they change their --

MEMBER BROWN: It's the same sensor.

CHAIR KIRCHNER: It's the same sensor. It's a safety-grade sensor.

MEMBER BROWN: Yeah.

CHAIR KIRCHNER: Its functionality and the applicant's here and can correct me, is just for the

pressure riser. They're not doing the riser --

MEMBER BROWN: They're not doing the riser level anymore for ECCS.

CHAIR KIRCHNER: Level, the trigger. No.

MEMBER BROWN: It's only the containment level? Okay, I missed that, I wanted to clarify that. That's, but there are -- is the containment level, I didn't read far enough, is that one also a radar-based?

MEMBER MARCH-LEUBA: Yes.

MEMBER BROWN: Okay, so that runs into, it's not quite as bad as the, I don't think, I'm not sure. Well, you're not as bubbly on the containment level as you are on the pressurizer, I would think.

MEMBER REMPE: The pressurizer and the RPV --

MEMBER BROWN: No, you're overflowing now. So I mean, there's a, and you're cooling to the pool. So I mean, it's going to be a slightly different environment by the time it rises up some.

MEMBER REMPE: So at the beginning of this session, the applicant discussed a little bit about the various sensors, and I pointed out that tomorrow we're going to have Chapter 20 and we're going to talk about the changes made to Chapter 20.

But the staff is going to come and also talk about some of the questions raised about the RPV riser and the pressurizer water level sensor. So we'll have time to read over this Rev 2, and we can have any questions we want to have by tomorrow.

MEMBER BROWN: I'm going to read Rev 2 tonight.

MEMBER REMPE: Only 70 pages, you can make it Charlie.

MEMBER BROWN: Yeah, right, in your dreams, Joy, okay.

MEMBER REMPE: But anyway, well, if you want to you can read through it and ask any questions.

MEMBER BROWN: I'll sit down and I'll stay up till four in the morning to do it.

CHAIR KIRCHNER: Okay, we're off the PRA, but yes, tomorrow we will hear more on sensors.

MEMBER BROWN: Yeah, that's fine.

CHAIR KIRCHNER: So last chance, any other comments of the staff, questions?

DR. SCHULTZ: Just one more on the -- excuse me, just one more on the PRA side, just a follow-on here. We were talking about how you would capture things going forward for the advanced plants. And the other thing that you might want to try to

focus on is for this plant, which as we've seen from the presentations and so forth, the numbers associated with core melt frequency and large early release are very, very low.

And so, and yet we have in the licensing stage the COL activities, the COL PRA. And then four years later, the revised PRA. So how, the question is how do you keep appropriate attention and focus for those teams that are going to be working on those things many years hence?

And the influence of what they're going to have in terms of findings may be somewhat lower than what we've seen from, in other areas. Or they may need to be looking at things which are not typically looked at today, specifically human performance, errors of commission, and the importance of those influencing the safety of the facility. And how does that get captured and pushed by the regulator going forward, and by the licensee, of course?

MR. NAKANISHI: Right, I mean, that's a great question. I think it kind of comes down to ensuring sort of the bench strength, if you will, of the staff. I think, you know, when the staff will look at the PRA, that's typically when there's an application of that PRA for some use.

So it may be, you know, maintenance rule, for example, down the line that as part of an inspection for maintenance rule implementation there will be some staff engagement relative to the risk assessment.

DR. SCHULTZ: Yeah, those are good questions.

MR. NAKANISHI: Right. And I would expect that there would be additional risk-informed applications, you know, for the NuScale design by the COLs. So each of those opportunities I think would provide a chance for the staff to engage.

MS. POHIDA: Yeah, I was going to add if the PRA is going to be used for a risk-informed application, then the staff would have to do a PRA acceptability review in context of that application.

DR. SCHULTZ: Thank you.

MS. POHIDA: You're welcome.

CHAIR KIRCHNER: Okay, we are in an open session, so therefore, I'm going to turn to the public.

MR. SNODDERLY: I'm sorry, well, before we do that, I just, I had some notes and I wanted to make sure, well first of all, what was the Committee's -- the Subcommittee's expectations for a possible staff

presentation on PRA at the full committee on April 8? That's, well, so --

CHAIR KIRCHNER: Yeah, we're writing a letter.

MEMBER MARCH-LEUBA: If we are writing a letter, our process has been lately the staff will need to give us, for the public on the phone line or whoever wants to show up, a summary presentation of what we've done. And it has to be 20 minutes, I mean, high level and non-proprietary so that the public finds out what your position is. And then we're going to write a letter.

MEMBER DIMITRIJEVIC: Or you can just tell us what are the changes in the SERs since the last version.

MR. SNODDERLY: Well, I also had a note that they were also, they said that they were going to consider possible mechanisms for documenting some of the insights they've gained in part of the PRA.

MEMBER DIMITRIJEVIC: What's the status of this containment bypass, the day, on the 19.2?

CHAIR KIRCHNER: We're going to hear about that tomorrow. I was going to share our agenda for tomorrow before we close.

MR. SNODDERLY: And then the only other

note I had was that the staff said that they went back and forth with the applicant as far as the CVCS being included in a DRAP, but it ultimately they agreed that it did not meet the criteria from DRAP.

And then I had, Vesna said that you also agreed that it looked like it didn't meet the Fussell-Vesely imports measures of 20%, but it was close. You mentioned several sequences that were seven percent, four percent contributors for several sequences. But you didn't think it exceeded 20%. But you were surprised that the sensitivity analysis, it didn't exceed 20%.

MEMBER DIMITRIJEVIC: Yeah, I would like to know the Fussell-Vesely on that, yes.

MR. SNODDERLY: And I didn't hear anyone from the staff or NuScale say that they were going to come back do that critical --

MEMBER DIMITRIJEVIC: Only NuScale can give us that.

MR. SNODDERLY: Right, only NuScale can do that. So I'm just trying to get, so right now I leave it as an open item for NuScale to consider whether they're going to come back and answer that on April 8 or not.

MEMBER DIMITRIJEVIC: They can send us

the, these are just two numbers we are asking, Fussell-Vesely on human action to start charging with the current model and with this change in ECCS failure rate. That's all.

DR. CORRADINI: Careful, we're crossing closed to open, so make sure what we're talking about.

MEMBER DIMITRIJEVIC: That's all right, it should be open, it's a PRA.

MR. SNODDERLY: Then --

MEMBER DIMITRIJEVIC: No, no, it's a PRA --

MR. SNODDERLY: The last thing I had was that how could operator action to initiate CVCS be an important action, but the CVCS system not be. And I didn't know if you wanted any followup by the staff or NuScale to respond to that further or, okay.

So that's all I had. With that I'll go.

CHAIR KIRCHNER: Thank you, Mike. Okay, so now I'll turn to the public, if there's any member of the public in the audience, if you would wish to make a comment, please come up to a microphone, state your name, and make your comment.

Seeing none, we'll wait for the bridge line to be opened to the public. Okay, if there's any member of the public listening in, if you wish to make

a comment, please state your name and make your comment.

MR. LEWIS: Marvin I. Lewis. Can you hear me?

CHAIR KIRCHNER: Yes, Marv, go ahead.

MR. LEWIS: Thank you. I've been following these public meetings for an awful long time. I have even been following back to '79, wondering have you ever tried to get tags under control so they don't block the view of operators, which was the causation, supposedly, of Three Mile Island Number Two accident.

Also, as I go along I don't hear any really approaching looking at problems from day to day. I don't hear anybody looking at, just looking at the surface of anything to see if there's good workmanship. I don't hear, I don't hear an awful lot, and I'm done with it. Thank you very much for listening to my comment, bye.

CHAIR KIRCHNER: Thank you, Marv. Is there any other member of the public who wishes to make a comment?

MS. FIELDS: Yes, this is Sarah Fields. My first comment is the only prospective NuScale COL applicant is the Utah Associated Municipal Power

Systems, or UAMPS. UAMPS has no experience whatsoever in nuclear reactors. I'm sure they'll be getting some help, but in the end they will be the responsible party, and they do not have any nuclear reactor licensing, construction, operation, decommissioning experience.

My second comment is when the ACRS looks at the NuScale standard design approval application, which will be based this DCA, which is currently under review, the ACRS should take a hard look at the multi-module aspects of the design. From today's discussion it's clear that there may be aspects related to the multi-module construction operation that have not been addressed by NuScale and the NRC staff.

The ACRS should go back and bring up issues that have not been satisfactorily addressed in the DCA review, including PRA and other considerations. Thank you.

CHAIR KIRCHNER: Thank you. Is there any other member of the public who wishes to make a comment? Hearing none, we'll close the bridge line. And at this point, any comments, further comments from members, question?

So if not, I think tomorrow, I'm, I've talked with both the applicant and the staff. I think

we will probably finish in the morning, by lunchtime. So that's the plan going in. We'll keep some contingency, but that's my estimate at this point of the material to cover tomorrow. So we may have the afternoon free to do other work on committee business.

With that, we are recessed for the day.

(Whereupon, the above-entitled matter went off the record at 4:07 p.m.)

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United States Nuclear Regulatory Commission

Protecting People and the Environment

Probabilistic Risk Assessment

NuScale Design Certification Application

ACRS Subcommittee Meeting
March 3, 2020

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UNITED STATES NUCLEAR REGULATORY COMMISSION
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Topics

- DC PRA uses and review
- ECCS model
- Sensitivity and uncertainty analyses
- Reactor building crane operations

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DC PRA Uses

- Identify and address potential design features and plant operational vulnerabilities
- For new design, reduce or eliminate significant risk contributors identified at operating plants
- Identify risk-informed safety insights based on systematic evaluations of the risk
- Determine how risk compares against Commission's goals of less than $1x10^{-4}$ per year for CDF and less than 1×10^{-6} per year for LRF
- Demonstrate whether design represents a reduction in risk compared to operating plants
- Use results and insights to support programs such as RTNSS, ITAAC, RAP, TS, COL action items, and interface requirements

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Availability of Information at Various Licensing Stages

Information Availability	Licensing Stage: DC Applications 52.47(27) COL Applications 52.79(46)	Licensing Stage: COL Holders 50.71(h)(1) "fuel load PRA"	Licensing Stage: COL Holders 50.71(h)(2) 1st four-year update
• Site-specific information	Unknown for DCs	Known	Known
• Layout, cable routing, equipment capacities	Not fully known	Known	Known
• Plant-specific operating guidance	None	Available	Available
• Plant operating experience	None	None	Available
• Trainers or operations staff with plant-specific experience	None	None	Available
• Walkdowns	Not possible	Possible	Possible
PRA acceptability guidance	• RG 1.200, as modified by DC/COL-ISG-028	• RG 1.200 • Portions of DC/COL-ISG-028 are still relevant	• RG 1.200 • DC/COL-ISG-028 not applicable

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NuScale DC PRA Review

- PRA acceptability is to be commensurate with its intended use
- Staff findings are made to support Commission's objectives for use of PRA in design; findings are not made on specific numerical results
- PRA acceptability is sufficient to support PRA uses for design certification
- Established regulatory framework will ensure PRA reflects as-built, as-operated plant for operational phases
- Staff applied Enhanced Safety Focused Review Approach during its PRA review to focus on information needed to reach a safety finding

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ECCS Model

- Modeling is adequate for DC purposes
  - Model is sufficiently consistent with DC/COL-ISG-028 and SRP 19.0
- Assumptions are used to address issues associated with level of detail, completeness, and data
- System/component reliability data is uncertain due to unavailability of design-specific operating experiences
- Staff evaluated assumptions for impact on safety findings made for the DCA and found them acceptable

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Sensitivity and Uncertainty Analyses

- Sensitivity and uncertainty analyses have been performed to support regulatory findings
- NuScale identified important SSCs, operator actions, and risk insights to support programs such as DRAP and human factors engineering
- Focused PRA showed Commission goals met without credit for SSCs that are not safety-related
- Additional analyses are not expected to alter risk insights or inputs to operational programs expected at DC stage

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Reactor Building Crane Operations (1)

- Calculated drop probability dominated by:
  Operator errors (over speed, over raise, etc.)
  AND
  Failure of instrumentation (interlocks/switches) for safety stop

- Key Assumptions for the LPSD PRA added to DCA Table 19.1-71
  1. Movement of the RBC is modeled as being operator controlled
  2. Administrative controls will ensure that RBC safety features (e.g., limit switches, interlocks to prevent undesired movement) are functional during module movement

- Validity of RBC assumptions in DCA and crane data supporting the PRA will be confirmed by COL applicant per COL item 19.1-8

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Reactor Building Crane Operations (2)

- DCA Table 9.1.5-1 documents max. speeds and lift heights
- RBC is single failure proof, consistent with operating plants
- COL applicant will describe process for handling and receipt of critical loads including NuScale Power Modules per COL Item 9.1-5
- RBC is within scope of human factors process during COL per "Human Factors Engineering Design Implementation Plan" (Report RP-0914-8544)
- Risk significance of RBC resulted in additional ITAACs
  - Rated load test of module lifting fixture and module lifting adapter
  - Inspection of as-built module lifting fixture and module lifting adapter
- Postulated single module drop does not lead to a large release

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Abbreviations

- **ASME** – American Society of Mechanical Engineers
- **CDF** – core damage frequency
- **CIV** – containment isolation valve
- **COL** – combined license
- **CVCS** – chemical and volume control system
- **DC** – design certification
- **DCA** – design certification application
- **DHRS** – decay heat removal system
- **DRAP** – Design Reliability Assurance Program
- **ECCS** – emergency core cooling system
- **EPZ** – emergency planning zone
- **ITAAC** – Inspection, Test, Analysis, and Acceptance Criteria
- **ISG** – Interim Staff Guidance
- **LPSD** – low power and shutdown
- **LRF** – large release frequency
- **PRA** – probabilistic risk assessment
- **RAP** – Reliability Assurance Program
- **RBC** – reactor building crane
- **RG** – Regulatory Guide
- **RSV** – reactor safety valve
- **SER** – safety evaluation report
- **SRP** – standard review plan
- **TS** – Technical Specification