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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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719TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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WEDNESDAY

OCTOBER 2, 2024

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The Advisory Committee met via Videoconference, at 8:30 a.m. EDT, Walter Kirchner, Chairman, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chairman

GREGORY H. HALNON, Vice Chairman

DAVID A. PETTI, Member-at-Large

RONALD G. BALLINGER, Member

VICKI M. BIER, Member

VESNA B. DIMITRIJEVIC, Member*

CRAIG D. HARRINGTON, Member

ROBERT P. MARTIN, Member

SCOTT P. PALMTAG, Member

THOMAS E. ROBERTS, Member

ACRS CONSULTANT:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

ALSO PRESENT:

SCOTT MOORE, Executive Director

*Present via telephone

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

8:30 a.m.

CHAIR KIRCHNER: Okay, the meeting will now come to order.

This is the first day of the 719th meeting of the Advisory Committee on Reactor Safeguards, ACRS. I am Walt Kirchner, Chair of the ACRS. ACRS members in attendance in person are Ron Ballinger, Vicki Bier, Greg Halnon, Craig Harrington, Robert Martin, Scott Palmtag, Dave Petti, and Thomas Roberts. ACRS members in attendance virtually via Teams are -- is Vesna Dimitrijevic. If I've missed anyone, either ACRS members, please -- any ACRS members, please speak up at this point. Looking to see if we have our -- if any of our consultants online. I see Dennis Bley and Steve Schultz are with us. Thank you.

The ACRS -- excuse me. Christopher Brown of the ACRS staff is the Designated Federal Officer for this morning's full committee meeting. No Member conflicts of interest were identified for today's meeting. And I note we have a quorum, as well.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, FACA. The NRC implements FACA in accordance with its regulations. Per these regulations and the

Committee's Bylaws, the ACRS speaks only through its published letter reports.

Therefore, all Member comments should be regarded as only the individual opinion of that Member, and not a Committee position. All relevant information related to ACRS activities, such as letters, rules for meeting participation and transcripts are located on the NRC public website and can be easily found by typing, about us ACRS, in the search field on NRC's home page.

The ACRS, consistent with the Agency's value of public transparency in regulation of nuclear facilities, provides opportunity for public input and comment during our proceedings. We have received no written statements or requests to make an oral statement from the public. Written statements may be forwarded to today's Designated Federal Officer. We have also set aside time at the end of this meeting for public comments.

A transcript of the meeting is being kept and will be posted on our website. When addressing the Committee, the participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. If you are not speaking, please mute your computer on Teams. If

you are participating by phone, press star-six to mute your phone and star-five to raise your hand on Teams.

The Teams chat feature will not be available for use during this meeting. For everyone in the room, please put your -- all your electronic devices in silent mode, and mute your laptop microphone and speakers. In addition, please keep sidebar discussions in the room to a minimum since the ceiling microphones are live.

For presenters, the table microphones are uni-directional, and you'll need to speak into the front of the microphone to be heard online. Finally, if you have any feedback for the ACRS about today's meeting, we encourage you to fill out the public meeting feedback form on the NRC's website.

During today's meeting, the Committee will consider two topics. In the morning session we will discuss the Topical Report PWROG-18068, Use of Direct Fracture Toughness for Evaluation of Reactor Pressure Vessel Integrity. And in the afternoon session, which will begin at 1:00 p.m., we will have our Planning and Procedures Session.

Tomorrow morning the Committee will receive an information briefing on the Palisades Nuclear Plant restart, and further information in

tomorrow morning's introductory comments.

And with that, I will now turn to the -- the Committee's deliberations over to the Fuels, Materials and Structures Subcommittee Chair, Ron Ballinger. Ron?

MEMBER BALLINGER: Thank you --

VICE CHAIR HALNON: Before we get started, the court reporter may not be familiar with the Members here in the room. So, at least for a few times, make your name clear when you talk, and then I think they'll get, eventually, familiar with who's in the room. James is not on -- not as familiar with us as James is.

CHAIR KIRCHNER: Yeah, so again, just to reiterate Greg's comment, just introduce yourself when you first speak, so --

VICE CHAIR HALNON: Which I failed to do when I spoke.

CHAIR KIRCHNER: That was Vice Chairman Greg Halnon.

(Laughter.)

MR. MOORE: Chair Kirchner --

(Simultaneous speaking.)

CHAIR KIRCHNER: Thank you Greg, though, for the reminder. And I'm remiss, Members, any

opening comments or other -- our Executive Director Scott Moore has a comment. Go ahead, Scott.

MR. MOORE: Thank you, Chair Kirchner. So, one of the things that the Committee will have to decide is when they want the court reporter to stop recording, because you're going into deliberation.

CHAIR KIRCHNER: Okay, thank you. And with that, now we turn to Member Ballinger. Ron?

MEMBER BALLINGER: Thank you, Mr. Chairman. I guess, during the previous Subcommittee meeting we had a presentation related to the PWROG Topical Report. And at that Subcommittee meeting we decided that we would not invite the applicant or the staff to come and give any further presentation on the topic, but that we would produce what amounts to a draft letter on the topical report. And that's what I've done.

And I think I've incorporated comments or suggestions from Members that provided them. And so, what we have today is a draft letter which I would propose that we just read in and then go from there. I'm not sure what the best path forward is with respect to reading in, waiting for comments, line-by-line. I'm not sure what the best way is to go

CHAIR KIRCHNER: I think your proposal is

good. When I -- Sandra is ready, let's go ahead and put the letter up, and I'll ask you to read the letter into the record. And then, with the advice of our Executive Director, we can make a decision on when we do not need further services of the court reporter --

(Simultaneous speaking.)

MEMBER BALLINGER: I might also add that we haven't actually decided to write a letter, we've asked the Committee's -- well, it's the Committee's choice. So, I guess it's after we read in, we see what happens.

Okay. Dear Chair Hanson, during the 719th meeting of the Advisory Committee on Reactor Safeguards October 2-through-4, 2024, we completed our review of Topical Report PWROG-18068-NP Revision One, Use of Direct Fracture Toughness for Evaluation of Reactor Pressure Vessel Integrity and the Associated Safety Evaluation, SE.

Our Fuels, Materials and Structure Subcommittee reviewed this matter on September 20, 2024. During these meetings, we've had the benefit of discussions with the NRC -- with NRC staff and representatives from the Pressurized Water Reactor Owners Group -- whoops, PWROG. We also had the benefit of reference documents.

Inclusions and recommendations. The use of direct fracture toughness data proposed in PWROG-18068-NP represents a significant advancement in the methods for estimating reactor pressure vessel, RPV, embrittlement.

The methodology proposed -- Two, the methodology proposed in PWROG, I'll just abbreviate it from now on, provides for more consistency of prediction as well as reduced uncertainty, especially at subsequent license renewal fluences.

Three, the methodology proposed in PWROG will allow more accurate pressurized thermal shock, PTS, and pressure-temperature, P-T, limit curve determination. The SE should be issued.

Background. The fracture toughness of the RPV steel provides a key input to calculations that commercial licensees perform to demonstrate the integrity of the vessel during both normal operation and postulated accident conditions, e.g. PTS.

Currently the American Society of Mechanical Engineers K1C and K1R curves indexed to the reference temperature for nil-ductility transition, RTNDT, of the unirradiated material describe the toughness of the RPV materials and their variance with temperature. These curves were adopted in 1972 as a

lower bound representation to a set of 173 toughness values derived from Charpy data. These data have been incorporated into the Regulatory Guide, RG 1.99 Revision Two. RPV irradiation embrittlement prediction methodology -- a bunch in parenthesis.

The use of RTNDT to normalize temperature was designed to account for heat-to-heat differences in the ductile-brittle transition temperature thereby collapsing the fractured toughness data onto a single curve. However, this Charpy-based fracture toughness correlation approach is broadly conservative which propagates forward in the development of PTS limits, 10 CFR 50.61, as well as the development of P-T limit curves, 10 CFR 50 Appendix G, for operation.

Since the development of the correlation in Reg Guide 1.99, database for RPV embrittlement has been greatly expanded with 1,878 data points added to the database. This data has been employed in the development of an updated embrittlement correlation codified in American Society for Testing and Materials, ASTM, E900-15, Standard Guide for Predicting Radiation-Induced Transition Temperature Shift in Reactor Vessel Materials.

Analysis of this more extensive data set has shown that the current approach, RTNDT plus

embrittlement shift prediction plus margin, is not the best fracture metric. Data analysis has shown that the actual margin for any given material is generally unknown and inconsistent but is substantial, and the RG 1.99 prediction contains considerable uncertainty.

The staff has proposed a path forward to update the PV embrittlement process in SECY-22-0019 rulemaking plan for a revision of operation embrittlement and surveillance requirements for high-fluence plants in long term. Options two and three in SECY-22-0019 would allow the use of E900-15 to estimate the degree of PV embrittlement.

The Committee has endorsed the use of option two in an April 28, 2022 letter rulemaking plan for the revision of embrittlement and surveillance requirements for high-fluence nuclear power plants and long-term operation.

In addition to the above issues, the current PWR fleet license life of 40 years is now being exceeded, or will be exceeded, for most plants, with some units now approved for life extension to 80 years.

It has been shown that the deviation in the predicted versus measured temperature shift, when applying the correlation in Reg Guide 1.99 become

significantly negative, implying reduced margin at fluences greater than approximately 3E times 10 to the 19. Several current PWRs are predicted to exceed this value during SLR.

The methodology proposed in PWROG will provide a method to address the limitations described above. The methodology also makes use of the vastly increased RPV embrittlement database. Note I used the word vastly.

Discussion. PWROG proposes a methodology that justifies the use of direct fracture toughness data to evaluate RPV integrity as an alternative to the requirements of PTS and P-T limit curves. Specifically, the Topical Report presents a methodology to generate a ductile-brittle transition reference temperature, T0, adjust the data for differences between tested material and RPV component of interest master curve approach, account for at least result -- for test result uncertainty and material variability in the respective RPV component and to apply the data using the ASME Section XI Code.

The approach represents a departure from the approach used in the current methods required for the PTS rule and the development of the P-T limit curve. Current approaches make use of an -- of

empirical embrittlement correlations, Reg Guide 1.99, that are based on Charpy data correlated with material toughness from the PWROG.

And then there's now a transition. Transitioning from the current -- this is from their report. Transition from the current unirradiated reference temperature for nil-ductility transition and the predicted embrittlement shift approach for RPV integrity evaluations, to a direct fracture toughness approach, is expected to benefit RPV operation for license renewal and subsequent license renewal by reducing uncertainties.

The available irradiated master curve data show, in many cases, that substantial conservatism exists due to uncertainties in the current approach. Thus, application of irradiated master curve data as an alternative to 10 CFR 50.61 and 10 CFR 50 Appendix G RPV evaluations is expected to show a margin -- to show margin in these analyses. Establishing a robust fracture toughness basis will ensure public health and safety by reducing uncertainty and enabling a statistical understanding of the actual irradiated RPV fracture toughness.

The approach taken in the proposed methodology uses NRC-approved methodologies in ASME

Section XI Appendix G Subsection G-2010 RTT0 and the NRC-endorsed Code Case N-830-1. Direct use of fractured toughness for flaw evaluations of pressure bounded materials in class one ferritic steel components.

The methodology used is the industry consensus ASTM E1921 standard test method for determination of reference temperature, T0, for ferritic steels in the transition range and the ASTM E900-15 standard guide for predicting embrittlement, and ensures uncertainties are properly addressed and appropriately bounding.

The proposed approach in PWROG represents a significant improvement in estimation of the extent of embrittlement since it makes use of actual toughness data as opposed to empirical correlations, and thus will allow for both a reduction in, and better characterization of, uncertainties.

Benefits will likely include improved PTS evaluations for license renewal, power uprates and other operational changes, and extend the applicability or improve the operating margin for heat-up/cool-down P-T limit curves in 10 CFR 50 Appendix G.

Summary. Use of direct fracture toughness

proposed in PWROG-18068-NP represents a significant advancement in the method for estimating PV embrittlement. Methodology proposed in PWROG provides for more consistency in prediction as well as reduced uncertainty, especially at SLR fluences. The methodology proposed in PWROG will allow more accurate PTS and P-T limit curve determination.

The SE should be issued. We are not requesting a formal response from the staff to this letter. Sincerely, Walt Kirchner.

I might add that the staff has not asked for a letter. In their presentation, they explicitly said that --

CHAIR KIRCHNER: So, for anyone listening, we had this letter evolved from a Subcommittee meeting held on September 20. One can go to that and see the presentations that were made, and also there's a transcript at that meeting which had a majority of the Committee in attendance. We decided that we would write a letter and -- so, thank you for the letter, Ron.

And at this point, high level comments from any of the Members?

MEMBER BIER: With comments. First of all, Ron, that was very clear. I understand it better than

I did before, so that's good.

MEMBER BALLINGER: Thank you for the input from the other Members, by the way. They're the ones that made it clearer --

(Simultaneous speaking.)

CHAIR KIRCHNER: By clearer --

MEMBER BALLINGER: Other Members made it -- were the ones that made it clearer.

(Simultaneous speaking.)

MEMBER BIER: Oh, okay. Anyway, I thought it was a good letter. And I'm somewhat leaning to, that yes, we should go ahead and write the letter just because of the importance of the issue and, again, to kind of, you know, make it clear to the public that yes, we think this is okay. But I don't feel strongly about that.

CHAIR KIRCHNER: Any other comments? Go ahead, Tom.

MEMBER ROBERTS: When we come off the transcript now? When should we come off the transcript, just now or should we have a high level comment?

CHAIR KIRCHNER: Why don't we have our discussion, and then we will go off the transcript when we actually do line-by-line.

MEMBER ROBERTS: Okay, high level. I agree with what Vicki just said, I think this is a very well-written letter and it, you know, clarified the issues for me. Where it leaves me, the first time I read the letter and then hearing it read now, I'm still a little bit confused as to what we're communicating beyond what we communicated in 2022.

In 2022 we communicated that we agree with option two of the rulemaking, which essentially uses the fracture toughness methods at more of a high level, you know, go use that method instead of the existing Reg Guide. And then this is the, I think, the next step in saying okay, this is how you would do it.

And so, if that's really what we're saying, maybe there's some, you know, clean-up in the language a little bit to kind of connect those dots a little better. But if this is basically us saying that, yeah, we've now convinced ourselves that there is a method and the details are now filled in, so it's even more support for option two of the rulemaking, that might be a good way to paint this. I mean, because -- make sure, if I understood that.

MEMBER BALLINGER: A couple of comments on that. That white paper that was -- the SECY that was

sent to the Commission, which we reviewed, has not been acted on by the Commission. And Reg Guide 1.99, which would be basically revised as a result of that SECY, has not been done, and we would see that. And so, that's why that stuff is in there.

The importance, for me, is the use of direct fracture toughness data, which is a departure, a significant departure and a welcomed one, at least in my personal opinion. And, it being the first time it's being used in a formal sense, we're going to see the words fracture toughness going forward with ALS and everything else continually from now on. So I think that that's, you know.

And also, there are a few plants -- I still have not been able to find that table. Gosh. Anyway, there was a table that was produced by one of the staff members, I think it was Mark Kirk, who identified which plants would likely be an issue at SLR. And this helps them out a lot. Not the least of which is probably Palisades.

VICE CHAIR HALNON: I have a comment too, Walt. This is Greg. Kind of building what Ron -- I was thinking the same thing. We're sort of building a mosaic of high fluence operations in SLR, and this is a piece of that mosaic that I think that it would

be important to have on the record as a letter so that, as we walk through this, we can say here's the five, four, whatever amount of reports that we've made on high fluence operations, and this is a piece of that. So I think it's a good thing to document, to make sure it's clear, and to go forward with building that picture that we're building in the future.

MEMBER BALLINGER: And I say this with a bit -- a bit tongue-in-cheek, the white paper that went to the Commission identified this issue as, of high priority, and that was two-and-a-half years ago. So I wonder what happens if something is not identified as high priority. And so this letter would probably reinforce the importance of getting this done.

VICE CHAIR HALNON: Do you --

MEMBER BALLINGER: I mean, I'll bet you --

VICE CHAIR HALNON: Should we say that in the letter?

MEMBER BALLINGER: Probably shouldn't.

(Laughter.)

MEMBER BALLINGER: I probably shouldn't. But, you know, what we'll -- the tripwire for applying this will be the first plant that exceeds the screening criteria at SLR. And that's -- those guys,

for those Members that don't know what that is, the welds and plates, there have to -- the licensees have to do a projection to end-of-life on whether they will exceed the transition temperature limits, which is 300 degrees for plate and I think 270 for welds, I don't know for sure. And if that happens, they have to back adjust their plant so that they don't exceed those criteria at the end-of-life.

So I'm guessing that we'll have a few plants that will exceed that -- will exceed the screening criteria. Although they won't -- they technically haven't yet.

And there's also the issue of the Reg Guide 1.99, that white paper, where applicants have been adjusting their removal of capsules to do toughness measurements because, when the plant was built, they had X capsules in place with a 40-year licensed life and now they're out to 60 or 80 years, and so they're having to do gymnastics, if you will, to get capsules that allow them to do the prediction to the end-of-life, so.

That's not part of this but it's part of that white paper, and that's why pushing this a little bit would be helpful, I think.

PARTICIPANT: So, adding to what Ron said,

direct fracture toughness is not what the subject of the '22 SECY was?

MEMBER BALLINGER: No.

PARTICIPANT: Okay, so E900, the ASTM standard, that has nothing to do with direct fracture toughness? Okay, thank you.

(Simultaneous speaking.)

MEMBER BALLINGER: That's -- I tried -- I took your comment and I tried to change the words a little bit, hopefully I've done a little bit better job at addressing what you said.

PARTICIPANT: Okay, thanks. So it's -- basically it's putting quite a bit more meat on the bones of the '22 SECY approach.

MEMBER BALLINGER: Yeah.

PARTICIPANT: That seems to make sense.

CHAIR KIRCHNER: Okay, further comment?

Then I believe at this juncture we can release the court reporter -- or, hold on one minute --

MR. MOORE: So Chairman, you may want to -- we're in a full Committee meeting, you may want to take public comments before --

(Simultaneous speaking.)

CHAIR KIRCHNER: Okay, thank you for the

reminder. Yes, okay. So if we have any participants from the public who wish to make a comment, please raise your hands so we can see you.

Not seeing any hands raised right now on our screens. If anyone would like to make a comment, just unmute your mic, identify yourself, affiliation as appropriate, and state your comment.

Hearing none. So now, at this juncture we can release the court reporter. Thank you for your service this morning.

(Whereupon, the above-entitled matter went off the record at 8:57 a.m.)

C E R T I F I C A T E

This is to certify that the foregoing transcript

In the matter of: Advisory Committee on Reactor Safeguards

Before: NRC

Date: 10-02-24

Place: teleconference

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Neal R. Gross

Court Reporter