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Open Session

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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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SUBCOMMITTEE ON METALLURGY AND REACTOR FUELS

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OPEN SESSION

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TUESDAY, JULY 7, 2020

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The Subcommittee met via Teleconference, at 2:00 p.m. EDT, Ronald G. Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

DAVID A. PETTI, Member

PETER RICCARDELLA, Member

JOY L. REMPE, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

DEREK WIDMAYER

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

P R O C E E D I N G S

2:00 p.m.

CHAIRMAN BALLINGER: Okay. This meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, Materials and Reactor Fuels Subcommittee. I'm Ron Ballinger, Chairman of the Metallurgy and Reactor Fuels Subcommittee.

Members in attendance are, I believe, Charles Brown, Walt Kirchner, Jose March-Leuba -- let's see -- Dave Petti, Joy Rempe, Pete Riccardella, Vesna Dimitrijevic.

If I have missed anybody, please say something. I think I got everybody.

Christopher Brown and Derek Widmayer are the designated federal officials for this meeting.

Chris or Derek, I guess we need to be sure that the recorder is on. Are we sure?

PARTICIPANT: Shane (phonetic) has verified that.

CHAIRMAN BALLINGER: Good. Thank you.

The purpose of today's meeting is for the Subcommittee to receive a briefing on staff safety evaluation for the topical report Deformable Spacer Grid Elements. Today we have members of the NRC staff

and industry to brief the Subcommittee.

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 found in Title 10 of the Code of Federal Regulations, Part 7.

The Committee can only speak through its published letter reports. We hold meetings to gather information and perform preparatory work that will support our deliberations at a full Committee meeting. The rules for participation in all ACRS meetings were announced in the Federal Register on June the 13th, 2019.

The ACRS section of the US NRC public website provides our charter, bylaws, agendas, letter reports, and full transcripts of all full and subcommittee meetings, including slides and presentations there. The meeting agenda for this meeting was posted there.

Portions of this meeting will be closed to protect proprietary information pursuant to 5 U.S.C. 552 (b)(c)(4). For the open portion of this meeting, we have also set aside five minutes for comments from members of the public attending or listening to this meeting. We have no requests so far for making a

statement to the Subcommittee has been received by the public.

A transcript of the meeting is being kept and will be made available on our website for the open portion of the meeting. Therefore, we request that participants in this meeting should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard. Please pause from time to time to allow members to --

(Simultaneous speaking.)

PARTICIPANT: We're wonderful. How are you?

PARTICIPANT: Somebody has got a mic open somewhere.

PARTICIPANT: Remember, please mute your mic.

CHAIRMAN BALLINGER: Well, we are all wonderful, I guess.

Please indicate the slide number that you're on. We have a bridge line established for the public to listen to the meeting. To minimize disturbance, the public line will be kept in a listen-only mode. The public line will be terminated during the closed portion.

To avoid disturbance, we request that

attendees make sure they are muted. And, again, I've got to check.

Thomas, is the public line all set?

MR. DASHIELL: Public line is all set.

CHAIRMAN BALLINGER: Very good. Thank you.

Okay. Note that we have a scheduled meeting, on full Committee, on September 10th.

We'll now proceed with the meeting, and I'm going to ask Brian Painter, Framatome, to share his screen with us. He already has done that. Ms. MJ Ross-Lee, Deputy Division Director, Division of Safety Systems NRR, and after, any introductory remarks to make before we begin with today's presentations.

And I see she is here, I think.

MS. ROSS-LEE: Yes. Hi. Thank you.

Good afternoon. As introduced, my name is MJ Ross-Lee. I am the Deputy Director for Division of Safety Systems in NRR. Today we will be discussing a supplement to the topical report, which describes the Framatome analysis methodology for capturing the dynamic behavior of fuel assemblies during oscillatory loads typical of seismic and/or LOCA events.

This methodology is used to demonstrate compliance with several regulatory requirements which

ensure that, among other things, the fuel geometry ensures adequate cooling and the guide tubes are not so severely deformed that control rod insertion is impeded.

The supplement adds a new model element that can be utilized within the previously approved analysis framework to represent the unique behavior of certain spacer grid designs such as the GAIA spacer grid. The engagement on this review between NRC, PNNL, and Framatome staff was very efficient, effective, with the use of a regulatory audit which was used to identify and address significant issues via a single round of requests for additional information despite the novel nature of the proposed analysis model element.

And with that I will turn it over to Framatome.

CHAIRMAN BALLINGER: Brian, are you up?

MR. PAINTER: Yes. I'm here.

Hello. My name is Brian Painter. I'm an engineer in the Fuel Mechanical Analysis Group at Framatome. And I'll start my presentation.

So, moving to slide 2, I'll discuss in this presentation a review of the base methodology, an overview of the GAIA fuel assembly design, and then a

description of the deformable grid methodology.

Moving to slide 3, this is a review of the base methodology. So Framatome's generic base methodology, ANP-10337, which is for PWR Seismic and LOCA mechanical evaluations -- it was approved in August 2018. And what it accomplishes for us in the methodology space is it updates the lateral dynamic models, vertical dynamic modeling, and the on-grid component stress analysis. It also addresses NRC information that is 2012-09, which were radiation effects on spacer grid crush strength.

CHAIRMAN BALLINGER: Somebody's got their microphone not muted. Please.

MR. PAINTER: Okay. Thank you.

It also defines the spacer grid allowable impact load and allowable spacer grid permanent deformations.

So, in the base methodology, the impact response of the spacer grid is assumed to be linear up to the allowable impact load. With new spacer designs, as mentioned, the GAIA design in particular, they exhibit a linear impact response but a limited one, which is then followed by a nonlinear impact response.

So the deformable spacer grid methodology,

its intent is to extend the base methodology to address spacer grids with these nonlinear impact responses.

On slide 4, I would like to say that most of the base topical remains applicable to this supplement, to the deformable grid supplement. So the fuel assembly beam model architecture is unchanged. The damping and the hydrodynamic coupling terms that we apply in the row models and vertical models, they're unchanged.

How we treat irradiation effects on spacer grade testing is unchanged, and the non-grid component stress evaluations are unchanged. So the deformable grid supplement, all it's doing, in essence, is replacing the linear grid impact element with a nonlinear impact element.

Moving to slide 5, so we'll speak about the GAIA fuel assembly and the GAIA spacer grid a lot during the open and close presentation because this was the spacer grid that kind of launched this effort. So it's worth giving an overview of the fuel assembly design.

So it's Framatome's latest fuel assembly design for Westinghouse 17 x 17 reactors. As I've already mentioned, the GAIA spacer grid introduces a

nonlinear response in seismic and LOCA excitations from moderate impacts. So, smaller energy impacts, the grid remains linear. But, as we increase the impact energies, we can see that -- and we'll show in the close presentation -- that the nonlinearities become more important.

Now, the spacer grid linear response has been analyzed using the generic base methodology, the topical report 10337. It was analyzed as part of the sample problem for ANP-10342, which is the GAIA mechanical design topical report.

Moving to slide 6. So a little more detail about the deformable grid methodology. So the supplement, it implements a nonlinear deformable grid model, and that will replace the linear viscoelastic spring that is described in the base methodology.

The deformable grid element, or DGE for short, it can simulate the nonlinear impact response, and it can predict the residual spacer deformations that occur during seismic and LOCA events. Including the DGE or the nonlinear element, it doesn't alter the modeling of fuel assembly tentative response.

As mentioned earlier, the beam model architecture is unchanged, as are other aspects of the analysis. One thing that does change is we knew from

an exception to criteria in the base method that's based on a limiting impact load and we're replacing this with a limiting residual deformation.

I will take any questions you have.

CHAIRMAN BALLINGER: Okay. We have a 15-second rule, I guess. If there are no comments on this, I think we need to first check the public line to see if there's any members of the public that would like to make a statement.

Thomas, I'm assuming the public line is open.

MR. DASHIELL: Public line is open.

CHAIRMAN BALLINGER: Yeah. So are there any members of the public that would wish to make a statement regarding this?

(Pause.)

CHAIRMAN BALLINGER: Okay. Hearing none, I guess we can close the public line. And this would be, also, the end of the public part of this meeting. And so what we need to do, and Chris can correct me if I'm wrong, is we need to -- there's a different invitation, right, Chris?

MR. BROWN: Absolutely.

CHAIRMAN BALLINGER: So everybody needs to get out of this meeting, and then we rejoin the

meeting using the invitation for the closed session. So --

MEMBER REMPE: Ron, before you do that, though, don't you need to ask for public comment?

CHAIRMAN BALLINGER: I did.

MEMBER REMPE: I'm sorry. Then I guess I missed it. Okay. I apologize.

CHAIRMAN BALLINGER: Yeah. Senior moment.

(Simultaneous speaking.)

CHAIRMAN BALLINGER: Anyway, okay. So I think what we need to do is say goodbye to this meeting, and then we'll see you shortly in the closed session.

MR. BROWN: And Derek and I will verify the people that are coming into the closed session. Thank you.

(Whereupon, the above-entitled matter went off the record at 2:14 p.m.)

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ACRS Subcommittee Meeting

Topical Report Supplement to ANP-10337P-A for Deformable Grids

Brian Painter

July 7, 2020

CONTENT

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Review of Base Methodology

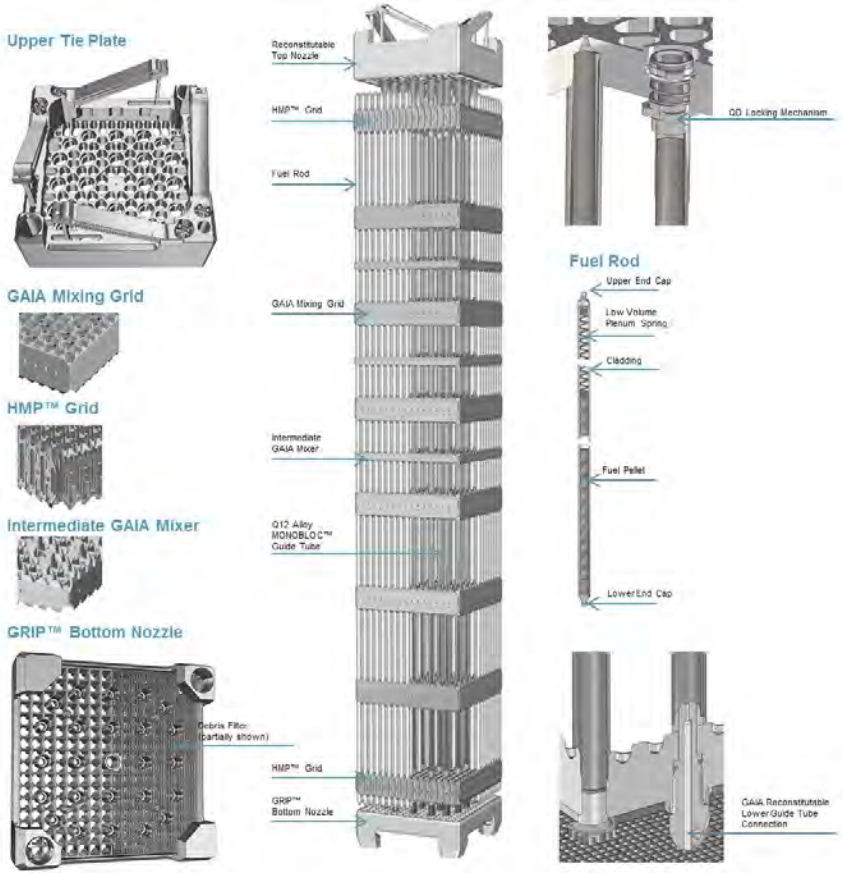
- Framatome's generic base methodology for PWR Seismic / LOCA mechanical evaluations, ANP-10337P-A, was approved in August 2018
- ANP-10337P-A:
  - Updates the lateral dynamic modeling, vertical dynamic modeling, and component stress analysis
  - Addresses NRC Information Notice 2012-09 "Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength
  - Defines spacer grid allowable impact load and allowable grid permanent deformations
- In the base methodology, the spacer grid impact response is assumed to be linear up to the allowable impact load
- New spacer grid designs, such as the GAIA design, exhibit a limited linear impact response followed by a nonlinear response
- The deformable spacer grid methodology is intended to extend the base methodology to address spacer grids with these nonlinear impact responses.

Review of Base Methodology

- Most of the base topical remains applicable to the deformable grid supplement
  - Fuel assembly beam model architecture is unchanged
  - The applied damping and hydrodynamic coupling are unchanged
  - The treatment of Irradiation effects on spacer grid testing is unchanged
  - Non-spacer grid component stress evaluation is unchanged
- The deformable grid supplement simply replaces the linear grid impact element with a nonlinear impact element

GAIA Fuel Assembly

- The GAIA assembly is Framatome's latest 17x17 design for Westinghouse reactors
- The innovative GAIA spacer grid introduces a nonlinear response to external excitation
  - For moderate impacts, the grid remains linear
  - For larger impacts, the nonlinearities become important
- The grid linear elastic response was analyzed in the ANP-10342P-A sample problem using the generic ANP-10337P-A methodology



Deformable Grid Methodology

- Supplement 1 to ANP-10337P-A implements a nonlinear, deformable spacer grid model to replace the linear visco-elastic spring prescribed in the base methodology
- The deformable grid element (DGE) can simulate the nonlinear impact response and predict residual spacer grid deformations due to seismic and LOCA events
- The inclusion of the DGE does not otherwise alter the modeling of the fuel assembly dynamic response
- The limiting impact load acceptance criteria from the base methodology are replaced with limiting residual deformations

Acronyms

- ANCOVA – Analysis of Covariance
- BOL – Beginning of Life
- EOL – End of Life
- LOCA – Loss of Coolant Accident
- NRC – U.S. Nuclear Regulatory Commission
- SSE – Safe Shutdown Earthquake
- UCL – Upper Confidence Limit

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Thank you