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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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689TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

TUESDAY

OCTOBER 5, 2021

+ + + + +

The Advisory Committee met via Videoconference, at 1:00 p.m. EDT, Matthew W. Sunseri, Chairman, presiding.

COMMITTEE MEMBERS:

MATTHEW W. SUNSERI, Chairman

JOY L. REMPE, Vice Chairman

RONALD G. BALLINGER, Member

VICKI M. BIER, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

JOSE MARCH-LEUBA, Member

DAVID A. PETTI, Member

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DESIGNATED FEDERAL OFFICIAL:

ZENA ABDULLAHI

ALSO PRESENT:

MORRIS BYRAM

ANDREI BURGHELEA

ANDERS GILBERTSON

MATHEW PANICKER

HANH PHAN

MEHDI REISI FARD

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

(1:01 p.m.)

1  
2  
3 CHAIR SUNSERI: All right. Good  
4 afternoon. It is one o'clock Eastern Time. This is  
5 Matt Sunseri and I'm now going to call to order the  
6 689th full committee meeting of the Advisory Committee  
7 on Reactor Safeguards.

8 I am Matthew Sunseri, Chair of the ACRS.  
9 I'll now call the roll to verify quorum and that  
10 effective communications exist. I'll start with Ron  
11 Ballinger.

12 MEMBER BALLINGER: Here.

13 CHAIR SUNSERI: Dennis Bley? I can't  
14 remember if he's supposed to be here today or not.

15 Vicki Bier?

16 MEMBER BIER: Here.

17 CHAIR SUNSERI: Charles Brown? Charles  
18 Brown? Vesna Dimitrijevic?

19 MEMBER DIMITRIJEVIC: I am here.

20 CHAIR SUNSERI: Greg Halnon?

21 MEMBER HALNON: Here.

22 CHAIR SUNSERI: Jose March-Leuba?

23 MEMBER MARCH-LEUBA: Here.

24 CHAIR SUNSERI: Dave Petti?

25 MEMBER PETTI: Here.

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1 CHAIR SUNSERI: Joy Rempe?

2 MEMBER REMPE: Here.

3 CHAIR SUNSERI: Myself. I think that is  
4 everybody. Did I miss anybody?

5 Okay. So Charles Brown? Dennis Bley?  
6 And Walt Kirchner's not available either. So we do  
7 have a quorum and we will proceed.

8 MEMBER BROWN: I'm here.

9 CHAIR SUNSERI: Okay.

10 MEMBER BROWN: It's Charlie. Couldn't  
11 get my mute unmiked.

12 CHAIR SUNSERI: Your mute unmiked. Okay.

13 MEMBER BROWN: Right. That was  
14 deliberate.

15 CHAIR SUNSERI: Right, right. I have two  
16 left thumbs also.

17 Okay. ACRS was established by the Atomic  
18 Energy Act and is governed by the Federal Advisory  
19 Committee Act. The ACRS section of U.S. NRC public  
20 website provides information about the history of the  
21 ACRS and provides documents such as our charter, bylaws,  
22 Federal Register notices for meetings, letter reports,  
23 and transcripts for all full and subcommittee meetings  
24 including the slides presented at the meeting. The  
25 Committee provides its advice on safety matters to the

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1 Commission through its publically available letter  
2 reports.

3 The Federal Register notice announcing  
4 this meeting was published on September 24th, 2021,  
5 and provided an agenda and instructions for interested  
6 parties to provide written documents or request  
7 opportunities to address the Committee. The  
8 Designated Federal Officer for this meeting is Ms. Zena  
9 Abdullahi.

10 During this week's sessions, we plan to  
11 complete two letter reports. We plan to begin our  
12 deliberations of work group review of agency research,  
13 leading up to, ultimately, our biannual report. And  
14 we will be providing a briefing to the Commission on  
15 selected topics.

16 During today's meeting the committee with  
17 consider the following; and both of these are to let  
18 the two letter reports that we will produce this week.

19 The first one is Framatome Topical Report on GALILEO  
20 implementation of loss of coolant accident methods.  
21 The second topic is Draft Reg Guide 1.247 endorsing  
22 non-light water reactor probabilistic risk assessment  
23 standards. Portions of the GALILEO topic may be closed  
24 to protect the confidential and proprietary  
25 information.

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1           A communications channel had been arranged  
2 to allow members of the public to listen in on the  
3 presentation and committee discussions. We have  
4 received no written comments or requests to make oral  
5 statements from members of the public regarding today's  
6 session. There will be an opportunity for public  
7 comment. We have set aside time in the agenda for  
8 comments from members of the public attending or  
9 listening in, and we will call for those comments at  
10 the appropriate time. Written comments may be  
11 forwarded to Ms. Zena Abdullahi, the Designated Federal  
12 Officer.

13           A transcript of the open portion of the  
14 meeting is being kept and it is requested that the  
15 speakers identify themselves and speak with sufficient  
16 clarity and volume so that they may be readily heard.

17           Additionally, participants should mute themselves  
18 when not speaking.

19           I do not have any other pertinent opening  
20 remarks to make. I will call on the members. Any  
21 questions about the agenda or any comments that any  
22 of the members would like to make before we get started?

23           All right, then. It looks like I will turn  
24 to Member March-Leuba for the first topic and that's  
25 the Framatome GALILEO implementation of the loss of

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1 coolant accident methods.

2 MEMBER MARCH-LEUBA: Thank you, Mr.  
3 Chairman. Thank you. Yes, we are going to be hearing  
4 from Framatome and the staff about their Topical Report  
5 ANP-10349P, GALILEO implementation of LOCA methods.

6 We heard many technical details about this  
7 topic in our subcommittee meeting, September 21st, and  
8 we are going to hear a summary now in the open session.

9 We do have a closed phone number or MS Teams room ready  
10 in case we have to do some proprietary discussions,  
11 but I don't anticipate having to do that.

12 With that said, I would like to give the  
13 floor to Framatome to start their presentation.

14 MR. OTTO: This is Ngola. I will go ahead  
15 and share my screen. Just want to make sure that works  
16 for everyone.

17 MEMBER MARCH-LEUBA: I can see it.

18 MR. OTTO: Okay. Perfect.

19 MEMBER MARCH-LEUBA: So Andrei,  
20 Framatome, whoever is going to talk. You have the  
21 floor.

22 MR. BURGHELEA: Yes. I am here. Can you  
23 hear me?

24 MEMBER MARCH-LEUBA: Yes.

25 MR. BURGHELEA: Great. So, my name is

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1       Andrei Burghelea. I'm an engineer with Framatome in  
2       the Westinghouse and C-LOCA group. This presentation  
3       is about our implementation of the GALILEO fuel  
4       performance code in our LOCA methods. And if you go  
5       to the next slide, please, Ngola?

6               So I'm going to give you a brief  
7       introduction, describe what is intended with this  
8       topical report, how it is accomplished, and why it is  
9       acceptable, and a short summary. Next slide. Thank  
10      you.

11              So, currently, Framatome has two  
12      evaluation models for LOCA that are approved and are  
13      S-RELAP5 based. S-RELAP5 is our thermal hydraulics  
14      code. A small break LOCA, which is the Topical Report  
15      EMF-2328(P) (A), originally approved in March of 2001,  
16      and supplemented later on with Supplement 1, which was  
17      approved in December of 2016.

18              The small break LOCA evaluation model uses  
19      the RODEX2 field performance code and is an Appendix  
20      K-type method, so it's a conservative evaluation model.

21              For the large break LOCA, we have a  
22      realistic large break LOCA evaluation model, which is  
23      described in the Topical Report EMF-2103(P) (A) Revision  
24      3. That was approved in June of 2016 and it uses a  
25      fuel performance code COPERNIC.

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1           These are realistic evaluation methods.  
2           So it's a best-estimate process. Both of these LOCA  
3           evaluation models are applicable to Westinghouse 3-loop  
4           and 4-loop plants and combustion engineering plants.  
5           Basically, plants that have a bottom reflood.

6           MEMBER REMPE: So, this is Joy, and during  
7           the subcommittee discussions, there were some questions  
8           related to what else limits the applicability of these  
9           methods. And I know we talked about burnup and some  
10          other things like that, but I was thinking about this  
11          a bit more since our subcommittee week, and I'm thinking  
12          about what's being emphasized right now with industry.

13          There's an effort underway to try and go to higher  
14          burnups. There's an effort to think about  
15          accident-tolerant fuels.

16          Could you talk a little bit about, other  
17          than it's applicable to Westinghouse 3- and 4-loop and  
18          CE plants, what else are the limits associated with  
19          the applicability of this methodology?

20          MR. BURGHELEA: So, right. Distinctly,  
21          each method itself has its own limits. For instance,  
22          for small break LOCA, we do have -- the method is  
23          approved for both Zircaloy-4 and M5 cladding.

24          For realistic LOCA, it is only approved  
25          for M5 cladding. The current burnups are not the

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1 extended burnups we are talking about in the ATFFM  
2 program, in the advance fuel methods. So they're just  
3 regular fuel, and for each one of them, let's just say  
4 for the small break LOCA, the limit of applicability  
5 includes a limitation or condition that allows it to  
6 be applied up to 10 percent of the break spectrum.

7 And for large break LOCA, there's a lot  
8 more. There's like 13 limitations and conditions there  
9 that kind of put limits on where it can be applied and  
10 under what conditions.

11 MEMBER REMPE: So there's somewhere in the  
12 document, or in the staff's SE, that says this cannot  
13 be used for anything above 5 percent enriched fuel?

14 MR. BURGHELEA: I think that would be a  
15 question that the staff would answer later on.

16 MEMBER REMPE: But your report doesn't say  
17 we don't tend to use this for anything above 5 percent  
18 enriched fuel?

19 MR. BURGHELEA: I think we say that we  
20 intend to use them for the same applications that the  
21 current methods are approved for. We are not extending  
22 the applicability of these methods to anything that  
23 includes high enriched fuel or higher burnup.

24 MEMBER REMPE: Okay. Thank you.

25 MR. BURGHELEA: Sure.

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1                   MEMBER MARCH-LUEBA: This is Jose, for the  
2 record, Andrei. We are -- I mean, you have submitted,  
3 and it's currently review, two topical reports of  
4 extended enrichment and burnups, correct?

5                   MR. BURGHELEA: Right. Yes. And if we  
6 go to the next slide, I was going to mention that.

7                   So, the purpose of this topical report is  
8 to add GALILEO to the LOCA methods. So it's  
9 supplementing the existing methods to include GALILEO.  
10 It does not address any of the future objectives that  
11 Framatome has.

12                   Increased enrichment, increased burnup,  
13 chromia-doped fuel, chromium-coated cladding, these  
14 are blocks that will come later on. And in the big  
15 picture, this GALILEO implementation is one block in  
16 this entire endeavor.

17                   It serves us because GALILEO is one of the  
18 foundational -- or a piece of the foundation that we  
19 are building upon. It is the fuel performance code  
20 that adds, or will add in the future, there capabilities  
21 to our methods.

22                   But, currently, this is just the vanilla  
23 implementation with the same capabilities as the  
24 existing methods. All the other capabilities will be  
25 added later on, or are added with separate topical

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1 reports that are, or have been, already submitted.

2 MR. BYRAM: Hello. This is Morris Byram,  
3 licensing. Jose, I wanted to clear up something I  
4 thought I heard. You asked the question if both the  
5 increased enrichment and increased burnup topical  
6 reports had been submitted. We have only submitted  
7 the increased enrichment topical report. The high  
8 burnup topical report has not been submitted yet.

9 MEMBER MARCH-LEUBA: Oh, my mistake. I  
10 thought it was submitted to NRC in August. But I might  
11 have the wrong information.

12 MR. BYRAM: I just wanted to clear that  
13 up so we wouldn't be going under any -- yes. Thank  
14 you.

15 MEMBER MARCH-LEUBA: All right.

16 MR. BURGHELEA: Okay. We can go to the  
17 next slide, then. So, how is this implementation of  
18 GALILEO accomplished? For the small break LOCA part,  
19 this is basically a reflection of the topical report  
20 content. There are the steps that we perform in there  
21 to evaluate the regulatory requirements, in this case  
22 NUREG-800 and Appendix K, 210 CFR 50. And then define  
23 these requirements in terms of analysis purpose,  
24 transient class, power plant class, figure of merit.

25 Establish an assessment database, which

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1 in our case includes the LOFT test, only ones that have  
2 nuclear fuel. And for small break LOCA include the  
3 L3-6/L8-1 series of tests. These were also previously  
4 included in Supplement 1 to EMF 2328, so it gives us  
5 a baseline for comparison.

6 And then we described the EM changes and  
7 present our results, which are the assessment of those  
8 LOFT small break tests and a sample problem.

9 Next slide, please. For a realistic large  
10 break LOCA, the implementation follows a very similar  
11 approach. Obviously, there are some particular  
12 changes that are specific to large break LOCA and to  
13 realistic methods.

14 So, in terms of regulatory requirements,  
15 there are two Regulatory Guides that direct  
16 implementation and development of best-estimate  
17 models, 1.157 and 1.203. And for the realistic large  
18 break LOCA implementation, we took advantage of the  
19 graded approach for EMDAP described in Appendix B2 Reg  
20 Guide 1.203 given the limited scope changes to the  
21 evaluation model.

22 We then, again, describe the evaluation  
23 model requirements in the same terms as above, but for  
24 large break LOCA we also include the PIRT review and  
25 define an assessment base. Again, LOFT tests for large

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1 break are only ones to include nuclear fuel. And in  
2 this assessment database, we included the L2-3, L2-5,  
3 LP 02-6, and LP-LB-1 series of tests from LOFT. Again,  
4 these were previously included in EMF-2103 Rev. 3.

5 We then describe the evaluation model  
6 changes and presented the results of the assessment  
7 for the LOFT large break LOCA tests mentioned above,  
8 and the results of a sample problem.

9 Okay. Next slide. Thank you.

10 So, was it acceptable? GALILEO is an  
11 acceptable fuel performance code that has been approved  
12 recently, November last year. The evaluation model  
13 is an evolution that adds one fuel performance code  
14 with the same functionality as the ones existing in  
15 the current approved methods.

16 For the small break LOCA tests, the  
17 assessment with LOFT showed good agreement with the  
18 data, and the sample problem shows good agreement with  
19 the current method.

20 Similarly, for the large break LOCA method,  
21 the assessments show good agreement with the LOFT large  
22 break LOCA tests and good agreement with the current  
23 methods for the sample problem.

24 Next slide. And in summary, it is a  
25 straightforward process. It's basically adding the

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1 same functionality for the existing fuel performance  
2 codes, COPERNIC and RODEX2, and implementing GALILEO  
3 with the exact same capabilities.

4 It's an EM revolution that is supporting  
5 future objectives. In both cases, the analysis  
6 workflow for both methods remains unchanged. And the  
7 assessments against benchmarks and the comparison to  
8 the approved methods, the current approved methods,  
9 show good agreement.

10 And that would be all.

11 MEMBER MARCH-LEUBA: Andrei --

12 MR. BURGHELEA: Yes, please?

13 MEMBER MARCH-LEUBA: Thank you, Andrei.

14 I think you were going to say you're done.

15 MR. BURGHELEA: Yes.

16 MEMBER MARCH-LEUBA: Okay. I spoke too  
17 early. First, I'd like to correct the record. When  
18 I said that extended burnup was expected in August of  
19 2022, I was mistaken. The chromia-doped fuel LTR is  
20 expected in August of 2022.

21 So, with that, any questions for Framatome  
22 from the members, ACRS members? If not, let's move  
23 to the staff, staff the presentation.

24 So Mathew, whenever you're ready.

25 MR. PANICKER: Yes.

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1 MEMBER MARCH-LEUBA: We can see your  
2 slides.

3 MR. PANICKER: My name is Mathew Panicker.  
4 I belong to the Nuclear Materials and Fuel Analysis  
5 Branch in the Division of Safety Systems in NRR. I  
6 will be talking about how the GALILEO code is  
7 implemented in Framatome LOCA methods.

8 Next slide, please. I will have a few  
9 slides. First thing is a summary of what we are going  
10 to review, the diagrams. Some applicability of  
11 regulations and guidance. Implementation of S-RELAP5,  
12 which is the thermal-hydraulics code, and as a result,  
13 the realistic large break LOCA analysis. We'll deal  
14 the implementation of S-RELAP5 and eventually in the  
15 small break LOCA and some conclusions.

16 Next, please. In the Framatome realistic  
17 large break LOCA methodologies, here we note the  
18 accepted version, version 3, which used S-RELAP5  
19 COPERNIC combination. COPERNIC is a best-estimate fuel  
20 performance code, which was approved early 2000 or  
21 around that time.

22 That combination is used in the  
23 initialization conditions for thermal-hydraulics code,  
24 which eventually will be used in large break LOCA.  
25 In the small break LOCA, EMF2328, which was a supplement

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1 approved in 2016, used a S-RELAP5/RODEX2 combination.  
2 RODEX2 is a fuel performance code, which was earlier  
3 than COPERNIC. And the combination is used in the  
4 initialization conditions for thermal-hydraulics core,  
5 which are normally used for small break LOCA analysis.

6 The new code, which is GALILEO, was  
7 approved in late 2020 and the code is best-estimate  
8 code that uses latest available data. The code models  
9 thermal and mechanical behavior of the fuel rods during  
10 normal and transient operations.

11 Framatome, through ANP-10349, which is the  
12 current topical report, is supplementing the GALILEO  
13 methodology to its realistic large break LOCA and small  
14 break LOCA methodologies. Next, please.

15 Some of the applicable regulations, the  
16 common one is 10 CFR 50.46, acceptance criteria for  
17 ECCS; 10 CFR Part 50; GDC 35, which is evidence in core  
18 cooling. The guidance of chapter 6.3 of SRP provides  
19 guidance for performing system review of the ECCS; and  
20 15.6.5, loss of coolant accidents of the SRP.

21 Next, please. Regarding the use of  
22 GALILEO as a supplement to COPERNIC in the realistic  
23 large break LOCA, the broadest analysis to S-RELAP5,  
24 thermal-hydraulic fuel and thermal-hydraulic  
25 calculations in realistic large break LOCA.

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1           The evaluation was done through audit,  
2           which lasted for some time because it was a virtual  
3           audit. The staff had access to documents for a longer  
4           period of time than conventional audit. And it issued  
5           the ARS to confirm the documentation of the  
6           GALILEO/S-RELAP5 combination hybrid scheme, which is  
7           elaborated in the topical report, as well as the closed  
8           session to the ACRS.

9           And small break LOCA sensitivity analysis.

10          The LOFT tests were written, the four of them, in  
11          combination, they used all configurations of the  
12          reactor, scaled-down reactor, with the LOCA fuel. So  
13          it is benchmarked using the coupled S-RELAP5/GALILEO.

14          And there was a sample problem, which is  
15          a normal Westinghouse 3-loop reactor, which this  
16          problem presented in the approved realistic large break  
17          LOCA evaluation methodology topical report, EMF-2103.

18          The same problem was repeated using the new code,  
19          GALILEO. We verified for the results from LOFT tests  
20          and sample problem results. It indicates reasonable  
21          agreement between GALILEO and COPERNIC combinations.

22          Next slide, please. Part of the small  
23          break LOCA, the GALILEO code supplements the RODEX2  
24          in small break LOCA analysis for S-RELAP5  
25          thermal-hydraulic calculations.

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1           Again, the GALILEO was introduced into the  
2           -- is used to input into S-RELAP5. For verification  
3           of their methodology, two LOFT tests were used to assess  
4           the base for the supplemental small break LOCA  
5           evaluation model and benchmarked using the combined  
6           S-RELAP5/GALILEO.

7           As soon as the sample problem was done,  
8           which was done for EMF-2328, using both RODEX2 and  
9           GALILEO. The sample problem results indicated  
10          reasonable agreement between GALILEO and RODEX2.

11          Next slide, please. The staff found that  
12          the process and the results from the supplemental  
13          evaluations model for both large break and small break  
14          LOCAs supplements both COPERNIC and RODEX2 with  
15          GALILEO. Both LOFT tests and the sample problem  
16          results shows that there is a reasonable agreement  
17          between GALILEO and COPERNIC, RODEX2, or both realistic  
18          large break LOCA and small break LOCA.

19          Realistic large break LOCA and small break  
20          LOCA supplemental evaluations model, which is in  
21          ANP-10349, which is the current topical report that's  
22          the subject of discussion, satisfies applicable  
23          regulations and guidance in the SRP.

24          The staff is going to put one of the  
25          conclusions: Framatome shall publish the approved

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1 version of ANP-10349 as a supplemental topical report  
2 to the final approved versions of large break LOCA and  
3 small break LOCA.

4 MEMBER MARCH-LEUBA: I know we talked  
5 about this in the subcommittee; are they going to issue  
6 two supplementals? One for EMF-2103, another one for  
7 2328, with the same topical report? Actually how you  
8 do this? I assume you've talked to Framatome and you  
9 guys have a process forward to accomplish this.  
10 Because the way normally you would do it, you have an  
11 approved methodology, EMF-2103, and if you want to  
12 modify it, you issue a supplemental to that report.  
13 And then you issue a supplemental to 2328. So do you  
14 want them to issue two reports with the same content?

15 MR. PANICKER: No, the EMF and the  
16 ANP-10349 has both large break LOCA and small break  
17 LOCA.

18 MEMBER MARCH-LEUBA: Correct, but in the  
19 limitation you say that they have to issue a  
20 supplemental to two existing reports. I was asking  
21 if you have talked to Framatome about how they're going  
22 to implement this --

23 MR. PANICKER: I talked to -- I haven't  
24 talked to them specifically, but my understanding is  
25 that they may have only one, ANP-10349, for both.

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1 MEMBER MARCH-LEUBA: Sure. Sure, that  
2 makes sense.

3 MR. PANICKER: Otherwise they are to do  
4 two of them with replacing both codes in the two of  
5 them.

6 MEMBER MARCH-LEUBA: It's an  
7 administrative question; it's not a technical question.  
8 I'm sure, when there is a will, there is a way.

9 MR. BYRAM: Jose, this is Morris Byram  
10 again. We state in the topical report itself that this  
11 is a supplement to both the small break and the realistic  
12 large break LOCA topicals. And we're going to make  
13 that statement in the submittal letter that we send  
14 to the NRC, as well. So, right now, we're expecting  
15 it to be a standalone topical report, and those  
16 statements are made within the topical report in the  
17 submittal letter.

18 MEMBER MARCH-LEUBA: And you think that  
19 will be sufficient, right? I think so.

20 MR. BYRAM: Yes. Framatome believes so.  
21 Yes.

22 MR. OTTO: This is Ngola. We did have a  
23 discussion about that with Framatome, and the goal is  
24 for us to put a statement in our summary and also for  
25 them to, when they send the approved version, to include

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1 that in their letter. And that's what we had agreed  
2 on as far as addressing this issue.

3 MEMBER MARCH-LEUBA: Yeah. Okay. And on  
4 an also administrative or non-technical question, we  
5 talked during our subcommittee meeting, which was  
6 relatively close, September 21st, that you were going  
7 to issue a revised SER. Where are we on that step?  
8 Because I haven't seen it.

9 MR. OTTO: Yes. Our schedule for issuing  
10 a final safety evaluation is at the end of the month.

11 I do have a markup of that, that shows the changes  
12 that we discussed with respect to -- there was a comment  
13 the last time that you mentioned about when we used  
14 the word replace or replaced, to say we're replacing  
15 the old codes with this code. We changed the language.

16 So instead of saying replace, we did updated language  
17 to say supplement or supplements or supplemented. And  
18 that's in -- it occurs in maybe 12 times or so in the  
19 safety evaluation, so we did go and make those updates.

20 MEMBER MARCH-LEUBA: Any other changes?  
21 Let me tell you where I'm coming from. Probably within  
22 the hour we'll be reading a letter, and hopefully voting  
23 on it this afternoon. I am going to get some pushback  
24 from members of the Committee saying that, how are we  
25 approving the publication of an SER we have not seen?

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1       So can you describe us any other changes you made to  
2       the one we have seen? The word replace, we understand  
3       that's, yes, a typo, but --

4               MR. PANICKER: We're going to introduce  
5       a couple of conditions, which were subject (audio  
6       interference) in the ACRS letter. But those have to  
7       be modified or amended, and that we'll discuss --

8               (Simultaneous speaking.)

9               MEMBER MARCH-LEUBA: Let me ask Ngola and  
10       Framatome. If we delay issuing the letter until  
11       November, would that be a problem for you guys? I mean,  
12       we can finish the letter today, but since we have not  
13       seen -- I mean, if you are issuing some two new  
14       limitations that we haven't seen, I don't see how we  
15       can recommend publication if we haven't seen it.

16              MR. OTTO: I think we can have a discussion  
17       during the letter writing session with respect to some  
18       of the recommendations that you have. We do have a  
19       presentation that kind of outlines what are plans are.

20       And then, based on that, we can move forward with  
21       respect to the changes we made.

22              MEMBER MARCH-LEUBA: We're working on the  
23       FACA rules, and during the letter writing only ACRS  
24       talks unless there is a factual error.

25              MR. OTTO: Okay.

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1                   MEMBER MARCH-LEUBA:     Or we ask you  
2 specifically.  So if you do have a presentation ready,  
3 now is the time to do it.  During the letter writing,  
4 you won't be able to do it.

5                   MR. PANICKER:  We can do that now.

6                   MR. OTTO:  Okay.

7                   MEMBER MARCH-LEUBA:  Please do, because  
8 in the letter writing only ACRS members talk and make  
9 decisions.  And we ask questions and you answer.  And  
10 you're only allowed to interrupt us if there is a factual  
11 error.

12                  MR. OTTO:  Okay.

13                  (Pause.)

14                  MR. PANICKER:  Shall I proceed?

15                  MEMBER REMPE:  You know, your "responding  
16 to ACRS Subcommittee recommendations."  Those are  
17 comments from individual members.  There's no such  
18 thing as an ACRS Subcommittee recommendations, so I'm  
19 puzzled by that slide that was briefly on the screen.

20                  MR. PANICKER:  Okay.

21                  MEMBER MARCH-LEUBA:  Yeah, but -- okay,  
22 so, that was the wrong title, but you can still put  
23 the information.

24                  MR. PANICKER:  Okay.  The recommendation  
25 from the letter was: the SE report should incorporate

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1 the demonstrated range of applicability the  
2 methodology. The staff should --

3 MEMBER MARCH-LEUBA: Yes. That was a  
4 recommendation from an individual member, which was  
5 me.

6 MR. PANICKER: Okay.

7 MEMBER MARCH-LEUBA: Not from the  
8 Committee.

9 MR. PANICKER: Okay.

10 MEMBER MARCH-LEUBA: And it's perfectly  
11 okay. I mean, I just gave you some advice, saying that  
12 during the full committee, I will argue with my  
13 colleagues to create a recommendation from the  
14 Committee. I gave you a heads-up during the  
15 subcommittee, okay? But it was only my recommendation.  
16 The full committee had not voted on it.

17 MR. PANICKER: Okay.

18 MEMBER MARCH-LEUBA: I know, it's process,  
19 but it's important.

20 So if we could see those slides again, you  
21 can still present them and we may -- but start thinking  
22 about what would be consequences if we delay our letter  
23 to the next full committee.

24 MEMBER REMPE: And let's think, also,  
25 Jose, that if they're trying to anticipate what a

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1 recommendation is and they're going to change the  
2 report, it's very much out of process. They would have  
3 to update the draft SE and then let us see it 30 days  
4 in advance and discuss it, and then write a letter based  
5 on the new report.

6 I think it would be better to stay in  
7 process. Stick with the SE that they have, wave us  
8 write the letter with some suggested changes, and go  
9 forward. I think this is a bit unusual for the staff  
10 to be so forward-leaning on this.

11 MEMBER MARCH-LEUBA: I understand what  
12 you're saying. And at this point I would ask the  
13 parliamentarian. I'm perfectly happy to write a letter  
14 on the draft SE, and when the staff reconciles or if  
15 they say, we have updated the SER to acknowledge your  
16 recommendations, and here it is.

17 MEMBER REMPE: Because what the letter has  
18 in it may change based on our discussions during letter  
19 writing. And so they're chasing a moving target, is  
20 what I'm trying to say.

21 MEMBER MARCH-LEUBA: Okay. So at this  
22 point I'm going to ask the Chairman, since we don't  
23 have a parliamentarian in town. Matt, I don't know  
24 if you have been following the situation.

25 One option, Plan A, is to continue with

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1 our letter with the draft SE as we know it and issue  
2 it. Another option, Plan B, would be to wait until  
3 an updated SE exists and we will reconsider it either  
4 in November or December and issue a letter then. And  
5 I guess that's it.

6 CHAIR SUNSERI: Well, I mean, it's bad  
7 choices either way, right?

8 MEMBER MARCH-LEUBA: I kind of like Joy's  
9 proposal: issue the letter on the draft SE, and during  
10 reconciliation the staff can tell us, this is how we  
11 addressed your comments, and we'll tell them thank you  
12 very much, if we agree with them.

13 It's the fastest and easiest way. I think  
14 what Joy suggested is the fastest and easiest way.

15 MEMBER REMPE: And it's the way we normally  
16 do things. If they wanted to change the report, they  
17 could have withdrawn it after the subcommittee meeting  
18 and said, we think ACRS has brought up a major issue  
19 and we don't want to go forward with this until we send  
20 you an updated SE.

21 But, with fairness to the staff, chasing  
22 a moving target based on what they heard in a  
23 subcommittee meeting, and may not appear in the letter  
24 when it's all said and done, or we may have new findings  
25 that they didn't address and they can keep updating

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1 things a lot. So this is just the normal way things  
2 progress.

3 MEMBER MARCH-LEUBA: Yeah. And  
4 furthermore, the issues I raised are minor. They're  
5 more editorial than real technical problems. So I'm  
6 voting with Joy. But, Matthew, I think you have the  
7 last voice.

8 CHAIR SUNSERI: Well, I mean, either way  
9 is acceptable. I mean, I'm going to lean on the  
10 subcommittee chair, if you feel confident to proceed  
11 forward with a letter report on a draft document. And  
12 then we can write a letter at any time on anything,  
13 right? When is it final?

14 MEMBER MARCH-LEUBA: Okay. So we're  
15 proceeding with our plan. And staff you can save the  
16 -- sorry you had to prepare so much slides for this,  
17 but you can save it for the reconciliation package when  
18 you receive our letter. And maybe when we do the  
19 letter, those recommendations won't even be there,  
20 because, as I said, they're minor. They're editorial.

21 MR. OTTO: Not a problem. You know, we'll  
22 wait for the letter and then we'll address whatever  
23 comments in the final safety evaluation.

24 MEMBER MARCH-LEUBA: Excellent. Any  
25 member of the Committee wants to make any comments or

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1 questions?

2 Any member of the public want to make any  
3 comments or questions?

4 CHAIR SUNSERI: So the members of the  
5 public would have to unmute their Teams channel and  
6 then make their comment.

7 MEMBER MARCH-LEUBA: I don't hear anybody,  
8 Matt. So, Mr. Chairman, I hand over the Committee back  
9 to you. I will suggest that we have our 10- to 15-minute  
10 break and transition to letter writing.

11 CHAIR SUNSERI: Let me see what time is  
12 it? 10:42, yes, we can do that. That's a good  
13 recommendation. So we will go onto recess until two  
14 o'clock, and then at two o'clock we will begin the  
15 read-in of your -- you have a draft ready to go, right,  
16 Jose?

17 MEMBER MARCH-LEUBA: Yes, it is.

18 CHAIR SUNSERI: Okay.

19 MEMBER MARCH-LEUBA: It's short.

20 CHAIR SUNSERI: We'll proceed with that.

21 All right. We are recessed until 2:00 p.m.

22 (Whereupon, the above-entitled matter went  
23 off the record at 1:43 p.m. and resumed at 3:45 p.m.)

24 CHAIR SUNSERI: All right. It's 3:45.

25 This is Matt Sunseri. We'll reconvene the 689th ACRS

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1 meeting. I'm going to start with a roll call since  
2 this is a new topic.

3 Ron Ballinger?

4 MEMBER BALLINGER: Here.

5 CHAIR SUNSERI: Charles Brown?

6 MEMBER BROWN: Here.

7 CHAIR SUNSERI: Vesna Dimitrijevic?

8 MEMBER DIMITRIJEVIC: Here.

9 CHAIR SUNSERI: Greg Halnon?

10 MEMBER HALNON: Here.

11 CHAIR SUNSERI: Jose March-Leuba?

12 MEMBER MARCH-LEUBA: I'm back here.

13 CHAIR SUNSERI: Dave Petti?

14 MEMBER PETTI: Here.

15 CHAIR SUNSERI: Joy Rempe?

16 MEMBER REMPE: Here.

17 CHAIR SUNSERI: And myself. So that's the  
18 expected crowd right now. And I forgot to check, do  
19 we have the court reporter back on? I see him on my  
20 list, so I guess so.

21 All right. We will get started here, then.

22 This topic is on Draft Reg Guide 1.247, endorsing  
23 non-light water reactor probabilistic risk assessment  
24 standard.

25 And I'm going to turn to Member Petti to

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1 lead this discussion. Dave?

2 MEMBER PETTI: Okay. So this is a  
3 follow-up from the subcommittee meeting we had earlier.  
4 We're going to hear from the staff. But, before that,  
5 I guess we're going to hear from RES management if they  
6 would like to make an opening statement.

7 MR. REISI FARD: Good afternoon. My name  
8 is Mehdi Reise Fard, I'm the branch chief for the  
9 Performance and Reliability Branch in the Office of  
10 Nuclear Regulatory Research.

11 First of all, I want to thank the committee  
12 for the opportunity to present the draft of Reg Guide  
13 1.247, which is the acceptability of probabilistic risk  
14 assessment results for advanced non-light water reactor  
15 risk-informed activities.

16 As you'll hear today in the staff  
17 presentation, this guidance, you'll be able to call  
18 on our team and find PRA information and risk-informed  
19 approaches in our regulatory activities related to  
20 advanced non-light water reactor.

21 I want to start with a few points about  
22 the driver behind the non-light water reactor PRA  
23 acceptability project. The organization and execution  
24 of the staff's effort to develop and publish Reg Guide  
25 1.247 have been a substantial and unprecedented

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1           undertaking given the project scope and the timeframes  
2           the NRC staff committed to meet.

3                       In January 2019, the Nuclear Energy  
4           Innovation and Modernization Act -- or NEIMA -- was  
5           signed into law, which created a driving force for the  
6           NRC to prepare for anticipated new applications for  
7           advanced reactors.

8                       Before NEIMA, the staff had no near-term  
9           plans to endorse a consensus standard for advanced  
10          non-light water reactor PRA.

11                      However, NEIMA accelerated the need for  
12          the standards of local inter-organizations to publish  
13          and for the NRC to endorse a consensus standard for  
14          advanced non-light water reactor PRA.

15                      So the staff had to quickly organize and  
16          plan for their efforts in anticipation of the  
17          publication of the PRA standard.

18                      Besides the accelerated schedule, another  
19          unique aspect of this standard endorsement is that the  
20          scope of this standard is broader than the scope of  
21          any previously considered or endorsed PRA consensus  
22          standard.

23                      The scope includes all radiological  
24          hazards -- sources, hazards, plant operating states,  
25          and all levels of analysis.       Because of the

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1 relationship between the non-light water reactor and  
2 related light water reactor PRA standards, and because  
3 we anticipate endorsing the future light water reactor  
4 PRA standards, the staff recognized early the need to  
5 endorse positions on the non-light water reactor PRA  
6 standard to ensure positions under non-light water  
7 reactor PRA standard would be consistent with  
8 anticipated future endorsements.

9 I'll also highlight a few points about the  
10 process and the staff efforts so far. As I stated  
11 earlier, staff developed an aggressive schedule to  
12 issue this Reg Guide.

13 Staff have achieved key project milestones  
14 to date. Developing this guidance required extensive  
15 coordination across different groups to establish the  
16 staff position with a singular and consistent  
17 narrative.

18 Given the NRC's completion schedule and  
19 the project's complexity, several steps in the  
20 publication process are performed in parallel.  
21 Therefore, the internal concurrence review process is  
22 somewhat dynamic.

23 We are currently considering feedback on  
24 the Reg Guide and slight adjustments in the schedule  
25 to address the feedback.

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1                   With that, I conclude my opening remarks.  
2                   We greatly appreciate this opportunity today and we  
3                   look forward to your comments.

4                   MEMBER PETTI: Okay. Thank you. So now  
5                   I guess we'll go to the slides and either Anders or  
6                   Hanh, whoever's going to start.

7                   MR. GILBERTSON: Yes. Thank you. Good  
8                   afternoon, committee members. My name is Anders  
9                   Gilbertson. I am a reliability and risk analyst in  
10                  the Office of Nuclear Regulatory Research.

11                  I'll be presenting today with Hanh Phan  
12                  who is a senior reliability and risk analyst in the  
13                  Office of Nuclear Reactor Regulation. And we'll be  
14                  presenting to you on the staff's development of the  
15                  trial use Reg Guide 1.247.

16                  Next slide, please. This is slide 2 for  
17                  anyone on the phone.

18                  So first, I will go over a brief background  
19                  followed by discussions of the regulatory paradigm and  
20                  the staff development approach for Reg Guide 1.247,  
21                  and then a comparison with Reg Guide 1.200, which is  
22                  the starting point or the foundational document for  
23                  1.247.

24                  I will then wrap up my portion with a  
25                  discussion of the novel staff positions in Reg Guide

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1 1.247. And after that, Hanh Phan will talk more about  
2 the staff endorsement of the non-LWR PRA standard and  
3 NEI 20-09, the industry peer-review guidance document.

4 And then he'll conclude with the discussion  
5 of the next steps in our process.

6 So slide 3, please.

7 Okay. So Mehdi already touched on that  
8 first point. So I won't spend time on that. So I'll  
9 just move on to the second point.

10 The staff, after the effort was organized,  
11 we worked toward developing a draft white paper that  
12 related to a set of non-LWR PRA acceptability issues  
13 that were under consideration for Reg Guide 1.247.

14 Subsequent to making that publicly  
15 available, the staff did hear public feedback on the  
16 white paper, which helped inform the development of  
17 the Reg Guide.

18 The publication of the non-LWR PRA standard  
19 in February of this calendar year was a substantial  
20 effort by the ASME and ANS Joint Committee on Nuclear  
21 Risk Management -- or JCNRM -- and the staff did  
22 participate in the process, the consensus standard  
23 development process.

24 So we did provide feedback and offer  
25 technical expertise to that end. Regarding NEI 20-09,

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1 likewise, that document was largely modeled after the  
2 industry guidance on PRA peer review for LWRs in NEI  
3 17-07, which was endorsed in Reg Guide 1.200, revision  
4 three. But like the PRA standard, the development of  
5 NEI 20-09 was also informed by NRC feedback.

6 Later on -- or I guess earlier this last  
7 month, the staff issued a draft version of the trial  
8 use Reg Guide 1.247 in advance of the ACRS subcommittee  
9 briefing. And that was the first opportunity the public  
10 has had to review the actual contents of the proposed  
11 regulatory guide.

12 We've already heard some feedback, both  
13 from the subcommittee and from members of the public,  
14 in particular the JCNRM, some of the JCNRM members.  
15 And staff are presently eager to hear and are actively  
16 considering all feedback on this draft as we finalize  
17 the Reg Guide for publication.

18 Following publication, there will be a  
19 trial use period. The length of that trial use period  
20 will depend on a number of activities including gaining  
21 sufficient experience with the use and application of  
22 Reg Guide 1.247 to help inform any needed changes to  
23 the Reg Guide and JCNRM publication of multiple other  
24 LWR consensus PRA standards, which the non-LWR PRA  
25 standard is intimately related to and will eventually

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1 be brought into alignment with those LWR PRA standards.

2 Okay. Slide 4, please.

3 So now I'd like to talk generally about  
4 the regulatory paradigm that Reg Guide 1.247 is expected  
5 to operate in. Regarding regulatory requirements, Reg  
6 Guide 1.247 is not intended to meet any one specific  
7 requirement. However, like Reg Guide 1.200, it is used  
8 to determine the acceptability of a PRA that is used  
9 to support a regulatory decision.

10 Now, at the moment, a PRA is currently  
11 required for new Part 52 applications. However, while  
12 it's not required for Part 50 application, a PRA may  
13 be used in support of such an application. Reg Guide  
14 1.247 is expected to eventually be applicable to 10  
15 CFR Part 53 on the risk-informed technology-inclusive  
16 regulatory framework for advanced reactors. But the  
17 Reg Guide won't speak to that and doesn't speak to it  
18 now because that is -- it's an incomplete activity and  
19 the staff don't -- we avoid talking to future activities  
20 in Reg Guides.

21 So, the next point. I'll talk in a few  
22 slides about a few general comparisons, like I said,  
23 but at a higher level I wanted to point out that the  
24 use of Reg Guide 1.247 in risk-informed decision making  
25 is intended to reduce the need for an in-depth review

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1 of PRA by the staff.

2 Now, this is different from Reg Guide  
3 1.200, which relates more to obviating the need. And  
4 this is primarily because of the difference in the scope  
5 of regulatory activities addressed in the two Reg  
6 Guides.

7 In particular, Reg Guide 1.200 is primarily  
8 used for voluntary risk-informed regulatory  
9 activities, whereas Reg Guide 1.247 may be used for  
10 a PRA that is required by a regulation and to establish  
11 a licensing basis. In that regard, the staff will have  
12 greater regulatory latitude in the context of Reg Guide  
13 1.247 to request additional information as needed since  
14 the PRA under consideration is being used to meet  
15 regulatory requirements.

16 Now, talking about the term application.

17 In Reg Guide 1.200, that term is used mostly to refer  
18 to voluntary regulatory activities occurring after the  
19 issuance of a license. However, because of the range  
20 of potential regulatory activities for non-LWRs that  
21 Reg Guide 1.247 may be used for, the term application  
22 in Reg Guide 1.247 refers to both initial licensing  
23 regulatory activities and risk-informed regulatory  
24 activities that follow the issuance of a license  
25 certification or permit.

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1           And finally, peer reviews are an integral  
2 part of the non-LWR PRA standard. The non-LWR PRA  
3 standard requires a peer review of the PRA and provides  
4 requirements on the performance of a peer review. And  
5 further, NEI 20-09 provides industry guidance on the  
6 peer review process. And Hahn will go into that in  
7 a little more detail.

8           And so if --

9           MEMBER DIMITRIJEVIC: I have a question.

10          MR. GILBERTSON: Yes.

11          MEMBER DIMITRIJEVIC: If I could just  
12 summarize what I just heard. Are you basically saying  
13 that peer review of the PRA would not only be required  
14 for risk-informed application, but also for the  
15 licensing submittals for like design certification and  
16 things like that, is that what you just said?

17          MR. GILBERTSON: They are not required as  
18 a regulatory requirement. However, if someone wants  
19 to use Reg Guide 1.247 to demonstrate the acceptability  
20 of their PRA, included as part of that the staff have  
21 endorsed those peer-review requirements that are in  
22 the PRA standard and we've endorsed the PRA standard  
23 -- the non-LWR PRA standards approach to having a peer  
24 review be performed.

25          So it's --

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1 MEMBER DIMITRIJEVIC: So there is a  
2 difference of the current situation. That's what I'm  
3 trying to say.

4 MR. GILBERTSON: Yes. Yes. That's --

5 MEMBER DIMITRIJEVIC: Okay. All right.

6 MR. GILBERTSON: -- that is correct.

7 MEMBER DIMITRIJEVIC: Okay.

8 MR. GILBERTSON: Yes. Okay. We can move  
9 on to slide 5 now.

10 Okay. So I'll talk a little bit now about  
11 a slightly more direct comparison of Reg Guides 1.247  
12 and 1.200.

13 Just to go over some of the similarities,  
14 you know, most of the PRA elements in Reg Guide 1.247  
15 have analogous elements in Reg Guide 1.200.

16 Both documents provide guidance on what  
17 is an acceptable PRA using voluntary consensus  
18 standards in a peer-review process, acceptability of  
19 a PRA for an application and documentation needed to  
20 support a regulatory decision.

21 Both guidance documents provide a list that  
22 includes, but is not limited to, hazards and hazard  
23 groups that should be considered in the development  
24 of a PRA. And the scope of both documents includes  
25 addressing all hazards and hazard groups.

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1                   Now, regarding some of the differences --  
2                   notable differences, as I mentioned before, Reg Guide  
3                   1.247 relates to the PRA acceptability for a PRA that  
4                   may be used to meet regulatory requirements. Which,  
5                   again, is different from the voluntary regulatory  
6                   activities under Reg Guide 1.200.

7                   There are four novel staff positions in  
8                   Reg Guide 1.247 and I'll go into that on the next slide.

9                   Regarding risk significance, determination, guidance  
10                  on making that determination includes that relative  
11                  risk-significance criteria should be used to develop  
12                  the PRA. However, that doesn't mean that the use of  
13                  absolute or relative risk-significance criteria may  
14                  not occur in an application. And that will be  
15                  application specific. So that's just to say that you  
16                  could have an application that is only focused on  
17                  absolute risk-significance criteria to determine  
18                  what's important.

19                  And then finally, consistent with the  
20                  approach in the non-LWR PRA standard, Reg Guide 1.247  
21                  does not refer to discrete levels of PRA analysis like  
22                  level one, level two, or level three.

23                  So we have taken the same approach where  
24                  it's a -- it's starting from initiator and the analysis  
25                  extends all the way out to consequence.

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1 Slide 7, please.

2 Okay. So now I'll just go over some of  
3 these novel staff positions. Regarding the first one,  
4 I should make a slight correction. You know, that says  
5 plant operating states for all POSes. What that should  
6 really say is plant operating states for all types of  
7 POSes.

8 So what that means is that we've  
9 acknowledged that there may be more than one type of  
10 a given plant operating state. For example, for at  
11 power for, as we have talked about it, for low-power  
12 -- for light water reactors.

13 So there could be a type of at power plant  
14 operating state that is distinct enough from the normal  
15 steady state operation of a plant, such as online  
16 refueling. They're refueling at full power kind of  
17 thing.

18 Reg Guide 1.200 does address the low-power  
19 shutdown mode of operation for LWRs, but it's limited  
20 to consideration of internal events and for up to a  
21 level two PRA.

22 So like Mehdi had mentioned at the  
23 beginning, Reg Guide 1.247 goes well beyond the scope  
24 of Reg Guide 1.200.

25 Regarding internal fire low-power shutdown

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1 types of plant operating states, there were no  
2 requirements developed for this PRA scope item in the  
3 non-LWR PRA standard. So accordingly, for applications  
4 that include internal fire PRA for low-power shutdown  
5 types POSes, the acceptability of the PRA would be  
6 determined based on the related staff positions in  
7 Section C.

8 And then finally, with that point, I wanted  
9 to note that research -- the Office of Research has  
10 initiated an effort -- a research effort into developing  
11 the guidance on an acceptable method for developing  
12 an internal fire PRA for low-power shutdown types of  
13 plant operating states. So that is an in-progress effort  
14 that we've initiated relatively recently.

15 As far as the radiological consequence PRA  
16 element, the staff position is largely driven by  
17 anticipated licensing modernization project -- or LMP  
18 -- applications, which will require analysis of  
19 frequency and consequence of radiological risk. For  
20 applications that do not use LMP, it is still considered  
21 important to meet the Commission expectations as  
22 expressed in various policy statements.

23 And then I want to just briefly apologize.

24 That last bullet there for radiological consequence,  
25 the they, that pronoun there is referring to risk

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1 surrogates. So the point really is just that it is  
2 possible that risk surrogates could be used, which would  
3 be consistent with Commission direction.

4           However, such surrogates would need a  
5 strong justification for how and why they represent  
6 the consequence-risk metrics and how they would meet  
7 those Commission expectations, which is generally  
8 expected to be fairly challenging. And I should also  
9 point out that the non-LWR PRA standard does not  
10 accommodate the use of risk surrogates. It talks about  
11 intermediate risk metrics that may be used in the course  
12 of an analysis, but not a surrogate, if you will.

13           And then, finally, for risk integration,  
14 the staff position on risk integration is -- again,  
15 is anchored in the Commission's expectations as it  
16 relates to policy statements and meeting the  
17 quantitative health objectives.

18           Another aspect of the staff position is  
19 that although a specific type of application may not  
20 use relative importance measures, the criteria for  
21 determining risk significance during the development  
22 of a PRA should always relate to relative importance  
23 measures.

24           And then, risk reporting thresholds are  
25 not considered in the staff position in Reg Guide 1.247,

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1 as those are considered on an application-specific  
2 basis. And application-specific guidance beyond that  
3 for LMP is expected to be developed in the future, but  
4 it was not included within the scope of Reg Guide 1.247.

5 So that concludes my portion of the  
6 presentation. I would like to now hand it off to Hahn  
7 Phan unless there are any questions. Okay. Thank you.

8 Hahn?

9 MR. PHAN: Thank you, Anders. Good  
10 afternoon. My name is Hahn Phan. I'm a senior PRA  
11 analyst in NRR, Division of Advanced Reactors. In the  
12 second half of this presentation, I will focus on the  
13 staff positions documented in Appendix A of Reg Guide  
14 1.247.

15 Before getting to them, I would like to  
16 briefly outline the scope of this Reg Guide. The staff  
17 guidance and position in Reg Guide 1.247 applied to  
18 all non-light water reactors, risk-informed regulatory  
19 activities, and for all applications including  
20 construction permits and operating license under 10  
21 CFR Part 50 and the standard design certification  
22 combined license, standard design approval, and  
23 manufacturing license under 10 CFR Part 52.  
24 Furthermore, Reg Guide 1.247 is the Reg Guide  
25 coordinating with the ongoing 10 CFR Part 53 rulemaking

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1 effort.

2           However, this Reg Guide only applies to  
3 the stationary non-LWRs, which miss that. The reactors  
4 that are constructed at an off-site facility and  
5 subsequently transported and installed at the site are  
6 those modular reactors, which could be relocated to  
7 multiple sites. They are not covered by this Reg Guide.

8           Next slide, please. Slide nine.

9           Reg Guide 1.247 endorsed all 18 technical  
10 elements in the non-LWR PRA standard I've listed on  
11 this slide. In addition to that, it endorsed the  
12 definition and risk assessment application guidance,  
13 the PRA configuration control, the peer review  
14 requirements, the newly developed methods and the note  
15 in the nonmandatory appendices of the standard.

16           Next, please. Slide 10.

17           You may wonder and ask why there are so  
18 many, over 100 staff positions in the Reg Guides. How  
19 significant are they? What does that mean to the  
20 attribute condition of the standard and so on?

21           First, I want to highlight that the non-LWR  
22 PRA standard is in essence an American national 456-page  
23 standard, which includes approximately 247 high-level  
24 requirements; 1,233 supporting requirements; 670 notes  
25 in the nonmandatory appendices; 238 definitions and

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1 all the technical discussions in the main chapters.

2 On those, these numbers look big. It  
3 should be recognized that about 80 percent of the  
4 requirements in the PRA standard was taken as-is from  
5 the light water reactor PRA standard, which many of  
6 these requirements have been endorsed in Reg Guide  
7 1.200.

8 During the first part of last year, the  
9 NRC staff reviewed the standard and submitted 489  
10 comments out of 1,319 total comments portionate  
11 (phonetic).

12 During the recirculation ballot, the NRC  
13 staff provided an additional 70 comments out of the  
14 total 86 comments submitted.

15 Next, please. Slide 11.

16 However, the JCNRM did not incorporate all  
17 NRC comments. For about 20 of 70 staff comments, the  
18 JCNRM proposed and said that these comments need to  
19 be addressed in the light water reactor PRA standard  
20 first.

21 Eight comments would consider as  
22 regulatory issue. Some comments was a stretch and fell  
23 short in satisfying the staff expectation.

24 Some comments were not fully addressed by  
25 the JCNRM. In addition to this, some staff position

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1 in Reg Guide 1.247 was developed to be consistent with  
2 the position in Reg Guide 1.200, revision three. And  
3 some new consideration, the staff identified after  
4 balloting.

5 Next please, slide 12.

6 So similar to Reg Guide 1.200, it's  
7 supporting requirements in the PRA standard is binned  
8 into one of the three groups. No objection; no  
9 objection with clarification; or no objection subject  
10 to the following qualification.

11 Regarding the staff position in the Reg  
12 Guides, its position is categorized into either the  
13 second or third group. The second group no objection  
14 with clarification.

15 It's missed that. The staff has no  
16 objection to the requirement. However, the  
17 requirements as written, it's not clear. And  
18 therefore, the staff provided its understanding of the  
19 requirements.

20 So if not that, the position it assigned  
21 to the third group, no objection subject to the  
22 following qualification, which missed that. These  
23 positions, the staff has a technical concern with the  
24 requirements and will write a qualification to resolve  
25 the concern.

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1 Next, please. Slide 13.

2 There are currently 147 staff endorsement  
3 positions in Reg Guide 1.247, Appendix A. 33 are  
4 qualifications, and 114 are clarifications.

5 Within these positions, many of them are  
6 considered to be more substantive than the others.  
7 These positions are relevant to the low-power and  
8 shutdown external events, errors of commission, risk  
9 significance, and reporting requirements.

10 In general, the staff advised that the ASME  
11 ANS, A-S-1.4-2021 PRA standard for non-light water  
12 reactors is reasonable.

13 This can be used to assess the  
14 acceptability of a PRA performed to support an  
15 application while taking into consideration the staff  
16 position in Reg Guide 1.247.

17 Note that these staff positions may change  
18 after considering the ACRS comments. On those, there  
19 are 147 staff positions in the record. If compared  
20 against the technical information and requirements in  
21 the PRA standard, the overall findings is not that  
22 significant.

23 The staff continues to revise the records  
24 by engaging with the public and JCNRM to reduce the  
25 numbers of staff position and modify the text, if

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1 needed, to make the Reg Guides easy to follow.

2 Next, please. Slide 14.

3 The staff also endorsed NEI 20-09 in Reg  
4 Guide 1.247, which is the guidance to conduct a peer  
5 review for a non-LWR PRA.

6 NRC staff received revision zero of any  
7 (audio interference) last year on June 1st. The staff  
8 reviewed and provides observation to NEI's during three  
9 public meetings.

10 NEI addressed the staff comments and  
11 submitted revision one on May 5th this year. NEI  
12 20-09's revision 1 is based on a related PRA  
13 peer-reviewed guidance documents.

14 NEI 17-07, revision two, entitled  
15 Performance of PRA Peer Reviews Using the ASME ANS PRA  
16 Standard as Endorsed by Reg Guide 1.200, Revision 3.

17 The staff finds that the guidance in NEI's  
18 20-09 revision 1 is acceptable and thus endorsed the  
19 documents with no exception.

20 Next, please. Slide 15.

21 This is my last slide on the part. The  
22 staff did address comments from the ACRs and the  
23 external stakeholders. The staff to hold public  
24 meetings in early November to go over the ACRS feedback  
25 and gather public comments.

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1           The staff to issue Reg Guide 1.247 for trial  
2 use by early next year. Note that the staff has not  
3 yet set the duration for the trial-use periods depending  
4 on timing of the next revision of the non-standard UR  
5 (phonetic) PRA standard. The Part 50 and 53 (audio  
6 interference) and feedback from the early users.

7           The staff will continue to brief ACRS on  
8 future changes to the Reg Guides. I have now come to  
9 the end of the presentation. Thank you so much for  
10 your time, and at this point we will take any questions  
11 that you may have.

12           MEMBER PETTI: Yes. This is Dave. Just  
13 a question, have you made any changes since our  
14 subcommittee meeting in September?

15           MR. PHAN: Not yet. We took --

16           MEMBER PETTI: Not yet. Thank you.

17           Other members, questions, comments?  
18 Okay.

19           MEMBER DIMITRIJEVIC: Hi, this is Vesna.  
20 I have a question for Hanh. Are you expecting that  
21 those things where you have, you know, the -- this --  
22 main comments will be resolved in the next PRA standards  
23 and that will change the position? You know, in that  
24 third category.

25           MR. PHAN: Would you please be more

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1 specific on which areas?

2 MEMBER DIMITRIJEVIC: Okay. When -- for  
3 every of these, the, you know, supporting the  
4 requirements, you have a three out, but one is that,  
5 you know, the accepted need clarification and then the  
6 third one is, you know, need the -- how do you call  
7 the third one. I don't have a slide. If you go back  
8 to that -- right. No objection subject to the following  
9 qualification.

10 Do you think that next version of the  
11 standards will address some of those third categories?

12 MR. PHAN: Personally, I don't think so.

13 MEMBER DIMITRIJEVIC: Why?

14 MR. PHAN: For example, the fire during  
15 low power and shutdowns, there are no requirements for  
16 fires during low power and shutdown in the standard.  
17 So within a couple years, that what I think when we  
18 will issue a revision, I don't think that's sufficient  
19 time to address that concern.

20 So that qualification position will be  
21 opened until then. For other areas like errors of  
22 commission or risk significance, the staff is working  
23 on the white paper and engaged the industry on those  
24 topics.

25 Hopefully, we resolve those items before

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1 the issuance of the next revision. So there are 33  
2 qualification position; hopefully, we will resolve  
3 about half of them by then.

4 MEMBER DIMITRIJEVIC: Okay. Thank you.

5 MR. PHAN: Thank you.

6 MEMBER PETTI: Other members? Okay, how  
7 about members of the public? You can unmute, identify  
8 yourself, ask your question.

9 CHAIR SUNSERI: Members of the public may  
10 have to press \*6 to unmute.

11 MEMBER PETTI: Well, not hearing anything,  
12 I guess we can close this session, Mr. Chairman, and  
13 turn it back over to you. I thank the staff for the  
14 presentations.

15 CHAIR SUNSERI: Yes. Thank you, Dave, and  
16 thank you, staff, for the presentation.

17 At this time -- excuse me. At this time  
18 we do not have a draft letter report quite ready yet.

19 We'll pick that up tomorrow. So we've kind of -- we've  
20 reached the end of our, at least, published agenda for  
21 today.

22 (Whereupon, the above-entitled matter went  
23 off the record at 4:27 p.m.)

24

25

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# **Trial Use RG 1.247 “Acceptability of Probabilistic Risk Assessment Results for Advanced Non-Light Water Reactor Risk-informed Activities”**

Briefing for the Advisory Committee on Reactors Safeguards  
Full Committee

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Office of Nuclear Reactor Regulation

October 5, 2021

# Presentation Outline

- Background
- RG 1.247 regulatory paradigm
- RG 1.247 development approach
- RG 1.247 v. RG 1.200 comparison
- Novel staff positions in RG 1.247
- Endorsement of the NLWR PRA standard and NEI 20-09
- Next steps

# Background

- NEIMA signed into law in January 2019; Staff immediately began organizing effort to endorse the NLWR PRA standard
- Staff issued draft white paper on NLWR PRA acceptability issues 1/15/2021 (ML21015A434)
- ASME and ANS jointly issued ASME/ANS RA-S-1.4-2021, “Probabilistic Risk Assessment Standard for Advanced Non- Light Water Reactor Nuclear Power Plants,” 2/8/2021
- NEI 20-09, Rev. 1, transmitted on 5/5/2021 (ML21125A284)
- Published draft of the trial use RG 1.247, 9/20/2021 (ML21246A216), endorses ASME/ANS RA-S-1.4-2021 and NEI 20-09
- RG 1.247 trial use period will allow experience to be gained and lessons learned on its use
- NRC has participated throughout the consensus standards development process, including providing feedback on proposed PRA standards and industry guidance documents

# RG 1.247 Regulatory Paradigm

- RG 1.247 may be used to meet regulatory requirements related to the use of PRA
- The use of RG 1.247 helps *reduce* the need for an in-depth review of the PRA (RG 1.200 relates to *obviating* the need)
- RG 1.247 defines an application more broadly to accommodate design, construction, and operational regulatory activities
- Peer reviews are important for establishing confidence in a PRA for RIDM and required by the NLWR PRA standard

# RG 1.247 Development Approach

- RG 1.200 is the starting point for RG 1.247
  - Organization and substance of content in RG 1.247 broadly mimics that of RG 1.200
- Staff positions in RG 1.247 consider the close relationships between the NLWR and LWR PRA standards
- Staff have considered the potential impact on future endorsements of LWR PRA standards

# RG 1.247 v. RG 1.200 Comparison

Some Similarities	Some Differences
Most PRA elements addressed in RG 1.247 have an analog in RG 1.200	RG 1.247 directly relates to meeting regulations
Both provide guidance to applicants and licensees on: <ul style="list-style-type: none"> <li>• What is an acceptable PRA</li> <li>• The use of voluntary consensus standards and an acceptable peer review process</li> <li>• Demonstrating the acceptability of a PRA for an application</li> <li>• PRA documentation needed to support a regulatory decision</li> </ul>	RG 1.247 provides staff positions on the acceptability of PRA technical aspects for NLWRs that have not previously been provided for LWRs in RG 1.200 <ul style="list-style-type: none"> <li>• Plant Operating State Analysis for all POSs</li> <li>• Internal fire PRA for LPSD-types of POSs</li> <li>• Radiological consequence</li> <li>• Risk Integration</li> </ul>
Both provide a table that includes, but is not limited to hazards that should be considered in the development of a PRA	RG 1.247 provides specific guidance on determining risk significance and the use of relative and absolute importance measures
Both address all hazards and hazard groups	RG 1.247 does not refer to discrete levels of PRA analysis such as Level 1, Level 2, or Level 3 PRA

# Novel Staff Positions in RG 1.247

PRA Element	Some Considerations
Plant Operating States for all POSs	<ul style="list-style-type: none"> <li>• In addition to the possibility of PRAs for multiple LPSD-types of POSs, the staff position considers that there may be more than one type of at-power POS (e.g., online refueling)</li> <li>• Staff position considers the potential need for a similar staff position for LWRs in the future</li> </ul>
Internal fire PRA for LPSD-types of POSs	<ul style="list-style-type: none"> <li>• Staff position accounts for the potential need for a similar staff position for LWRs</li> <li>• NRC initiating a research project to develop guidance</li> </ul>
Radiological Consequence	<ul style="list-style-type: none"> <li>• LMP applications evaluate frequency and radiological consequence risk</li> <li>• It is important to meet Commission expectations as expressed in various policy statements</li> <li>• Though not required, Commission direction in SRM-SECY-82-102 dictates that they may be used</li> </ul>
Risk Integration	<ul style="list-style-type: none"> <li>• Basis for staff position relates to meeting Commission expectations, as expressed in the Advanced Reactor Policy Statement, which in turn references the Safety Goal Policy Statement and the importance of meeting the QHOs</li> <li>• Unless justified, relative risk significance criteria should be used to develop the PRA.</li> <li>• Staff determination of PRA acceptability does not include consideration of risk reporting thresholds</li> </ul>

# Regulatory and Applicability Aspects

- RG 1.247 applies to risk-informed NLWR regulatory activities under:
  - 10 CFR Part 50 (construction permit, operating license)
  - 10 CFR Part 52 (standard design certification, combined license, standard design approval, manufacturing license)
- RG 1.247 is being coordinated with 10 CFR Part 53 rulemaking effort
- RG 1.247 applies to stationary NLWRs only



# Endorsed Technical Elements

All 18 technical elements in NLWR PRA standard:

1. Plant Operating State Analysis
2. Initiating Event Analysis
3. Event Sequence Analysis
4. Success Criteria Development
5. Systems Analysis
6. Human Reliability Analysis
7. Data Analysis
8. Internal Flood PRA
9. Internal Fire PRA
10. Seismic PRA
11. Hazards Screening Analysis
12. High Wind PRA
13. External Flooding
14. Other Hazards PRA
15. Event Sequence Quantification
16. Mechanistic Source Term Analysis
17. Radiological Consequence Analysis
18. Risk Integration

... and ASME/ANS RA-S-1.4-2021:

- Definitions and risk assessment application
- PRA configuration control
- Notes in the nonmandatory appendices
- Peer review requirements
- Newly developed methods

# Some Background Information

- NLWR PRA standard includes about:
  - 247 high level requirements (HLRs)
  - 1,233 supporting requirements (SRs)
  - 617 notes in the nonmandatory appendices
  - 238 definitions
- About 80% of the requirements in the NLRW PRA standard were taken as-is from the set of LWR PRA standards
- NRC staff submitted 489 comments during the first consideration ballot (May 2020)
- NRC staff submitted 70 comments during recirculation ballot (August 2020)

# Bases for the Staff Positions

- JCNRM did not address about 20 staff comments during ballot process stating that comment needs to be addressed first in the LWR Level 1/LERF PRA standard
- 8 comments were considered as regulatory issues
- Some comments were not satisfactorily addressed during balloting
- Some comments were not fully addressed by the JCNRM
- Staff positions in RG 1.247 were developed to be consistent with the staff positions in RG 1.200, Rev. 3
- New considerations after balloting

# Staff Position Categories

Each staff position is categorized into:

- **No objection** - The staff has no objection to the requirement
- **No objection with clarification** - The staff has no objection to the requirement, however, clarified its understanding of these requirements
  - Generally speaking, this includes cases where a statement is judged to be ambiguous enough to be mis-interpreted and the acceptability of the PRA may be impacted
- **No objection subject to the following qualification** - The staff has a technical concern with the requirement and provided a qualification to resolve the concern
  - Generally speaking, this includes cases where a statement is judged to have a specific technical issue and the acceptability of the PRA may be impacted

# Staff Positions on NLWR PRA Standard

- There are currently 147 staff endorsement positions in RG 1.247, Appendix A
  - 33 qualifications
  - 114 clarifications
- Staff positions may change after considering ACRS comments

# Endorsement of NEI 20-09 PRA Peer Review Guidance

- NRC staff received NEI 20-09, Rev. 0 on June 1, 2020
- Staff reviewed and provided observations during a public meetings
- NEI addressed and submitted Rev. 1 of NEI 20-09 on May 5, 2021
- NEI 20-09, Rev. 1, is based on a related industry PRA peer review guidance document, NEI 17-07, Rev. 2, “Performance of PRA Peer Reviews Using the ASME/ANS PRA Standard,” as endorsed by RG 1.200, Rev. 3
- The staff finds that the guidance in NEI 20-09, Rev. 1, is acceptable and thus endorses NEI 20-09, Rev. 1, without exception, in RG 1.247, Section C.2.2

# Next Steps

- Consider feedback from ACRS and external stakeholders
- Public meeting – early November 2021
- Issue RG 1.247 for trial use – early 2022
- Duration of the trial-use period will depend on timing of the next published versions of PRA standards, rulemakings, and feedback from early uses
- Brief ACRS on future changes to the RG

# Acronyms

- **ACRS** - Advisory Committee on Reactors Safeguards
- **ANS** - American Nuclear Society
- **ASME** - American Society of Mechanical Engineers
- **10 CFR** – Title 10 of the *Code of Federal Regulations*
- **JCNRM** - Joint Committee on Nuclear Risk Management
- **LERF** - large early release frequency
- **LPSD** - low-power and shutdown
- **LWR** - light-water reactor
- **NEI** - Nuclear Energy Institute
- **NEIMA** - Nuclear Energy Innovation and Modernization Act
- **NLWR** - non-light water reactor
- **NRC** - Nuclear Regulatory Commission
- **QHO** - quantitative health objective
- **POS** - plant operating state
- **PRA** - probabilistic risk assessment
- **RG** - regulatory guide
- **RIDM** - risk-informed decision making



# **GALILEO Implementation in LOCA Methods (ACRS Full Committee)**

**Andrei Burghilea**

**10/05/2021**

# CONTENT

Introduction

What is intended

How it is accomplished

Why it is acceptable

Summary

# Introduction and Background

- Current LOCA topical reports – S-RELAP5 based:
  - SBLOCA
    - EMF-2328P-A (March 2001) and EMF-2328 Supplement 1P-A (December 2016)
    - Current fuel performance code – RODEX2
    - 10 CFR 50 Appendix K EM
  - RLBLOCA
    - EMF-2103P-A Revision 3 (June 2016)
    - Current fuel performance code – COPERNIC
    - Realistic EM (BEPU)
- Applicable to Westinghouse (3 and 4 loop) and Combustion Engineering plants

# What is intended

- Purpose of new topical report is to add the fuel performance code GALILEO to LOCA methods
  - GALILEO (ANP-10323P-A Revision 1) - Approved November 2020
- Supplementing the RLBLOCA EM and SBLOCA EM to include GALILEO
- Support future Framatome objectives (addressed separately)
  - Increased enrichment and burnup
  - Chromia-doped fuel and Chromium coated cladding

# How it is accomplished – SBLOCA Implementation

- Regulatory Requirements
  - NUREG-0800
  - 10 CFR 50 Appendix K
- EM Requirements
  - Analysis purpose, transient class, power plant class
  - Figures of merit
- Assessment Data Base
  - Only LOFT tests include nuclear fuel - LOFT Small Break Tests L3-6 / L8-1
- EM Changes
- Assessment Results for LOFT Small Break Tests L3-6 / L8-1
- Sample Problem

# How it is accomplished – RLBLOCA Implementation

- Regulatory Requirements
  - NUREG-0800
  - RG 1.157
  - RG 1.203 – Graded Approach to EMDAP
- EM Requirements
  - Analysis purpose, transient class, power plant class
  - Figures of merit
  - PIRT Review
- Assessment Base
  - Only LOFT tests include nuclear fuel
  - LOFT L2-3, L2-5, LP-02-6 and LP-LB-1
- EM Changes
- Assessment of LOFT LBLOCA Tests L2-3, L2-5, LP-02-6 and LP-LB-1
- Sample Problem

# Why it is acceptable

- GALILEO an acceptable FPC
- EM evolution adding one FPC with the same functionality as current methods
- Assessment Results for LOFT SBLOCA Tests – good agreement with data
- SBLOCA Sample Problem – good agreement with current method
- Assessment of LOFT LBLOCA Tests – good agreement with data
- RLBLOCA Sample Problem – good agreement with current method

# Summary

- Straight forward process COPERNIC/RODEX2 ⇒ GALILEO
- EM evolution supporting future objectives
- Analysis workflow unchanged for both methods
- Assessments against benchmarks show good results
- Comparisons to current approved methods show good agreement



# Acronyms

- BEPU – Best-Estimate Plus Uncertainty
- EM – Evaluation Model
- EMDAP – Evaluation Model Development and Assessment Process
- FPC – Fuel Performance Code
- LOCA – Loss-of-Coolant Accident
- LOFT – Loss of Fluid Test
- LBLOCA – Large Break LOCA
- RLBLOCA – Realistic LBLOCA
- SBLOCA – Small Break LOCA
- TR – Topical Report

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## **NRC STAFF EVALUATION OF FRAMATOME**

### **TOPICAL REPORT**

**ANP-10349P, REVISION 0, GALILEO IMPLEMENTATION IN LOCA**

**METHODS**

### **OPEN SESSION**

**Mathew Panicker  
Nuclear Methods and Fuel Analysis Branch  
(NRR/DSS/SFNB)**

**ACRS Full Committee Meeting  
October 5, 2021**

# PRESENTATION OUTLINE

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- Background
- Applicable Regulation and Guidance
- GALILEO Implementation in S-RELAP5 and RLBLOCA
- GALILEO Implementation in S-RELAP5 and SBLOCA
- GALILEO Implementation in LOCA EM – Conclusion

# BACKGROUND

- **RLBLOCA**
  - EMF-2103-P-A, Revision 3 (2016) - used S-RELAP5/COPERNIC combination for initialization conditions for thermal hydraulics (T-H) Code.
- **SBLOCA**
  - EMF-2328 (2001) and its Supplement (2016) - used S-RELAP5/RODEX2 Combination for Initialization Conditions for T-H Code.
- **Fuel Performance Code GALILEO**
  - ANP-10323-P Revision 1, Approved in 2020
  - The GALILEO code models the thermal-mechanical behavior of the fuel rods during normal operation and transient scenarios.
- Framatome intends to supplement GALILEO methodology to its RLBLOCA and SBLOCA methodology.

# APPLICABLE REGULATION & GUIDANCE

- 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems (ECCS) for Light-Water Nuclear Power Reactors"
- 10 CFR Part 50 Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 35, "Emergency core cooling"
- Chapter 6.3, "Emergency Core Cooling System," of the Standard Review Plan (SRP) provides guidance for performing the system review of the ECCS.
- Chapter 15.6.5, "Loss of Coolant Accidents," of the SRP provides guidance for performing reviews of loss of coolant accident (LOCA) analyses



# GALILEO IMPLEMENTATION IN S-RELAP5 AND RLBLOCA

## ■ EM

- GALILEO code is added analysis to S-RELAP5 T-H fuel and T-H Calculations in RLBLOCA methodology.

## ■ Staff Evaluation

- Conducted audit and issued RAIs to confirm documentation for GALILEO/S-RELAP5 Hybrid scheme and SBLOCA sensitivity analysis.
- Verified the LOFT tests used to assess the base for the supplemental RLBLOCA EM and benchmarked using the coupled S-RELAP5/GALILEO.
- Sample problem is similar to the problem presented in the approved RLBLOCA evaluation and methodology TR was solved (Appendix B, EMF-2103-P-A, Revision 3).

## ■ Results

- The LOFT Tests and Sample problem results indicate reasonable agreement between GALILEO and COPERNIC.

# GALILEO IMPLEMENTATION IN S-RELAP5 AND SBLOCA

- EM
  - GALILEO code supplements RODEX2 in SBLOCA analysis for S-RELAP5 T-H fuel and T-H Calculations.
- Staff Evaluation
  - The LOFT tests were used to assess the base for the supplemental SBLOCA EM and benchmarked using the coupled S-RELAP5/GALILEO.
  - Sample problem is similar to the problem presented in the approved RLBLOCA evaluation and methodology TR was solved (EMF-2328 P-A).
- Results
  - The LOFT Tests and Sample problem results indicate reasonable agreement between GALILEO and RODEX2.

# **GALILEO IMPLEMENTATION IN LOCA EM - CONCLUSIONS**

- The NRC staff found that the process and the results from the supplemental evaluation model (ANP-10349P) for both RLBLOCA and SBLOCA supplements both COPERNIC and RODEX2 with GALILEO.
- LOFT tests and sample problems results shows there is reasonable agreement between GALILEO and COPERNIC/RODEX2 for both RLBLOCA and SBLOCA analyses.
- RLBLOCA and SBLOCA supplemental evaluation models (ANP-10349) satisfies applicable regulations and guidance in SRP.
- Framatome shall publish the approved version of ANP-10349P as supplemental TR to the final approved versions of EMF-2103 and EMF-2328.

# ACRONYMS

- CE Combustion Engineering
- ECCS Emergency Core Cooling System
- EM Evaluation Model
- FPC Fuel Performance Code
- LBLOCA Large Break Loss of Coolant Accident
- LOCA Loss-of-Coolant Accident
- LOFT Loss-of-Fluid
- PWR Pressurized Water Reactor
- RLBLOCA Realistic Large Break LOCA
- SBLOCA Small Break LOCA
- SRP Standard Review Plan
- T-H Thermal Hydraulics
- W Westinghouse Electric Company