

Official Transcript of Proceedings
NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactors Safeguards
 Thermal Hydraulics Subcommittee
 Open Session

Docket Number: (n/a)

Location: teleconference

Date: Thursday, February 16, 2023

Work Order No.: NRC-2267

Pages 1-26

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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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 THERMAL HYDRAULICS

+ + + + +

THURSDAY

FEBRUARY 16, 2023

+ + + + +

The Subcommittee met via Teleconference,
at 8:30 a.m. EST, Jose March-Leuba, Chair, presiding.

COMMITTEE MEMBERS:

- JOSE MARCH-LEUBA, Chair
- RONALD G. BALLINGER, Member
- VICKI M. BIER, Member
- CHARLES H. BROWN, JR., Member
- VESNA B. DIMITRIJEVIC, Member
- WALTER L. KIRCHNER, Member
- GREGORY H. HALNON, Member
- DAVID A. PETTI, Member
- JOY L. REMPE, Member
- MATTHEW W. SUNSERI, Member

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ACRS CONSULTANT:

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

KENT HOWARD

AGENDA

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Revision 0: HTP fuel assembly, Regulatory
Requirements, critical heat flux (CHF)
Testing and data, Subchannel Analysis code,
Correlation development and performance,
Correlation assessment and statistical
analysis 11

5. ANP-10311P, Revision 1, Supplement 1P,
Revision 0: OREFO-HMP CHR Correlation,
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February 21, 2023

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

2 8:30 a.m.

3 CHAIR MARCH-LEUBA: The meeting will now
4 come to order. This is a meeting of the Accident
5 Analysis Thermal Hydraulics Committee. I am Jose
6 March-Leuba, the Chairman.

7 In addition to in-person attendance at NRC
8 headquarters, the meeting is broadcast via MS Teams.
9 Members in attendance are Ronald Ballinger, Vesna
10 Dimitrijevic, Greg Halnon, Dave Petti, Joy Rempe, and
11 our consultant, Steve Schultz, is also present. We
12 expect Member Charles Brown to come here any minute.

13 MEMBER KIRCHNER: Jose, this is Walt. I'm
14 here too.

15 CHAIR MARCH-LEUBA: And I see that Walt
16 Kirchner has logged in and Matt Sunseri has logged in.
17 Anybody else?

18 MEMBER BIER: Jose, did you get my name?
19 I ducked out for a minute. This is Vicki.

20 CHAIR MARCH-LEUBA: So, Vicki Bier is also
21 here.

22 MEMBER BIER: Okay.

23 CHAIR MARCH-LEUBA: We have a full
24 complement of members. Today, we are reviewing
25 Supplement 1P of Topical Report AMP-10311P-A, or not

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1 A, entitled COBRA-FLX: ORFEO-HMP Critical Heat Flux
2 Correlation. Portions of our meeting will be closed
3 to the public to protect Framatome proprietary
4 information.

5 We have not received requests to provide
6 comments, but we have an opportunity for public
7 comments before the beginning of the closed section of
8 the meeting.

9 The ACRS was established by a statute and
10 is governed by the Federal Advisory Committee Act,
11 FACA. As such, the Committee only speaks through its
12 published letter reports.

13 The rules for participation in all ACRS
14 meetings were announced in the Federal Register on
15 June 13, 2019.

16 The ACRS section of the U.S. NRC public
17 website provides our charter, bylaws, agendas, letter
18 reports, and full transcripts for the open portions of
19 full and subcommittee meetings, including slides
20 presented there. The Designated Federal Official
21 today is Ken Howard.

22 A transcript of the meeting is being kept.
23 Therefore, speak into the microphones clearly and
24 state your name for the benefit of the court recorder,
25 and if you're in the conference room with many people

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1 on the line, please remember to identify yourself
2 regularly for the accuracy of the transcript. Please
3 keep all of your electronics and the microphone on
4 mute when not being used.

5 Members, I have reviewed the safety
6 evaluation and my conclusion would be to write a
7 positive ACRS letter recommending that the staff issue
8 the SER.

9 However, a full committee letter will
10 require a new presentation and will delay SER
11 publication by up to a couple of months, which I don't
12 think is worth it. Therefore, I am proposing that
13 according to our bylaws, we use the P&P approved
14 meeting summary procedure.

15 I will write a couple of paragraphs that
16 will be included in the official summary of this
17 meeting, and the full committee P&P approves it by a
18 vote. Think of it like a letter lite.

19 During the presentations today, keep in
20 mind if any item raises to the importance of requiring
21 a letter, in which case we will follow standard
22 procedure and write a letter during the full
23 committee.

24 Basically, if our letter would have said
25 great job, issue it, it is not worth delaying SER

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1 publication. If our letter will have substantive
2 comments that need to be addressed, the delay is
3 necessary. At the end of the meeting, I will poll you
4 about your opinion. Once more, the situation is
5 covered by our bylaws.

6 At this point, I'd like to request M.J.
7 Ross-Lee from the NRC staff to present her opening
8 remarks. M.J.?

9 MS. ROSS-LEE: Thank you. Good morning.
10 My name is M.J. Ross-Lee. I am the Deputy Division
11 Director of the Division of Safety Systems at NRR.

12 This topical report was one of two that
13 were used to test the efficiency of the regulatory
14 framework that was established in NUREG-KM-0013 for a
15 CHF topical report.

16 The staff performed a joint audit to
17 address both topical reports at the same time, which
18 further increased the efficiency of resource
19 allocation by both the agency and the applicant.

20 Framatome did their part in submitted
21 high-quality topical reports and responding to
22 requests for additional information in a timely
23 manner.

24 As a result, the safety evaluation for
25 this topical report review was completed in just five

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1 months, which is significantly shorter than the
2 average time of over 12 months for CHF topical reports
3 in the past.

4 We believe this type of regulatory
5 framework can be a large benefit to the NRC and are
6 actively developing frameworks in other technical
7 areas. And with that, I will pass it back. Thank
8 you.

9 CHAIR MARCH-LEUBA: Thank you for that
10 presentation and now we'll pass the microphone to
11 Framatome. Gayle Elliott, I believe you have some
12 opening remarks, or anybody from --

13 MS. ELLIOTT: Yes, this is Gayle Elliott
14 and I am the Director of Licensing and Reg Affairs for
15 Framatome.

16 And first of all, good morning, and
17 welcome to the ACRS subcommittee members, NRC staff,
18 and our own Framatome Inc. staff for attending our
19 discussion today on the ORFEO-HMP Critical Heat Flux
20 Correlation topical report.

21 This health report was a result of the
22 efforts of their fuel organization's Mihnea
23 Anghelescu, Bob Baxter, and Marc Dziuba, as well as
24 one of your own former staff, Tony Attard. Their time
25 and efforts resulted in a quality submittal to the NRC

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1 in December of 2021 and NRC's review of the topical
2 report in less than a year.

3 So, thank you, gentlemen, Mihnea, and
4 Marc, for your efforts, but I'd also like to recognize
5 Dr. Kaizer for his detailed review of the report and
6 the timely and efficient manner in which he performed
7 his review.

8 Framatome has found that Dr. Kaizer is one
9 of the leading reviewers who can successfully perform
10 an audit for understanding at our facility and have a
11 safety evaluation substantially drafted before he
12 leaves the facility.

13 So, as I discussed in our ACRS
14 Subcommittee meeting yesterday, Framatome's objective
15 is to get innovation and improved performance methods
16 to the industry, and with our submittal and NRC's
17 review, when it is as cohesive and efficient as the
18 review on this topical report, then we are able to
19 meet that objective, so thank you as well, Dr. Kaizer.

20 So, as we continue to work towards quality
21 reports for all of our submittals, I'd like to
22 encourage the NRC to continue to develop their own
23 reviewers to be able to perform audits for
24 understanding that result in a draft SE during the
25 audit or in a short duration afterwards.

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1 I understand some of our topical reports
2 are more complex than others and it may take more than
3 one audit for understanding, but we have found that if
4 there's a large time lapse between audits and
5 discussions with our subject matter experts, then
6 context and understanding sometimes may not be as
7 distinct.

8 So, that concludes my opening remarks, and
9 again, thank you for your attendance today.

10 CHAIR MARCH-LEUBA: Thanks, Gayle. I'd
11 like to note for the record that Member Brown has
12 joined us, so we now have full contingent of our
13 members.

14 And as I said in my introductory remarks,
15 ACRS only speaks through letter reports and we have
16 spoken on this topic before, and it's related to what
17 Gayle was talking about of the quality of the review
18 that Dr. Kaizer performs.

19 So, I wanted to, even though ACRS wrote a
20 letter on that, I wanted to put my personal opinion
21 that Gayle is right. The moment I saw who had written
22 the SER, I knew we wouldn't have any problems.

23 With that in mind, let's go into the
24 Framatome presentation. Let me remind you that this
25 is the open session, so do not discuss any data or any

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1 proprietary information.

2 So, for any member of the public that is
3 really interested, you will find that it's a little
4 short, but we members are going to dig into all of the
5 details and numbers in the closed session.

6 So, Framatome, it's your turn and you can
7 start sharing the slides in open session. So far, we
8 see no action.

9 MR. ANGHELESCU: Good morning, everyone.
10 My name is Mihnea Anghelescu. I'm a core thermal
11 hydraulics engineer with Framatome and I'm going to
12 present the ORFEO-HMP critical heat flux correlation.
13 So, I understand you want me to share the slides,
14 right?

15 CHAIR MARCH-LEUBA: Yes, you were going to
16 share the slides, right?

17 MR. ANGHELESCU: Okay.

18 CHAIR MARCH-LEUBA: I don't know.

19 MR. ANGHELESCU: Give me a second, please.

20 CHAIR MARCH-LEUBA: We can see a screen.
21 Can you maximize it somehow so we can actually read
22 it?

23 MR. ANGHELESCU: Can you see it now?

24 CHAIR MARCH-LEUBA: No, we are seeing your
25 desktop.

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1 MR. ANGHELESCU: Okay.

2 MR. OTTO: I can share if you want me to,
3 Mihnea.

4 (Simultaneous speaking.)

5 MR. OTTO: This is Ngola. Just let me
6 know if you wanted me to share. I can share.

7 MR. ANGHELESCU: Yes, I'd prefer you to
8 share.

9 MR. OTTO: All right.

10 CHAIR MARCH-LEUBA: And you will have to
11 stop sharing first or maybe you can link it all by
12 yourself, Ngola.

13 MR. OTTO: If you can please stop sharing,
14 Mihnea, I'll go ahead and share.

15 MR. ANGHELESCU: Yeah, give me a second,
16 please.

17 MR. OTTO: Sure, no problem.

18 CHAIR MARCH-LEUBA: Are you a presenter?

19 MR. ANGHELESCU: Give me a second, please.
20 Okay, I can see now, yes.

21 CHAIR MARCH-LEUBA: Okay, Mihnea, you can
22 go ahead. We can see everything.

23 MR. ANGHELESCU: Yeah, so good morning,
24 everyone, again. My name is Mihnea Anghelescu. I'm
25 a core thermal hydraulics engineer with Framatome and

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1 I'm going to present the ORFEO-HMP critical heat flux
2 correlation. Next slide, please?

3 So, I'm going to discuss the HTP fuel
4 assembly design and the ORFEO-HMP version of the
5 capability to this fuel assembly design. I'm going to
6 discuss the regulatory requirements for this
7 correlation, the CHF testing and data, the subchannel
8 analysis code, the correlation development and
9 performance, and then the correlation assessment and
10 statistical analysis. Next slide, please?

11 This is a list of acronyms that are common
12 throughout the presentation slides. Next, please?

13 CHAIR MARCH-LEUBA: Well, at this point,
14 this is the end of your presentation.

15 MR. ANGHELESCU: It is through, yes.

16 CHAIR MARCH-LEUBA: So, if you could give
17 us a summary? I see you don't have a slide here that
18 summarizes. What have you done? What is the ORFEO
19 correlation used for? And what are the conclusions?
20 Anything that you can say in the open session, nothing
21 propriety.

22 MR. ANGHELESCU: Yes, I can discuss a
23 little bit of correlation. So, essentially, ORFEO-HMP
24 CHF correlation is applicable to the HTP fuel assembly
25 design. This is a standardized fuel assembly design

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1 that's produced by Framatome and delivered to our
2 customers.

3 The HMP correlation is applicable for the
4 entire fuel end of the assembly. In terms of
5 regulatory requirements, we use 10 CFR 50, GDC 10. IN
6 terms of CHF data, we collect the data in each of the
7 facilities and the data was not new for this
8 correlation. It was before.

9 In terms of subchannel code analysis, we
10 use COBRA-FLX, which is fully approved by the NRC.
11 For correlation development and performance, we use
12 the framework that is described in NUREG-0013, and the
13 statistical analysis was performed using standardized
14 statistical methods. That's pretty much it.

15 CHAIR MARCH-LEUBA: Okay, thank you very
16 much.

17 MR. ANGHELESCU: Thank you.

18 CHAIR MARCH-LEUBA: So, at this point, we
19 will transfer the open session to the staff which has
20 a little more longer slides.

21 MEMBER KIRCHNER: Jose, this is Walt. I
22 have a question for levity.

23 CHAIR MARCH-LEUBA: Please.

24 MEMBER KIRCHNER: What does ORFEO stand
25 for? Orfeo is famous Greek mythology and Monteverdi's

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1 first modern opera, in fact, the first modern opera is
2 1600s. So, what's ORFEO stand for?

3 MR. ANGHELESCU: So, yes, it comes from
4 the Greek mythology, I believe. I didn't propose this
5 name, but the idea was not to produce here an acronym,
6 but to take a name from history, from the past, so it
7 doesn't stand for anything in particular.

8 MR. KAIZER: When we went to see some test
9 data -- Jeff Kaizer, NRC staff. The staff visited the
10 Karlstein test facility and we actually commented on
11 it. I think I lost a dollar because I was sure that
12 AREVA was just trying to spell Oreo and misspelled it.

13 But they, I think, had a number of things
14 that were developed that were based on that kind of
15 Greek literature, and I'm not sure if ARITA falls in
16 there because I don't know about that area, but I know
17 there were a number of different names. They were
18 trying to come up with some interesting back stories.

19 MR. ANGHELESCU: ARITA is an acronym.
20 ARTEMIS is from the Greek mythology, I believe.

21 CHAIR MARCH-LEUBA: Excellent. Any more
22 questions?

23 MR. KAIZER: All right, so Josh Kaizer,
24 NRC staff. I was the lead reviewer for this, and
25 primarily the reason we're here is the COBRA-FLX

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1 ORFEO-HMP critical heat flux correlation, but there
2 was also another correlation associated with this,
3 which was the Biasi CHR correlation, and they looked
4 very different if you saw the documents that came in.

5 One came in as a supplement to a topical.
6 One seemed to come in under, I think it was EMF 23-10
7 as a supplement, but they were both CHF correlations.
8 They came in around the same time, and so the staff
9 reviewed them pretty much at the same time.

10 It was because when you're looking at CHF
11 correlations, you're generally looking at the same
12 things, so it was just a very good efficiency gain and
13 the -- I remember having the discussion with my branch
14 chief at the time, Bob Lukes, about how we would
15 perform this review.

16 The NRC staff, like everybody else, you're
17 always worried about okay, we take, use this as a
18 training exercise for someone new, have them more
19 involved in it, and at the time, we said, you know,
20 we've developed this NUREG. We've used this NUREG a
21 lot. We want to see how much we can actually push
22 this.

23 And I kind of thought and discussed it
24 with my branch chief and said we have two options.
25 One, we can have someone else do the review and I can

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1 kind of do a peer review, or two, we can say okay, if
2 we really needed to, how fast can we get these reviews
3 done? And my branch chief said let's try that second
4 one, so that was kind of the main focus.

5 We wanted to use this as, I'd say
6 demonstration cases, even though this NUREG has been
7 used a number of times by different individuals, but
8 this was okay, how good can it get? So, the joint
9 review was also a new aspect. Sorry.

10 CHAIR MARCH-LEUBA: Yeah, first, for the
11 transcript, you're talking about NUREG-KM?

12 MR. KAIZER: Correct, yes.

13 CHAIR MARCH-LEUBA: I&C still says draft.

14 MR. KAIZER: Yes.

15 CHAIR MARCH-LEUBA: It was like four years
16 that we've been --

17 MR. KAIZER: Yes, and I'm glad you're
18 yelling at me for this because the last time I
19 presented in front of the ACRS, I specifically asked
20 you guys to yell at me to get the NUREG-KM done
21 because I had had it mostly done. I had a couple of
22 public comments, some changes to make, and it was very
23 hard, but I had resources to it.

24 I mean, I just had, every time I'd go
25 back, there was always other things popping up, and

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1 because I knew I had to come back here today, after
2 you yelled at me then, I made sure that earlier this
3 week, I actually turned it all over to the person who
4 is doing peer review.

5 So, I was literally writing Tuesday,
6 finishing it up. Okay, I've got all of the comments
7 addressed. I've got all of the updates. It's now
8 going to that peer review person.

9 I expect Newsham (phonetic), she'll
10 probably look at it within a month or two because of
11 just other priorities, and then after that, it will go
12 to OGC to be finalized.

13 So, I am, I'm grateful for that, and we
14 actually used the ACRS letter as a part of the
15 abstract in the NUREG saying hey, we not only
16 developed it, but we used this and it works.

17 Side note, I do a lot of stuff for VVUQ
18 and everybody loves coming up with frameworks. Oh,
19 you should use this framework to determine if you can
20 trust your model or simulation. And the biggest
21 problem with almost every framework I've seen is
22 nobody validates them.

23 Nobody actually uses their framework and
24 says hey, does this actually work? And I think that's
25 one of the biggest advantages of this framework.

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1 We've used it and I was counting coming in this
2 morning. It's about ten or 11 times, and so it's been
3 really successful. It works.

4 We wanted to focus on efficiency, review
5 efficiency, and here we got very, I'll say lucky,
6 fortunate. Framatome, and I don't know, okay, yeah,
7 so Framatome provided a very high-quality submittal,
8 and the NRC has used that term multiple times and it's
9 sometimes hard to judge what it is, but here, I think,
10 a high-quality submittal was a submittal that
11 addresses all of the things that you need to make that
12 regulatory decision.

13 And so, what you're going to hear more in
14 the closed session are there weren't really any major
15 issues. Like almost always when I go to a CHF
16 correlation, there are certain major issues that I
17 find. Here, Framatome had already found them and
18 addressed them, and so when I was reading the topical,
19 it was like well, there's not a ton for me here to do.

20 On those couple of issues -- oh, okay, on
21 those couple of issues where we did have some minor
22 review issues, and we'll go into those and that's what
23 I'm going to highlight, Framatome actually kind of
24 thought about those, addressed those, already had the
25 plots, just didn't put it in the topical.

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1 So, I think that having this type of
2 NUREG, having this very clear technical guidance, it
3 allows high quality submittals to go through, and I
4 think M.J. said like we had a cost savings of review
5 time of like over 50 percent, so compared to other
6 topical, the review time for this was less than 50
7 percent --

8 CHAIR MARCH-LEUBA: So, in your opinion,
9 NUREG-KM-0013 was not only used for the review, but it
10 was also used to generate a topical report?

11 MR. KAIZER: Yeah.

12 CHAIR MARCH-LEUBA: So, they used it with
13 your review in mind.

14 MR. KAIZER: Yeah.

15 CHAIR MARCH-LEUBA: So, that, the
16 fastness, and the quickness, and the efficiency of the
17 review --

18 MR. KAIZER: Yeah.

19 CHAIR MARCH-LEUBA: -- was a two-way
20 street.

21 MR. KAIZER: Yeah, for us, and it's
22 similar to like a reg guide where a reg guide, ideally
23 the reg guide is what the industry gets and they write
24 their document according to the reg guide, and then
25 the standard review plan is what the staff uses to

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1 review the document.

2 Sometimes there isn't a one to one parity
3 between the two, but usually the industry knows hey,
4 this is what the staff is going to look for, and so
5 here, because we were able to clearly say hey, these
6 are all of the things we're looking for, we could get
7 that.

8 It's important to me as a regulator that
9 I don't want my review to just be an extra 200 or 300
10 hours. To me, the goal is to bring every approved
11 method up to a certain level, and if it comes in very
12 far below the level, it might take 200 or even 2,000
13 hours to bring it up to the level, but if that method
14 is already really close to at that level, it should
15 just be documentation and that's it.

16 So, I think having this type of reg guide
17 or, sorry, NUREG is extremely helpful in that area.
18 I think Joy has a comment or question.

19 MEMBER REMPE: Sure, thank you. I was
20 impressed with the opening statements made on your
21 behalf, Josh, and I know what you mean when you say
22 that ACRS was yelling at you, that you meant that we
23 gently nudged you, but this is the transcript for it
24 that can be preserved, and some folks, and I can't
25 imagine why, think ACRS isn't a friendly, professional

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1 organization, and so perhaps we ought to correct the
2 transcript to -- I was present in those meetings and
3 I don't think anyone yelled at you at all.

4 (Laughter.)

5 MEMBER REMPE: So, if you don't mind, for
6 ACRS' benefit, perhaps some corrections or
7 modifications to that statement?

8 MR. KAIZER: Absolutely. To clarify, I
9 requested the ACRS, well, I say yell at me, but I
10 asked that you guys provide me with that deadline
11 because I knew that if you provided me with a
12 deadline, I would now have a justification, and then
13 you certainly provided me with the deadline and then
14 I could actually meet that deadline. So, is that --
15 hopefully that's a good enough correction.

16 MEMBER REMPE: Yes, that's a more, I
17 think, factual way of putting it. Thank you very
18 much.

19 MR. KAIZER: Sure.

20 DR. SCHULTZ: Josh, this is Steve Schultz.
21 Just for clarity in terms of the overall process, in
22 using the NUREG and setting up for this review, then
23 early on in the process, you set the structure that's
24 shown in the safety evaluation?

25 MR. KAIZER: Yes, this is the --

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1 DR. SCHULTZ: All of the elements that --

2 MR. KAIZER: Yeah.

3 DR. SCHULTZ: -- would be essentially
4 filled in by you at the end of the evaluation so that
5 the applicant, so Framatome knew what was expected --

6 MR. KAIZER: Yes.

7 DR. SCHULTZ: -- right from the outset --

8 MR. KAIZER: Yes.

9 DR. SCHULTZ: -- and could work on
10 developing the details for your review throughout the
11 process?

12 MR. KAIZER: Correct, I would say the
13 structure was, I think the first time we were really
14 developing it was in 2017. So, I mean, we had
15 previously used this with the OREFO-CHF correlation.
16 I think that was actually one of the first ones that
17 we used the NUREG on, so Framatome was well aware of
18 it.

19 On a side note, we've had some challenges
20 with some critical heat flux and critical power,
21 because this works for both correlations, where we've
22 seen some interesting data appear in the real world,
23 and one of the things that made us very happy with the
24 framework was those challenges didn't have us adjust
25 the framework, like the framework already had areas

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1 where it would identify those.

2 So, this is, I think, is very robust in
3 terms of if you can address all of these issues, then
4 you have a CHF or critical power correlation that can
5 be considered credible.

6 DR. SCHULTZ: That helped with our review
7 also.

8 MR. KAIZER: Yeah. So, the summary for
9 the open session, we think the credibility frameworks,
10 we know they can resolve the large efficiency
11 increases. On average, it's about 50 percent. I've
12 actually got a couple of different data points for
13 that where I've seen that consistently.

14 And I think one of the major issues here,
15 or not major issues, but major benefits is that while
16 I think these frameworks are good in general for
17 bringing all reviews up to the same standard, if you
18 do give a high-quality review, you can get that much
19 faster turnaround at less resources.

20 And then the last thing, which is what
21 you'll see mostly in the closed slides, is I'll go
22 over those remaining issues that Framatome didn't
23 address and just how they were easily resolved.

24 So, yeah, the final is my conclusion. The
25 NRC staff believes the CHF correlation's design limit

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1 has the same predictive capability as other
2 correlations the staff had previously approved. So,
3 that is the end of my open session if there are any
4 questions or comments.

5 CHAIR MARCH-LEUBA: Thank you, Josh. Any
6 more comments or questions from the members?

7 MEMBER KIRCHNER: Jose, I think I should
8 finish the story. It's rather early in the morning.
9 Orfeo went into the underworld to rescue his beloved,
10 Eurydice, and he sang so well that he convinced the
11 gods of the underworld to let her come back to the,
12 you know, the real world, but on the way back, there
13 was a condition.

14 Don't look back, but he did, and they
15 turned her into stone. So, my -- I guess the lesson
16 here or the parable is don't look back. Move forward.
17 Let's get onto the closed session.

18 (Laughter.)

19 CHAIR MARCH-LEUBA: Any more Orfeo
20 references? So, at this point, I would like to open
21 the microphone to any members of the public that would
22 want to raise a comment on the record? If so, just
23 unmute yourself and state your comments.

24 Hearing none, we are going to go on a
25 recess on this line. In a moment, we are going to

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1 transfer to the closed session, which is to say
2 everybody that is somebody has a link to the closed
3 session, but it's going to take us ten minutes to
4 unmute everybody in the lobby to make sure that they
5 are allowed to see the proprietary information.

6 So, let's restart at 9:10. So, we'll go
7 on recess until 9:10. We will not come back to this
8 line and we will continue the meeting on the closed
9 link. So, we're on recess.

10 (Whereupon, the above-entitled matter went
11 off the record at 8:56 a.m.)

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U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

NRC Staff Safety Evaluation:
**COBRA-FLX: ORFEO-HMP Critical Heat
Flux Correlation**
(open session)

Joshua Kaizer

NRR/DSS/SFNB

February 16, 2023

ORFEO-HMP and Biasi CHF

- Demonstration cases of DRAFT NUREG/KM-0013 – CHF CAF.
- Two topical reports were performed in a joint review.
- Review efficiency was a large focus.
- NUREG was necessary for maintaining the same standard.
- NUREG demonstrated that these were “high quality” submittals.



Summary

- Creditability Assessment Frameworks can result in large efficiency increases – estimated resource savings of over 50%.
- Framatome had already addressed the major issues which would have been the staff concerns.
- The NRC staff raised some minor issues which were easily dispositioned.
- The NRC staff believes the CHF correlation and its associated design limit has the same predicative capability as the other CHF correlations that staff has previously approved.



The ORFEO-HMP Critical Heat Flux Correlation

Mihnea Anghelescu, US PWR Fuels, Framatome

Rockville, MD, 02/16/2023

CONTENT

1. HTP Fuel Assembly
2. Regulatory Requirements
3. CHF Testing and Data
4. Subchannel Analysis Code
5. Correlation Development and Performance
6. Correlation Assessment and Statistical Analysis

Acronyms

- ANOVA – Analysis of Variance
- ARITA – ARTEMIS/RELAP Integrated Transient Analysis Methodology
- BOHL – Beginning of Heated Length
- CE14x14 – Combustion Engineering type 14x14 fuel assembly design for PWRs
- CE16x16 – Combustion Engineering type 16x16 fuel assembly design for PWRs
- CHF – Critical Heat Flux
- DNB – Departure from Nucleate Boiling
- EOHL – End of Heated Length
- GAIA – Framatome's PWR fuel assembly and grid design
- GT – Guide Tube
- IFM – Intermediate Flow Mixer
- HMP – HMP grid design
- HTP – HTP grid design
- M/P – Measured CHF divided by predicted CHF
- MSLB – Main Steam Line Break
- OEFE0 – Framatome's CHF correlation form for PWR fuel assemblies
- PWR – Pressurized Water Reactor
- W15x15 – Westinghouse type 15x15 fuel assembly design for PWRs
- W17x17 – Westinghouse type 17x17 fuel assembly design for PWRs

Begin CLOSED SESSION

