

**Official Transcript of Proceedings**  
**NUCLEAR REGULATORY COMMISSION**

Title: Advisory Committee on Reactor Safeguards  
Kairos Power Licensing Subcommittee

Docket Number: (n/a)

Location: teleconference

Date: Wednesday, March 1, 2023

Work Order No.: NRC-2289

Pages 1-160

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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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KAIROS POWER LICENSING SUBCOMMITTEE

+ + + + +

WEDNESDAY

MARCH 1, 2023

+ + + + +

The Subcommittee met via Teleconference,  
at 8:30 a.m. EST, David A. Petti, Chair, presiding.

COMMITTEE MEMBERS:

DAVID A. PETTI, Chair

RONALD G. BALLINGER, Member

VICKI M. BIER, Member

CHARLES H. BROWN, JR., Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

JOY L. REMPE, Member

MATTHEW W. SUNSERI, Member

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ACRS CONSULTANTS :

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL :

WEIDONG WANG

C O N T E N T S

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Meeting Adjourned

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

8:30 a.m.

CHAIR PETTI: Okay. The meeting will now come to order. This is a meeting of the Kairos Power Licensing Subcommittee of the Advisory Committee on Reactor Safeguards.

I'm David Petti, Chairman of today's Subcommittee meeting. ACRS Members in attendance are Charles Brown, Jose March-Leuba, Joy Rempe, Matt Sunseri, Ron Ballinger, Walt Kirchner, Vesna Dimitrijevic, Vicki Bier, and Greg Halnon.

ACRS Consultants Dennis Bley and Stephen Schultz are also present remotely. Weidong Wang of the ACRS Staff is the Designated Federal Official for this meeting.

During today's meeting the Subcommittee will review the staff's safety evaluation on Kairos Power Hermes Non-Power Reactor Preliminary Safety Analysis. The Subcommittee will hear presentations by and hold discussions with the NRC Staff, Kairos Power representations and other interested persons regarding this matter.

First, we'll hear today about the standards that the staff uses to evaluate and test a non-power reactor, since most of what we review is

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1 power reactors, which is a slightly different  
2 standard. So, this is going to help us inform our  
3 review.

4 The rules for participation in all ACRS  
5 meetings, including today's, were announced in the  
6 Federal Register on June 13, 2019. The ACRS Section  
7 of the U.S. NRC public website provides our Charter,  
8 Bylaws, Agendas, Letters, and of course full  
9 transcripts of all full and subcommittee meetings,  
10 including slides presented there.

11 The meeting notice and agenda for this  
12 meeting were posted there. Today's meeting is open to  
13 public attendance. We have received no written  
14 statements or requests to make an oral statement from  
15 the public.

16 The Subcommittee will gather information,  
17 analyze relevant issues and facts, and formulate posi  
18 -- proposed positions and actions as appropriate for  
19 deliberation by the full Committee.

20 A transcript of the meeting is being kept  
21 and will be made available. Today's meeting is being  
22 held in person and over Microsoft Teams for ACRS Staff  
23 and Members, NRC Staff, and the Applicant.

24 There's also a telephone bridge line and  
25 a Microsoft Teams link allowing participation of the

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1 public.

2 When addressing the Subcommittee, the  
3 participants should first identify themselves and  
4 speak with sufficient clarity and volume so that they  
5 may be readily heard. When not speaking, we request  
6 that participants mute their computer microphone or  
7 phone by pressing start six.

8 We'll now proceed with the meeting. I'd  
9 like to start by calling up Bill Jessup.

10 MR. JESSUP: Thank you Member Petti for  
11 the opportunity to present to the Subcommittee today.  
12 I'm Bill Jessup, Chief of Advanced Reactor Licensing  
13 Branch One in the Division of Advanced Reactors in  
14 Non-Power Production and Utilization Facilities, or  
15 DANU in the Office of Nuclear Reactor Regulation or  
16 NRR.

17 Today the staff will be providing an  
18 overview of the strategy that's been implemented to  
19 support the staff's review of the Kairos Power  
20 Construction permit application for the Hermes test  
21 reactor.

22 Our recent interactions with the Kairos  
23 Subcommittee have focused on discrete issues related  
24 to the Kairos Power fluoride-cooled high temperature  
25 reactor technology, also referred to as the KP-FHR

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1 technology, including recent meetings on topical  
2 reports for graphite and metallic materials.

3 Today's presentation will be the first of  
4 many over the next several weeks, focused on the  
5 staff's review of the broader aspects of the KP-FHR  
6 technology as reflected in the Hermes construction  
7 permit application.

8 The staff's presentation this morning is  
9 going to cover the foundational aspects of the  
10 construction permit application and review strategy,  
11 including requirements and guidance that are specific  
12 to testing facilities and the license type under  
13 consideration.

14 The staff provided a similar presentation  
15 to the Subcommittee at the outset of the Hermes review  
16 in April 2022.

17 Given that we are nearing the end of the  
18 construction permit application review, and before we  
19 progress into more detailed presentations in the  
20 coming weeks, the staff felt it appropriate to revisit  
21 the aspects of the review strategy, and also provide  
22 some examples of how the strategy was implemented  
23 during the review.

24 The staff's looking forward to today's  
25 discussion. Always appreciative of the Committee's

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1 insights and comments.

2 And, with that, I'll turn it back over to  
3 you, Member Petti.

4 CHAIR PETTI: We're ready to start.

5 MR. JESSUP: Okay. I'll turn it over to  
6 Ben Beasley.

7 MR. BEASLEY: Thank you, Bill. Well, I am  
8 Ben Beasley. I am a Project Manager in the Advance  
9 Reactor Licensing Branch of DANU and NRR.

10 I'm the lead Project Manager for the staff  
11 safety review of the Kairos construction permit  
12 application for the Hermes test reactor. Presenting  
13 in a few minutes will be Jeff Schmidt, the lead  
14 technical reviewer for the application.

15 And, also here to help answer your  
16 questions is Ed Helvenston. Ed is also a Project  
17 Manager on the Hermes project and is in the Non-Power  
18 Production and Utilization Facility Licensing Branch.

19 We will provide a brief overview of the  
20 staff's review process and discuss a couple of  
21 examples of how we conducted the review of the  
22 preliminary design of a non-power testing facility.  
23 Next slide, please.

24 So, the review of applications for non-  
25 light water reactors such as Hermes, is an important

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1 milestone in advancing nuclear technologies in the  
2 United States. It is the responsibility of Kairos and  
3 other designers to demonstrate the safety of their  
4 designs.

5 The NRC staff must perform its mission of  
6 independently reviewing the safety of the designs in  
7 an efficient and effective manner. Accordingly, the  
8 staff's review of the preliminary design of Hermes was  
9 focused on matters that are most safety significant.

10 The scope of the staff's review of the  
11 design of a structure system or component was  
12 commensurate with the risk posed by that SSC.

13 Although the application provided only  
14 preliminary design of a testing facility, the mission  
15 of the staff is unchanged. We must have reasonable  
16 assurance of adequate protection to public health and  
17 safety.

18 MEMBER MARCH-LEUBA: Can I interrupt you  
19 in a moment?

20 MR. BEASLEY: Yes.

21 MEMBER MARCH-LEUBA: A PRA has not been  
22 before, correct?

23 MR. BEASLEY: Has not.

24 MEMBER MARCH-LEUBA: Okay. So, how do we  
25 determine what is risk significant?

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1           Let me be the devil's advocate and I'll  
2 give you an extreme. Why are you not deciding by the  
3 seat of your pants how this cuts corners in the  
4 review?

5           Explain to me that. Why not that?

6           MR. BEASLEY: And so, I -- two thoughts.  
7 First, it will be, you know, good for you to have the  
8 examples that Jeff presents in a few minutes.

9           And second, I didn't say risk  
10 significance, I said safety significance. And so,  
11 it's not based on a risk number. It's based on the  
12 design of the system and what is needed to assure safe  
13 shut down, you maintain subcriticality, you know,  
14 provide cooling, those types of things.

15           And so, the design informs what is, needs  
16 to be safety related.

17           MEMBER MARCH-LEUBA: I'm taking my  
18 argument to extreme, to give you an opportunity. I  
19 mean, I'm guessing there was application position,  
20 right?

21           You have some slides that only would say  
22 that you have not reviewed that method, because it's  
23 not needed for a construction license. We will do it  
24 later.

25           So, how do you know what the safety

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1 significance is if you have no confidential what they  
2 are?

3 I'm taking this is risk informed safety  
4 significant review to an extreme.

5 MR. BEASLEY: Right.

6 MEMBER MARCH-LEUBA: And will let you  
7 explain yourself. Jeff is dying here.

8 MR. SCHMIDT: I am. I am.

9 MR. BEASLEY: Well, I was going to say,  
10 let -- you know, it's probably a good discussion to  
11 have when he presents his examples.

12 MR. SCHMIDT: Yeah. You'll want to get  
13 into it when we go down the slide, like the second one  
14 down.

15 MEMBER MARCH-LEUBA: You know I'm talking  
16 about that.

17 MR. SCHMIDT: Yeah, yeah. We can talk  
18 about that.

19 MEMBER MARCH-LEUBA: I'm, you know, I'm  
20 not to raise a portion of this risk informed being a  
21 risk is mathematically and thoroughly performed  
22 properly.

23 It is not mathematically incorrect. It is  
24 often used improperly. And, I would like to use this  
25 as a forum for discussion of how we have used it.

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1                   And again, I'm exaggerating.     Okay?  
2     Before you do that.

3                   MR. BEASLEY: And one other quick thought,  
4     we didn't -- we didn't, I forget the term you used,  
5     trim back our review, you know, cut corners in the  
6     review.

7                   MEMBER MARCH-LEUBA: Right.

8                   MR. BEASLEY: We did not. You know, we  
9     reviewed everything in the application to the extent  
10    that information was provided, design information was  
11    provided.

12                   And so, again, you know, our mission was  
13    to assure that its safe. And --

14                   MEMBER MARCH-LEUBA: And the -- the scope  
15    of the review was commensurate with the risk caused by  
16    the design.

17                   MR. BEASLEY: So, we can -- yes. We can  
18    get into that --

19                   CHAIR PETTI: So, let me just --

20                   MR. BEASLEY: Now and in the future, in  
21    Chapter information.

22                   CHAIR PETTI: I might think very simply.  
23    Construction permit operating different standards. A  
24    non-power reactor power reactor, I think in that four  
25    quadrant box it will be helpful to kind of understand,

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1 you know, you're doing -- this is because that's a  
2 construction permit.

3 It would be the same if it were a power  
4 reactor or a non-power reactor. This is what I do  
5 because it's an S-reactor. But, this is a power  
6 reactor.

7 You know, both things are floating in it.

8 MR. BEASLEY: Um-hum.

9 CHAIR PETTI: I think we can get confused  
10 sometimes. You know, so you might -- we might ask you  
11 to say, okay, so if it were a power reactor, would it  
12 be different?

13 Would the standard be different here or  
14 not? So, we can figure out is it a CPOL issue? Or is  
15 it a non-power reactor power reactor?

16 MR. BEASLEY: Okay.

17 CHAIR PETTI: In terms of the standard.

18 MR. BEASLEY: Yeah. And, I think what  
19 we're presenting today will help --

20 CHAIR PETTI: Great.

21 MR. BEASLEY: Come up with that.

22 CHAIR PETTI: Great.

23 MR. BEASLEY: So, onto the next slide.

24 MR. SHAMS: If I may offer this here,  
25 because it's --

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1 MEMBER MARCH-LEUBA: Can you state your  
2 name?

3 MR. SHAMS: I'm going -- oh, sure. (Off  
4 mic comment) Thank you. Mo Shams, I'm with the  
5 staff.

6 So, I think these are incredibly important  
7 questions. You know, how were we risked informed?  
8 How did we apply the regulations?

9 But, I just wanted to make sure that we're  
10 reflecting that we did not take any corners or cut any  
11 corners in the review.

12 We've done the review as appropriately as  
13 -- for the CP level of information needed by the  
14 regulation and by the level of review associated with  
15 that, as well as what we need for a research reactor,  
16 or excuse me, a test reactor, Kairos is a test  
17 reactor, what we need for a test reactor.

18 We looked at the regulations, what's  
19 required. And we hopefully throughout the  
20 presentation today, we can particularly show you that.

21 It's not about a preference of a power  
22 reactor versus a non. At the end of the day, we need  
23 to make the safety case.

24 They're reactors. They're important for  
25 us to make sure that we've seen the information we

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1 needed to render the appropriate regulatory findings  
2 on them. And, hopefully we can show you how we've  
3 done that today.

4 MEMBER MARCH-LEUBA: Okay. If you keep  
5 that in mind during the presentation, I won't keep  
6 asking the same questions.

7 MR. BEASLEY: Okay. Okay. Well, and we  
8 may not fully answer, you know, your concern or your  
9 interest until we get into the Chapter presentations.

10 MEMBER MARCH-LEUBA: Yes. Just so you  
11 understand, life is a degree of grace and course.  
12 And, I'm reducing the area into black and white to  
13 make it more to the point where you have to come up  
14 with the answer. Whereas, it's 50 percent there.

15 (Off mic comments.)

16 MR. BEASLEY: Next slide, please. So, in  
17 accordance with NRC regulations and the Atomic Energy  
18 Act any Class 104c facility must be useful in the  
19 conduct of research and development activities.

20 In its construction permit application,  
21 Kairos states that it plans to apply for a Class 104c  
22 utilization facility operating license.

23 Accordingly, the staff conducted its  
24 review of the Hermes construction permit application  
25 consistent with the regulatory requirements that apply

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1 to testing facilities and support the conduct of  
2 widespread and diverse research and development.

3 Many -- in CFR Part 50 requirements are  
4 for power reactors and do not apply for testing  
5 facility requirements such as combustible gas control,  
6 ECCS requirement for LWRs, environment qualification  
7 of electrical equipment, ATWS, and many others.

8 Testing facilities are subject to the  
9 cited requirements in 10 CFR Part 100, including  
10 accident reference doses. Testing facilities are also  
11 subject to a few 10 CFR Part 509 requirements that do  
12 not apply to research reactors, including a required  
13 ACRS review of construction permit and operating  
14 license applications and mandatory hearings for the  
15 construction permit application. Next slide.

16 MEMBER BROWN: Does that mean you don't  
17 have to talk to us? Is that including the ACRS?

18 So, this is a courtesy? That's the way I  
19 read that sentence in that.

20 MR. BEASLEY: No, no. So, for a testing  
21 facility, we do have to talk to you. For a research  
22 facility, ACRS review is not required.

23 MEMBER BROWN: Okay. I didn't get that  
24 differentiation. I'm sorry.

25 MR. BEASLEY: That's okay.

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1 MEMBER BROWN: Now, what is this? Is  
2 this a testing facility?

3 MR. BEASLEY: This is a testing facility.

4 MEMBER BROWN: Not research?

5 MR. BEASLEY: Not a research facility,  
6 right.

7 MEMBER BROWN: Okay. All right. Thank  
8 you. I missed that nuance.

9 MR. BEASLEY: Yeah. And so, there are  
10 requirements in 10 CFR 50 that apply to testing  
11 facilities that do not apply to research facilities.

12 MEMBER BROWN: Thank you very much.

13 MR. BEASLEY: But then, there's also that  
14 distinction of requirements that apply to commercial  
15 licenses that do not apply to testing facilities. So,  
16 it's kind of the three levels in requirements in CFR  
17 50.

18 MEMBER BROWN: Well, my concern well, if  
19 this is some kind of parochial protection systems, it  
20 is a reactor.

21 MR. BEASLEY: Yes.

22 MEMBER BROWN: It does generate some  
23 power. And, it should have safe, reliable reactor  
24 protection and whatever -- whatever in lab safeguards  
25 are requirement, whatever those are.

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1 I mean, I'm not saying they are, but  
2 whatever they are. Okay.

3 MR. BEASLEY: Okay.

4 MEMBER BROWN: That was my concern when I  
5 saw that. We lost a bubble, thank you.

6 MR. BEASLEY: Okay.

7 MEMBER REMPE: I have a question actually.  
8 I know with Kairos it may not be a concern because  
9 they aren't a light water reactor.

10 But, I think you said in the prior slide  
11 that when you were talking about Part 50 requirements  
12 that for power reactors don't apply to testing  
13 facilities. And, you mentioned hydrogen, combustible  
14 gas generation,

15 MR. BEASLEY: Right.

16 MEMBER REMPE: You don't have to worry  
17 about it. If it were a water one, and it had  
18 circular-based cladding, you just won't worry about  
19 combustible gas generation?

20 MR. BEASLEY: If it's -- so, the  
21 combustible gas control rule does not, it only applies  
22 to power reactors.

23 So yes, if it was a water reactor testing  
24 facility, then the combustible gas and hydrogen  
25 control would not apply.

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1 MEMBER REMPE: That's good insight. That  
2 might be less that you're kind of missing something  
3 you might want to think about.

4 MR. BEASLEY: Well --

5 MEMBER REMPE: I'm just curious, because  
6 it doesn't apply -- if this is just --

7 MR. SHAMS: Dr. Rempe, if I'm -- yes, if  
8 I may comment on that, I'm sorry. If it's a relevant  
9 act, then we'll look at it, regardless of it.

10 MEMBER REMPE: I would hope so.

11 MR. SHAMS: But, the requirement in the  
12 reg -- yeah. The requirement in the Reg is for power  
13 reactors. That doesn't mean that we would not look at  
14 it as a relevant act for that reactor.

15 MEMBER REMPE: That's good to know. Okay.  
16 Everyone in the staff is aware of that too. Okay.

17 MR. SHAMS: Absolutely.

18 MEMBER REMPE: Okay. Thank you.

19 CHAIR PETTI: Yeah. And, there's a  
20 regulatory analysis white paper from Kairos where they  
21 go through all the rules. And this is one of the ones  
22 where the intent, you know, even though it's held to  
23 be a specific thing, they argue that something has  
24 sort of a relevance in a different sense.

25 MR. BEASLEY: Right.

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1 CHAIR PETTI: And they -- they've got to  
2 do it. So, they did a pretty good job, I think, at  
3 it.

4 MR. BEASLEY: Right.

5 CHAIR PETTI: And, in the buckets, they  
6 both have a different requirement.

7 MR. BEASLEY: Right. And we did the same.

8 CHAIR PETTI: Right.

9 MR. BEASLEY: And so, there is a  
10 requirement, 10 CFR 50.46(a), I believe it is, for  
11 high point vents, it does not apply to SC facilities.  
12 But, there is non-condensable gasses in this design.

13 And so, we asked the question, is it a,  
14 you know, is there a need for a high point vent?  
15 Would it affect the design if there's non-condensable  
16 gases in there?

17 And, it doesn't have an effect on the  
18 design. So, that's a case, and just a very small one,  
19 where yes, the regulation didn't apply to this  
20 facility, but, we considered it anyway just to make  
21 sure that it wasn't an issue.

22 MEMBER REMPE: Thank you.

23 MEMBER MARCH-LEUBA: Okay. But, I like  
24 his answer. The regulation doesn't tell you thou  
25 shall have a high point vent.

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1           But, it tells you you should analyze in  
2 Chapter 15 or the actual analysis, and one of them is  
3 innovative of gasses. And, if you don't have a way to  
4 get rid of them, you have a bad accident.

5           That is how we catch it. And, we keep  
6 saying, and again, I do it every single day, on  
7 selecting the accidents, we have to start with a white  
8 piece of paper, because it's often very human to start  
9 with the actions that all reactors have and to scratch  
10 out the ones you don't have from that list and add the  
11 ones that you do.

12           And, that is something that your review is  
13 you have to get to really what is missing is the most  
14 important part of all.

15           CHAIR PETTI: So, similarly, the rule will  
16 probably act as an ATWS and station blackout. Okay,  
17 it's not a primary, but you guys obviously think about  
18 those sorts of events, right?

19           MR. BEASLEY: Yes.

20           CHAIR PETTI: For all systems, because,  
21 you know, it's sort of a generic issue that you'd want  
22 to look at as a for lack of action in the back up.

23           MEMBER HALNON: Well, it's my  
24 understanding that it was on the applicant to consider  
25 that and to justify why they didn't have to have

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1 beyond design basis type, you know, the ATWS and other  
2 things like these events.

3 Did they do that? Or, is that -- I didn't  
4 review the safety analysis. But, really it's not  
5 applicable to the analysis.

6 But, it was, it's on them to do that and  
7 then you guys review it. You shouldn't be left to ask  
8 a question or avoid if you don't see that.

9 MR. BEASLEY: Well, yeah. So, if there  
10 was something that we felt was needed, then we would  
11 ask them for that.

12 MEMBER HALNON: But, that's my point. Is  
13 that you shouldn't have to feel it's needed. They  
14 should justify regulation by regulation why they  
15 shouldn't have to.

16 And, I believe that's in the guidance to  
17 do that. I'll have to go back and look. But, I  
18 remember reading where the applicant has to consider  
19 all the regulations and tell you why this one doesn't  
20 apply.

21 MR. BEASLEY: Right. And, they did that.  
22 They -- I always prepare a topical report on  
23 regulatory analysis, identifying which regulations are  
24 required --

25 MEMBER HALNON: I'd love to see that.

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1 MR. BEASLEY: And which ones don't. And,  
2 it was, that topical report wasn't just for a testing  
3 facility. It was for their design.

4 And so, as a non-water reactor, you know,  
5 what applies and what doesn't. And so, that's --

6 MEMBER HALNON: So, you weren't just left  
7 to wonder way. You actually had --

8 MR. BEASLEY: Yes.

9 MEMBER HALNON: Some analysis then.

10 MR. BEASLEY: Yes.

11 MEMBER HALNON: Okay. I see.

12 MR. SHAMS: If I may make just one more  
13 comment?

14 MR. BEASLEY: Yes.

15 MR. SHAMS: Mo Shams for the staff again.  
16 So, it's just one of the probably the important  
17 concepts to share is for research and test reactors,  
18 currently the method is for safety assessment, risk  
19 assessment is the maximum hypothetical event.

20 So, to your point, you've got to go  
21 through a sheet, you know, a blank sheet of paper and  
22 assume all the relevant accidents for that reactor,  
23 and, then come up with an event that actually  
24 encompasses all those.

25 And, our review would be actually to

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1 scrutinize that assessment to see did they considered  
2 all the relevant events. To your point, if it's not  
3 a light water reactor, you know, you're going to need  
4 to look at, you know, did they consider the right ones  
5 from the light water reactor, and do we know have they  
6 considered the relevant ones for that particular  
7 technology, what makes sense.

8 So, to the point of the question about,  
9 what if its light water reactors, would the hydrogen  
10 explosion be relevant? Of course, it would be  
11 relevant for a light water reactor. And, we'd want  
12 to, you know, need to know that that the maximum  
13 probability would capture that.

14 So, hopefully we'll walk you through that  
15 today. We'll see what they have done and how they  
16 have done it. So, that goes to the, how do we do a  
17 risk assessment that works for them.

18 CHAIR PETTI: I think there will be lots  
19 of questions on that.

20 MR. SHAMS: Yes.

21 CHAIR PETTI: How you get to every case,  
22 so, yeah.

23 MEMBER REMPE: Since we're going down the  
24 combustible gas rabbit hole, we're going to probably  
25 add another piece of interesting information. In

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1 Japan, I'm trying to understand what happened in Units  
2 Three and Four. They can't identify the sources for  
3 all the combustible gases.

4 And so, they're doing a lot of testing on  
5 cabling and trying to see if combustible gases could  
6 have contributed to the amount from the cabling  
7 heating up so that they could get not only what they  
8 saw at Unit Three, but also at Unit Four.

9 MR. SHAMS: Interesting.

10 MEMBER REMPE: So, even reactors we've  
11 been running for a long time, we still can't  
12 understand fully. And so, I wouldn't totally say oh,  
13 we don't have to worry about that.

14 MR. SHAMS: Great point. Thank you for  
15 that.

16 MR. BEASLEY: So, a primary focus, factor  
17 influencing the safety review was the consideration  
18 that Kairos submitted a construction permit  
19 application. For a construction permit, the level of  
20 detail in an application and the associated NRC staff  
21 review, are different then are needed for an operating  
22 license.

23 The construction permit application  
24 describes preliminary design of a facility. While an  
25 operating license application needs to describe a

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1 final design as well as administrative plans and  
2 programs that are not provided in the construction  
3 permit application.

4 Review guides for testing facilities does  
5 not differentiate between the level of detail needed  
6 for a construction permit versus an operating license  
7 application. Or, provides specific guidance on what  
8 maybe deferred to the license application.

9 In making this determination on what types  
10 of things maybe reasonable deferred versus what is  
11 required for a construction permit, the staff used its  
12 technical judgment and also considered the  
13 requirements in 10 CFR 50.34(a) and (b), regarding  
14 information that must be included in preliminary and  
15 final safety analysis reports.

16 In addition, the staff based its review on  
17 the specific findings it needs to make before issuance  
18 of a permit, which are provided in 10 CFR 50.35. As  
19 provided by 10 CFR 50.35, the principal architectural  
20 and engineering criteria for a design must be  
21 described in a construction permit application.

22 But, some technical or design information  
23 maybe left for later consideration in an operating  
24 license application.

25 Not all safety questions need to be

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1 resolved for the issuance of a permit. But, an  
2 applicant must identify research and development which  
3 is to be completed prior to the completion of  
4 construction to resolve these questions.

5 In making a recommendation that a permit  
6 should be issued, the staff also considers  
7 requirements in 10 CFR 50.40 and 50.50.

8 CHAIR PETTI: So, just a question that I  
9 -- it's the sub-bullet, the last sub-bullet of the  
10 second bullet. That they have to com -- resolve the  
11 safety questions by the completion of construction.

12 I thought it would always be prior to  
13 being allowed to move to operation. Is that a  
14 difference in those two?

15 I mean, there could be a timing  
16 difference. But, you're basically saying it has to  
17 all be done before construction is complete.

18 MR. BEASLEY: Yes. And, I, you know, I'm  
19 not sure which regulation that comes from.

20 CHAIR PETTI: I just -- yeah. I just  
21 wondered if it was just the words meant something  
22 different than what it says.

23 MR. BEASLEY: No. It --

24 CHAIR PETTI: Okay.

25 MR. BEASLEY: That's probably in 50.35.

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1 Is that right, Ed?

2 CHAIR PETTI: Yeah. And then the other  
3 question is, okay, this is all CP. Is it any  
4 different for a power reactor?

5 The CP guidance, in terms of what the CP  
6 application has to describe?

7 MR. BEASLEY: No. So, this is --

8 (Simultaneous speaking.)

9 CHAIR PETTI: So, this is --

10 MR. BEASLEY: No, this is a testing  
11 reactor, no. It --

12 CHAIR PETTI: This is a CP issue.

13 MR. BEASLEY: This is a CP issue. It's  
14 not a --

15 CHAIR PETTI: Okay.

16 MR. BEASLEY: testing facility, so.

17 CHAIR PETTI: Okay.

18 MR. BEASLEY: Yeah.

19 MEMBER REMPE: So, I have another question  
20 that's more pertinent to the Hermes facility. This  
21 facility doesn't have any experimental facilities  
22 capabilities in it, but the whole thing is sort of a  
23 demonstration or an experiment.

24 I'm thinking Chapter 10 and the staff  
25 response. And, although -- and again, this probably

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1 is something that would come up with the operating  
2 license, but on the other hand, as you go through and  
3 review the construction permit as well as the  
4 operating license, there's going to be things that you  
5 don't know all the details.

6 You'll have some data, but there will be  
7 extrapolation. Or, the codes won't be fully  
8 validated. The coupled effects of radiation and  
9 thermo-hydraulics and reactor physics behavior,  
10 there's going to be some data obtained as it operates  
11 that will confirm analyses.

12 And, I know that there's like an Appendix  
13 A, what we have with a construction permit, where the  
14 staff identifies things from the construction permit  
15 that have to be answered for the operating license.

16 But, you also have a subset in Appendix A  
17 which, by the way, isn't posted when I looked last  
18 time. We don't have the staff's Appendix A yet, which  
19 I'd like to see at some point.

20 But, anyway, will that Appendix A also  
21 talk about things you're identifying as you go through  
22 the review that you know won't even be available at  
23 the time you start up with the operating license that  
24 you'd like to see validated as data are obtained from  
25 running this facility?

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1 MR. BEASLEY: So, Appendix A does include  
2 the research and development activities that Kairos is  
3 planning.

4 MEMBER REMPE: For this facility? For  
5 this operating?

6 MR. BEASLEY: For this facility. You  
7 know, and this maybe more of a question for Jeff.  
8 But, I'm not aware of anything that we are putting off  
9 past the operating license.

10 We expect the codes, the modeling codes  
11 that they used to be validated for use in the  
12 operating license. And, Jeff's going to talk a little  
13 bit to that in his example.

14 So, it, you know, we want to assure safety  
15 before they get --

16 MEMBER REMPE: They have to have --

17 MR. BEASLEY: To the operating license.

18 MEMBER REMPE: Fully validated codes for  
19 the -- I mean, this is a new facility where you're  
20 looking at corrosion effects of the -- of slide with  
21 the graphite and long term behavior combined with the  
22 radiation.

23 They'll be periodically looking at the  
24 pebbles. And, you've got criteria if it's of such,  
25 you know, if something is 10 percent off of the

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1 validation that they're predicting, you're not going  
2 to say, I want you to shut this thing down or  
3 something.

4 Or, I just am a little surprised by that.  
5 I have talked with a former member of ACRS, and issues  
6 came up over the years with the insights gained for  
7 flow instabilities.

8 And, I think that was something I thought  
9 I'd seen in an upcoming slide here. Where you wanted  
10 them to test -- and that was done for an operating  
11 reactor in the U.S. over the years.

12 So, I guess I'm not sure that everything  
13 is fully validated that you aren't going to be  
14 exploring something from what I've read so far. And,  
15 I think there may be some other things.

16 And, as I go through this review, I would  
17 want us as members to be looking for things that ought  
18 to be validated at this facility.

19 CHAIR PETTI: My view is there's a handful  
20 of things that no matter what we do, no matter how  
21 good a job Kairos does analytically, well, it's just  
22 until you run the reactor, you're not going to know.

23 So, that's just the nature of it.

24 MEMBER MARCH-LEUBA: And, it is the reason  
25 why we're building this facility.

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1 MEMBER REMPE: Right. Exactly.

2 CHAIR PETTI: Exactly. Exactly.

3 MEMBER REMPE: No. So, yeah. I think  
4 there are some things. Only, I'm not sure I agree  
5 with you.

6 But, you've been looking at it more than  
7 I have. But, I'm going to be looking as I go through  
8 this review for things.

9 And, I'm hoping that they're documented  
10 and it's something that I don't think you want to --  
11 I think you'd want someone at headquarters to be kind  
12 of involved in this long term operation as they do  
13 these tests and confirm this information.

14 MR. SCHMIDT: Yeah. Could I just  
15 interrupt real quick? This is Jeff Schmidt from the  
16 staff, Advanced Reactor Division.

17 So, the things that you are referring to,  
18 you'll see a fair number of those are testing done  
19 during say the construction and before the operating  
20 license. In other words, there's a pretty extensive  
21 Kairos testing program.

22 And, the specific thing you were talking  
23 about was the decay rule system, which I do have a  
24 slide on. You know, they have -- I would characterize  
25 it as robust testing programs.

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1           So, we can get into that, where they are  
2           looking for things. But, this is -- these would -- by  
3           and large, these are programs that would be completed  
4           before either the construction is completed, or the  
5           operating license.

6           So, just put it in that time frame or that  
7           reference.

8           MEMBER REMPE: There's nothing you think,  
9           I mean, this is a test facility to demonstrate the  
10          technology for subsequent reactor applications.

11          MR. SCHMIDT: Right.

12          MEMBER REMPE: I would think that it  
13          wouldn't be fully validated. But, the thing is a low  
14          power thing and the staff saying, okay, it's probably  
15          going to be safe enough that we're not worried about  
16          public protection.

17          But, I would think you'd want to have more  
18          confidence in the performance or the technology before  
19          --

20          MR. SCHMIDT: So, one of the areas that  
21          might fall into the category you're speaking about, it  
22          was when we discussed the fuel qual. Right?

23          There's a fuel qual program that will  
24          inform the commercial reactor. Right, they're going  
25          to take samples out of this reactor and inform

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1 information for the test reactor.

2 So, if that's what you're referring to,  
3 yeah. But, you know, we are making a reasonable  
4 assurance finding her for the test reactor.

5 MEMBER REMPE: Thank you.

6 CHAIR PETTI: Yeah, so you know, if it's  
7 a fuel thing so the tritium control in the system,  
8 it's a hot, high temperature system. Tritium is going  
9 to go places.

10 You know, it's not a public safety issue.  
11 It's a worker safety issue. But, trying to prejudge  
12 all of that before you have any operating things, it  
13 seems difficult.

14 Yeah, it looks like, you know, they're  
15 going to be able to meet the requirements. But, you  
16 know, go talk to the utilities that are irradiating  
17 with TPBARs.

18 You know, that's a low temperature system.  
19 They don't like the fact that -- they've got tritium  
20 going everywhere and it's a low temperature system, a  
21 beryllium control.

22 Again, a worker safety issue. That's  
23 really hard to analytically put your hands around. I  
24 mean, so I see a number of things like that. That  
25 until you get those operating figures and inform the

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1 power the power reactor.

2 Those are just realities. That's why it's  
3 a test reactor, right? I mean, I've already written  
4 a paragraph of a letter saying, we think these are  
5 things that everybody should know. They're just  
6 there.

7 And, that's why they're building the test  
8 reactor.

9 MEMBER REMPE: Yeah. And, I would hope  
10 that and maybe it doesn't have to be in the  
11 construction permit, but it seems like a good place to  
12 start such a list and have it in Appendix A that we  
13 expect to have data to confirm some of the information  
14 that wasn't fully validated as a long term operation.

15 And, have that list identified and makes  
16 sure that the, if there are any controls that the  
17 staff wants to impose and say if you see something is  
18 -- a lot more tritium coming out then you expect, or  
19 something like that.

20 And have those kind of tech specs  
21 identified so that everybody understands what's  
22 expected when you have this type of a first of a kind  
23 --

24 MR. SCHMIDT: Right.

25 MEMBER REMPE: Little operating

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1 experience. And, is that going to be in your Appendix  
2 A or some place?

3 MR. SCHMIDT: Well, so not for the  
4 construction permit. So, you're a step beyond us a  
5 little bit in the operating license phase.

6 So, Appendix A does identify the research  
7 and development activities that Kairos is undertaking  
8 for, you know, for this reactor. And so, we'll, you  
9 know, we'll -- or that need to be done in order to get  
10 the license, operating license application.

11 But, that's a very good idea. I think,  
12 you know, that is something that we, you know, we  
13 should start thinking about and, you know, planning  
14 ahead as we, you know, as we get the construction  
15 permit finished.

16 If it is decided to award the permit, then  
17 we would start thinking ahead about what we should do  
18 with the operating license application. And certainly  
19 the affirmatory activities that you're talking about  
20 are, you know, a major purpose for building Hermes a  
21 testing facility.

22 There are, you know, there's a lot of  
23 reasons to building a testing facility. Kairos wants  
24 to exercise a supply chain.

25 They want to develop the scale of craft

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1 workers. They want to find out, you know, what costs  
2 are like for building and for all the materials they  
3 need.

4 So, there's a number of reasons beyond  
5 just confirming the technical aspects that the testing  
6 facility is being built.

7 CHAIR PETTI: So, just sort of a bigger  
8 picture. This is the first low advanced reactor, non-  
9 light water reactor.

10 And, we're going to be talking later in  
11 our meeting this week about how we're going to  
12 approach our letter. And, it's going to be different  
13 perhaps than previous letters. It's going to be more  
14 high level.

15 The question is, when you don't have  
16 operating experience, how do you make your assessment?  
17 And, we've given it some thought.

18 And, the outlying kind of addresses sort  
19 of a punch list of things that, you know, safety  
20 margin for instance, it's critical in my opinion. You  
21 go back to the early light water reactors, they do  
22 tons of margin.

23 And so, it should be incumbent on the  
24 applicant to show how they have a lot of margin in all  
25 the different dimensions of what safety margin is.

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1           So, those are the things we're going to be  
2           looking for as we think about it. Because, you know,  
3           it's not going to be, you know, oh, let's see that  
4           validation experiment and make sure that that code,  
5           you know, is calculated right.

6           I think we have to see these things on  
7           that. But, you know, do you really have the margin?  
8           Do you, you know, how great is it? Where is it? How  
9           are your safety functions implemented?

10          That's sort of a look at things. And  
11          what's novel and new? And you guys, I think, are  
12          thinking along the same lines as I am.

13          So, that's sort of, at least in my -- how  
14          I'm looking at it.

15          MR. BEASLEY: Thank you. So, next slide,  
16          Ed.

17          So, considering that the application is  
18          for a testing facility construction permit, the staff  
19          performed a, well, not a PRA risk informed reviewed,  
20          but a generic risk informed review. In that the  
21          review depth and scope were commensurate with the  
22          safety significance of areas under review.

23          MEMBER MARCH-LEUBA: Let me air my  
24          grievance. Excuse me. But, everybody in this room,  
25          I have been trained to risk inform my decision whether

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1 to ride a bike to work or take the metro.

2 And, at the end of spending two hours  
3 doing that training, you just go by the seat of your  
4 pants and do whatever you want. Because that's  
5 basically the conclusion I got from that training.

6 And, I think it can be done better for  
7 here. I mean, we have the mathematics and we have the  
8 ways to actually go have two hypothesis and pick the  
9 one that is better of the two.

10 And, thoroughness, instead of the seat of  
11 the pants, is desired, when it's not your decision to  
12 ride the bike or take the metro.

13 MR. BEASLEY: Yes.

14 MEMBER MARCH-LEUBA: I'm airing my  
15 grievance.

16 MR. BEASLEY: Thank you. So, the staff  
17 maintained a big picture safety perspective of the  
18 Hermes design considering the small size of Hermes,  
19 the short operating life, and the safety case with low  
20 radiological consequences.

21 The staff tailored its review for the  
22 unique and novel Hermes technology described in the  
23 preliminary design. The staff used NUREG-1537, the  
24 licensing guidance for non-power reactors to perform  
25 the review.

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1 NUREG-1537 is designed to be technology  
2 neutral and provides flexibility for a review such as  
3 the Hermes application. NUREG-1537, part 1, is also  
4 the guidance that Kairos used in preparing its  
5 application. Next slide.

6 So, this is a list of the Chapters in  
7 NUREG-1537 which aligns with the Chapters in Kairos'  
8 preliminary safety analysis report and with the  
9 staff's safety evaluation.

10 As noted on the slide, some of the NUREG-  
11 1537 Chapters, for example, Chapters like 16, 17, and  
12 18, are not applicable to the construction permit  
13 application.

14 The project core team in the Division of  
15 Advanced Reactors and Non-Power Production and  
16 Utilization Facilities reviewed technical topics  
17 integral to the reactor design, such as fuel and core  
18 design, thermal and structural analysis, and  
19 accidents.

20 Other topics reviewed by subject matter  
21 experts from other divisions, include those such as  
22 quality assurance, fire protection, site  
23 characteristics, and emergency preparedness. Next  
24 slide, please.

25 MEMBER HALNON: Hey, Ben?

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1 MR. BEASLEY: Yes?

2 MEMBER HALNON: Do you recall when the  
3 last revision to NUREG-1537 was made?

4 MR. BEASLEY: I'm going to ask --

5 (Simultaneous speaking.)

6 MEMBER HALNON: If I recall it, it was  
7 like three --

8 MR. BEASLEY: I'm not in the non-power --

9 MEMBER HALNON: It was like in '90  
10 something.

11 MR. HELVENSTON: Okay. This is Ed  
12 Helvenston from the staff. It was 1996.

13 MEMBER HALNON: So, given that, and the  
14 fact that we have at least exercised the more  
15 contemporary, is there any talk about adding lessons  
16 learned and doing a revision so that we have some of  
17 the -- I mean, the post-911 regulations are not  
18 included.

19 The Fukushima regulations are not, I mean,  
20 those orders are not included. A lot of things are  
21 not included in 1537 now. And, it just seems like  
22 it's old.

23 MR. BEASLEY: So, I'm not in the non-power  
24 side of the Division. And so, I don't want to speak  
25 for them.

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1 MEMBER HALNON: So, it's not a good  
2 question for you.

3 MR. BEASLEY: Yes. It's not a good  
4 question for me. I don't want to get myself in  
5 trouble with other Branch Chiefs, committing them to  
6 something.

7 MEMBER HALNON: Okay.

8 MR. BEASLEY: But so, --

9 MEMBER HALNON: I'd like to have a  
10 conversation about that. Maybe somewhere about  
11 whether or not 1537 used today as written is really  
12 adequate for some of these new advanced reactors that  
13 are coming online now.

14 MEMBER BALLINGER: Didn't they cover some  
15 of this in the ISG? There's an ISG associated --

16 MEMBER HALNON: That maybe. And I --

17 MEMBER BALLINGER: That's for power  
18 reactors.

19 MEMBER KIRCHNER: There's an ISG for  
20 construction.

21 MEMBER HALNON: And, just a question out  
22 there. Maybe I can look up and have a discussion  
23 later on.

24 MR. SHAMS: If I may offer. Mo Shams with  
25 the staff. We are making updates to 1537 by adding a

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1 appendices if you would. And, intended -- I believe  
2 we have --

3 MEMBER REMPE: Mo, talk to the mic side.

4 MR. SHAMS: I'm sorry. I'm sorry.

5 CHAIR PETTI: Yeah. Everybody out there  
6 can hear you. But, not in here. Yeah, it's one of  
7 the bad spots.

8 MR. SHAMS: I believe we have a section  
9 that was developed for molten salt reactors. We're in  
10 the process of endorsing another one that addresses  
11 reactors like in Abilene Christian University.

12 So, to your point, there is an effort to  
13 include the new technologies, the nuances associated  
14 with it, the lessons learned that we've had, you know,  
15 over time.

16 So, we're mindful of the new updates.

17 MEMBER HALNON: Okay. Good. Thank you,  
18 I appreciate that.

19 MR. TAYLOR: And, Rob Taylor. Just one  
20 other thing. Especially going back to 911  
21 requirements. The Commission made specific decisions  
22 and we can go look at those about what the  
23 applicability of those requirements were to different  
24 facilities as they evaluated.

25 And, some of those played out over years

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1 as they made decisions on the CAT II facilities and  
2 things like that. So, we'd have to look at what the  
3 Commission instructions were on those.

4 With regards to Fukushima, we have to look  
5 -- we would look at Fukushima and ask the question, is  
6 this applicable to a small test reactor of this design  
7 and those lessons learned.

8 So, I mean, it's something we can do.  
9 But, it -- given what we're supposed to do under  
10 minimum regulations, you also have to ask yourself,  
11 does that make sense for a research and test reactor?

12 MR. SHAMS: I'll build on what Rob said.  
13 For Fukushima actually, we took a sweeping look at all  
14 other facilities. We stated out with power reactors,  
15 but we looked at all other facilities.

16 There were SECY papers that were written  
17 up assessing where it was fuel facilities, whether it  
18 was ISFSIs, whether it's research and test reactors.  
19 For the research and test reactor community in  
20 particular, we've identified a handful, and we looked  
21 at the hazard and assessed if there's a need.

22 So, that look has been taken, you know,  
23 taken into consideration as well.

24 MEMBER HALNON: Okay. And, thank you. I  
25 -- yeah, I agree the Fukushima stuff -- really light

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1 water, being a light water reactor, even though you  
2 have to keep funding standards and other things, and  
3 those are picked up in other Reg Guides and the sort.

4 So, but just an audit of 1537 seems like  
5 it could be good.

6 MR. SHAMS: Yeah.

7 MEMBER HALNON: Could benefit from a look  
8 back and a refresh. Thank you.

9 MR. BEASLEY: Thanks. So, Ed, we can go  
10 to the next slide.

11 So, the staff conducted audits in the  
12 topics listed on this slide. I identified the  
13 approximate number of questions for each audit to  
14 illustrate that we conducted a substantial review,  
15 and, that our review dug into the areas that were  
16 safety significant.

17 Jeff Schmidt is going to provide an  
18 overview of a few technical items to illustrate how we  
19 carried out the review on our preliminary design of  
20 the testing facility.

21 So, I'm going to turn it over to Jeff  
22 unless you have any other questions for me.

23 (No response.)

24 MR. BEASLEY: Okay. Next slide.

25 MR. SCHMIDT: Yeah. This is Jeff Schmidt

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1 with the staff. I was lead technical reviewer for the  
2 Hermes construction permit.

3 I wanted to give you two examples, I'm  
4 sure we'll probably get into more, that covers some of  
5 the questions that you were talking about earlier,  
6 like what's it based on, preliminary information, what  
7 maybe applicable for test reactors versus a power  
8 reactor.

9 I picked out, I think, two examples of  
10 interest and two that were, you know, were deemed to  
11 be -- well, certainly the first one, deemed to be a  
12 high safety significant system. And, I'll get into  
13 that.

14 So, a decay heat removal system, is safety  
15 significant for maintaining vessel temperature within  
16 the accepted limits of the stainless steel 316.

17 You know, the staff's assessment was that  
18 the vessel is probably the limiting component in this  
19 design based on the available fuel margins. And,  
20 we'll get into that when we get into the substantive  
21 review.

22 But, you know, it became clear to the  
23 staff early in the review that temperature  
24 distributions within the vessel are going to need high  
25 fidelity and that they're relatively close to some of

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1 those stainless steel limits.

2 So, that was the primary focus of, well,  
3 not primary, but a significant focus of what we found,  
4 to put it in context. And, for those -- that vessel  
5 to remain intact, the decay heat removal system has to  
6 perform its function when you get it above a certain  
7 power level, or threshold power level as its referred  
8 to in the safety evaluation.

9 So, that's the context of why I picked  
10 this system for discussion. I guess I covered the  
11 second bullet that, you know, it's placed in service  
12 when basically passive radiated cooling is not, is no  
13 longer adequate.

14 There is a regime there where you  
15 obviously always have that cooling component. But,  
16 there is a time where that decay heat removal system  
17 has to be placed in service.

18 And that placing in service was a focus of  
19 the review too, in terms of what could happen placing  
20 that system in service. Or, if that system, when it's  
21 placed in service if you had a reactor shortly  
22 thereafter, what would happen when you just met the  
23 threshold power.

24 So, those were kind of areas of the review. The  
25 staff went through the preliminary design and

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1 identified potential failure modes.

2 So, we tried to take a high level look at  
3 the system to see where potential failure modes could  
4 be, especially if anything had to move into position  
5 to perform that function.

6 And so, I think we'll probably be talking  
7 about that fairly significantly during the  
8 Subcommittee meeting. There was, you know, some  
9 things identified that were just higher, of higher  
10 interest than others.

11 CHAIR PETTI: Jeff, the question I had is  
12 sort of the opposite, which is there is a system to  
13 keep the salt hot.

14 MR. SCHMIDT: Yeah --

15 (Simultaneous speaking.)

16 CHAIR PETTI: I don't want to lose the  
17 heat. I want to keep the heat held in there --

18 MR. SCHMIDT: Right, right.

19 CHAIR PETTI: -- in freezing events and  
20 they don't claim that's a safety system.

21 MR. SCHMIDT: That's correct.

22 CHAIR PETTI: And I'm still, I guess, I  
23 mean, I'll be asking about the thought process there  
24 because I -- you know, if you freeze, as Ron would  
25 say, it's a bad day. You'll probably fail welds and

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1 the like, and so I keep thinking why isn't this safety  
2 related?

3 So, you know, okay, under control heat  
4 generation, I mean, you could have a separate safety  
5 function for coolants that are hot, that have to stay  
6 hot, but you could also put it under the umbrella of  
7 controlling heat. You're trying to get it out or keep  
8 it in depending on what's going on. I didn't see that  
9 logic in any of their documentation, and again, I  
10 haven't got into that chapter again.

11 MR. SCHMIDT: I will say on the second  
12 slide, the next slide, we address that a little bit --

13 CHAIR PETTI: Oh, good.

14 MR. SCHMIDT: -- from a 72-hour kind of  
15 coping time period. It is an area of interest to the  
16 staff. Let's put it that way. If I could get to the  
17 second slide, we could discuss it more.

18 Let's see, so as far as we audited -- so  
19 the calculation that has been performed by Kairos has  
20 been like the max heat removal system to keep the  
21 vessel temperature intact, and you'll probably see  
22 presentations with curves that show, you know, the  
23 vessel temperature limit relative to the transients,  
24 but we do get to your freezing question here also.

25 The staff also performed just to ensure

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1 water tank volumes were sufficient for seven days of  
2 cooling. Staff ensured testing plans, addressed  
3 potential flow and heat removal and stability issues  
4 during the transition and in-service phases, including  
5 the effects of identified potential failure modes of  
6 the system.

7 So, here the staff was concerned about,  
8 you know, initially, at least the way it's described  
9 now, the system is dry and water is introduced to the  
10 system when you get to a certain threshold power.

11 The staff was concerned that that  
12 evolution could lead to flow instabilities, and the  
13 staff was also concerned that even once flow was  
14 established, you know, the boiling process in these  
15 tubes can be fairly violent and subject to things like  
16 back pressure changes and things like that which might  
17 cause an instability.

18 So, those, the staff asked questions in  
19 that area and really focused on the testing plans.  
20 So, they have a testing plan for those items and the  
21 staff is going to, I hope, be heavily involved during  
22 the testing process as well.

23 But, you know, the staff did identify  
24 these issues. Kairos did respond that they are aware  
25 of those and that that will be addressed in their

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1 testing program as they come up with a final design of  
2 the heat removal system.

3 MEMBER MARCH-LEUBA: And you expect that  
4 this will be addressed in the final safety analysis  
5 report, correct?

6 MR. SCHMIDT: I'm sorry, say that again?

7 MEMBER MARCH-LEUBA: They will be  
8 addressed in the final safety analysis report?

9 MR. SCHMIDT: Yes, yes, all of these, so  
10 all of the testing programs. So, Appendix A, and  
11 thank you, correct me if I'm wrong, are effectively  
12 commitments by Kairos made in the PSAR of the testing  
13 programs, so that's the way you should review that  
14 appendix.

15 There is a separate list that the staff is  
16 keeping for lessons learned, areas of interest to  
17 inform the OL review. It's not part of the safety  
18 evaluation, but there's a separate document out there  
19 in our SharePoint drive that's saying, you know,  
20 whoever is responsible for looking at this in the  
21 future, look at these items, right? These are  
22 identified areas that the staff should, at least the  
23 staff as it is now that could identify are areas of  
24 interest, so they're kind of like two separate  
25 documents.

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1 MEMBER HALNON: So, Weidong, can we get  
2 that uploaded to ours, that list? I know it's going  
3 to be a moving target, but, because I've been keeping  
4 my set of stuff, or at least point us to it.

5 MR. BEASLEY: So, confirming, Jeff, yes,  
6 Appendix A is commitments that, things that Kairos  
7 said that they were going to do during our audit  
8 discussions. I'd like to think about the staff's  
9 internal --

10 MEMBER HALNON: Okay, well, we can give  
11 you our list and hopefully it will be --

12 (Simultaneous speaking.)

13 MR. BEASLEY: So, in some respects, those  
14 are just staff notes for themselves --

15 MEMBER HALNON: I got it. I get it. I  
16 know.

17 MR. BEASLEY: -- to allow them to think  
18 about that.

19 MEMBER HALNON: Right, I understand.  
20 Okay, we'll just make sure that our list is discussed  
21 in the meetings and you guys can go --

22 (Simultaneous speaking.)

23 MEMBER BALLINGER: Yeah, I mean, in the  
24 chapters that I've looked at, they've done a pretty  
25 darn good job. I mean, the applicant looks at the

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1 PDCs and discusses how they meet them.

2 The staff takes a look at it in the SE and  
3 says here are how they compare with the PDCs, and by  
4 the way, here are the following limitations and  
5 conditions we're going to put on the system that have  
6 to be satisfied before they're operating. So, it's  
7 pretty straightforward, and at least from the ones  
8 I've looked at, pretty thorough.

9 MEMBER HALNON: Yeah, I don't disagree  
10 with that. What I see though is a lot of repeat back  
11 of what the regulation requires. Yes, we'll do this.  
12 It requires this. Yes, we'll do that, and then as you  
13 go through it and we talk a little bit more about, you  
14 know, referencing other things like 20.1406.

15 We're going to minimize contamination.  
16 Okay, great. You know, how is that area through to  
17 the translation into the operating license application  
18 and who is taking a look at it from that perspective?  
19 So, there's just things like that.

20 Now, I know those very overt commitments  
21 are probably on your list as well. It's the -- I  
22 wonder why things that, you know, pop into your mind  
23 as you're reading this stuff based on past experiences  
24 and biases, so those are the types of things, I guess,  
25 that we just need to make sure that if we've got them

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1 on our mind, to let you know about it.

2 MR. JESSUP: Yes, Member Halnon, that's  
3 good feedback. This is Bill Jessup from the staff.  
4 So, this is, you know, kind of the foundational  
5 meeting today.

6 I think this is really good feedback we  
7 can take into the chapter specific discussions, and  
8 so, you know, we can go take a look at the notes we've  
9 put together, go back to the SEs and see if there are  
10 those items.

11 I think Chairman Rempe gave us similar  
12 feedback about, you know, what are we keeping track  
13 of? What's in Appendix A versus what are we keeping  
14 track of? So, it's good feedback.

15 MEMBER HALNON: Well, at least for me, I'm  
16 putting those thoughts, at least the major ones, in  
17 the memos to Dave.

18 CHAIR PETTI: We don't SharePoints. I  
19 don't think we would put our stuff on a SharePoint  
20 site. We will have it in the memos so that that's our  
21 way to translate to you guys hey, whoever is going to  
22 pick this up in the future --

23 MEMBER HALNON: Some may be very important  
24 and some may not be important at all --

25 MR. JESSUP: Right.



1                   MEMBER HALNON:  -- but just the thought  
2 process.

3                   MR. JESSUP:  I think it's clear we're  
4 definitely going to hear you all's list.

5                   CHAIR PETTI:  Sure, yeah.  No, I think the  
6 other thing as I think about this and your earlier  
7 slide about the number of questions, you know, in the  
8 old review where we had the two stages, right, with  
9 open items, we kind of collectively had this set of  
10 ideas and it was sort of (inaudible).

11                   Now, it comes to us with everything done  
12 and sometimes you don't see all of the hard work that  
13 was done behind the scenes, so it requires probably  
14 the presentations to be a little bit different than  
15 the way it used to be to convince us that you guys  
16 have done the homework as opposed to us living it when  
17 we did it in the optimal phase things in the past.

18                   MR. SHAMS:  That's great feedback.  Mo  
19 Shams with the staff.  Great feedback, Dr. Petti, for  
20 us, such that we continue to keep this process as  
21 efficient as possible.

22                   CHAIR PETTI:  Right.

23                   MR. SHAMS:  We need to calibrate our  
24 presentation to you in a way that satisfies that need.  
25 I got you.

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1           MEMBER BROWN:    Can I ask a technical  
2 question as opposed to this esoteric (inaudible)? The  
3 second bullet says the DHRS must be placed into  
4 service above a certain threshold. Does that imply  
5 that they need to have an automated system that does  
6 that or is it totally operator in the present design?  
7 I'm totally clueless as to what --

8           MR. SCHMIDT:    Yeah, it doesn't get into  
9 the details of that system. That's going to -- that,  
10 right now, I'm reading it as operator action, but I  
11 don't know the details of how that is implemented.

12          MEMBER BROWN:    So, that's an open point?

13          MR. SCHMIDT:    I would say it's more  
14 consistent with the OL review to be looking at that.  
15 I mean, we did have --

16          MEMBER BROWN:    As opposed to the  
17 construction permit?

18          MR. SCHMIDT:    That's right.

19          MEMBER BROWN:    Oh, okay.

20          MR. SCHMIDT:    That's right. I mean --

21          MEMBER BROWN:    But we've got to design  
22 systems.

23          MR. SCHMIDT:    Right.

24          MEMBER BROWN:    At some point, you've got  
25 to have the systems being designed if you want it and

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1 what the criteria are.

2 MR. SCHMIDT: Right.

3 MEMBER BROWN: And that just stuck out to  
4 me in terms of how I'm glad DHRS had to be, you know  
5 had a differential ahead of this, a power level  
6 determination of when it was needed and when it was  
7 not. You know, if not -- if it is needed, then it  
8 sounds to me like you don't want distractions to  
9 prevent it from not getting activated.

10 MR. SCHMIDT: So, you're kind of getting  
11 to what I refer to as the staff notes, you know, that  
12 are kept in the background. You know, this is a  
13 preliminary design and I think everybody needs to  
14 understand that. The details of a lot of exactly how  
15 these things are implemented is going to be coming as  
16 part of the OL.

17 So, you identified, I mean, we identified  
18 human actions that could lead to problems where you  
19 didn't turn it on when you should have or you've  
20 turned it on too soon. Too soon can be as challenging  
21 as too late, so you identified some of the things on  
22 our list.

23 MEMBER BROWN: Okay, so this is a question  
24 you've got on your list that would be answered later?

25 MR. SCHMIDT: That's correct.

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1 MEMBER BROWN: I don't have to go find it

2 --

3 MR. SCHMIDT: No, no.

4 MEMBER BROWN: -- two years from now?

5 MR. SCHMIDT: No. I mean, those --

6 MEMBER BROWN: All right.

7 MR. SCHMIDT: Those considerations, you  
8 know, such as human error or human actions if it's a  
9 manual system will have to be addressed.

10 MEMBER BROWN: Thank you.

11 MR. SCHMIDT: Let's go to the next slide,  
12 please. Okay, this is getting back to the testing  
13 plans I was referring to and I talked already a little  
14 bit about this. You know, when in service, potential  
15 dynamic loads on the structure, both due to the  
16 transition phase and effectively thermal shock during  
17 the transition phase is a concern to the staff, and  
18 in-service evaporator boiling, you know, that's the  
19 continuous operation mode. Those, again, I think were  
20 pointed out and I think Kairos is addressing those as  
21 part of their testing program.

22 Staff ensured the testing program  
23 addressed the potential for corrosion and fouling in  
24 the evaporator tube affecting both structural  
25 integrity, that's kind of like the stress corrosion

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1 cracking issue if you're running it for longer than  
2 not, and the ability to remove any potential fouling.  
3 You know, we're thinking of things like what's the  
4 quality of the water source that are going into those  
5 evaporator tubes? Those are the considerations.

6 Staff noted the DHRS design must  
7 accommodate the highest heat loads for vessel  
8 integrity and the lowest in-service heat loads to  
9 prevent freezing without operator action within 72  
10 hours.

11 So, this is kind of getting to your  
12 question. This is like, you know, you have two design  
13 constraints you're trying to design to. You know, the  
14 detailed design will have to address those competing  
15 design requirements.

16 You know, I think that it's possible to do  
17 those, but we'll need the details of the design. So,  
18 that's really the bullet there is final determination  
19 of the accuracy of the decay heat removal system for  
20 these competing designs will be made based on the  
21 design presented in the FSAR.

22 So, the staff was concerned about could a  
23 situation occur where you've met the threshold  
24 requirement and you have to turn it on, but then you  
25 trip and maybe you don't have the decay heat at --

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1           You know, it was necessary for vessel  
2           cooling should you have a transient, but it also could  
3           lead to a freeze situation in a shorter period of time  
4           than the 72 hours. So, the staff is focused on that  
5           issue.

6           As Dr. Petti stated, you know, the  
7           auxiliary heating system is non-safety related, so  
8           we're using this 72 hours kind of as a guide to say  
9           it's time to get the system back in service if it's  
10          not in service at that time to prevent the freeze.  
11          The design goal is to prevent freeze. Freeze is a  
12          non-analyst condition.

13          MEMBER      KIRCHNER:           And      these  
14          considerations, Jeff, are applied to just normal  
15          operation of the primary system across the board, so  
16          you're going to see all of these issues for the  
17          primary system, including the reactor vessel.

18          MR. SCHMIDT:   Yeah --

19          MEMBER BROWN: Does that imply you need an  
20          automatic auxiliary heating system to make sure it  
21          doesn't freeze as well?

22          MR. SCHMIDT:   There is an auxiliary  
23          heating system, but it's non-safety.

24          MEMBER BROWN: It's an automatic -- how  
25          can it be non-safety if it's going to be, if you can

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1 break the system?

2 MR. SCHMIDT: You can as long as, I mean,  
3 as long as you have adequate decay heat. If you don't  
4 have adequate decay heat, you wouldn't be turning off  
5 that system. So, it's really a function of before the  
6 threshold power, you still have to provide cooling,  
7 and that will be passive needs and that will be  
8 adequate.

9 At some point after like, say, a reactor  
10 trip, you will have to go onto that auxiliary heating  
11 system. What we want to do is just make sure it's far  
12 enough out in time that you have capability to, you  
13 know, restore that non-safety system.

14 MEMBER MARCH-LEUBA: What you're talking  
15 about, what's the power source for the aux system?

16 MR. SCHMIDT: That, I would have to look  
17 up.

18 MEMBER MARCH-LEUBA: It's likely offsite  
19 electrical?

20 MR. SCHMIDT: I'd have to look it up. I  
21 don't remember.

22 CHAIR PETTI: My concern is, you know,  
23 when you start up a pebble bed, it takes a heck of a  
24 long time to get it to equilibrium. So, they're  
25 sitting at conditions.

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1 MR. SCHMIDT: Yeah.

2 CHAIR PETTI: It could be the entire four  
3 years, that they'll never actually get to true  
4 equilibrium where you have full 100 percent decay  
5 heat, you know, if you shut down.

6 All of that has to be analyzed. I mean,  
7 it's almost -- you know, it's not like something in  
8 ten years where there's a true steady state and that's  
9 what my concern was. It's complicated --

10 MR. SCHMIDT: Right.

11 CHAIR PETTI: -- in that startup.

12 MR. SCHMIDT: Yeah, it is complicated  
13 because I think it's a function obviously of the decay  
14 heat, but also maybe just the reactor power itself at  
15 that point.

16 CHAIR PETTI: Yes.

17 MR. SCHMIDT: You know, so it's a function  
18 of two powers if you will, and I agree, you know, it  
19 is complicated.

20 MEMBER BROWN: It just seems to me you've  
21 got competing issues. You've got to make sure you can  
22 take it when it gets above a certain threshold --

23 MR. SCHMIDT: Yes.

24 MEMBER BROWN: -- so that the radiated  
25 doesn't do the work, and you've got another threshold

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1 on the bottom end because I can't let it get too cold  
2 because otherwise the system is going to freeze, and  
3 yet the whole system in which it breaks, and now it's  
4 a non-safety system.

5 Just for some reason, my brain doesn't  
6 work very well with that regardless of whether it's a  
7 test reactor or a power reactor. I mean, it's got  
8 enough --

9 MEMBER MARCH-LEUBA: Educate me about it.  
10 Freezing is a bad thing, but isn't that an operational  
11 concern more than a safety concern?

12 MR. SCHMIDT: So, I personally view  
13 freezing at this point as just an unknown. I mean, it  
14 could be argued that --

15 (Simultaneous speaking.)

16 CHAIR PETTI: It could. I mean, I have  
17 seen Flibe freeze inside the welds, yes, in labs, in  
18 lab scale stuff. Remember there's a weld at the  
19 bottom of the vessel. That's the one that, you know,  
20 you'd be worried about.

21 MEMBER MARCH-LEUBA: Does it expand like  
22 ice does? I mean, I don't know what, if it expands a  
23 lot.

24 CHAIR PETTI: So, let me just ask Jeff.  
25 Is this a case where, I mean, given how complex this

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1 is, that for the OL, you guys would do confirmatory  
2 calcs and try to convince yourself?

3 MR. SCHMIDT: Yeah, I mean, I can't commit  
4 to that at this point.

5 CHAIR PETTI: Right, but, I mean, this is  
6 sort of moving in that direction.

7 MR. SCHMIDT: I think you could tell by  
8 the purpose of the slide and what's stated here that  
9 it is an area of concern for the staff, yeah, because,  
10 you know, we're just not sure what happens with  
11 freezing, right?

12 You could argue it's vessel protection.  
13 You might, you know, you could argue it's safety  
14 related. Maybe if it's frozen, I don't care if I  
15 break welds or something like that, but that's not  
16 where we are today.

17 Where we are today is to prevent freezing  
18 within 72 hours. That's the design commitment. That  
19 could evolve, I guess, if they're unable to finalize  
20 this design. Well, then I, you know, I think we're  
21 going to have to revisit that again. It's going to be  
22 potentially revisited.

23 You know, I will say that all of these  
24 issues have been brought up with Kairos. You know,  
25 that freezing is as much a concern right now as it is

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1 vessel integrity and the maximum temperatures and I  
2 think I'll just have to leave it at that.

3 MEMBER HALNON: So, when you all look at  
4 that, at the freezing, and the temperature range, and  
5 low decay heat, just from experience, you know, when  
6 you have a scram from a low decay heat perspective,  
7 things happen.

8 There are other effects from other systems  
9 and I will try to translate it, maybe like the inner  
10 gas system or some other system that may either remove  
11 a little bit of heat that's significant now because  
12 you have a low decay heat, or maybe it would add some  
13 heat ahead of the scram or the pressurizer heaters and  
14 a little bit of vent insulation cause more heat than  
15 the core was putting out and cause natural circulation  
16 issues.

17 So, there's some interactions that go  
18 forth beyond just the core and the decay heat recovery  
19 system, so you might want to make sure that we look  
20 at, you know, expand your bubble a little bit, your  
21 circle of what you're going to analyze as you look at  
22 low decay heat type situations.

23 MR. SCHMIDT: Yeah, I mean, I can think of  
24 one system off the top of my head that, I mean, is  
25 kind of in that same vein is the cover gas system.

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1 MEMBER HALNON: Right.

2 MR. SCHMIDT: Let's say you increase the  
3 flow of the cover gas system, either it might be some  
4 cooling effect associated with the Flibe and hence you  
5 get to freeze faster, so that's kind of like a control  
6 system if I were to group it that could, you know,  
7 lead to an earlier freeze. You know, we are -- we  
8 have noted that.

9 MEMBER HALNON: Okay, that's the thought  
10 process I was hoping to get to.

11 MR. SCHMIDT: Yeah.

12 MEMBER HALNON: Good.

13 MR. SCHMIDT: You know, some of these  
14 systems, I think, as you go through are not well-  
15 defined in a preliminary design. We're going to need  
16 final design like flow rates and things like that to  
17 really determine if that is a significant factor or  
18 not.

19 You know, some of these things are on the  
20 staff's mind, but we're not able to nail some of these  
21 down yet without the final details, and I think you're  
22 going to be hearing that multiple times, you know, in  
23 the subcommittee meetings coming forward.

24 DR. BLEY: Hey, Jeff?

25 MR. SCHMIDT: Yes?

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1 DR. BLEY: Dennis Bley. This is an odd  
2 question. All of these construction permits, we built  
3 in language that implies completeness, but we know  
4 there are gaps.

5 The one thing we came to on a couple of  
6 cases in the past is what you really want for the  
7 construction permit is to be convinced that there are  
8 no issues that could become really important later  
9 that construction or elements of the construction  
10 could make it almost impossible to address, and we're  
11 really trying to have a cushion and make sure there's  
12 no real big thing sitting there.

13 Has there ever been a construction permit  
14 issued with step-wise requirements? You know, before  
15 you do this certain weld somewhere, you have to find  
16 out the aggressiveness of some of the materials that  
17 will be there?

18 I don't know that there ever has been a  
19 construction permit that had a staging kind of way to  
20 it. It's a stage thing itself in getting to the  
21 operating license, but I'm just curious if there has  
22 been.

23 MR. SCHMIDT: I'm going to have to call  
24 for help here because this is my first construction  
25 permit, so, you know, maybe others would be better

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1 able to answer that question, like Ed. I'm looking at  
2 Ed.

3 MR. HELVENSTON: Yeah, I'll say -- this is  
4 Ed Helvenston from the staff. And this kind of works  
5 into the research and development aspect of that  
6 requirement that they identify R&D programs that are  
7 important and for safety questions brought up during  
8 the CP, and we have issued CPs that have had R&D  
9 commitments associated with them in the past.

10 DR. BLEY: Yeah, I've not foreseen these,  
11 but it seems like that could be really a safe way to  
12 go if there are some things that remain as crucial  
13 issues.

14 MR. SCHMIDT: This is Jeff Schmidt. Well,  
15 in chapter one, there are the R&D items listed and  
16 I'll just throw one out like the fluidic device. The  
17 staff spent a fair amount of time contemplating. You  
18 know, that's necessary for decay heat removal and we  
19 were looking for failure modes associated with such a  
20 device.

21 You know, that is listed as an R&D because  
22 the design is conceptual at this point and they are  
23 going through a series of tests of different fluidic  
24 devices, and so, you know, that one, I don't know if  
25 I'd call it step-wise, but, you know, they have a

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1 program.

2           They have a schedule. They have, yeah, I  
3 mean, they have a test. They're setting up testing  
4 programs to find the final design, but I don't know if  
5 it's -- I don't necessary consider it, you know, an  
6 incremental step. In other words, it's just part of  
7 their test program that's a continuum from the CP to  
8 the OL.

9           DR. BLEY: Yeah, but it's kind of close,  
10 so thanks. That helps. And there are some things  
11 that are just really worth getting straight before you  
12 build things. Okay, go ahead.

13           MR. SCHMIDT: So, yeah, I think the ones  
14 listed in chapter one, I want to say it's 1.3.9,  
15 section 1.3.9, and, you know, I think some of the  
16 things that we'll be talking with the decay heat  
17 removal system is another one of those things, right,  
18 for the reasons we just described. Okay, let's go to  
19 the next slide.

20           MEMBER DIMITRIJEVIC: Actually, I have a  
21 question on this slide, this is Vesna Dimitrijevic,  
22 and in the previous slide. So, I'm not seeing this  
23 example.

24           For example, you have defined that DHRS is  
25 safety significant because, you know, vessel

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1 temperature, and you have discussed the two different  
2 safety functions here. One is, you know, to cool the  
3 vessel and one is to prevent freezing.

4 In the subtext of defining significance of  
5 the system, we have, one of the options is that we can  
6 discuss significant safety functions. So, did they go  
7 into this process of defining the safety functions and  
8 their significance? That's my first question.

9 My second question is (inaudible) what we  
10 are calling the PRA mission times. One is that you  
11 want to assure there is volume of the water tanks  
12 enough for seven days of cooling, and here you want to  
13 prevent the freezing within 72 hours, and so why are  
14 there those two different mission times discussed in  
15 this case? So, those are my two questions.

16 MR. SCHMIDT: So, this is Jeff Schmidt.  
17 The first part of your questions is, you know, Kairos,  
18 as part of their PSAR, identified what they thought as  
19 safety significance and the safety-related systems to  
20 mitigate those events, and then the staff reviews  
21 those. The second part of your question --

22 MEMBER DIMITRIJEVIC: Did they define the  
23 safety functions in this process?

24 MR. SCHMIDT: Yeah, the safety functions,  
25 yes, yes.

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1 MEMBER DIMITRIJEVIC: Okay, so they  
2 defined the safety functions and then tagged them as  
3 important and as not important, because we can see  
4 here that cooling the vessel is an important safety  
5 function, but prevent freezing was determined, maybe  
6 wasn't even defined as a safety function.

7 MR. SCHMIDT: It was defined as a safety  
8 function. I think the staff had concerns whether the  
9 design could accommodate both. Yeah, their goal was  
10 always to prevent freezing with a specific mission  
11 time, and we had to ensure that the language was clear  
12 throughout the document that that was a commitment.

13 I'm sorry, the second part of your  
14 question was?

15 MEMBER DIMITRIJEVIC: This mission --  
16 (Simultaneous speaking.)

17 MR. SCHMIDT: The mission, oh, mission  
18 time. Thank you, yeah.

19 MEMBER DIMITRIJEVIC: You said about six,  
20 seven days of cooling and 72 hours without operator  
21 action.

22 MR. SCHMIDT: Yeah, so the 72 is borrowed  
23 from the power reactors' phase for passive systems,  
24 the utility, I think it's called resource document  
25 URD. The seven days is kind of analogous to the

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1 thought process for diesel fuel going out to seven  
2 days.

3 They had the capacity to do seven days  
4 and, you know, part of the, I guess, staff's concern  
5 was, you know, if you have an external event that's  
6 pretty severe, you know, would you have enough onsite  
7 water to be able to cope with that? And that was kind  
8 of where the seven days comes from. Again, it's  
9 analogous to the diesel fuel for existing light water  
10 reactors.

11 MEMBER DIMITRIJEVIC: All right, well,  
12 thanks. I mean, you know, I would like to see some  
13 systematic definition of these things. In the  
14 beginning, 72 hours from what, from onset of what type  
15 of transient?

16 Also, I wanted to add if you don't use the  
17 PRA determining safety significance or something that  
18 is basic principles like the systems which perform  
19 safety-significant functions, the systems which are  
20 preventing the important transients, the systems which  
21 are bad for defense-in-depth.

22 So, that is always better when there is  
23 some systematic approach to that instead of just  
24 stating or say this is the case of this source. All  
25 right, so this is just my personal comment.

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1 MR. SCHMIDT: Yeah, I guess I'd like to  
2 follow up because I think Jose had the same comment.  
3 So, there was, before the PSAR was submitted, there  
4 was an analysis. I don't know if analysis is the  
5 right word. There was a document that Kairos went  
6 through and basically did like fault tree analysis on  
7 the system.

8 So, they had their system, you know, to  
9 the level of detail that was designed at that point,  
10 and they went through a fault tree to basically say,  
11 you know, how this would be addressed, what system  
12 would be addressed, the potential failure modes of  
13 these events, and the ones that they were going to  
14 preclude by design.

15 So, there was a systematic approach that  
16 Kairos used prior to the PSAR, and I'm sorry I can't  
17 remember the name of that document. I'll have to get  
18 back to you on that, but the staff did review to try  
19 to determine if, you know, events not normally  
20 considered were captured by this fault tree analysis.

21 MEMBER MARCH-LEUBA: Is that a docketed  
22 document? The question is can we get a copy or was it  
23 internal?

24 MR. SCHMIDT: It was an audit.

25 MEMBER MARCH-LEUBA: It was an audit?

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1 MR. SCHMIDT: It was an audit.

2 MEMBER MARCH-LEUBA: Do we have a Reading  
3 Room that Kairos can put it in so we can look?  
4 Because that's something we would be very interested  
5 in.

6 MR. SCHMIDT: I'll get back to you on  
7 that, yeah.

8 MEMBER MARCH-LEUBA: So, you'll take the  
9 action item? Because that's some very interesting  
10 document.

11 MR. SCHMIDT: Yeah.

12 PARTICIPANT: The functional failure modes  
13 and effect analysis.

14 MR. SCHMIDT: Yeah, I think that was the  
15 title of it, yeah, but I'm not 100 percent sure. I  
16 reviewed it quite a while ago, so I'm not sure I  
17 remember the name.

18 MEMBER KIRCHNER: It's interesting to  
19 observe, Jeff, that we, with other applicants, we've  
20 seen this too where they've done this kind of what I  
21 would call what you just called it, failure modes and  
22 effect analysis, kind of getting at Jose's point of  
23 this blank sheet of paper, but it wasn't part of the  
24 formal submittal. It wasn't part of the -- I think  
25 you know which applicant I'm talking about.

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1 MEMBER MARCH-LEUBA: Yeah, the staff has  
2 access to all of those non-docketed documents via  
3 audits and we have access via Reading Room through the  
4 courtesy of the applicant.

5 MEMBER KIRCHNER: And the staff, that's  
6 correct.

7 MEMBER MARCH-LEUBA: Because they're not  
8 public documents, so you cannot put it on your NRC  
9 laptop. You have to go through their website.

10 MR. SCHMIDT: I guess the point I was  
11 trying to make is that Kairos has done those type,  
12 that type of work to try to identify events.

13 MEMBER MARCH-LEUBA: Yeah, that would  
14 satisfy many, many of my questions, and I'm sure Walt  
15 is in charge of Chapter 13, so it would satisfy many  
16 of his questions too.

17 MR. SCHMIDT: Okay, yeah, let's move on.  
18 The other example I wanted to get out in front of  
19 everybody was, you know, how the staff approached the  
20 methodologies and evaluation models.

21 Just for reference, there are illustrative  
22 examples of some of the transients in a technical  
23 report that's referenced in the PSAR, and so there are  
24 figures comparing to larger than MHA in most cases, at  
25 least for some of the transients, that kind of inform,

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1 helped inform staff's review, but those codes are not  
2 -- you know, they're using codes that have not been  
3 validated. None of the codes have been V&Ved in this  
4 submittal, so I think keep that in mind.

5 So, the staff focused on important  
6 phenomenon. The methodologies and the codes pick up  
7 the important phenomenon in an event and I'll just  
8 throw out an example.

9 I reviewed the pebble handling system.  
10 You know, one of them is that pebbles get out and they  
11 oxidize in air. You know, what does the oxidation  
12 model look like? Does it seem reasonable for the  
13 matrix material that I expect to see, you know, for  
14 this pebble?

15 So, we looked at, you know, are the  
16 important phenomena picked up like oxidation and the  
17 potential release due to oxidation? The range of  
18 conditions evaluated, there was a fair amount of  
19 discussion of do the methodologies really cover a  
20 broad range of conditions?

21 The classic example is rod withdrawals.  
22 You know, you're limiting rod withdrawal that may  
23 bypass your flux rate trip and be more limiting than,  
24 say, a fast, big pull withdrawal that would be  
25 terminated by the flux rate trip, right?

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1           So, did the methodologies and the  
2           construct cover events like that and was it explicit  
3           in that it covers those events? So, that was an area  
4           for the staff's review.

5           Consideration of uncertainties, the staff  
6           said, you know, the document has to reflect there are  
7           uncertainties associated with these and what  
8           uncertainties are important and how will they be  
9           captured.

10          You know, certainty values are not  
11          available, but the concept of where you need  
12          uncertainties, that's what the staff tried to pick up  
13          in its review.

14          Identifying model conservatisms, and this  
15          kind of goes with the margin is, you know, the staff  
16          looked at areas where we thought margins may be  
17          stressed, or challenged is probably a better word to  
18          say.

19          So, margins in our review were always on  
20          our mind and I alluded to the vessel as being one, and  
21          the vessel and even like what are going to be your  
22          temperature measurements for how many are you going to  
23          have and where are they going to be type of questions.

24          You know, we didn't resolve all of those  
25          to the level of detail because that's probably, you

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1 know, commensurate with the OL, but we were asking  
2 those type of questions of like you might need more  
3 than just the outlet plan in this design as, say, what  
4 might be a necessary temperature measurement for  
5 vessel purposes.

6 So, all of those things, the staff looked  
7 at through the chapter, you know, primarily the  
8 Chapter 13 and 4 events. Again, I mentioned the codes  
9 are not validated.

10 Staff performed a detailed review of the  
11 MHA and underlying supporting calculations within the  
12 limits of the preliminary design information. So,  
13 there, there are supporting documents that we can look  
14 at and a good example would be like tritium uptake.

15 You know, we spent a fair amount of time  
16 reviewing tritium uptake models, methods, and release  
17 fractions that would be associated with, say, tritium.  
18 So, that is one calculation that I think, you know, is  
19 more fleshed out, obviously, than some of the  
20 underlying Chapter 13 postulated events. Next slide,  
21 please?

22 So, because, you know, we haven't  
23 performed V&V, the staff had to use a variety of means  
24 to reach its reasonable assurance finding, and I  
25 provided a list of -- you know, not all are used in

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1 every case.

2 It was a case by case basis, but, you  
3 know, when correlations were used, we would look to  
4 see if those correlations are typically used in pebble  
5 beds. Are they correlations that, say, Sandia is  
6 using in MELCOR or its models? You know, are those  
7 correlations reasonable at this stage of the design?

8 We reviewed journal articles that  
9 performed similar analysis or similar modeling  
10 approaches to get a feel for how the system responds,  
11 whether the margins seemed reasonable. So, we did a  
12 fair amount of, you know, journal searching, a lot of  
13 times associated with the UC Berkeley Mark 1 design.  
14 You know, we looked at some of those journal articles.  
15 I looked at some journal articles on pebble design,  
16 for example.

17 Integral tests, you know, primarily that  
18 was in the area of fuel and I used the AGR program  
19 data and the EPRI topical report for like, you know,  
20 do fuel failure fractions look reasonable? You know,  
21 is it reasonable to assume relatively small or  
22 negligible transient-induced failures? I used the AGR  
23 data to help inform that decision.

24 We did perform some scoping, what I would  
25 call scoping calculations to inform our engineering

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1 judgement. There, we utilized the UC Berkeley Mark 1  
2 design that research had set up and we modified it to  
3 the extent that could be supported with the  
4 preliminary design information to model what we call  
5 our Hermes-like design.

6 You know, we can't say it's Hermes because  
7 we don't have the details to really say it's Hermes,  
8 but there we wanted to get a feel for things like  
9 power distribution, reactivity coefficients, whether  
10 we were seeing the right signs, the signs were  
11 consistent with like different areas of the core.

12 We ran some transients to see if the  
13 transient behavior was somewhat similar to what was in  
14 their illustrative examples. It's really focused on  
15 the term scoping calculations.

16 Now, normally I use the word confirmatory,  
17 but the level of detail is not sufficient to call them  
18 confirmatory and they shouldn't be judged that.  
19 Again, we were just trying to inform our engineering  
20 judgment as best we could at the time with the  
21 information provided.

22 MEMBER MARCH-LEUBA: In that light, I  
23 don't really like the concept of technical reports  
24 because all of this, the technical report is embedded  
25 in the chapter of the PSAR, but by you issuing an SER

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1 on the PSAR, are you implicitly approving this  
2 methodology?

3 You're telling me you're not, that you are going  
4 to have to issue a new SER for the OL? So, they're  
5 going to have to attach, for example? I'm thinking of  
6 topical report 017 --

7 MR. SCHMIDT: Right.

8 MEMBER MARCH-LEUBA: -- which is the  
9 methodology.

10 MR. SCHMIDT: Well, okay, so 017 is a  
11 technical report.

12 MEMBER MARCH-LEUBA: Correct.

13 MR. SCHMIDT: Yeah, that's referenced in  
14 Chapter 4. So, to the level we're able to, yes, we're  
15 effectively approving that. Could it change? Yes,  
16 I'll give an example.

17 So, on the pebble handling system, they  
18 use an oxide correlation that is specific to what the  
19 journal article called the new A3-3 matrix material,  
20 but Kairos is doing their own testing of their own  
21 matrix material.

22 So, the methodology was reviewed, but the  
23 actual final values may change because their matrix  
24 material may be different than that, and hence the  
25 oxidation rates may be different, or as, say, the

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1 building or wherever the worst case where the pebbles  
2 might spill, you know, might have different heat  
3 transfer modes than are just assumed in this design  
4 and maybe the temperatures could change.

5 So, I think the way to look at it is, the  
6 way we looked at it was we were looking for important  
7 physical phenomenon and methodology. The final values  
8 are subject to change based on the preliminary nature.

9 MEMBER MARCH-LEUBA: Yeah, but the final  
10 values were reflected in Chapter 13 of the FSAR.

11 MR. SCHMIDT: Yes.

12 MEMBER MARCH-LEUBA: The methodology is in  
13 TR17. Is that fully reviewed? And if there is a lot  
14 to change in that report, can they use that for the  
15 operating license?

16 MR. SCHMIDT: Yeah, so it's incorporated  
17 by reference, so if the PSAR changes, so when the PSAR  
18 becomes the FSAR, that is subject to change, right.  
19 That's going to be --

20 MEMBER MARCH-LEUBA: Because the technical  
21 report cannot be used in the FSAR. It hasn't been  
22 approved for any application.

23 MR. SCHMIDT: Well, like a modification to  
24 that will likely appear in that.

25 MEMBER MARCH-LEUBA: Basically, I know

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1 you're going to review it and we want you to review it  
2 again.

3 MEMBER HALNON: The technical report  
4 initially was done under the quality program  
5 calculations, so it's subject to 50.59 as soon as you  
6 issue the SER for the PSAR. I assume that any changes  
7 from there on our is subject to 50.59 in some respect.  
8 Just make sure that those changes you're talking about  
9 are captured under the quality program. Is that --  
10 I'm stating that. Is that correct?

11 MR. SCHMIDT: I guess I'm going to have to  
12 defer whether 50.59 applies to a construction permit.

13 MEMBER HALNON: Well, it may not be 50.59  
14 in itself, but it still, the changes have to be  
15 controlled by some quality program and some --

16 MR. SCHMIDT: Oh, yes.

17 MEMBER HALNON: -- change program --

18 MR. SCHMIDT: Yes.

19 MEMBER HALNON: -- that allows you to  
20 review it against the PSAR --

21 MR. SCHMIDT: Yes.

22 MEMBER HALNON: -- assumptions or what  
23 you're going to reviewing in the FSAR has to start  
24 from scratch.

25 MR. SCHMIDT: No, we don't anticipate

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1 starting from scratch and all of the changes have to  
2 be done under a quality program, yeah.

3 MEMBER HALNON: So, you'll have a record  
4 of those changes and you'll know where it's been and  
5 where it's going.

6 MR. SCHMIDT: Yeah, I know it has to be  
7 done and I think we can audit those as we see fit,  
8 but, I mean, we really care primarily about the final,  
9 right. The emphasis will be on the final design and  
10 we'll compare the final probably back to the PSAR.

11 MEMBER HALNON: Yeah, so much like a  
12 calculation that's done onsite, maybe just a very  
13 simple one that's referenced in the FSAR, you'll look  
14 at the calculation to make sure it's all correct, and  
15 then from there on out, any changes have to be  
16 assessed through 50.59 to the FSAR.

17 MR. SCHMIDT: Right, after the --

18 MEMBER HALNON: So, is there an equivalent  
19 thing in the construction portion? I know it's  
20 controlled by the quality program, but is there --

21 MR. SCHMIDT: Yeah, beyond --

22 MR. SHAMS: I can respond to that.

23 MR. SCHMIDT: I'm going to need some help  
24 on that, yeah.

25 MR. SHAMS: Mo Shams with the staff.

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1 There is. The space that the licensee would be in or  
2 the applicant would be in after the construction  
3 permit is the inspection phase.

4 We have every ability to go in and inspect  
5 the construction activities, as well as their  
6 implementation of their QA program, including  
7 correction to their documentation calculations, as  
8 well as, you know, whatever is being done on  
9 construction itself. So, that's inherent in the  
10 process that we apply during construction.

11 MEMBER HALNON: And the fact that it's  
12 preliminary allows that final --

13 MR. SHAMS: Correct.

14 MEMBER HALNON: It's the final safety, but  
15 what we're really interested in is making sure those  
16 technical reports are validated or correct.

17 MEMBER REMPE: So, I have, one, I wanted  
18 to note that I was glad to hear that the research  
19 efforts to do the pilot plan evaluations were helpful,  
20 and that you even further modified another design and  
21 used the MELCOR code or whatever codes from research.

22 One of the things that I know we mentioned  
23 to the staff when they presented and discussed them  
24 with us was about what were some key assumptions or  
25 properties that most affected the results, and did

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1 those kind of insights come through and help you in  
2 your evaluation of what Kairos presented for their  
3 analyses to help you focus on hey, that data is not  
4 yet available and it needs to be obtained?

5 And then in looking at your examples  
6 again, I just want to reiterate a point I think, I  
7 hope I tried to make before that I'm not sure it's  
8 realistic to expect that everything will be validated  
9 or done by the time the plant Hermes starts up because  
10 of the fact that there's not much, if any, operating  
11 experience for this type of reactor and its fuel, et  
12 cetera.

13 And, I mean, we've heard that for a  
14 demonstration facility like this, one can have a  
15 lighter touch. It's just low power, but it sure seems  
16 like that there are some key things that staff would  
17 want to identify and say we're letting you have a  
18 lighter touch, but we sure would like to see this  
19 validated later on.

20 And I think those kind of things should be  
21 documented somewhere so the folks that are out in the  
22 region understand what headquarters has said and  
23 perhaps consults with headquarters to say yeah, this  
24 is what we need to do and how it will be monitored.

25 MR. SHAMS: So, Mo Shams with the staff.

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1 Let me try to take a shot at it because I think this  
2 is an incredibly important sort of conceptual or  
3 foundational thought on how we approach testing  
4 research reactors.

5 MEMBER REMPE: Yeah, and this goes beyond  
6 key permits.

7 MR. SHAMS: Absolutely, I think what  
8 you're describing is totally integral to our thinking.  
9 Do we have the right information to be able to  
10 authorize that facility to operate? And that's what  
11 we're seeking.

12 Now, the level of information drives what  
13 we put in the tech specs, how much power. These  
14 facilities are in their own dynamics with the staff  
15 are and sort of a more dynamic operation than a power  
16 reactor in the sense that they come back for renewals  
17 or they come back for changes in the tech specs.

18 So, this is how we are actually sort of  
19 applying what we know and the confidence that we have  
20 in the safe operation of the facilities through the  
21 different requirements that are applied to them.

22 And the entire nature of a test reactor is  
23 one of let me start here and then I'll go forward to  
24 be able to obtain the information, either offer it  
25 just for other power reactors or for one that's

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1 entirely based on that technology as well.

2 So, we're confident that we're going to  
3 get to the place. Wherever they're starting is  
4 commensurate with the information provided,  
5 commensurate with the risk of the facility,  
6 commensurate with the licensing terms for the  
7 facility.

8 Kairos is not a 40-year facility. It's --  
9 yes. So, that sort of informs our look into the  
10 durability of the material or such that the burnup,  
11 you know, sort of information for the fuel. That sort  
12 of stuff all feeds into how we look at the facility  
13 and what solution we get.

14 MEMBER REMPE: So, the tech specs are  
15 where I expected it to be, but I hope that it's -- I  
16 mean, the tech specs are kind of out there like in one  
17 area, but there are certain concepts that one expects  
18 to be evaluated and the tech specs would guide it, and  
19 I just am wondering will there be a list of those  
20 concepts?

21 And again, this is just the PSAR. I get  
22 it that you could wait until later, but it just seems  
23 like a good place to start making that list and have  
24 it --

25 MR. SHAMS: Sure.

1 MEMBER REMPE: -- documented and --

2 MR. SHAMS: Sure, and I think what Jeff  
3 was indicating earlier is such thinking is honest. If  
4 there's a formalized part which is Appendix A, these  
5 are particular commitments that the applicant needs to  
6 do, there's a formalized part. That's the research  
7 plan and testing plan that's intended to be done.

8 There's also something else which is  
9 Kairos is actually building three different  
10 engineering units prior to actually they get into the  
11 nuclear unit itself, to be able to validate certain  
12 concepts.

13 So, and the point I'll get to, and I know,  
14 the last one, is there's information that we need for  
15 the test facility itself and there is information that  
16 we're going to need from the test facility to the  
17 power reactor, and to your point, we cannot start the  
18 power reactors without the testing facility giving us  
19 all of this information. So, one way or another,  
20 we're going to need information from that machine.

21 MEMBER REMPE: So, I think we're on the  
22 same path, but Appendix A is stuff, traditionally has  
23 been stuff just needed to be completed by the  
24 operating license --

25 MR. SHAMS: Yes.

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1           MEMBER REMPE:  -- but my point is that  
2           we're giving it a lighter touch.  I think there are  
3           some things that after you start operating also should  
4           be done, perhaps to have a little more confidence  
5           through the four years this thing's going, but also  
6           for the future reactor, and where will they -- where  
7           is that documented?

8           MR. SCHMIDT:  So, can I kind of just -- I  
9           think there's one other aspect and that probably won't  
10          fully address your concern, but, you know, the other  
11          thing that we are thinking about is, you know, we have  
12          startup tests.

13          Startup tests will, you know, don't get  
14          the time evolution failure modes maybe or concerns,  
15          but they allow, you know, kind of like goal posts, and  
16          to say that, just to say that like the Chapter 13  
17          safety analyses are still valued, right, you know,  
18          rods or reactivity coefficients.

19          So, we have been thinking, you know, what  
20          needs to be in that startup test plan that would, you  
21          know, inform us that, yeah, if they were to complete  
22          that successfully, they could continue.  If they  
23          couldn't, then maybe they would have to pause, right.

24          So, the startup tests and the startup  
25          tests for this reactor will be different and probably

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1 larger than a traditional light water reactor, but the  
2 staff has already been going there thinking about  
3 things like what would this even look like?

4 MEMBER REMPE: This is good. I know so  
5 many times in the past when we asked questions about  
6 startup testing or operating procedures, we always get  
7 the response oh, we're going to do that later. It's  
8 not part of the operating license.

9 And again, I just kind of think a list  
10 somewhere, and again, the startup test plans are  
11 another place where it can be done, but just a list of  
12 things that are areas that might be considered, that  
13 will be better fleshed out at the operating license  
14 stage, but I just think a list would be nice as again,  
15 because it's not just with Kairos.

16 It's going to come up with other designs  
17 we're reviewing, and it's just something to think  
18 about that I think would be helpful for an early  
19 indicator for the applicant as well as for the staff  
20 in future reviews.

21 MR. SCHMIDT: Okay, thank you.

22 MEMBER REMPE: If one member's --

23 (Simultaneous speaking.)

24 MR. SCHMIDT: I guess I want to just  
25 finish up my two slides here. Let's see, so we kind

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1 of went through the various tools that were available  
2 for the staff's review based on the preliminary  
3 information. So, you know, I want to be clear what's  
4 going to be like between now, the CP roughly, and the  
5 OL.

6 So, review software quality assurance and  
7 implementation. Those are things like, you know, part  
8 of V&V, code error, code error notices. Are you  
9 picking those up? Are they relevant? Are you  
10 evaluating those?

11 Like code nodal maps, right, nodalization,  
12 you know, we didn't go through like nodalization  
13 studies to pick up if -- I mean, the state of the  
14 models, I don't think it's -- that would be picked up  
15 effectively as part of the OL or another topical  
16 report that would, say, pertain to their KP-SAM code.  
17 You know, we would look at nodalization studies there.

18 Review code inputs, we didn't ask for  
19 input decks. We didn't go through and see if those  
20 input decks are reasonable. Again, that is something  
21 that would be done during, you know, really at the OL  
22 stage for the final FSAR.

23 Material properties, you know, we have  
24 obviously some insights into the material properties  
25 based on the topical reports, things like effective

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1 safety analysis, like the viscosity is a function of  
2 temperature is kind of a key one.

3 You know, they acknowledge that they're  
4 going to look at a range and the range is consistent  
5 with their topical report. We didn't go and check  
6 that their codes did that, that had that input. We  
7 just kind of said, you know, these are important. You  
8 need to include them in the methodology.

9 And we didn't exercise the applicant's  
10 code or perform confirmatory analysis. I said  
11 scoping. I'm clearly defining the difference between  
12 scoping and confirmatory here. We just don't have the  
13 design information to do what I would consider  
14 confirmatory analyses at this point.

15 Justification of models may be provided by  
16 test results. I indicated that the ADR program is  
17 probably the most relevant one there. It will also be  
18 their test results, right. They have an extensive  
19 testing program. We'll be looking at that data.

20 The code V&V, the tradition sense of code  
21 V&V will be done, and then other methods before and  
22 during the operating license review. So, just to put  
23 it in context, I mean, we'll be reviewing this I would  
24 say similar to what we do for power reactors in the  
25 sense of codes and methods. There's not going to be

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1 a big space in that differential.

2 CHAIR PETTI: But in the end -- for  
3 instance, there's a lot of pebble bed stuff out there  
4 for gas pebble beds.

5 MR. SCHMIDT: Yes, yes.

6 CHAIR PETTI: And I'm sure they're going  
7 to use those.

8 (Simultaneous speaking.)

9 MR. SCHMIDT: There are certain things  
10 that they are examining whether they're applicable.

11 CHAIR PETTI: Sure, but I mean, just, you  
12 know, calculating K-effect or calculating reactivity  
13 coefficients, you know, I think you're going to start  
14 -- you should use the (inaudible) cases to give you  
15 some confidence that you're code knows what it's doing  
16 --

17 MR. SCHMIDT: Right.

18 CHAIR PETTI: -- and then you move on, but  
19 it's putting the salt with the pebble together that  
20 there's just going to be little data, but they're get  
21 some great thermal hydraulic data out of their test  
22 facilities hopefully --

23 MR. SCHMIDT: That's right.

24 CHAIR PETTI: -- that will inform that.  
25 So, you know, it's a patchwork, but in the end, the

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1 only integral test is the actual reactor, right, so.

2 MR. SCHMIDT: Yes, that is correct, yeah.

3 MEMBER MARCH-LEUBA: My only question is  
4 when I look at this technical report, it looks like a  
5 topical report, and if it was a topical report, you,  
6 Jeff Schmidt, would have written an SER underneath  
7 that would be at least 50 page, if not 150 pages, no,  
8 not yet.

9 But all I see in the documentation is half  
10 a page in the SER for Chapter 4, so however we are  
11 proving on the methodology by implicitly approving  
12 Chapter 4 and the whole PSAR. I mean, whereas your  
13 expectation is that it's going to be further reviewed.  
14 They will have to do a lot more evaluation and we, the  
15 staff, and I mean you, are going to look at it again.

16 MR. SCHMIDT: Yes.

17 MEMBER MARCH-LEUBA: So, that's why I  
18 don't understand all of the technical reports.

19 MR. SCHMIDT: So, in some sense, it's  
20 better. It's not a topical report because there are  
21 probably going to be some changes to that inevitably,  
22 and if we wrote a safety evaluation like you said,  
23 there would probably be as many pages of limitations  
24 and conditions as there are pages to the safety  
25 evaluation. I'm not sure that makes a lot of sense at

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1 this point.

2 MEMBER MARCH-LEUBA: But your expectation  
3 is for the OL, the operating license, you will review  
4 the methodology again?

5 MR. SCHMIDT: Yes.

6 MEMBER MARCH-LEUBA: Because it will have  
7 changed.

8 MR. SCHMIDT: Absolutely, this is  
9 methodology for a construction permit and the level of  
10 detail, we thought it was commensurate with a  
11 construction permit. Everything starts again at the  
12 OL.

13 MEMBER MARCH-LEUBA: And you will not be  
14 heard if I propose to the members that our letter says  
15 that, that the methodology (inaudible) CP and the  
16 methodology is expected to increase for the OL and we  
17 have to review it again.

18 MR. SCHMIDT: Yes, I mean, I expect that  
19 to be true.

20 CHAIR PETTI: Yeah, just, and, you know,  
21 if you remember, other applicants we've had between  
22 preliminary and final panel, it wasn't just changing  
23 the correlation. There were major changes to  
24 materials, the processes, and it took a lot of -- it  
25 changed the whole nature of the review, but, you know,

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1 so --

2 MEMBER MARCH-LEUBA: I'm more concerned --

3 CHAIR PETTI: This is why you serve a top  
4 down functional thing. You do the best you think you  
5 can.

6 MEMBER MARCH-LEUBA: You asked me to write  
7 you a couple of paragraphs on TR 017 and this is what,  
8 this is perfectly -- what we've done is more than  
9 sufficient for the CP. The oil will change and will  
10 need to be done again.

11 MR. SCHMIDT: Agree.

12 MEMBER KIRCHNER: We'd just like to make  
13 an observation that the staff, back when the advanced  
14 reactor policy statements were written, now we're back  
15 in the '90s time frame, opined extensively on  
16 prototypes.

17 And what I would just like to observe is  
18 that this is a good thing, what's happening here with  
19 the Hermes test reactor. They're not trying to make  
20 that leap right to a power reactor. Yesterday, we  
21 heard from another applicant. They are going to also  
22 do a prototype.

23 And I think, again, this is a preliminary  
24 design, so from what I see, this is one person's  
25 opinion, I think the staff is doing a reasonable job

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1 for where the applicant is at this point with the  
2 preliminary design and this allows the technology to  
3 go forward, and I think that's extremely important.  
4 Not every I and T is going to be crossed at this  
5 point.

6           Going back to technical reports, I could  
7 see -- I'll make up a simple example which actually is  
8 derived from what's in front of us from another  
9 applicant is that there's a technical report on the  
10 choice of the stainless steel material for a vessel,  
11 reactor vessel, and a lower head. I could see that  
12 changing as they learn more or they identify a better  
13 material and so on.

14           So, that's just a rhetorical example, but  
15 what I've seen so far there, yeah, you don't need  
16 quite the in-depth that goes into a topical report for  
17 a methodology that we were just talking about at this  
18 point.

19           So, I think maybe we should ask the staff  
20 about how they're going to handle technical reports  
21 that are attached to FSAR or PSAR chapters in the  
22 future and --

23           MEMBER MARCH-LEUBA: That's exactly what  
24 I'm asking.

25           MEMBER KIRCHNER: -- the process there.

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1                   MEMBER MARCH-LEUBA: One concern that I  
2 have, I have --

3                   (Simultaneous speaking.)

4                   MEMBER KIRCHNER: That's only on FSARs,  
5 so.

6                   MEMBER MARCH-LEUBA: You know I have a  
7 dirty mind and I'm thinking here an applicant can save  
8 a lot of money by saying you already approved it  
9 before, well, yeah, I'm going to use that one that you  
10 approved and I'm not going to change it. Kairos is  
11 too responsible to do that because I know them, but we  
12 should not allow them the temptation.

13                  MR. SCHMIDT: Yeah, I mean, we reviewed  
14 the methodology to see if it picked up all of the  
15 important phenomena. The final like correlations, for  
16 example, they're all subject to either the test  
17 programs or change at this point.

18                  So, you know, I think the framework is  
19 pretty good. I don't expect a lot of changes in the  
20 overall framework, but the final details, I guess I  
21 expect changes and the staff is going to have to re-  
22 view all of that stuff again to the level that it's  
23 commensurate with an FSAR.

24                  MEMBER MARCH-LEUBA: All of the  
25 correlations are going to be different and all of the

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1       uncertainties are going to be different because --

2                   MR. SCHMIDT: Certainly, the uncertainties  
3       are not identified, yeah.

4                   (Simultaneous speaking.)

5                   MR.     SCHMIDT:         The     theories     of  
6       uncertainties are. The final values are not.

7                   MEMBER MARCH-LEUBA: So, it's going to  
8       change.

9                   MEMBER KIRCHNER: To repeat myself, when  
10       the staff back 30 years ago opined about prototypes,  
11       they basically looked at it in the sense of the  
12       prototype should be of sufficient scale and fidelity,  
13       these are my words, not the staff's words, such that  
14       the primary safety functions can be demonstrated  
15       through the concept, and that was how they basically  
16       put together guidance on the topic of prototypes.

17                   So, what we have in front of us now is  
18       indeed a prototype that is addressing those major  
19       safety functions, hopefully successfully.

20                   MR.     SCHMIDT:         So,     that     ends     my  
21       presentation about that. Is there anything after  
22       these slides?

23                   MR.     BEASLEY:        The     last     slide     is     just  
24       contact information.

25                   CHAIR PETTI: Okay, so I have a question.

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1 Let's talk about MHA for a minute --

2 MR. SCHMIDT: Okay.

3 CHAIR PETTI: -- because that's going to  
4 come up. How do you establish the reasonableness of  
5 the MHA? Is it, if I think in power reactor terms, is  
6 it supposed to be sort of a worst-case DBA or is it,  
7 because it's hypothetical, sort of slightly beyond the  
8 DBA?

9 MR. SCHMIDT: So --

10 CHAIR PETTI: Because, I mean, we're going  
11 to talk about it. I'm sure we're going to get into  
12 that in detail.

13 MR. SCHMIDT: So, Ed can correct me or Ben  
14 can correct me as we go, but, you know, the construct  
15 is the MHA forms the box or outer envelope, and all  
16 the DBAs effectively have to fall, you know, below it  
17 or MHA bounds it.

18 And, you know, you look at both material  
19 limits, like the stainless steel we were talking  
20 about, as well as the dose criteria. So, all of your  
21 events, and I'll just throw one out for an example,  
22 like the salt spill accident, you know, that event, at  
23 the end of the day, has to be bounded by the dose  
24 associated with MHA.

25 So, the MHA is bounding from that, but it

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1 is not a DBA. It also assumes some functions perform  
2 as expected. Some safety-related functions perform as  
3 expected and I'll give you a specific example, reactor  
4 trip.

5 It assumes you have reactor trip and you  
6 have at least three trains of decay heat removal. So,  
7 with certain assumptions, what I typically call like  
8 reactor system assumptions, system performance  
9 assumptions, then the MHA bounds those other events.

10 CHAIR PETTI: So, you don't -- I mean,  
11 let's go over the sodium reactors and unprotected  
12 transients. You know, it was such a big deal back in  
13 the day that EBR2 did with the reactor unprotected  
14 transients, right.

15 MR. SCHMIDT: Right.

16 CHAIR PETTI: The system did not trip and  
17 they showed the safety. That certainly sort of would  
18 bound any MHA or could be a surrogate for MHA, but  
19 you're saying that no, you tend to assume the safety  
20 functions?

21 MR. SCHMIDT: There is a section called  
22 precluded events. Those events are precluded. Those  
23 are -- you know, there are certain assumptions that  
24 will, that have to happen to ensure, I think, the MHA  
25 is bounded.

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1 MEMBER MARCH-LEUBA: Is that consistent  
2 with a single failure criteria or it's more of an LMP?

3 MR. SCHMIDT: The single failure criteria  
4 is addressed. So, like when I talked about like the  
5 decay heat removal --

6 CHAIR PETTI: Yeah, three out of four.

7 MR. SCHMIDT: -- I did one train.

8 MEMBER MARCH-LEUBA: No, I'm talking about  
9 the MHA, what you were talking now about the precluded  
10 events.

11 MR. SCHMIDT: The precluded events?

12 MEMBER MARCH-LEUBA: A lot of it's based  
13 on single failure criteria or LMP frequency?

14 MR. SCHMIDT: I mean, it's not based on  
15 LMP. I'll just give you an example, like an ATWS-type  
16 event is precluded and, you know, we spent a fair  
17 amount of time making sure that that was a reasonable  
18 assumption based on like testing for control rod  
19 insertion into the pebble bed, that you could have  
20 adequate control rod insertion.

21 MEMBER MARCH-LEUBA: Yeah, and we have  
22 approved, I mean, you guys have approved some reactors  
23 for that.

24 MR. SCHMIDT: Well --

25 MEMBER MARCH-LEUBA: For no power.

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1 MR. SCHMIDT: Return to power, are you  
2 referring to or you're referring to ATWS?

3 MEMBER MARCH-LEUBA: The high quality of  
4 the scram system from reactor (inaudible).

5 MR. SCHMIDT: So, the staff looked at  
6 aspects that could potentially challenge the  
7 assumptions that went into the MHA is the best way to  
8 say it. Again, reactor scram is assumed as part of  
9 the MHA. The staff made sure that effectively in the  
10 staff's mind, the probability of occurrence was low  
11 and they had information supported by testing to  
12 ensure that.

13 CHAIR PETTI: I mean, with this system,  
14 you could do an unprotected transient and you're  
15 probably going to be okay because of the strong  
16 negative coefficient calculations, right, which I, you  
17 know, have no reason not to believe that they're  
18 right, so, but you're saying that you basically don't  
19 -- that's sort of beyond.

20 MR. SCHMIDT: That's beyond, I think, what  
21 is constructed for the MHA.

22 CHAIR PETTI: That's what they say, but,  
23 I mean, are you referring -- is there some guidance  
24 that you guys used to, this idea of the safety systems  
25 program, I mean, is that written down somewhere that

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1 --

2 MEMBER MARCH-LEUBA: What I'm hearing is  
3 that this reactor is limited by the vessel, that the  
4 fuel is so good that it's transferred immediately to  
5 the vessel wall. There is no temperature.

6 CHAIR PETTI: Yeah, but, well, on a  
7 reactivity event, I'm not sure that there's some  
8 temperatures challenged. There is some temperatures  
9 challenged on heat removal, right?

10 MEMBER MARCH-LEUBA: On long term.

11 CHAIR PETTI: Long term.

12 MR. SCHMIDT: I mean, they could be  
13 challenged on both. I think you'll see the curves.  
14 If we look at the curves in the illustrative example,  
15 you know, vessel temperatures can be --

16 MEMBER MARCH-LEUBA: If you're going to  
17 scram, the vessel will be --

18 (Simultaneous speaking.)

19 DR. BLEY: If you can use the microphone,  
20 it will help.

21 MEMBER MARCH-LEUBA: It's extremely  
22 (inaudible). Just talk to it.

23 MR. SCHMIDT: Okay, all right, yeah, sorry  
24 about that. I apologize. Yeah, so, you know, all of  
25 the events look at whether, their material limit and

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1 the dose consequence. That's the best way to say it  
2 and you'll see those plots. The plots are in the, I  
3 want to say the appendix to technical report KPTR018.

4 So, you know, the temperatures feed the  
5 releases, dose releases, as well as obviously the  
6 limits. The limits for the fuel are, you know,  
7 they're nowhere near the limits of the fuel, so that's  
8 not really in play, but the vessel limits are, the  
9 temperatures associated with the reflector and not  
10 necessarily the reflector material limits, but the  
11 dose associated with that, those temperatures, and  
12 those are all discussed in the safety evaluation, but  
13 the MHA is bounding from a dose standpoint.

14 CHAIR PETTI: Any other questions,  
15 members, particularly those online?

16 MEMBER SUNSERI: This is Matt. I don't  
17 have any questions. Thanks.

18 CHAIR PETTI: Well, then I guess I want to  
19 thank you guys.

20 MEMBER MARCH-LEUBA: Are we asking for  
21 public comments?

22 CHAIR PETTI: Oh, I suppose so. We'll go  
23 out for public comment. If there's any member of the  
24 public that wishes to make a comment, please unmute  
25 yourself, state your name and your comment. Okay, I'm

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1 not hearing any.

2 Then, again, I want to thank you. I think  
3 this was good. It was productive. It clarified some  
4 things, at least in my mind, so with that, I think we  
5 should probably go for a small break. Let's --

6 MEMBER REMPE: Your agenda only gave us  
7 five minutes. Can we have a little more than five  
8 minutes?

9 CHAIR PETTI: So, yeah, let's come back at  
10 10:45 then.

11 MEMBER REMPE: Okay.

12 CHAIR PETTI: Thank you.

13 (Whereupon, the above-entitled matter went  
14 off the record at 10:26 a.m. and resumed at 10:46  
15 a.m.)

16 CHAIR PETTI: Okay, folks. We're back in  
17 session, and we've got most members, not all members  
18 yet.

19 MEMBER SUNSERI: This is Matt. I'm here  
20 if you need a quorum.

21 CHAIR PETTI: No, I think we have a  
22 quorum. Subcommittee, so we don't have a quorum. So  
23 we're going to deviate a little bit from the agenda.  
24 The agenda says we're going to start with Chapter 1,  
25 but the staff is going to present Chapter 1 in March

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1 subcommittee. So we'll hold off doing that until we  
2 hear their presentation, in which case we're going to  
3 move in to the afternoon chapters.

4 So the first one up is Chapter 10. So if  
5 Sandra could bring up the Chapter 10 memo. Is she  
6 there? Yes.

7 MS. WALKER: I'm here. I just don't have  
8 rights to share.

9 CHAIR PETTI: Oh, okay. Hold on. We're  
10 going to do 10, 12, 14, 16, 17, and 18. The memos,  
11 yes, because the staff will not present on these  
12 because these really have limited information. But  
13 for completeness, we're going to still provide a memo  
14 on it.

15 So, Joy, it's yours.

16 MEMBER REMPE: Thank you. So when Dave  
17 assigned Chapter 10 to me and I looked at it in the  
18 application for Hermes, I said, hallelujah, it's only  
19 a paragraph long, it's on experimental facilities, and  
20 there are none; this ought to be easy. But, anyway,  
21 I went ahead and wrote the background up and talked  
22 about that and the guidance that was applicable.

23 And if you'll scroll down, Sandra, I did  
24 read what the staff wrote, but then I got to thinking  
25 about it a bit and, even though there aren't really

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1 any experimental facilities, there is a capsule where  
2 they can irradiate some specimens that it's not  
3 supposed to affect reactivity, et cetera. But the  
4 thing is the whole test reactor is an experiment, and  
5 that is why I, even if you'll even go on down to later  
6 parts, there's a lot of things that I just don't  
7 think will be known, and that's what I harped on today  
8 with the staff about that we hope they validate their  
9 codes entirely.

10 We hope they have some adequate knowledge  
11 about the performance of the instrumentation, which  
12 isn't even identified what sensors they're going to  
13 use in the construction permit because they don't have  
14 to in a construction permit, but I think that's  
15 unrealistic optimism and I think that there will be  
16 some things that will have to be identified and  
17 investigated further after the plant is granted an  
18 operating license because it is a low-power facility  
19 and I think the staff will have confidence for  
20 adequate safety to give them a reasonable, have  
21 reasonable assurance to let them have an operating  
22 license.

23 But there ought to be some things that are  
24 explored and validated more for continued operation of  
25 Hermes, as well as follow-on power reactors, and I

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1 think that a list ought to be formulated. Again, I  
2 don't know what it will be. They might pick their  
3 sensors and we may have confidence in them by the time  
4 it starts operating, but I have a possible activities  
5 include and I have a list there. If somebody wants to  
6 add something to the list, I'm willing. This is a  
7 draft memo to add it to the list if I agree with it  
8 because it is my memo. And I don't think any  
9 additional discussion on Chapter 10 is needed, but I'm  
10 writing this mainly for the members also to think  
11 about this as we go through and maybe in the final  
12 letter have a better list than what I have in my memo.

13 And that's about all I wanted to say on  
14 this chapter. Vicki, you look like you have a --

15 MEMBER BIER: Yes, I just have a question,  
16 which you may not know the answer to. I would be  
17 curious, do you sense that they probably do have a  
18 first set of sensors picked out and just didn't want  
19 to put it in a docketed filing or they really haven't  
20 gotten that far in the design yet?

21 MEMBER REMPE: I don't know.

22 CHAIR PETTI: I mean, they're doing these  
23 engineering test runs. They're going to have to have  
24 some instrumentation there, some instrumentation. But  
25 that's in no radiation, but they've got to have some

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1 instrumentation for that. My guess is they're going  
2 to test some stuff and see what works.

3 MEMBER REMPE: Okay. So they talk about  
4 the Flibe as a fission product retention barrier.  
5 Okay. So how far, what's the height of the Flibe over  
6 the core if you're going to count that as a barrier  
7 for fission product release, and I know I asked that  
8 question and they said we haven't decided yet. Then  
9 suddenly that level sensor becomes more important. In  
10 light water reactor designs, water level is sometimes  
11 a difficult thing to measure and what's the accuracy  
12 of it. But there's just a bunch of questions that --  
13 and, again, we're going to first-of-a-kind things, and  
14 I just think it's important to start thinking about  
15 this. And it's not just a Hermes question. It's  
16 something that I think ought to be considered for a  
17 lot of these test facilities.

18 MEMBER HALNON: So, philosophically, on  
19 these prototypes and test reactors that will  
20 eventually morph into a larger power-producing  
21 reactor, are we expecting them to push the envelope in  
22 the operating parameters and maybe even operate it at  
23 values that it would not be? In other words, the  
24 high-level limits and other things to get data so that  
25 they can better inform the higher, for lack of a

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1 better word, higher risk of the power reactor here?

2 MEMBER REMPE: That's something that came  
3 up with another applicant we discussed, but, again, I  
4 think that's something that the staff should  
5 communicate to the applicant that has informed them  
6 they're planning to do this and when they inform it  
7 with Hermes. I haven't heard them talk about the  
8 higher power ones like we have with other applicants,  
9 so I wouldn't have put that in here. I'm just saying,  
10 you know --

11 MEMBER HALNON: Well, that's why I was  
12 just thinking philosophically because I wouldn't learn  
13 a whole lot if I built a prototype and just ran it  
14 straight and normal for five years and said, okay,  
15 everything looks pretty stable and then not --

16 MEMBER REMPE: I think the staff's  
17 responsibility with others who have told us they plan  
18 to do it, and that was the question that I pursued in  
19 a prior subcommittee meeting that, you know, how is  
20 that interaction going, and the staff didn't  
21 understand my question because maybe I didn't make it  
22 clear enough, but I tried to follow-up because they  
23 were like, well, it's appropriate to have it  
24 authorized by DOE this time, but I'm like, again, you  
25 guys really have no authorities being authorized by

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1 DOE, but they actually are tasked these, not just the  
2 applicant who is paying for that demo, and I think  
3 that if NRC knows some things, they ought to be  
4 pointing out those things. And I think it's just a  
5 wise interaction; I don't think that I can do that  
6 with this facility.

7 MEMBER HALNON: Yes. Authorized by DOE,  
8 to me, didn't mean less study for lower standards of  
9 allowing them to cut corners, but I don't know their  
10 process. But, nevertheless, I had not heard, I mean,  
11 we're treating this thing like it's going to be  
12 operating in this envelope and we're going to be  
13 gathering data, but is that data really useful after  
14 a period of time?

15 CHAIR PETTI: My guess is that they  
16 obviously have the design of the bigger machine in  
17 mind. So, you know, assuming they have enough margin  
18 in a normal operation, which they should, you know --

19 MEMBER HALNON: They would put it through  
20 some exercises.

21 CHAIR PETTI: Yes. I mean, the tech specs  
22 and LCOs at levels that would allow them to do that.

23 MEMBER HALNON: Yes.

24 MEMBER REMPE: But, again, that may be  
25 something that they'll discuss with the staff later.

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1 What I really want, though, is to make sure the  
2 headquarters staff is engaged in it because, to convey  
3 my concern to Dave, I was like, well, Chernobyl was  
4 actually a safety test after the plant was operating,  
5 and we didn't want that to happen, although, again,  
6 that's a much bigger reactor and a different type and  
7 all that stuff. But that's a good way to communicate  
8 my concern.

9 MEMBER BIER: Yes. And I agree with some  
10 of the comments that Dave was making earlier, like not  
11 that it necessarily affects what we say about this one  
12 chapter. But the process is kind of opaque if there  
13 are some topics that, you know, the staff doesn't  
14 address explicitly in what they provide, we really  
15 don't know is that because they haven't even gotten to  
16 that yet and they don't have that info from the  
17 vendor? Is it because they've already reviewed it and  
18 decided it's a non-issue and they don't need to delve  
19 deeper? It's really hard to see, like, what we're  
20 critiquing.

21 CHAIR PETTI: I think this new process, I  
22 mean, we've all picked it up. It puts a little bit  
23 more work on the staff unfortunately, but they have to  
24 come to us and not just tell us what they found but  
25 lead us through their due diligence, right, so that we

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1 get the confidence. And you didn't have to do as much  
2 in the old process because we all did it together and  
3 it developed out of a common understanding. That's  
4 not necessarily come through the new process unless  
5 you deliberately think about it.

6 MEMBER MARCH-LEUBA: Speaking of process,  
7 for SHINE, we asked them, the reviewers, to write the  
8 chair a paragraph for him to put in the letter. And  
9 if there were conclusions and recommendations, now  
10 would be the time to do it instead of waiting until  
11 June.

12 CHAIR PETTI: Yes, yes, no, no, no. So  
13 what I'm expecting, when we talk about how we treat  
14 the outline of the letter, you'll see that, yes,  
15 please write your memos thinking about me listing --

16 MEMBER MARCH-LEUBA: The memo is too long.  
17 Now is the time to summarize my memo into one  
18 paragraph for a new letter.

19 CHAIR PETTI: Sure. If you want to put  
20 it, like, as a conclusion or something.

21 MEMBER MARCH-LEUBA: Oh, no, a separate  
22 document, an email.

23 MEMBER REMPE: I will do that. I'll take  
24 it -- actually, if I look at --

25 MEMBER MARCH-LEUBA: It makes your life

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1 much easier if Joy gives you a paragraph on what she  
2 meant for this --

3 CHAIR PETTI: But I think you need to see  
4 the outline so that you can see the context in which  
5 --

6 MEMBER REMPE: Well, you can write a  
7 paragraph and throw it in the trash or do what you  
8 want to do with it, and then I'll --

9 (Simultaneous speaking.)

10 MEMBER REMPE: Okay. One thing, though,  
11 when I look at this, I see a typo on my part. Sandra,  
12 the last thing led to several items that I recommend  
13 members explore in our reviews of subsequent, because,  
14 sorry, I was thinking about the final letter. But do  
15 you see where I'm saying that?

16 MEMBER MARCH-LEUBA: The very last line --

17 MEMBER REMPE: The very last line. And  
18 something I picked on Greg on in the past, so I better  
19 -- I'm surprised Greg didn't pick on me today. But,  
20 anyway, let's say items, yes, several items that I  
21 recommend members explore. Members. And then delete  
22 the words up to explore. And, again, this is a draft,  
23 and I know it will come for signature for me later,  
24 but I just was afraid I'd forget it because I looked  
25 at this several times and tried to correct things like

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1 that.

2 MEMBER MARCH-LEUBA: We don't want to fix  
3 all the references the panel --

4 MEMBER REMPE: Yes, I didn't do much on  
5 the references. I just listed what I thought should  
6 be there. Anyway, that's all I have to say for that  
7 simple paragraph I was assigned to read.

8 MEMBER MARCH-LEUBA: It's a new record.  
9 You wrote a memo that is 20 times longer than the --

10 MEMBER REMPE: Well, the staff did two  
11 pages, and I did two pages because --

12 (Simultaneous speaking.)

13 MEMBER MARCH-LEUBA: If the staff's  
14 (inaudible) is shorter than the topical report, they  
15 (inaudible).

16 MEMBER KIRCHNER: Just one observation I  
17 would make is that, at the OL stage, a lot of these  
18 things will be done.

19 MEMBER REMPE: Yes. I added that  
20 paragraph to respond back to Dave where it says they  
21 aren't related to items that will be done at the OL  
22 stage. I'm talking about things that go beyond that.

23 MEMBER KIRCHNER: Well, yes. So that's  
24 where I was going. So a lot of these things will be  
25 done as part of the OL and the startup of the reactor

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1 sample, instrumentation calibration set points and so  
2 on and so forth. It will measure things like  
3 reactivity coefficients, and they'll start pulling  
4 rods or turning drums or whatever. So it would be --  
5 I have no objection to this. I'm just saying that a  
6 lot of these things will be picked up at the OL stage.

7 What might be interesting for us to think  
8 about and you were hinting at, Joy, is that those  
9 things that might go beyond, as Greg was saying, just  
10 let's run it for four years and see how it goes kind  
11 of thing to some of the testing that would perhaps, at  
12 power, demonstrate, much like was done with EVR 2.  
13 I'm not suggesting that for this particular machine  
14 but where they just set it off on a significant  
15 transient that it would have a --

16 CHAIR PETTI: Right. I mean, I've put  
17 some notes in my outline about something that I think  
18 we ought to discuss. They have no plans to do that.  
19 I asked them explicitly whether they would do some  
20 sort of transient testing to demonstrate the, you  
21 know, the real robustness of the technology, if you  
22 will, and they said they didn't. But that said, I  
23 also have a list of things that you're not going to  
24 know until you build it, right: beryllium control,  
25 tritium control, lead ox control in the actual

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1 environment with neutrons in a temperature grade. You  
2 know, you can list a number of them. That's why you  
3 have to build one. And, again, it was just to say  
4 that there is some residual uncertainty, but that's  
5 what a test reactor is about.

6 MEMBER MARCH-LEUBA: Sandra, can you show  
7 us lower numbers to the paragraph with the staff  
8 concerns? You recommended that ACRS request the staff  
9 provide additional information. Is this a  
10 recommendation for the letter? I suppose not. What  
11 you're asking is, in a future subcommittee, they  
12 address this to us?

13 MEMBER REMPE: I just want more. Again,  
14 we heard about some sort of internal list they have,  
15 and it's just something that, again, how it gets  
16 addressed is beyond my memo. I can beef up a little  
17 more of what you're saying, Walt, but I tried to say  
18 that when I had these, you know, I said, basically,  
19 I'm not talking about the things in Appendix A, which  
20 are what you're talking about of things that they  
21 expect to be done, and I will add that the thing about  
22 startup testing will obviously address some of these  
23 things. But I'm thinking about things that will be  
24 used that need to be addressed that can only be  
25 addressed in a test facility for a first-of-a-kind

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1 technology with little operating experience.

2 MEMBER MARCH-LEUBA: Yes. My concern is,  
3 at this point, we could solve this by requesting the  
4 staff in the next subcommittee meeting they address  
5 this issue as part of Chapter 10. We don't have to go  
6 into Chapter 10, but we can ask them to address it.

7 MEMBER REMPE: I would like that.

8 MEMBER MARCH-LEUBA: In which case, this  
9 memo should not be part of the final letter because  
10 they already addressed it in April. So if we can  
11 rewrite this as a request or keep a (inaudible) that  
12 says we have reviewed with the staff the following  
13 items, you know, in the April meeting.

14 MEMBER REMPE: Well, it says our  
15 discussions regarding Chapter 10, however, led to  
16 several items we planned, I have now that I request  
17 that members explore in reviews of subsequent  
18 chapters. I don't know where. It may not get  
19 addressed. If it doesn't get addressed, we'll put it  
20 in the final letter. But I'm trying to give them  
21 opportunities to say, yes, we know this isn't going to  
22 be totally done, which I think is an important concept  
23 to --

24 MEMBER MARCH-LEUBA: I see a procedural  
25 (inaudible).

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1 MEMBER REMPE: (inaudible).

2 MEMBER MARCH-LEUBA: Yes. This is part of  
3 our final letter.

4 MEMBER REMPE: It doesn't have to be part  
5 of our final letter.

6 MEMBER MARCH-LEUBA: It is. It's going to  
7 be in our appendix, right, on this memo?

8 MEMBER REMPE: Yes. But then we need to  
9 say during our review we explored this (inaudible).  
10 Dave has to put something about this in his letter,  
11 either say we explored it and we've come to this  
12 realization, which the staff has perfect knowledge and  
13 that they don't need more or they need more. I don't  
14 know how it should be resolved at this stage.

15 MEMBER MARCH-LEUBA: Well, all they have  
16 to come is go directly to the microphone and say I do  
17 solemnly swear that this part of Jeff's checklist --

18 MEMBER REMPE: Oh, I'm from Missouri.  
19 They're going to have to give me a list to see that  
20 it's complete. And I doubt they're going to be able  
21 to do that at the end of the construction permit, but,  
22 you know --

23 MEMBER MARCH-LEUBA: My impression is we  
24 were in a hurry, and we wanted to have a final thing  
25 in May.

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1 MEMBER REMPE: Yes, but they've got April  
2 and full Committee May.

3 MEMBER MARCH-LEUBA: This is not their  
4 final memo. In this form, this cannot be a final  
5 memo.

6 MEMBER REMPE: It can be a final memo that  
7 was -- I had comments in the last, in the SHINE review  
8 that we got addressed in a subsequent meeting,  
9 remember, about the instrumentation set points?

10 MEMBER MARCH-LEUBA: I'm just raising my  
11 concern that (inaudible).

12 CHAIR PETTI: I don't actually think that,  
13 I think we're better off leaving it as a list. I see  
14 Matt's hand is up. Matt, Matt, go ahead.

15 MEMBER SUNSERI: Thanks, Dave. So just  
16 listening to this discussion, I have not seen and I  
17 wonder if it would be a fair request at some point for  
18 the operating license or whatever to ask the applicant  
19 to provide the strategic objectives and success  
20 criteria they are aiming for as a result of the  
21 operations of the facility over its life. You know,  
22 I mean, they're doing it for some objective, right.  
23 What are those objectives, and how will they know they  
24 would support that? That could go a long ways in  
25 addressing some of these questions, I think.

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1 MEMBER REMPE: I like that idea.

2 CHAIR PETTI: That's clearly an operating  
3 license. I mean, I'm sure they're not there today,  
4 right?

5 MEMBER REMPE: Yet, they're willing to pay  
6 the money to get a construction permit?

7 (Simultaneous speaking.)

8 MEMBER SUNSERI: They probably have some  
9 idea of what they're doing, or they wouldn't be going  
10 this route, right? They wouldn't be pursuing a small  
11 version, and they wouldn't be seeking a construction  
12 permit if they didn't have some big picture ideal of,  
13 strategically, what they want to accomplish. That's  
14 all I'm saying.

15 CHAIR PETTI: Yes. And I think they could  
16 write something at a fairly high level, though. The  
17 question is the level of detail, I think.

18 MEMBER HALNON: Right. I think the level  
19 of technical detail --

20 MEMBER REMPE: Matt, I think that's a  
21 great idea, but I'm also wondering our mission is  
22 safety and, I mean, I guess, I think they should do  
23 it, but is that a safety request?

24 MEMBER SUNSERI: Well, it depends on what  
25 their objectives are. I mean, you know, if they're

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1 going to be, as Greg said, maybe operating the reactor  
2 just to demonstrate some proof of principle or  
3 something, that might not be. But if they're going to  
4 challenge some of the safety limits because they don't  
5 know or whatever, that could be.

6 MEMBER BROWN: Can I provide something  
7 high level similar to what Matt just --

8 MEMBER REMPE: Sure.

9 MEMBER BROWN: -- went through? I'm  
10 trying to figure out what --

11 MEMBER REMPE: Speak closer to your mike.

12 MEMBER BROWN: Sorry about that. I'm  
13 trying to figure out what the objective of this review  
14 is. This is a construction permit. They've written  
15 an SE already, which says something. We are now  
16 reviewing in very rapid time comments, you know, six  
17 items or whatever the number is today, and there will  
18 be more in the next subcommittee meeting. And we're  
19 writing a memo. The purpose of the memo is to do  
20 what? Are we rubber-stamping their SE? I'm using a  
21 somewhat pejorative word. Let me finish my thought  
22 process, okay? Putting aside my pejorative comment,  
23 which was not meant to be nasty. And I'm taking this  
24 from our discussion that we had relative to the decay  
25 heat removal system today, relative to the concerns.

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1 But it's going to be addressed at the operating  
2 license. Shouldn't our memos reflect at least our  
3 concerns and -- we're not going to get any responses  
4 to our memos because they're going to go on. So why  
5 shouldn't our memos identify what we want to make sure  
6 gets addressed at the operating license stage?

7 CHAIR PETTI: We should. So the decay  
8 heat removal will come up when Walt's chapter comes  
9 up, yes.

10 MEMBER BROWN: Yes, but his memo ought to  
11 reflect that and, like mine on Chapter 7, would be to  
12 say if the description and the architecture is not  
13 complete but just kind of a sketchy thing, they ought  
14 to make sure they comply with the fundamentals, et  
15 cetera, and here's several items that we've emphasized  
16 in past ones and say we'd like to hear about that at  
17 the -- so, to me, that's the approach I was going to  
18 take on Chapters 7 and 8 and probably look at Chapter  
19 6, which is safeguards, as well, even though somebody  
20 else is assigned that one. Oh, you got that? If I  
21 have any feedback, I'll give it, but that's my  
22 thought. And I didn't hear us talking about that in  
23 terms of what the objective is for our memos. That's  
24 what I was going to be doing.

25 CHAIR PETTI: Just as it was for SHINE.

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1 I think, yes, no, exactly. I mean, I figure if  
2 they're important things that we think nothing less  
3 than a punch list of items, safety concerns for the  
4 OL, our letter is the only way to share that with the  
5 staff.

6 MEMBER BROWN: Yes. And then we'll have  
7 a more detailed review of individual chapter by  
8 chapter, as opposed to this mass attack.

9 CHAIR PETTI: Well, these are all --

10 MEMBER BROWN: No, they're --

11 (Simultaneous speaking.)

12 CHAIR PETTI: Right. They're two-page  
13 things --

14 (Simultaneous speaking.)

15 MEMBER BROWN: No, there's four. Even I  
16 can read this in four days. The point is I fall  
17 asleep halfway through; I'm just joking.

18 CHAIR PETTI: Even the ones in March,  
19 there's not that much there.

20 MEMBER BROWN: Mine are like 20 pages long  
21 in the PSAR, and there's some figures, and I haven't  
22 read the SEs, but I did take a quick look. It's 7 and  
23 8. I haven't looked at Chapter 6 yet. I've got to  
24 really read them now.

25 MEMBER MARCH-LEUBA: It's only functional

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1 containment on the decay heat.

2 MEMBER BROWN: Is that right? They hit  
3 the decay heat --

4 (Simultaneous speaking.)

5 MEMBER BROWN: Okay. Anyway, I'm just  
6 trying to make sure that I'm on the right track as to  
7 how I write my memo here and that we ought to, I hope  
8 that would be a consensus opinion that that's what we  
9 ought to be focusing on.

10 MEMBER MARCH-LEUBA: Going back to the  
11 problem at hand, if we can rewrite this paragraph to  
12 say that at the OL we will expect the staff address  
13 these issues because, when you're writing this, I  
14 don't know if you want the staff to address these  
15 concerns for you before the --

16 (Simultaneous speaking.)

17 MEMBER REMPE: Read the sentence that says  
18 these concerns are not related to items that are, I  
19 should say required to be resolved prior. I have  
20 another typo. Get rid of the second not; I'm sorry,  
21 Sandra. Right there. Do you see on the -- after the  
22 bullets, there's a not, not required. Okay. These  
23 are -- the second not. Not that one. Yes, right  
24 there.

25 Okay. These concerns are not related to

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1 those items that are required to be resolved prior to  
2 issuance of the construction permit. Oh, actually,  
3 that not was correct. But, anyway, but expect to be  
4 resolved prior to operating license. I get that  
5 there's some things that are going to be resolved when  
6 the operating license is issued because those items  
7 are identified by the staff and listed in Appendix A  
8 of the staff SE. Rather, I'm talking about  
9 uncertainties associated with the first-of-a-kind  
10 technology demonstration facility that cannot be  
11 resolved until after the facility is operational.

12 Again, it's just things that I think we  
13 won't know because we're taking this lighter approach  
14 with a small demonstration test facility.

15 MEMBER BROWN: No, but the safety issues  
16 that we have to deal with need to be addressed before  
17 the facility is operating. If we've got those, we  
18 ought to identify --

19 MEMBER REMPE: Because the maximum  
20 hypothetical accident doesn't have a large source  
21 term, okay, so, yes, maybe they have a small amount of  
22 radiation leak that's on the site and all this kind of  
23 stuff, but the long-term ability of a new sensor to  
24 perform in this corrosive environment with radiation  
25 exposure --

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1                   MEMBER BROWN: That's a different issue  
2 from a safety. That's a shutdown and have to fix it.

3                   CHAIR PETTI: That's an operation, it  
4 could be an operation --

5                   MEMBER BROWN: But if it fails, it' a  
6 shutdown and fix it issue. It's not a safety-safety  
7 issue because they will shut down if it breaks.

8                   MEMBER REMPE: But if it's water level or  
9 Flibe level and it's affecting their potential to  
10 retain radionuclides, what if it's a reactivity  
11 coefficient and they -- again, you can do some startup  
12 --

13                  MEMBER BROWN: When you find that out,  
14 it's a shutdown and then they recalibrate. That's a  
15 different issue, okay?

16                  MEMBER REMPE: I'm not trying to get the  
17 stuff that is required prior to operating license.  
18 I'm trying to think about other things that are beyond  
19 that.

20                  MEMBER BROWN: Well, I think the key for  
21 us is what's the safety issues we have to have  
22 resolved before the operating license is granted?  
23 What you're talking about are fundamental analytical  
24 physics issues of some type or will the instrument  
25 last long enough. That's an operating thing we find

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1 out they're going to break. I mean, those are -- we  
2 really ought to focus on what do we need to do for the  
3 operating license, get those so we get those resolved.  
4 And then, if we think there are what you call the more  
5 esoteric issues, throw them in as how are these going  
6 to be confirmed, okay, once the facility is operating.  
7 Is there a test program, is there things they can take  
8 periodically, is there whatever.

9 MEMBER REMPE: Okay. And so, again, I  
10 think other people will deal with the things that are  
11 documented in Appendix A that are what are needed for  
12 the operating license. What I'm talking about is  
13 Chapter 10, which is an experimental facility, because  
14 some test reactors have irradiation capabilities and  
15 you worry about their safe operation. This whole  
16 thing is an experiment --

17 MEMBER BROWN: I understand that. But  
18 we're mixing apples and oranges in terms of getting  
19 the construction permit done and what has to be  
20 satisfied to start up the plant as an operating --

21 MEMBER REMPE: And other people will take  
22 care of that. I hope so, but I'm only a Chapter 10  
23 person.

24 MEMBER BROWN: Well, that's what I tend to  
25 look at, you know, for 7 and 8 and safeguards, and

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1 they got to have some answer for the decay heat  
2 removal thing. Do they need an automatic system for  
3 that because they've got an upper end and a lower end?  
4 Are they going to worry about a guy reading the meter  
5 the right way or the glass panel or whatever hell he's  
6 got to monitor stuff? To me, that's unsatisfactory.  
7 You've got to have something that warns the operators,  
8 and I'm going to be looking for that --

9 MEMBER REMPE: And those things are very  
10 important and more important, frankly, than what I'm  
11 bringing up here. I'm talking about --

12 MEMBER BROWN: That's why we ought to  
13 focus on that.

14 MEMBER REMPE: Absolutely. But I only was  
15 given Chapter 10.

16 MEMBER BROWN: Yes, I understand that.  
17 That's my thought process.

18 CHAIR PETTI: Charlie, we agree with you.

19 MEMBER BROWN: Okay.

20 CHAIR PETTI: The strategy was there were  
21 a bunch of chapters that had very little safety  
22 significance.

23 MEMBER BROWN: I agree. We ought to get  
24 off of Chapter 10 right now.

25 MEMBER REMPE: Absolutely.

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1 CHAIR PETTI: We're going to move beyond  
2 those in this meeting and really the real meat starts  
3 at --

4 MEMBER BROWN: In March, March 24th and  
5 25th.

6 CHAIR PETTI: I thought these wouldn't be  
7 a big deal. Of course, I'm wrong.

8 MEMBER BROWN: They're not.

9 MEMBER BALLINGER: So this was the ramp.

10 CHAIR PETTI: Right. This was --

11 MEMBER REMPE: This is the easy-off. I  
12 thought, hallelujah, I only have a paragraph.

13 CHAIR PETTI: Okay. I move we can move to  
14 the next --

15 (Simultaneous speaking.)

16 MEMBER REMPE: I need to figure out my  
17 notes in that one sentence.

18 CHAIR PETTI: Chapter 12, please. Matt,  
19 you up there?

20 MEMBER SUNSERI: Yes, I am.

21 CHAIR PETTI: It's yours.

22 MEMBER SUNSERI: So while Sandra is  
23 bringing that up, I did look at Chapter 12, and I  
24 guess I drew the long stake in the thing. My chapter  
25 was several hundred pages long, considering all the

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1 appendices and everything.

2           And, you know, I just want to make a  
3 comment here. I've heard a couple of times either  
4 members or maybe even staff refer to it that this gets  
5 a lighter touch because it's a test reactor. I don't  
6 support those statements. There's fewer things to do,  
7 so there's less work overall, but the things that I  
8 review I give it the same level of rigor in the  
9 technical depth and detail as any other review that I  
10 do. So I just want to be on record for that. This is  
11 not a light touch for Chapter 12.

12           There were several activities covered in  
13 Chapter 12. Conduct of operations. It involved  
14 operator training, quality assurance program,  
15 emergency plan, startup. And I apologize; this copy  
16 of my memo was not the most up-to-date version. There  
17 was also material and accountability control plan as  
18 part of this chapter.

19           So my conclusion is, after a thorough  
20 review of all these areas of performance, I do not see  
21 anything that warrants additional chapter reviews at  
22 this time, nor do they affect any crosscutting areas  
23 that we would have to look at as far as the  
24 construction permit goes. I do have a couple of  
25 observations, though, that I would make and offer, so

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1 if you could maybe put -- yes.

2           When I was looking at the conduct of  
3 operations section specifically, I note that the plant  
4 manager is assigned overall responsibility for  
5 protecting personnel from radiation, from exposure to  
6 radiation. However, the radiation protection function  
7 and chemistry functions report to the manager of  
8 technical services. And although this alignment is  
9 satisfactory for the construction phase, I would  
10 recommend that consideration should be given to  
11 aligning those functions with the plant manager for  
12 the operation phase. That's where it's really going  
13 to count.

14           The Kairos stated that their operation  
15 program will comply with 10 CFR 50.55 or, I'm sorry,  
16 10 CFR 55, excuse me, and they will submit that plan  
17 with their operating license application. That's  
18 fine.

19           Looking over the quality assurance plan,  
20 it has all the elements in there. It follows the  
21 standard review plan, the guides. It parallels NQA  
22 requirements. It parallels Appendix B and CFR 50  
23 requirements. It's specific for this design.  
24 However, I did note that there's one minor discrepancy  
25 they might want to consider addressing in that in the

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1 Chapter 12 of their PSAR they say that quality  
2 assurance, which I think is good because I criticize  
3 other organizations for not calling out where quality  
4 assurance points out, so they do point out where  
5 quality assurance fits in in the big scheme of the  
6 operating model, but they have it reporting, and I'll  
7 have to read my words here to make sure I get this  
8 straight, I think it's Chapter 12 shows they're  
9 reporting to the site executive, but, yet, Chapter 2  
10 of the quality assurance program says it reports to  
11 the -- maybe I have this backwards. Chapter 12  
12 reports to the site executive. Chapter 2 through the  
13 oh, yes, through the chief executive officer. Okay.  
14 So it really doesn't matter. It needs to be  
15 independent of production operations, and it is.  
16 However, the Chapter 2 of the quality assurance plan,  
17 which will be the governing guidance, is that the QA  
18 function has access to all levels of management  
19 necessary to assure effective execution of the program  
20 irrespective of the organization structure, which I  
21 agree with that statement. They should just put that  
22 footnote in the PSAR, too, for consistency and  
23 clarity. Just a nit.

24 On a positive note, they have a very well  
25 thought-out emergency plan, and I just would like to

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1 note, we've had comments on this before, but I would  
2 note that it's a positive observation that they have  
3 had early engagement with the city of Oak Ridge, Oak  
4 Ridge Central Fire Department, the police department,  
5 and medical center, county agency, state of Tennessee,  
6 and other federal agencies. So we've been critical of  
7 some of that in the past, and they're doing a good job  
8 of engaging early.

9 Can you scroll further down a little bit,  
10 Sandra? These next two areas, Kairos did not provide  
11 any information on the material and control  
12 accountability program, which is appropriate for this  
13 phase. They're not going to be handling any special  
14 nuclear material, so that will all be sent in, as they  
15 say, during the operation license application.

16 And also Kairos did not present their  
17 startup plan in saying that this will be presented as  
18 part of the operating license also. And I think some  
19 of the comments we just had in the previous Chapter 10  
20 memo might carry over to things they want to consider  
21 as they develop that startup plan. Anyway, we'll give  
22 it a thorough review when it is submitted as part of  
23 the operating license.

24 So that's really all I had as far as the  
25 review. I'm not recommending any further, as I said

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1 before, any further changes or discussion. I don't  
2 want to take up the Committee's time with any  
3 grammatical or typographical errors because there are  
4 some in here, so if you have some send them to me.  
5 I'll take whatever I get by Friday and I'll write my  
6 final memo.

7 That concludes my presentation.

8 CHAIR PETTI: Thank you, Matt. Nice and  
9 concise. Any comments, members?

10 MEMBER BALLINGER: Yes. I'd like to make  
11 a comment for my time in the barrel over SHINE, and  
12 that is what happened was we got the memos and they  
13 had what are called recommendations and concerns in  
14 them, and interpreted those recommendations and  
15 concerns because the last thing that the person  
16 usually said was I have no concerns, it's fine. But  
17 when it came time to writing the letter, we got in  
18 extensive discussions about things that we wanted the  
19 letter to require the applicant to do, and that was  
20 different than what was said in the memos because the  
21 memo writer, in some cases, interpreted a  
22 recommendation as being a requirement.

23 So we need to be very careful, I think,  
24 this time around where, when we get to letter writing,  
25 we don't end up in an infinite loop where we get

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1       disagreements about what we would like the person to  
2       do versus what we would recommend that they consider,  
3       which is a lot different. So I can see that coming.  
4       I can see that coming.

5                   CHAIR PETTI: Good feedback for members as  
6       they write their memos.

7                   MEMBER BALLINGER: We're getting SEs with  
8       no open items, right?

9                   CHAIR PETTI: Right.

10                  MEMBER BALLINGER: So that means there  
11       shouldn't be any open items. And if we find what  
12       amounts to open items, that's a big deal.

13                  MEMBER HALNON: And that's to the staff,  
14       not the applicant.

15                  MEMBER BALLINGER: Yes. I mean, either  
16       way --

17                  MEMBER HALNON: Well, I mean, I think  
18       we've talked about in the past. We don't tell the  
19       applicant to do things. We work through the staff for  
20       them to assess and, if they say, no, we're not going  
21       to have them do it, then, you know --

22                  MEMBER BALLINGER: But if we tell the  
23       staff we disagree, you should do this, that feeds  
24       right back to the --

25                  MEMBER HALNON: Right. Just like we said

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1 it would be good to see it in a corrective action  
2 program, and then the applicant put it in the  
3 corrective action program and we were happy at that  
4 point on some stuff.

5 CHAIR PETTI: Okay. Thank you. Then  
6 let's do tech specs. I can't remember. Is that you,  
7 Greg?

8 MEMBER HALNON: Yes, it's me.

9 CHAIR PETTI: Chapter 14, Sandra.

10 MEMBER HALNON: Okay. So the tech specs,  
11 at this point, obviously, are very nonspecific because  
12 of the designs and parameters that you typically see  
13 listed in tech specs is not there. But they did pare  
14 it back effectively and accurately the requirements in  
15 1537 and the ANC document that covers tech specs for  
16 test reactors. So the framework is there, and it's  
17 solid, so I don't really have any issues with the way  
18 they have provided it and didn't have any issues with  
19 the way the staff has did their SER from the  
20 standpoint that, you know, they basically said the  
21 same thing, it meets all the requirements and is a  
22 very good springboard to get into the operating  
23 license when you start getting the parameters set for  
24 what you want to monitor and stay within the  
25 envelopes.

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1           The concerns aspect of it is where I was  
2 this morning on how do you tie it altogether? Tech  
3 specs kind of ties the entire envelope of the plant  
4 together at the end, and there's a lot of moving parts  
5 right now relative to detailed design parameters  
6 you're looking at, the decay heat removal envelope, if  
7 you will, temperatures, and things like that. And I  
8 started the review on Chapter 9, which is auxiliary  
9 systems, and there's a tremendous amount of  
10 information about how these systems are non-safety  
11 related, but, and those butts are pretty extensive, you  
12 know. So there's a lot of tentacles that could come  
13 back on these auxiliary systems and other safety  
14 systems that may be not necessarily specifically  
15 covered by the ANC document and others because it's a  
16 new technology.

17           So I said that there needs to be an  
18 important mapping of some of these support systems and  
19 support functional requirements that the tech specs  
20 and the safety envelope that you want this plant to  
21 stay within to ensure that tech specs is not too  
22 narrow and focused just because it's not necessarily  
23 a pool reactor or something to that effect, which is  
24 really where most test reactors are, you know,  
25 university reactors are.

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1           Just for example, functional containment.  
2           This is the first time we'll use functional  
3           containment, and how do you tech spec functional  
4           containment? You've got to do something. You need to  
5           have some, is it coolant monitoring, is that how  
6           you're going to do it? Is it isotopes? You know,  
7           what's too much, what's not enough, and that sort of  
8           thing. So there's going to be a lot of, I'm sure,  
9           back and forth with the staff and the applicant on  
10          what the applicable limits need to be to ensure the  
11          containment is adequate. And then how do you test it?  
12          Is it through the pebble handling system and, when you  
13          offload it, do you measure it? How do you look at the  
14          offgas system? How do you measure to make sure the  
15          containment is still there?

16                 So I make that mention is that this first-  
17          of-a-kind reactor has to not assume that the past tech  
18          specs are going to be all-inclusive of what we may see  
19          going forward in this tech spec. So it will be an  
20          interesting exercise to get there.

21                 Another just an example I put in there was  
22          that there's a heavy reliance on natural circulation  
23          cooling, and, you know, there's some passive  
24          components in that, obviously, and some redundancy.  
25          Is that going to be part of, you know, potential

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1 operability aspect of tech specs? Those types of  
2 things need to be carried through, and that's why I  
3 said there needs to be a close mapping of all these  
4 other systems to make sure that they're not affecting  
5 the safety envelope that we're trying to maintain.

6 So there's nothing that we need to do on  
7 this, but this is that list of things to look at as  
8 we're going forward and thought processes that I was  
9 hoping the staff was going to -- it sounds like  
10 they're keeping a list and having the same type of  
11 discussions internally.

12 Bottom line is that everything is fine for  
13 this PSAR. It met all the requirements.

14 MEMBER MARCH-LEUBA: Let me pound once  
15 again on my concern. These memos are going to be an  
16 appendix to our letter to the commissioners, right?  
17 That's the way we handled it before. And the  
18 Commission is going to turn to the staff and say what  
19 do these guys want us to do, and the staff will say I  
20 don't know. I don't know what you want me to do with  
21 this memo.

22 CHAIR PETTI: I didn't think we attached  
23 the memos. I thought we just referenced them.

24 MEMBER BALLINGER: No, we attached them.

25 CHAIR PETTI: We did attach them?

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1 MEMBER MARCH-LEUBA: So they're really  
2 part of the letter. Yes, we tell you don't bother to  
3 read in too much detail, this is the important part,  
4 but, I mean --

5 MEMBER HALNON: It says I recommend no  
6 further actions. That means nothing. It's  
7 information to the staff this is what we're thinking  
8 about, and they can take it or leave it.

9 MEMBER MARCH-LEUBA: But these are  
10 recommendations that the staff should look at during  
11 --

12 MEMBER HALNON: That's --  
13 (Simultaneous speaking.)

14 MEMBER MARCH-LEUBA: -- license stage.

15 MEMBER HALNON: Yes, but there's no  
16 recommendations.

17 MEMBER MARCH-LEUBA: I'm just saying --

18 MEMBER DIMITRIJEVIC: Well, I have a, I'm  
19 stubborn with this on the SHINE, too. We have our  
20 concerns, but we have no recommendations. So how can  
21 that be?

22 MEMBER HALNON: Concerns is not the right  
23 word for that. You know, that's the template. It's  
24 not concerns --

25 CHAIR PETTI: Observations?

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1 MEMBER HALNON: It's observations really.

2 MEMBER DIMITRIJEVIC: But you sort of also  
3 recommend something to be done in, you know,  
4 throughout the --

5 MEMBER HALNON: Or just discussion like we  
6 do --

7 CHAIR PETTI: Can we change the template?  
8 Just change concerns to observations.

9 MEMBER HALNON: Or just discussion. I  
10 would just say discussion.

11 CHAIR PETTI: Or discussion.

12 MEMBER HALNON: Yes, that goes along with  
13 our -- well, you letter reports have discussion. Our  
14 letter report has discussions, and I think that's  
15 probably appropriate because that's all it is at this  
16 point.

17 CHAIR PETTI: It's not so much for the  
18 Commission. It's for the staff. They've got an  
19 internal list; we know that. Oh, well, we didn't have  
20 that. Okay, we'll write that down.

21 MEMBER HALNON: But to Ron's point under  
22 recommendations, was there anything that I thought  
23 they needed to do differently in their SER that's a  
24 draft that would translate back into a revision or  
25 additions into the -- no, there's nothing.

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1                   MEMBER DIMITRIJEVIC:   Well, Greg, but  
2                   don't you want them to put something in the there for  
3                   the future things, like, you know, things that you  
4                   just discussed about?  You know, that's some things  
5                   which, you know, like Jose put, there's heavy lines,  
6                   blah, blah, blah.  I mean, don't you want that to be  
7                   somewhere?

8                   MEMBER HALNON:  Well, I don't think that  
9                   -- this is my position on what I think the staff  
10                  should do.  For one, I don't consider myself smarter  
11                  than the reviewers that are going to be doing this.  
12                  I have a comment that maybe they didn't think about  
13                  overtly that, hey, that's a good idea, but I don't  
14                  think that they're not going to do this.  I think that  
15                  they're going to do it.  I think they may not do it  
16                  in, quote, mapping sense or something to that effect.  
17                  But when I get to the operating license review of  
18                  Chapter 14, I'm going to take those core systems and  
19                  I'm going to walk them through how they affect the  
20                  safety of the plant and decide whether or not I feel  
21                  like there should be a tech specs.  Am I going to do  
22                  it comprehensively?  No, I'm going to pick and choose  
23                  very maybe obvious and not so obvious ones and do  
24                  that.

25                  I'm going to make the assumption that

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1 they're going to do that, and I'm going to go check  
2 it. I'm going to verify and validate that they did by  
3 sampling. So this is my thought process on why I'm  
4 going to do that.

5 MEMBER DIMITRIJEVIC: That maybe  
6 discussion is still not good thing. I was thinking  
7 when we were listening in the morning, you know, about  
8 this, you know, the reg and how it applies, and we  
9 come up with this Appendix A, which contains both  
10 commitments from the Kairos NRC expectations and maybe  
11 there could be third category there insides from the  
12 ACRS review or something like that, you know,  
13 something which we identify in our letters, and I can  
14 see that we identify those things which will be good  
15 to be monitored for in the future, you know. And that  
16 will not come this discussion. Maybe the concern  
17 wasn't a good name, but maybe that, say, insights or  
18 things to be monitored in the future. I don't know  
19 how to call it, you know.

20 MEMBER HALNON: Yes. Well, that's kind of  
21 descriptive of what it is. I mean, discussion is  
22 probably just --

23 MEMBER DIMITRIJEVIC: Very general, you  
24 know.

25 MEMBER HALNON: Yes.

1 MEMBER DIMITRIJEVIC: What is the name of  
2 -- does Appendix A has a title?

3 CHAIR PETTI: Well, we don't actually have  
4 Appendix A out on SharePoint, so I don't know. These  
5 are commitments, the commitments that Kairos has made  
6 to the staff on the R&D they will complete prior to  
7 the end of construction.

8 MEMBER DIMITRIJEVIC: You know, some  
9 concerns also, the policy contain issues to be  
10 addressed in the future identified by the staff.

11 MEMBER HALNON: That's on their one-off  
12 list that they're talking about that they keep on  
13 their SharePoint.

14 CHAIR PETTI: Staff can help you.

15 MEMBER DIMITRIJEVIC: So, basically, we  
16 are sort of giving recommendation to that list. I  
17 mean, you know --

18 CHAIR PETTI: So I can see us in our  
19 letter having information that we think is important  
20 that they have in the FSAR or the operating license,  
21 and it could be a list. And whether we actually put  
22 it in the letter or we make it an appendix, I don't  
23 know, but there's a number of things that we're just  
24 going to pick up.

25 MEMBER MARCH-LEUBA: All these items

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1 belong as a recommendation for review and inclusion in  
2 the FSAR, their operating license.

3 CHAIR PETTI: Yes, their future --

4 MEMBER MARCH-LEUBA: Future. But they  
5 should be tasked as such in the letter so, when I read  
6 it, I know what you're talking about.

7 MEMBER HALNON: My impression was that we  
8 were looking at the PSAR and trying to render judgment  
9 on whether or not the PSAR was adequate --

10 CHAIR PETTI: But we can't help ourself,  
11 we skipped over that line.

12 MEMBER HALNON: Right. So that's why I  
13 didn't bring it to the recommendation level because I  
14 didn't see any missed open items, if you will --

15 CHAIR PETTI: I just worry that it could  
16 become an extremely long list when you look at how  
17 preliminary so much of it is, and it's fine at this  
18 stage.

19 MEMBER HALNON: Right. And even, Joy,  
20 your letter, you could have probably expanded that  
21 bulletized list, you know, pages long.

22 MEMBER REMPE: Such as.

23 MEMBER HALNON: Right. You know, so what  
24 is the most on your mind in general, not in general,  
25 but, you know, what do you want to make sure they keep

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1 in mind and what we're going to keep in mind as we go  
2 --

3 CHAIR PETTI: So let me just ask, I mean,  
4 I haven't gone back and read the letter that we wrote,  
5 that you wrote, I wasn't part of the Committee, for  
6 SHINE construction permit. Did you guys have a list  
7 of things that you --

8 MEMBER REMPE: Oh, yes.

9 CHAIR PETTI: -- thought was important?

10 MEMBER REMPE: Yes. And, actually, the  
11 Commission meeting, the topic of, you know, what's  
12 needed for assurance for moving forward with the  
13 construction permit versus an operating license. You  
14 know, we got slapped back a little bit about asking  
15 for too much. That was my takeaway from that  
16 discussion with one of the commissioners that, again,  
17 there is this list in Appendix A which I think the  
18 staff was going to tell us we were going to get soon  
19 and it will be documented.

20 But I have a question for Greg. I mean,  
21 today, when I brought up these things, they said,  
22 well, the tech specs will help, you know, will be one  
23 mechanism, along with the startup plans, to help us.  
24 In light of the fact that this is a first-of-a-kind  
25 reactor, should the tech specs be more limiting? Do

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1 you want more monitoring on this facility to make sure  
2 it's not going south than you would with an operating  
3 plant for a known technology? Do you have any feeling  
4 for that yet? Because that's what I'm wondering about  
5 because --

6 CHAIR PETTI: I think it all depends on  
7 the margins, and there's huge margins.

8 MEMBER BALLINGER: Not got their head in  
9 the ground. They're going to say, if there's  
10 additional monitoring needed, they're going to say so.

11 MEMBER REMPE: Yes, but I'm asking Greg.  
12 I know the staff will do this, but what's your gut  
13 feeling? I know the staff will come up with  
14 something, but I'm just curious as a person who's  
15 running a plant for years and knowing about leaky  
16 valves that were allowed to leak and tech spec changes  
17 at TMI, too, you know, what do you think? Do you  
18 think we should have more for a first-of-a-kind than  
19 something that is well known?

20 MEMBER HALNON: Well, so the startup plan  
21 will be approved by the staff, and that startup plan  
22 will have some of those things in there. There are  
23 some one-cycle only, first-cycle only tech specs that  
24 we had when we started up the plants for testing, and  
25 those eventually went away the next revision of tech

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1 specs once you satisfy them.

2 So there's some one-time only tech specs  
3 that may be in there. I would assume --

4 MEMBER REMPE: And is that included in the  
5 PSAR, the acknowledgment that there will be some one-  
6 time tech specs? I mean --

7 MEMBER HALNON: No, I don't recall them in  
8 there, but I think that --

9 MEMBER REMPE: That might be something to  
10 add to your memo. It's up to you, but it's something  
11 that I think additional attention should be paid to  
12 the tech specs.

13 MEMBER HALNON: And a part of that comes  
14 back to what we were talking about earlier about what  
15 is the intent of having a test reactor. You're not  
16 just going to run it for four years and say, okay,  
17 everything runs really smooth. What is the intent,  
18 and that might come back again to that same question  
19 as, all right, if you're going to push the envelope,  
20 how much margin are you going to allow them to get to  
21 this tech spec limit before you say you've pushed that  
22 too far because now you're in my realm of margin,  
23 you're not in your realm of margin anymore.

24 So I think that's a very detailed  
25 discussion and something that will have to take place

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1 between the staff and the applicant.

2 MEMBER REMPE: And it would be good for us  
3 to know about how that discussion went is what I'm  
4 kind of --

5 MEMBER HALNON: Yes, and I would fully  
6 expect that to be in the FSAR.

7 MEMBER REMPE: Yes. I think, again, if  
8 it's not in the PSAR, if there's something like that  
9 that we expect, it would be a good place to mention it  
10 --

11 MEMBER HALNON: I'll go back and look at  
12 that with that in mind to see if there was anything in  
13 there. I don't recall just off hand --

14 MEMBER REMPE: I looked at the tech spec  
15 thing because that was acknowledged in Chapter 10 and  
16 the staff's PSAR or their SE, and I went and looked at  
17 the tech spec and I surely didn't see anything, and  
18 it's something I think might be mentioned.

19 MEMBER HALNON: I'll take a note and go  
20 back and look and see if there's something in there  
21 about potential one-time only or, you know, special  
22 tests type tech specs. I don't know. I just don't  
23 remember. If you didn't see it, then --

24 MEMBER REMPE: Well, I didn't, but, again,  
25 I did this a couple of weeks before meetings. I had

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1 other commitments the last week.

2 MEMBER HALNON: Okay.

3 MEMBER SUNSERI: This is Matt.

4 MEMBER BROWN: Oh, I'm sorry, Matt.

5 MEMBER SUNSERI: I just wanted to make a  
6 comment on the tech specs. I mean, the tech specs are  
7 the activities that the applicant or the operator uses  
8 to bound the safety analysis. It's not the, it  
9 wouldn't be the place to put things to limit  
10 operational issues. It's just, it safeguards the  
11 initiating conditions that ensures your safety  
12 analysis is valid. So I just think about that.

13 MEMBER HALNON: Yes, I agree, Matt. And  
14 that's why we don't have the final safety analysis,  
15 obviously, so we don't know what needs to bound it.  
16 But I agree we don't want to put operating limits in  
17 here, we want to put safety limits with margin. There  
18 are other programs that will provide the operating  
19 envelopes.

20 MEMBER BROWN: I guess I'm going to ask  
21 another question as to this is a construction permit.  
22 When I looked briefly at 7, for instance, there's not  
23 enough information in there to design the character of  
24 the reactor protection and/or safeguard systems, for  
25 whatever they are. It's general. There's some block

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1 diagrams, but they're very block. They talk nothing  
2 about the types of systems they would be using,  
3 whether it's processors or FPGAs or whether -- they do  
4 mention one-way data diode once, but it's off of  
5 everything in a big line and you have no idea how  
6 combined they are. Is it multiplex or what have you?  
7 So that chapter is, if they're going to use this  
8 chapter to build the reactor safety systems,  
9 protection system, it's not adequate.

10 So when we did NuScale, I had a complete  
11 --

12 CHAIR PETTI: Yes, but be careful.  
13 NuScale was one step.

14 MEMBER BROWN: I understand that. We had  
15 a single memo, but all I'm saying is the systems were  
16 defined as to how they were going to design them. If  
17 construction project, does this mean they can now go  
18 build everything? If that's the purpose of this  
19 construction process, that PSAR is not satisfactory  
20 for neither Chapter 6, Chapter 7 or Chapter 8. I  
21 haven't looked at 6 yet.

22 CHAIR PETTI: No, because that's not the  
23 way to think about the construction permit. They  
24 talked about it in this morning that it's about how  
25 their design criteria and does the design address the

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1 criteria at a conceptual level.

2 MEMBER BROWN: Is there going to be an  
3 FSAR?

4 CHAIR PETTI: Of course.

5 MEMBER BROWN: Will we review that before  
6 --

7 CHAIR PETTI: Absolutely.

8 MEMBER BROWN: -- the plant, before any  
9 construction starts?

10 CHAIR PETTI: No.

11 MEMBER BROWN: Before the systems are  
12 built?

13 MEMBER BALLINGER: Like we did SHINE.  
14 Construction permit, operating permit.

15 MEMBER BROWN: I had a lot of detail on  
16 SHINE.

17 MEMBER BALLINGER: When?

18 MEMBER MARCH-LEUBA: On the operating  
19 license.

20 MEMBER BALLINGER: The operating license.

21 MEMBER BROWN: All I want to make sure is  
22 when I come through and review it for the operating  
23 license and they say, hey, we've already designed the  
24 stuff, I'm going to just write a letter that says,  
25 propose that it's unsatisfactory and doesn't --

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1 MEMBER MARCH-LEUBA: That's correct.

2 MEMBER BROWN: -- meet all the  
3 requirements.

4 MEMBER MARCH-LEUBA: They design it at  
5 their own risk. The NRC just has to give them a  
6 license because it satisfies the requirement or not.  
7 But the designer, the applicant designs everything at  
8 their own risk. It has never happened that the NRC  
9 has rejected it, but that's the process.

10 MEMBER BROWN: If that's the point, then  
11 my comment on my memo is going to be fairly explicit  
12 relative to it's not satisfactory for designing --

13 MEMBER MARCH-LEUBA: I think that we  
14 should have a section here that says recommendations  
15 for review of the operating license, write in the way  
16 you want to because this is what you're writing here  
17 is for construction it's okay but, from now on, the  
18 staff needs to consider the following items.

19 MEMBER BROWN: For instance, defense-in-  
20 depth is how do you use computers in some of these  
21 systems. That was covered in the other items we've  
22 done. It was done, you know, suitably. And NuScale,  
23 I mean, excuse me, SHINE was not, I mean, I accepted  
24 less than what I would have seen for NuScale.

25 CHAIR PETTI: But, again, NuScale was a

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1 one-step licensing.

2 MEMBER BROWN: So was AP1000, so was --

3 CHAIR PETTI: Right. So they were at the  
4 FSAR stage.

5 MEMBER BROWN: I understand that. But so  
6 I knew what they were hidden, but in SHINE there was  
7 enough information in there so that I knew, I could  
8 tell that defense-in-depth was going to be okay, they  
9 knew they had processors and they knew they needed,  
10 they were keeping everybody out, no connecting to the  
11 internet. It was really clear.

12 MEMBER BALLINGER: But that was at the  
13 operating license.

14 MEMBER MARCH-LEUBA: Yes. And when we  
15 were reviewing Chapter 7 for SHINE, we walked inside  
16 a containment and (inaudible) so where the control  
17 room is going to be --

18 MEMBER BROWN: All right. I'll quit. All  
19 I'm saying is I just, I just want to make sure the  
20 architecture requirements and other types of stuff in  
21 the reg guides that define how they get used --

22 MEMBER MARCH-LEUBA: This is the point.  
23 We can make a recommendation about how that process  
24 happens.

25 MEMBER BROWN: Okay.

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1 (Simultaneous speaking.).

2 MEMBER HALNON: Yes. So I approached my  
3 reviews with this is what they're going to do and  
4 then, when we get to the operating license, the FSAR,  
5 it's the what and the how.

6 CHAIR PETTI: And the how. That's a good  
7 way to think about it.

8 MEMBER HALNON: And so if the what is  
9 adequate, they're meeting the right codes, they've got  
10 the right things, they say they're going to use  
11 analytical issues, they're going to use test data for  
12 this, the system is going to be able to take the  
13 gasses and they're going to be able to scrub them, and  
14 blah, blah, blah, blah, blah, you know, that's looking  
15 at it almost like a system description as opposed to  
16 a system design. There will be a design, and that  
17 design will be summarized in the FSAR.

18 MEMBER BROWN: As long as I'm getting an  
19 FSAR.

20 MEMBER MARCH-LEUBA: You will in a couple  
21 of years.

22 MEMBER BROWN: Okay. Or whoever is met at  
23 that time.

24 MEMBER MARCH-LEUBA: Maybe we can raise  
25 these things as recommendations for ACRS review of

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1 operating license. Fair warning: ACRS will look at  
2 these items when you send us an operating license to  
3 review. This is what we're going to look. You decide  
4 whether you want to risk it or not; that's your job to  
5 do it. But this is what we will look at.

6 MEMBER REMPE: Maybe give us a template.  
7 Some of us may think we might get some additional  
8 information as the review progresses in some of these  
9 cases, so I, you know --

10 MEMBER MARCH-LEUBA: You want to finish the  
11 thing by May. You're not going to get anything else.

12 MEMBER REMPE: When you're the first one  
13 out of the gate, I would hope I get something else.  
14 We didn't even see Appendix A and, you know, it's like  
15 it's a big guess right now.

16 MEMBER BROWN: I don't remember that. I  
17 don't think they did. I don't remember.

18 MEMBER BALLINGER: Somebody did.

19 MEMBER BIER: I like Jose's comment of the,  
20 you know, these are notes to ourselves in the future  
21 and, therefore, also notes to staff and licensee that,  
22 you know, we don't want anybody to forget that  
23 somebody is going to be looking at these things.

24 MEMBER HALNON: So back to Vesna's, it's  
25 more insights from our review, which maybe that's the

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1 right --

2 MEMBER MARCH-LEUBA: Our own Appendix A,  
3 if you want to call it that way.

4 MEMBER DIMITRIJEVIC: Well, I was thinking  
5 maybe we should say the name of this to be considered  
6 in the future or consideration or something when we  
7 just put discussion now.

8 MEMBER HALNON: That's true that many of  
9 us, some of us won't even be here for the operating  
10 license review, and that's the same thing with the  
11 staff. So they're keeping their list of lessons and  
12 insights, and that's the same thing that we're kind of  
13 doing with these.

14 CHAIR PETTI: I think we understand the  
15 comments. We need to break because we've got a P&P  
16 subcommittee. So let's take a break, and we will be  
17 back at 1:00.

18 (Whereupon, the above-entitled matter went  
19 off the record at 11:50 a.m. and then went back on the  
20 record at 1:01 p.m.)

21 CHAIR PETTI: Okay. So we officially  
22 close the meeting, and we're going to continue working  
23 on our memos.

24 (Whereupon, the above-entitled matter went  
25 off the record at 1:01 p.m.)

**NEAL R. GROSS**

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# **NRC STAFF REVIEW STRATEGY FOR THE SAFETY REVIEW OF THE KAIROS HERMES TESTING FACILITY CONSTRUCTION PERMIT APPLICATION**

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**Briefing for the Advisory Committee on Reactor Safeguards**

**Wednesday, March 1, 2023**

By the Division of Advanced Reactors and  
Non-Power Production and Utilization Facilities,  
Office of Nuclear Reactor Regulation

# Background

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- Test reactor – different licensing requirements than a commercial power reactor
- Construction Permit application – preliminary design.
- The NRC staff performed an appropriate level of review, focusing on matters that are most safety significant, and the scope of the review was commensurate with the risk posed by the design.
- Unswerving focus on adequate protection of public health and protecting the environment.

# Testing Facility Licensing

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- Kairos expects to apply for a Class 104c license for a utilization facility useful in the conduct of research and development activities. Accordingly, the staff conducted the CP review consistent with Section 104c of the Act.
- Many 10 CFR Part 50 requirements are for power reactors and do not apply to testing facilities.
- Testing facilities are subject to the requirements of 10 CFR Part 100, “Reactor Site Criteria.”
- Testing facilities are subject to a few 10 CFR Part 50 requirements that do not apply to research reactors, including Advisory Committee on Reactor Safeguards (ACRS) review, and mandatory hearings for CP applications (10 CFR 50.58).

# Construction Permits

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- The level of detail needed in a CP application and associated NRC staff SER are different than for an OL (or combined operating license)
  - The CP application describes the preliminary design of the facility, while an OL application should describe the final design of the facility, as well as plans and programs not provided in the CP application
- The staff must make the following findings to issue a CP, based on 10 CFR 50.35:
  - Facility has been described, including the principal architectural and engineering criteria for the design
  - Further technical or design information may be reasonably left for later consideration in the final safety analysis report (i.e., OL application)
  - Safety features or components requiring research and development have been identified
  - Safety questions will be resolved prior to the completion of construction and the proposed facility can be constructed without undue risk to the health and safety of the public
- Staff's conclusions are also based on the considerations in 10 CFR 50.40 and 50.50

# Risk-Informed Review

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- For its CP application review, the depth and scope of staff's review was commensurate with the risk or safety significance of items under review
- The staff maintained a “big picture” safety perspective of the Hermes design. The scope and level of detail of the review considered the small size of Hermes and the anticipated strong safety case with low radiological consequences, and as appropriate for a testing facility CP application.
- The staff's review is also tailored to the unique and novel technology described in the CP application, using the appropriate regulatory guidance in NUREG-1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors.” Other guidance (e.g., regulatory guides and industry standards) and engineering judgement are also used, as appropriate.

# NUREG-1537 Review Areas/Chapters

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1. The Facility/Introduction
2. Site Characteristics
3. Design of Structures, Systems, and Components
4. Facility Description
5. Coolant Systems
6. Engineered Safety Features
7. Instrumentation and Control
8. Electrical Power Systems
9. Auxiliary Systems
10. Experimental Facilities
11. Radiation Protection and Waste Management
12. Conduct of Operations
  - Emergency Planning
  - Physical Security
  - Operator Licensing
  - Startup Plan
  - Human Factors
  - Quality Assurance
13. Accident Analysis
14. Technical Specifications
15. Financial Qualifications
16. Other License Considerations
17. Decommissioning
18. Uranium Conversions
19. Environmental Review

(Note that some NUREG-1537 chapters are not applicable to the Hermes CP application)



# Hermes Review Examples

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- Staff conducted audits of:
  - Site characteristics (~ 30 questions)
  - Nuclear design and accident analysis (over 100 questions)
  - Decay heat removal system (16 questions)
  - Instrumentation and Controls (16 questions)
  - General (reactor fuel, reactor coolant system, electrical power, chemistry control, inert gas system, radiation protection, emergency planning, financial qualifications and other topics) (~130 questions)
- Example of DHRS review
- Example of methodologies and evaluation models

# Overview of DHRS Review

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- The DHRS is safety-significant for maintaining the vessel temperature within acceptable limits for SS-316
- DHRS is placed in service above a threshold power where passive radiative cooling only is not adequate
  - During this transition phase water is introduced to the guide tube and evaporator
- Staff reviewed the preliminary system design to identify potential system failure modes
- Staff audited the Kairos DHRS heat performance calculation which determined the level of system performance necessary to maintain the vessel below the SS-316 limit
- The staff performed independent calculations to ensure water tank volumes were sufficient for 7 days of cooling
- Staff ensured testing plans addressed the potential flow and heat removal instabilities issues during the transition and in-service phases including the effects of potential failure modes

# Overview of DHRS (cont.)

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- Staff ensured testing plans addressed the potential dynamic loads on the structure and components due to transition phase thermal shock and in-service evaporator boiling
- Staff ensured testing plans addressed the potential for corrosion and fouling in the evaporator tube affecting structural integrity and the ability to remove heat
- The staff noted the DHRS design must accommodate the highest heat loads for vessel integrity and the lowest in-service heat loads to prevent freezing without operator action within 72 hours
  - Final determination on the adequacy of the DHRS to meet these competing design requirements will be made based on the final design presented in the FSAR
- Staff concluded that the preliminary design is consistent with the associated PDCs

# Overview of Methodologies and Evaluation Models

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- Staff review of the methodologies included:
  - Consideration of important phenomena
  - Range of conditions evaluated
  - Consideration of uncertainties
  - Identifying methodology/model conservatisms
  - Margin to acceptance limits
- Codes used for the CP evaluation have not been validated
- Staff performed a detailed review of the MHA and underlying supporting calculations within the limits of the preliminary design information

# Overview of Methodologies and Evaluation Models (cont.)

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- Staff used various means to assess evaluation models to reach a reasonable assurance finding. Examples include:
  - The correlations or models used in the Kairos codes are used in established codes or evaluation models
  - Review of journal articles which perform similar analysis or describe the use of similar modeling approaches for related applications
  - Integral test results
  - Scoping calculations to better inform engineering judgement
  - Engineering judgement
- Staff plans for OL review will include:
  - Review software quality assurance program or implementation
  - Review code nodalization
  - Review code inputs
  - Review assumed material property inputs
  - Exercise the applicant's code or perform confirmatory analysis
- Justification of models may be provided by test results, code verification and validation, or other method before or during the Operating License review

# NRC Staff Contacts

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