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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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APR1400 SUBCOMMITTEE

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OPEN SESSION

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WEDNESDAY

JANUARY 24, 2018

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Ronald G. Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

CHARLES H. BROWN, JR., Member

MICHAEL CORRADINI, Member

VESNA B. DIMITRIJEVIC, Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

ALSO PRESENT:

JOE ASHCRAFT, NRO

JOHN BUDZYNSKI, NRO

ALEX BURJA, NRO

SANG-JU CHO, KNF

MANSEOK DO, KNF

ASHLEY FERGUSON, NRR

KEN GEELHOOD, PNNL

JIM GILMER, NRO

ZACH GRAN, NRO

CRAIG HARBUCK, NRR

JOHN HONCHARIK, NRO*

REBECCA KARAS, NRO

KERRI KAVANAGH, NRO

LAUREN KENT, NRO

IL-KYU KIM, KNF

JUNGHO KIM, KHNP

YOUNGLEI KIM, KEPCO E&C

YUNHO KIM, KHNP

NICK KLYMYSHYN, NRO

OHHYUN KWON, KNF

HIEN LE, NRO

SANWON LEE, KHNP

DAEHEON LIM, KEPCO E&C

TIM LUPOLD, NRO

MIKE MCCOPPIN, NRO

JILL MONAHAN, Westinghouse

JIYONG OH, KHNP

JONATHAN ORTEGA, NRO

JAEHYUK PARK, KEPCO E&C

CAYETANO SANTOS, NRO

KEN SCAROLAR, NAE

ROB SISK, Westinghouse

ANGELO STUBBS, NRO

ED STUTZCAGE, NRO

ROBERT SWEENEY, KHNP

MATT THOMAS, NRO

CARL THURSTON, NRO

T.R. TJADER, NRR

JESSICA UMANA, NRO

CHRIS VAN WERT, NRO

ANDREA D. VEIL, Executive Director, ACRS

DAVE WAGNER, AECOM

BILL WARD, NRO

STEVE WILLIAMS, NRO

CHENG-IH WU, NRO

GEORGE WUNDER, NRO

*Present via telephone

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

P R O C E E D I N G S

1:00 p.m.

CHAIRMAN BALLINGER: The meeting will now come to order, please. I got it, it's on.

This is a meeting of the APR1400 Subcommittee of the Advisory Committee on Reactor Safeguards.

I'm Ron Ballinger, now a Professor Emeritus, Chairman of the APR1400 Subcommittee.

MEMBER POWERS: And I assume that students throughout MIT campus are celebrating, right?

CHAIRMAN BALLINGER: Yes, major demonstrations. I'm getting gifts of vanilla, Swiss-almond ice cream.

The ACRS in attendance are Vesna Dimitrijevic. Did I get it right? Perfect, that's the last time that'll happen.

(Laughter.)

Walt Kirchner. I think Charlie Brown is lurking around here somewhere.

John Stetkar, Matt Sunseri, Dana Powers, Gordon Skillman, Stephen Schultz, former ACRS member and esteemable consultant. Michael Corradini.

We may have others join on the line but I'm not exactly sure. But Jose March-Leuba will be

here. Chris Brown is the Designated Federal Official, along with Zeynab Abdullahi. I probably did that bad.

The purpose of today's meeting is for the Subcommittee to receive briefings from Korea Electric Power Corporation, and Korea Hydro and Nuclear Power Company, HNP, regarding their design certification application, and the NRC Staff regarding their Safety Evaluation Report with no open items, no open items specific to verification programs, Chapter 14.1; specific information to be addressed in the initial plant test program, 14.2; Chapter 16, Technical Specifications; Chapter 18, Human Factors in Engineering.

Also, the topic report of NCR on the PLUS7 fuel design will also be presented.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act, FACA. That means that the Committee can only speak through its published letter reports.

We hold meetings to gather information to support our deliberations. Interested parties who wish to provide comments can contact our Offices requesting time after the meeting announcement is published in the Federal Register.

That said, we also set aside ten minutes

for comments from members of the public attending or listening to our meetings. Written comments are also welcome.

The ACRS section of the U.S. NRC public website provides our charter bylaws, letter reports, and full transcripts of all full and Subcommittee meetings, including slides presented at the meetings.

The rules for participation in today's meeting were announced in the Federal Register on January 12, 2018. The meeting was announced as an open, closed-to-the-public meeting.

This meant that the Chairman can close the meeting as needed, and we will do that for the staff presentation on the PLUS7 fuel.

I think everything else is non-proprietary, and the reason it is that way on the schedule the way you see it is that a consultant or somebody has to leave quickly to catch an airplane.

So, that's why the order is what it is. No requests for making statements of the Subcommittee has been received from the public. The transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice.

Therefore, I would request that participants of this meeting use the microphones

located throughout the meeting room when addressing the Subcommittee, and make sure the little green light is on when you're talking.

Participants are to first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have a bridge line established and I think there's one for Westinghouse, right? And also for interested members of the public to listen in.

The bridge number and password were published in the agenda posted on the NRC website.

To memorize disturbance, this public line will be kept in the listen-only mode. The public will have an opportunity to make a statement or provide comments at a designated time towards the end of the meeting.

I would request now that the meeting attendees and participants silence all their cell phones and other electronic devices.

Oh, he is here. Okay, he's hiding behind the post.

I invite Bill Ward, the NRO Project Manager, to introduce the presenters and start the Meeting.

Bill?

MR. WARD: Thank you. Once again, we thank the ACRS for having the meetings and we're getting pretty close to the end of Phase 5 here.

There's a couple more months left and we're really thankful for the flexibility the ACRS has shown in helping us get Meetings together a little bit, as we get chapters done so that we can meet our goals.

Thank you again.

MR. SISK: Thank you, Chairman. I'd like to echo the Staff's comments.

We do appreciate very much this opportunity to continue our presentations on our Phase 5 Review for SERs with no open items.

And we certainly appreciate ACRS's working with us and the Staff to make these meetings possible and maintain our schedules as we go forward.

So, without any further comments at this point in time, I'd like to turn this over to Mr. Il-Kyu Kim, who will be leading the presentation on Chapter 4.

MR. I. KIM: Good afternoon, my name is Il-Kyu Kim from KEPCO Nuclear Fuel. I will present Chapter 4, Reactors.

This presentation consists of four sections of review over Chapter 4, some are open items,

current status, and attachments.

Chapter 4 consists of six sections, which some are a description of fuel system design, nuclear design, thermal-hydro design, reactor motors, and the functional design of the reactivity control system.

This slide shows the lists of summary to the documents and the summary of RAIs.

This uncontrolled document of Chapter 4 and the six Topical Reports and the technical report was submitted for this Chapter 4.

62 RAIs were issued for Chapter 4 and there were four open items at Page 3. However, all of the RAIs have been resolved and there is no open item now.

Description and the resolution for the four open items will be explained in the next slide. This slide shows the list of open items.

There were four open items at Page 3.

The open items are impact of thermal conductivity degradation, fuel-assembly structural response, CPS set-point, analysis, and methodology, and also then to classification and experience.

This and the next slide show the summary of open items related to the impact of thermal conductivity degradation.

The description of the issue, NRC Staff

noted that 33B does not account for the effect over thermal conductivity degradation, and requested a TCD impact on fuel-rod design and the CFT analysis.

The resolution is TCD penalty was conservatively determined based on the analysis of a comparison to experimental data at various points.

And the KHMP responded that the (unintelligible due to accent) visuals for the fuel-rod design was satisfied with the constellation of the TCD.

Also, KHMP responded that as the original toggle for safety analysis with the constellation of the TCD, all the TCD-affected areas were satisfied here.

The following Topical Report and the technical report were revised to reflect the impact of TCD, and the following TCD-affected TCD Tier RAI sections were revised to reflect the impact of TCD.

And the next slide shows the summary of open item related to fuel-assembly structural response.

MEMBER KIRCHNER: May I stop you and go back one slide, please?

I was looking at the list of revisions, could you just explain why the TCD had an impact on your containment functional design?

MR. I. KIM: Chapter 6? Will you please explain for the Chapter 6.21 section?

MR. JEONG: Okay, this is Jaehoon Jeong from KEPCO Nuclear Fuel. Because TCD impacts the initial store of energy which is used for containment pressure and temperature calculations.

So, we reflected the TCD penalty on our containment analysis, we concluded that the current (unintelligible due to accent) is too varied. Even we considered the TCD impact on other systems.

MEMBER KIRCHNER: So, you still retain the significant margin?

MR. JEONG: Yes.

MEMBER KIRCHNER: On the containment response?

MR. JEONG: That's right.

MEMBER KIRCHNER: Okay, thank you.

MR. I. KIM: Okay, I will continue.

Okay, description of this issue, KPHM had provided a technical report, Revision 0, for the PLUS7 EOL analysis.

The report contains PLUS7 LOCA analysis result at EOL condition, to consider NRC Implementation Notice 2012-09.

The EOL PLUS7 fuel assembly model for the analysis was developed here based on EOL PLUS7 test data, and the BOL and the EOL test data from CENPD-178-P.

(Unintelligible due to accent) requested to provide the findings at the review, the technical report, seismic LOCA analysis result for the BOL conditions.

Because the technical report does not contain EOL analysis results and applicability of the EOL test data from CENPD-178-P, and the methodology used to obtain (unintelligible due to accent) over fuel assembly.

And the justification for the critical ratio uses the four-sided LOCA analysis. The last one is the justification for the closest strings of the breed.

This next slide shows the resolutions for the NRC request. KHMP performed the site LOCA analysis based on the new test to response the RAIs.

Following new tests for PLUS7 fuel assemblies and the (unintelligible due to accent) were performed using Westinghouse's Columbia facility, at BOL and/or EOL conditions to define their fuel-line assembly and characteristics.

The fuel assembly model for the site LOCA analysis was developed here. Site and LOCA analysis were performed at BOL and the EOL conditions.

The analysis results show that the PLUS7

fuel assembly maintains structural integrity for seismic or LOCA event at BOL and EOL conditions.

The methodology used for the test, model development and analysis is based on the CENDP-178-P, Revision 1, which was approved by NRC.

KHMP provided the following to NRC, the revision over the technical input for seismic and LOCA analysis and the responses for the RAIs, which was an open item.

This slide shows the summary of open items related to CPC set-point analysis methodology.

Description, analysis requested to provide the basis for using a one-sided tolerance limiting factor of 1.645 in the technical report.

And to discuss why this factor is consistent with Regulatory Guide 1.105. Set-point for safety-related instrumentation, Revision 3.

Resolution, KHMP responded that the application of the set-points for the CPC, CPC's the Core Protection Calculator, is inherently one-sided so that the value of 1.645 is the 95 by 95 one-sided tolerance limiting factor for an infinite number of data-points.

Other later protection system set-points complied with Reg Guide 1.105, Revision 3, except the CPC set-point complied with CPC set-point methodology

technical report.

Therefore, KHMP will revised the TCD Table 1.9-1, Table 7.1-1, Chapter 7 and the Chapter 15, with the exception of compliance with Regulatory Guide 1.105, Revision 3.

This slide shows the summary of open items related to adverse-event classification and experience.

Description of issue, the step did not believe that the adverse event is not the pressure boundary component since it replaces pressure boundary house nut.

KHMP was requested to provide data and operational experience that demonstrates work in practice.

Resolution, KHMP provided the explanation of functionality principle between the adverse event as the venting device seal, and the housing nut as a pressure boundary component with the seal weld.

KHMP provided relevant data and operational experience.

And this slide explains the current status of TCD Chapter 4. Chapter 4 is completed; KHMP continues to monitor Chapter 4 to assure any conforming changes are addressed.

All open items that were identified in Page 3 have been resolved with adequate discussion on the step.

Changes in Chapter 4, as it reviewed and marked up in response to the RAI, will be incorporated into the next revision, Revision 2, of the TCD.

This presentation has been finished. Thank you so much for listening.

MR. SISK: So, this is Rob Sisk.

So, this is on Chapter 4; we'll move to PLUS7 if there are no other additional comments on Chapter 4 at this point.

So, not hearing questions at this point, I would like to invite Mr. Kwon to provide a Chapter 7 overview?

MR. KWON: Good afternoon, my name is Ohhyun Kwon from KEPCO Nuclear Fuel. I represent the PLUS7 topical approach.

This slide shows the brief content such as introduction, summary of PLUS7 purity design Topical Report, RAI status, and quality status.

PLUS7 purity design Topical Report is to evaluate mechanical integrity of PLUS7 fuel assembly and PLUS7 purity design procurement.

PLUS7 fuel was developed to comply with

the 10CFR Regulatory Guide and the Review Plan.

The contents of PLUS7 purity design report consist of six chapters: introduction, fuel assembly, and component design, fuel design, PLUS7 fuel experience, and conclusion and reference.

Open disk describes various mechanical tests, operating experience, scram data, verification, and various improvements analysis.

This slide shows the PLUS7 design features. The fuel rod is 16 by 16, and the number of fuel rods in an assembly are 236. 9 number of degrees and 4 numbers of shingles are used.

On top, on bottom, and one protective grate are used at the top and the bottom position of fuel assembly.

For fuel assembly design evaluation, the integrity of PLUS7 fuel was verified based on RO5 test and the calculation.

In later performance data and operating experience, it compounded the performance of the PLUS7 fuel. PLUS7 fuel met all the design criteria related to the mechanical integrity.

For fuel-rod design evaluation, fuel-rod design evaluation was performed for design criteria including creating stress, strain, fatigue,

oscillation, high driving, rod internal pressure, collapse, overheating, and (unintelligible due to accent) interaction.

All of the fuel-rod design criteria were met up to the maximum fuel rod eligible for 60 kilowatts a day for the battery.

CHAIRMAN BALLINGER: I have a number of questions, I'm not sure where to ask them, and I'm just trying to find where in the presentation is appropriate, but this probably is good enough to start.

I'm looking at the fatigue analysis that was done, and I'm trying to figure out what the actual duty cycle was for the fuel to get to the cumulative usage factor.

I think it's 0.77 that you came up with. And so I can identify the load follow 10 percent to 100 percent, I can get that more or less.

I can get the AOOs and things like that, but is there a table somewhere -- and I couldn't find it, maybe it's in another Chapter -- where it lets me determine that usage factor?

Because the usage factor is presented as 0.77 but I can't get to there by looking at the data in the PLUS7 Fuel Design Chapter.

And it's not in Chapter 4, so I don't know

where -- it may be somewhere, I just don't know where it is.

MR. KWON: In the Topical Report, Chapter 3.43.

CHAIRMAN BALLINGER: 3.4, I have some of it here. 3.4, okay, that was the thing that got me going here on this.

And that is fatigue damage factor for the daily load following operation was calculated using the same -- you know, the FATES3B code.

So, that's all that says there, and it says the total cumulative fatigue damage factor from daily load following operation.

I'm assuming that's the 10 percent to 100 percent power and back? Reactor trips and starts and shutdowns was 0.77. So, I just can't deconvolute the 0.77.

I can get two out of the three, or three out of the four, components to the fatigue light, but I can't get everything.

MEMBER SKILLMAN: Rob, and others, I'm complicit with Ron in asking this question, and the question really starts on Chapter 3.2.3. and there, you identify startup and shutdown, power variations during normal operation and reactor trip.

And we kind of figured there must be a table in and around Table 3-4 that would account for those cycles.

And I'm looking through all of the tables in Chapter 3; we were not able to find an accounting for the startups and shutdowns, the power variations.

And they are 10 percent and 100 percent on a daily basis for each day. That would suggest in a 24-month fuel cycle a fairly large number of those cycles.

And then the reactor trips, we just couldn't find a table to account for those transients.

And it may be in another place and we just couldn't find it so we're not saying it's not there. We were just not able to find it.

CHAIRMAN BALLINGER: I think they could get back to us on that, right? We don't need to go hunting and pecking here.

MEMBER SKILLMAN: Yes, if we can have it sometime later, point us to it, that would be fine.

MR. SISK: We've taken the note down. We have limitations on time obviously, but we'll keep that going.

MEMBER SKILLMAN: The action item is reconcile 3.2.3.

MR. SISK: That's right.

MEMBER SKILLMAN: Reconcile 3.2.3.

MR. SISK: Reconcile 3.2.3, I've written that down.

MEMBER SKILLMAN: Thank you. Thanks, Ron.

CHAIRMAN BALLINGER: Okay, in 3.2.4, we are talking about oxidation and clotting oxidation and hydrating.

You're saying that as far as the parameters that you're using for the evaluation, a crud thickness of 0.3 millimeters.

And I understand how you got the 0.3 millimeters from the data that's also in the Chapter, but my question is how sensitive are the analysis results due to that crud thickness?

Because that's one variable where location plant to plant, how people operate the plant, that'll affect the crud thickness.

MR. SISK: We're going to take that aside. We'll come back if we can, but we're going to take a look at this on the side for time purposes.

CHAIRMAN BALLINGER: On 3.3.4, you're talking about the difference between ZIRLO and Zircaloy-4. And the original multiplier, conversion

multiplier, was 0.75.

I thought that was kind of unusual but not crazy. But it's been changed to 0.92, and to me, that is crazy because all the data I've seen, ZIRLO is a factor of 10 or more better than Zircaloy-4 for corrosion.

So, I'm curious as to -- I understand, I saw the data, the measurements that you made at various reactors in Korea and things to get that number.

But I'm just curious as to why -- that's basically saying that ZIRLO isn't any different than Zircaloy-4 from a corrosion point of view. And so it's kind of startling to me that that would be the case.

So, I'm just wondering whether or not there's something different about the reactors that you measured the corrosion rate in, although, you identified temperatures, and things like that, that compensated in one way or another.

But it just seems to me like a very small difference between ZIRLO and Zircaloy-4 for this application.

It's got to be very conservative, very conservative, but I'm just curious.

MR. KWON: The multiplier ZIRLO, 0.92, was determined under the experiment data.

CHAIRMAN BALLINGER: Yes, I understand it was determined by actual measurements, but I'm curious as to why there's such a small difference that was observed.

Because in the literature and in practical experience, ZIRLO is much better than Zircaloy-4. I mean, the data is what it is.

Okay, my inquisition is over for now. Thank you.

MR. KWON: For PLUS7 LTAs, two-sided imaging relations were conducted for LTA. Assay examination of LTAs has been completed after validation.

PSC and in-house examination shows the design requirements were met.

For operating experience, more than 5200 PLUS7 fuel assemblies have been supplied as of 2017.

PLUS7 fuel assemblies will be supplied for Barakah, and APR1400 NPPS in UAE, and 5 APR1400 NPPS in Korea.

As shown in this table, more than 5200 PLUS7 fuel assemblies have been loaded in 13 nuclear plants in Korea.

For conclusion, in PLUS7 in Topical Report, the design evaluation was performed to comply with the

Regulatory Guide Requirements. The fuel assembly met all the design criteria for mechanical integrity.

The fuel rods were evaluated up to the maximum fuel rod burnup of 60 kilowatts a day. The fuel rod satisfied all the design criteria related to the rod's overall performance and mechanical integrity.

The PLUS7 design was verified through the (unintelligible due to accent) test, the verification test, and operating experience.

RAI status, a total of 24 questions were ranging for the Topical Report. The responses for the 24 questions have been submitted. The impact of TCD was the main issue. TCD status will be explained in the next page.

For the TCD issues, NRC Staff noted that 33B does not account for the impact of TCD and the requested TCD impact on fuel design and safety analysis.

For the resolution, TCD penalty was conservatively determined based on the analysis of a comparison to the experimental data at various points.

KHMP performed the analysis for the design evaluation and the related safety areas with a TCD penalty.

As a result of the analysis, all the TCD-affected areas were satisfied.

RAI status continued, Topical Report was advised to consider TCD impact and was submitted in 2017.

The following TCD Chapters have been revised to include the impact of TCD. The TCD-affected areas have been covered in the previous presentations so I will skip this page.

The current status for PLUS7 Topical Report is complete. All the RAIs, including impact of TCD have been reserved.

Topical Report was revised and submitted in 2017, changes in TCD in response to the RAI have been incorporated in the last revision, Revision Number 2.

Thank you.

MR. SCHULTZ: I have one general question and I didn't want to include it in the discussion in the presentation because what you've presented with regards to the thermal conductivity degradation approach, to me, is fine.

But it does take the approach of using a computer code that does not have the degradation factors in it, and applies a penalty factor.

That's been derived and we've got the information that shows how that has been done. And

this has been done by others.

My question is more general, longer-term, because in going forward, licensees will have to repeat the analysis on a cycle-by-cycle basis to demonstrate that, in their cycle design and operations, the fuel temperatures are going to meet limits, and that the analyses that you performed in the base case apply to their fuel cycles.

Is there any future plan in your organization to develop a fuel performance code that, in fact, will include the thermal conductivity degradation technology, in itself included in the fuel performance code and the event fuel performance code, that would be licensed sometime in the future?

I know you wouldn't have time to have done that in the last year or two, but going forward, it would seem right to have a plan that would develop a more advanced methodology that would incorporate it distinctly.

MR. JEONG: This is Jaehoon Jeong from KEPCO Nuclear Fuel.

Actually, we have finished development of the code which considers TCD impact, but the start of these applications, we haven't finished that yet.

So, we may apply that code in the next

application.

MR. SCHULTZ: Thank you, I appreciate that.

MR. SISK: If there are no other questions, we're going to caucus while you have the NRC to talk about the issues.

CHAIRMAN BALLINGER: I think we've checked that the room is sanctified so we can get the Staff to come up.

Thank you.

Oh, I think Chris has got -- oh, the open session's over, we're now in closed session.

(Whereupon, the above-entitled matter went off the record at 1:39 p.m. and resumed at 2:19 p.m.)

MR. WUNDER: Okay, I guess we'll move on now to Chapter 4. We'll be presenting our safety evaluation with no open items. This is our outstanding review team. Matter of fact, it's like the 1927 Yankees of review teams. From Reactor Systems, we have Alexander Burja, Jim Gilmer, Carl Thurston, and Chris Van Wert.

From the Materials and Chemical Engineering Branch, our team members were John Honcharik and Dan Widrevitz. Contributing from the Office of Research were Andrew Bielen and Peter Yarsky.

And finally, providing additional assistance we have Nick Klymyshyn of PNNL. It's looks like Chris is probably going to be starting off for us today, so Chris, whenever you're ready.

MR. VAN WERT: All right, well thank you very much, you're not rid of me yet. So as we discussed before when we came in front of you before with the 4.2 with open items, we had two open items. The first one we just closed out, which is related to the fuel assembly mechanical design analysis, which was PLUS7 topical report.

At that time, the topical report was still under review. And due to at that time the question was revolving around TCD, we thought there were potential implications on DCD Sections 4.2, 4.3, and 4.4, which will all depend on the resolution path chosen by the applicant.

So now that we've closed out the topical report, we concluded, again, the four criteria that the SRP 4.2 guidance tells us to look at. And we assured that the fuel and cladding integrity is maintained. That allowed us to, well, because of that, the thermal design margin calculations in DCD Section 4.4 remained unaffected.

No design, nuclear design limitations or

changes were necessary based on the resolution passed, so therefore DCD Section 4.3 was not impacted by the issue. Based on that and the completion of the topical report review, the staff concludes that this item is now closed. So no further questions.

The second open item on 4.2 was related to the structural analysis of fuel assemblies for seismic and loss of cooling accident loading. At that time, the applicant was in the middle of revising their referenced technical report, which is now currently Revision 2, in order to address staff concerns. That was not completed at the time of our last presentation.

Now, Revision 2 has been completed as of July 2017, and we have completed our review of that. And it did address all the staff's concerns that we had at the time.

I will discuss in the next three slides the staff's review, but the, and the summary at this point is that the staff reviewed the information provided and determined that PLUS7 fuel assembly will meet the requirements of GDC-2 in terms of fuel assembly structural response to externally applied loads.

And so at least I wanted to give you a high level overview of our evaluation because that was not presented to you during the last go-round. In terms

of the analysis of loads for the PLUS7 fuel assembly, they did rely on previously approved CE codes and methods. And I've listed them here for your review.

The fuel assembly response characteristics were determined by testing, and they covered both BOL and EOL conditions, which did address the staff's Information Notice 2012-09. And they also performed tests in air, still water, and flowing water conditions.

The staff reviewed the tests and analyses and concluded that the referenced methodology was correctly followed, and that the seismic damping credit was supported by the test results. Therefore, the fuel assembly loading values are acceptable.

In terms of determination of strength, the application does follow the methodology highlighted in CENP-178-P, Rev. 1, for the strength calculations. And this included performing one-sided drop tests to represent grid to barrel impacts through grid long pulse testing to represent grid-to-grid impacts. And it did follow ASME Code Section 3 for components other than grids. And the acceptance criteria for grids were developed based on the grid crush test data.

These limits follow the staff guidance provided in SRP Section 4.2, Appendix A, and are therefore acceptable.

And in terms of the acceptance criteria and analysis performed, Revision 2 of the tech report presents the analysis of the PLUS7 fuel assembly in the APR1400 reactor design and provides the acceptance criteria by which the PLUS7 fuel assembly is evaluated.

The staff reviewed and concluded that the applicant adequately demonstrated that fuel rod fragmentation would not occur as a direct result of LOCA blowdown and SSE loads, and that the control rod insertability is always ensured.

Are there any questions on this topic? Okay, thank you very much.

MR. WUNDER: We have too, excuse me, Mr. Chairman, we have too many people to sit up here all at once. So we're going to briefly change out panels for the remainder of the chapter.

I'm now joined by Alex Burja and Jim Gilmer. And I was supposed to be joined by someone from Materials, but they don't appear to be here yet. So I will, fortunately their slide is the last one, and maybe they'll show up. So I'll turn it over to Jim and Alex.

CHAIRMAN BALLINGER: Those Materials people can't be trusted.

(Laughter.)

MS. BURJA: Thanks, George. Again, my name is Alex Burja, and I'm the staff reviewer for DCD Section 4.3.

Though there were no significant open items as of our last presentation to you, I will be addressing two questions or comments that have come up. The first is why Shin Kori data was allowed to be used to validate MCNP to calculate shape annealing functions when the staff did not accept a foreign plant as a prototype plant during the Phase 3 review.

So as will be discussed later today during the Chapter 14 presentation, the staff's position on referencing foreign plants as prototype plants is that it is acceptable, provided that the quality assurance program for construction and testing is consistent with the applicant's approved QA program.

But in this particular case for 4.3, it's a little bit of a different situation, because the Shin Kori data is being used to show that MCNP is an acceptable method for calculating shape annealing functions. It's not being used as a way to exempt the design from testing.

In fact in Chapter 14, there is a power ascension test that is used to verify the core protection calculator constants, including shape

annealing functions. So it is something that will be tested.

In terms of guidance that is specific to nuclear design calculations, Standard Review Plan Section 4.3 states that critical experiments and operating reactors should be used to validate codes and analysis procedures. But there isn't any hard and fast guidance on whether the data comes from domestic or foreign sources.

What is important in our view is that the data sources satisfy our QA requirements, and this validation technical report did go through KHNP's QA process. So for these reasons, the staff concludes that the use of Shin Kori data for validating MCNP is acceptable.

MR. SCHULTZ: Alex, in the first bullet, you say the applicant's approved QA program. Who has performed the approval of that program?

MS. BURJA: So that would the Quality Assurance Branch. I believe that topical report has been approved by them.

MR. SCHULTZ: And so we have these things done in the right sequence. In other words, that review has been done and the QA program has been found acceptable.

MS. BURJA: That's correct.

MR. SCHULTZ: Good, thank you.

MS. BURJA: Are there any other questions? All right, next slide, please. During the Phase 3 presentation, there was a lot of comments or concern about the fact that the staff didn't document the issue of load following in the safety evaluation, as it could lead to confusion or problems in the future.

So the staff took that into consideration and has revised SER Section 4.3 to explicitly discuss the related RAI that the staff issued to confirm that there would be no load following, and to explicitly state that the APR1400 is approved for base load operation only.

In addition, the staff did ensure that any references to load following throughout the DCD have been removed, with the exception of one confirmatory item that will be changed in the upcoming DCD revision.

CHAIRMAN BALLINGER: You might take a look at the topical report on the PLUS7 fuel and search on load following. It's there.

MEMBER SKILLMAN: But I think that the distinction is --

CHAIRMAN BALLINGER: Yeah, I know the distinction.

MEMBER SKILLMAN: The reactor coolant system on the NSSS versus the fuel. I mean, the fuel can be designed to do all kinds of things, whereas the commitment for load following on the NSSS is quite candidly just a different kettle of fish. That's a whole different deal. So the fuel's great, but --

CHAIRMAN BALLINGER: Yeah, it's just a matter of terminology, I think. But once a day ten percent to 100% power and back.

MR. SCHULTZ: What you're saying, Ron, is that the documentation ought to reflect the situation between what's been done for the fuel.

CHAIRMAN BALLINGER: Yeah.

MR. SCHULTZ: And what it is for the NSSS.

CHAIRMAN BALLINGER: Yeah.

MEMBER SKILLMAN: Well, it think that's what Alex just said, that the document, Chapter 4, for the NSSS has been purged of load following.

MS. BURJA: That's correct.

MEMBER CORRADINI: So can I ask a question? I'm just curious. So what is load following as a definition? If I go from 100% power to 90% power over two hours, is that load following?

MS. BURJA: So I --

MEMBER CORRADINI: What is it? I mean,

I know what Dick, I'm going from 10% to 100%, yeah, I get it. But if the plant maneuvers from 100 to 90 in half a day, that's not load following, in my mind. So where's the definition in all this documentation?

MR. LU: This Shanlai Lu from Reactor System. I'll just give you my perspective. In the load follow, basically what we mean is you follow the grade demand instantaneously.

So basically you have a change, if for example, you don't need that kind of power. And one of the steel mills shut down their, you know, their electrical oven. And then that's a lot demand is just shut down. So basically local grid that's not needed instantaneously, you drop the power, the map.

MEMBER CORRADINI: I understand, I figured that might be an answer. But practically I thought where Dick, where Member Skillman was going was that the vessel components may have a ramp rate this is more limiting than the fuel. So in the fuel section, I would expect you got some sort of ramp rate limits that are listed such that that's the limiting thing if it were the fuel only.

And then the plant has some sort of other limit, which is listed, so that we're clear as to what's what. Because load following to me is kind of mushy.

CHAIRMAN BALLINGER: There are no ramp or rate limits on the fuel. But there are this 10% to 100% cycles, one per day, which is counted in the fatigue data for the fatigue usage factor.

MR. VAN WERT: This is Chris Van Wert and --

UNIDENTIFIED SPEAKER: Closer to the mic.

MR. VAN WERT: Okay. The only thing I would like to add just for clarification too is that the PLUS7 Fuel Topical Report is a standalone topical report. So the limits on the APR1400 design are what you would see in the DCD, and that's what Alex has just discussed being put in there.

The referenced topical report might allow, and going to extremes here, but if the, for whatever reason the topical report showed and they had approval for a 100 gigawatt day burnup but the plant designed the DCD, only allowed it to go up to 60, then 60 is the limit, regardless of whatever the topical reports says.

MEMBER CORRADINI: Okay, all right, so then, so back to my original question. Should there be somewhere in the DCD which says load following is ramp rates that are greater than X over a time period? It seems to me there's got to some sort of engineering.

Otherwise, I can have normal maneuvering, PWRs do it now.

MR. VAN WERT: Yeah, I'm pretty sure you've been listening in on our conversations.

MEMBER CORRADINI: Okay, well, no I'm just, this is a hot topic.

MR. VAN WERT: Yes.

MEMBER CORRADINI: So I'm kind of curious what it means.

MEMBER MARCH-LEUBA: From my point of view, Mike, is you can have preplanned maneuvers from 10% to 100% and that's not load following. As long as it's preplanned and the Engineering Department has analyzed it before you send it on. So you knew it was okay.

Load following is you put it in automatic on the control system and it may give you demand to ten percent like that, which you have not pre-analyzed, and you don't know if it's going to be okay.

MEMBER CORRADINI: Okay, fine.

MEMBER MARCH-LEUBA: So in order for a plant to be approved for load following, they have to put drop limiters, they have to put some stuff.

MEMBER CORRADINI: Okay, thank you.

MS. BURJA: Any additional questions or

comments?

CHAIRMAN BALLINGER: We're lucky this only too that long.

MR. GILMER: Good afternoon, I'm going to talk on the second topic, the core thermal hydraulic design. When we last met with you for Phase 3, there were two open items associated with this section, both of which you heard earlier today, either from KHNP or the staff.

The first one was actually tied to Chapter 7 open item on the instrument set point methodology. It affects 4.4 because of the core protection calculator, the limiting safety systems settings, in particular linear power density and the departure from nucleic boiling.

In order to resolve the open item during an audit, KHNP showed us data that backed up their assertion that those particular limiting safety settings are inherently single sided. And in addition, during the startup testing, a large number of power shapes are collected, which effectively makes it a semi-infinite power shape. Or, uncertainty curves. So we were satisfied that it meets the 9595 criteria.

And KHNP agreed to indicate these exceptions to the Reg. Guide 1.105, Rev. 3. And they've

done that now, so we consider that issue closed.

We did have one COL information item that we wanted added to require the COL holder to develop procedures for the core protection calculator that were, this was not part of the design certification, but it would be done during the COL stage. And we were shown example procedures from Shin Kori, which presumably the COL holder would use as a starting point for developing their own.

There is one question from the Phase 3 meeting that Member Skillman raised on the three percent flow bypass, and we had a separate sidebar meeting as well. During the meeting we argued that three percent bypass is treated as a model uncertainty. And that it clearly is in the Thermodesign Methodology Technical Report.

Our sidebar discussion got into the hot versus cold gaps, and our mechanical engineering branch supported us, because they had some open RAIs on that issue. And KHNP provided their calculations. So from a 4.4 point of view, we were satisfied that that was not still a concern.

MR. SCHULTZ: Is that, when you say it's applied, treated as an uncertainty, that's in any analyses associated with that for safety analysis?

MR. GILMER: Well, at least for the TORQUE and CTOP, which are the two codes that are used for the core thermal design. And it's also applied in the large break LOCA methodology.

MR. SCHULTZ: And that's the application for RELAP.

MR. GILMER: Right, which we'll talk about in --

MR. SCHULTZ: Chapter 15.

MR. GILMER: Chapter 15.

MR. SCHULTZ: Okay, thank you.

MEMBER KIRCHNER: Do they make a three percent adjustment in core flow, a decrement for the core protection calculator input?

MR. GILMER: I don't remember the answer to that, honestly. But I believe there was some adjustment to the.

MEMBER KIRCHNER: Yeah, their CHF ratio is going to be a function of flow.

MR. GILMER: Right, and one place where that will probably enter in is the daily and monthly power calibration. Any deviations should show up there, and they're addressable constants that can be applied by the operator.

MEMBER KIRCHNER: So is that what you mean

on the middle bullet there, with the CPC, that for the actual plant they would consistently implement constants? In other words, would they adjust that CPC to account for what their flow balance is telling them they're losing on bypass?

MR. GILMER: Yes, that's correct. Any additional questions? Okay.

MR. WUNDER: I'm told that our materials guy will be, is calling in on the phone, which is good, because I was afraid for a minute that I was going to have to become the resident expert on Versa-Vent. And they don't have Versa-Vents on submarines, and if they don't have them on submarines, I don't know what they do. So I think --

MEMBER KIRCHNER: You had the Yankee '27 team, and they have a lot of backup hitters.

MR. WUNDER: I guess we're not as deep in the bench.

MR. WARD: John, I'm sure, did you call in?

MR. HONCHARIK: Yes, this is John Honcharik.

MEMBER SKILLMAN: John, this George Wunder. Your slide is up on the Versa-Vent, and we're just, if you'd please be so kind as to talk to it.

MR. HONCHARIK: Okay. My name is John Honcharik, Senior Materials Engineer at NRO. And the topic here is the control rod drive system materials. That previously had an open item with two questions.

Basically, the issue was that the DCD didn't have sufficient information of why the Versa-Vent does not considered reactor coolant pressure boundary. And also it didn't provide the operating experience of the Versa-Vent to reduce the dissolved oxygen levels in the CRD system.

We asked those RAIs and they responded. And basically they provided justification for why the Versa-Vent's not considered pressure boundary. Basically, they only credit the ball and vent stem for the pressure boundary and not the Versa-Vent. Only if the housing nut is installed, if the Versa-Vent were to leak, is when they credit the housing.

Also, they provided operating experience of Versa-Vent that's used in some Korean plants, and also I think Palo Verde had it. And basically it shows that they could reduce the dissolved oxygen levels to acceptable level.

And in addition, these CRD housings and vent stems, they're pretty, at lower temperatures than operating plants, about 135 degrees Fahrenheit. So

this also helps minimize the occurrence of stress corrosion cracking. So based on their response, we reviewed the information and found that it was acceptable. And basically it met the intent of the GDC-1, 14, and 26. And that concludes my presentation. Are there any questions?

MEMBER SKILLMAN: I'm good, thank you.

CHAIRMAN BALLINGER: Okay.

MR. WUNDER: Mr. Chairman, if there are no other questions, that concludes our presentation on Chapter 4. Thank you, gentlemen.

CHAIRMAN BALLINGER: Do I just -- I just keep turning it on. You need to shift to Chapter 14, page --

MR. SISK: This is Rob Sisk, Westinghouse. Before we shift to 14, KNF would like to offer a couple of comments based on the questions that were raised during our session. If that would be appropriate, we'd just offer a few, a brief response to some of the comments that were raised just a little bit earlier. So, Mr. Kwan.

So the purpose of this is really to address the three comments the Committee raised earlier that we were caucusing on here just briefly, and just wanted to get back some preliminary responses to your concerns.

So Mr. Kwon, why don't we start with the 0.77.

MR. KWON: Yeah, 0.77 for the particular calculation, this calculation was based on the power variation between 10% and 100%. Ten is the load following and the practical damage factor during the load following, which has its own stress, but the different stress makes the damage factor and for during the whole time of lifetime, the practical damage factor is cumulative. So --

CHAIRMAN BALLINGER: Yeah, I understand, it's like a minors rule thing. So it's a summation of various cycles. And the 10% to 100% is explicitly called out in the chapter. The AOOs are explicitly called out in the chapter, the number of them.

So there are several categories which are called out explicitly. But there's nowhere where those usage factors add up to 0.77. So that's what I was interested in.

UNIDENTIFIED SPEAKER: So the incremental usage factor for each --

CHAIRMAN BALLINGER: Yeah, how did you get to the 0.77?

MR. KWON: So yeah, right. This is a accumulated by the minor rule.

CHAIRMAN BALLINGER: Yeah.

MR. KWON: Yeah, the cumulative is calculated by the code.

CHAIRMAN BALLINGER: Yeah.

MR. KWON: Yeah.

CHAIRMAN BALLINGER: Oh, okay, I guess, it's not that a big deal, I guess. But you got 0.77, okay. Let's just say that the 10% to 100% excursions over the life gives you 0.5 of the 0.77, and the AOOs give you 0.2. So 0.7 now. But then there are other cycles -- what adds up to 0.77? What dominates? Does that load following thing dominate, which I suspect is true? What is the dominant fatigue usage factor?

MR. KWON: I understand the 100% of power dominate, which already surely exceeds the reactor power. That makes the boundary power. And between the lower power, 10%.

MEMBER SKILLMAN: May I ask this?

CHAIRMAN BALLINGER: Can you?

MEMBER SKILLMAN: You're on a 24-month fuel cycle, right. It's two years. You shut down for about 30 days, okay. So the fuel is in for three cycles.

MR. KWON: Yes, three cycles.

MEMNBER SKILLMAN: So in the first cycle, that fuel sees about 700 cycles. In the second fuel cycle, that fuel assembly sees 700 cycles. In the third

fuel cycle, that fuel sees 700 cycles. So that one fuel assembly, if it was in the first batch and the first core, sees about 2100 cycles, 100, 10%, 100, in accordance with your 3.2.

And in addition, it sees startups and shutdowns, three, and it sees some reactor trips, hopefully none. But you have at a minimum 2100 cycles. Is that the basis of the utilization factor that Dr. Ballinger asked about?

CHAIRMAN BALLINGER: If it's 0.77, and let's say you were to remove all of the 10% to 100% cycles, what would the fatigue usage factor be?

MR. SISK: This is Rob Sisk, Westinghouse. We're going to move on. The individual that would be most efficient on that is not really available today to go into the code detail.

CHAIRMAN BALLINGER: I'm just suspicious that this thing is completely dominated by an artificial --

MR. SISK: Understand.

CHAIRMAN BALLINGER: Set of transients.

MEMBER SKILLMAN: And you know, we know someone knows. We know that there's an individual that has this down to a third decimal place. We were just looking for it and we couldn't find it. And that's

why Ron asked the question.

MR. SISK: Understand, and we can only go to certain level today. But we want to get back to the extent that they could, and appreciate that. Thank you very much. So Mr. Kwon, let's move on to the 0.3 mils.

MR. KWON: Current thickness assumption of 0.3 mils. The current thickness comes from the corrosion model, yes, and this was assumed in the code model, in the model. Let me see, regular model.

CHAIRMAN BALLINGER: It can't really come from the corrosion model, can it? The crud thickness, that's not the same as oxide thickness. The crud thickness I thought came from measurements on rods from various reactor plants. Crud is an accumulation based on operating experience.

MR. SISK: Thank you for the patience, but I think we're going need to get the other. We'll look at this. We understand the comment, but we have no prepared responses today.

CHAIRMAN BALLINGER: Okay.

MR. SISK: So let's move on.

MR. KWON: Yeah, and the multiplier --

MR. SISK: Okay, this is --

CHAIRMAN BALLINGER: We're 0 for 3, is this

what you're saying?

MR. SISK: 0 for 2 so far.

MEMBER STETKAR: But even the '27 Yankees, batting 333 is not bad, so.

MR. SCHULTZ: One in three, right, one in three.

MR. KWON: And the model for load used 0.75. In the small group of data, in all data group, so in that case, CHOLO is better than the Zircaloy.

CHAIRMAN BALLINGER: Well, it better be.

MR. KWON: Yeah. But with many data accumulation, in the high burnup exceeding 50 kilowatt-days.

CHAIRMAN BALLINGER: Fifty or 59?

MR. KWON: More than 59.

CHAIRMAN BALLINGER: More than 59.

MR. KWON: Yeah.

CHAIRMAN BALLINGER: See the data, the data that I see, and I can, there's a plenty of papers which plot the oxide thickness versus burnup. Where you get the big advantage for ZIRLO is at high burn. No, I've got-- okay, all right. If we're going to say something, because I have a --

MR. SISK: I also want to caution this, I guess are we still closed?

CHAIRMAN BALLINGER: Oh, okay, we have to be careful then.

MR. SISK: Well, I think, I don't think we're ready for this. Let's just take it out. Yeah, three strikes, we're out.

CHAIRMAN BALLINGER: We're 0 for 3.

MR. SISK: So we're going to move Chapter 16 out.

CHAIRMAN BALLINGER: Good idea.

MR. SISK: Fourteen, going up to 14, I'm sorry, 14.1. O for 4. Ken.

UNIDENTIFIED SPEAKER: So M-5 does indeed.

UNIDENTIFIED SPEAKER: So this our factor of two different.

UNIDENTIFIED SPEAKER: So 0.92?

UNIDENTIFIED SPEAKER: But they showed data. So you know, in the US we have, EPRI has all these chemistry guidelines. But I don't know what they have there. So.

CHAIRMAN BALLINGER: Okay, I'm sorry.

MR. SISK: Okay, so this is Rob Sisk, Westinghouse. We're prepared now that we're going to begin the discussion on Chapter 14. I've introduced Mr. Sanwon Lee.

MR. LEE: Good afternoon, my name is Sanwon

Lee, and I work for KHNP as a technical manager of enterprise design of APR1400. Today I'd like to talk about Chapter 14 verification program.

This slide shows the overview of my presentation. And I will just briefly talk about the overview of Chapter 14 and technical topics and finalize with the current status.

Chapter 14 includes three sections. Today I will cover the Chapter 14.1 and 14.2. And the 14.3 ITAAC is to be discussed at future ACRS meeting. In Chapter 14.2, initial task program, most of the contents is Subsection 12, task description. It contains lateral system-based test program and integrity test program.

Test description consists of four phase. Phase one is the pro-operational test. And then geoloading and post-core hot functional testing. And initial criticality and low-power physics test. And finally we do some power ascension testing.

As of Rev 0, we submit the 178 individual test program. But during the RAI process, finally we've got a 199 test will be submitted at DCD Rev 2.

Summary of RAIs. We got 71 RAIs. And in page three, we got a open item of 12, 16 open items. But it was all resolved and right now we don't have

any open items now.

From this slide, I will briefly talk about several open items that is important in Chapter 16, or Chapter 14. Open item number one is the device that startup up the administrative manual in accordance with the SRP. So we advise the staff to incorporate into the SRP requirement.

And open item number two, some of the vibration monitoring tests. NRC require both, based on the required 1.2, but with some discussion. This is a monitoring system, so it's not a, for example, CVAP program. So it is related, but not directly related to the required 1.2.

And open item number three is natural circulation test as a book test. We designate Palo Verde as a prototype reactor of AP1400. So natural circulation test is not done as a book test.

And open item number six, radiation signal transmit, should be transmit to the emergency response data system. So we revised Chapter 11 and Chapter 12 because it's not a procedure-related issue, it is a design issue. So we modified Chapter 11 and 12.

And open item number nine, revised remote shutdown console test to verify manual control in the MCRs. So we revised the relative ITP, such as ESF

component control system test.

And open item number thirteen, radiation check source should be used to verify the radiation monitoring function. There are some calibrated, so sometimes calibrated sources used and sometimes radiation check sources used. But in the practical region, we, in the ITP process, we uses simulated, calibrated source. But in ITAAC, radiation check source will be used as a part of an ITAAC. So there is a result.

And finally, number sixteen, post-core, ex-core neutron flux monitoring systems is deleted as a post-quad test instead of it is performed in pre-operational testing period.

This slide shows the question when Phase 38 ACRS meeting, the question is that why the CVAP is not included as part of ITP. The answer is that APR1400 is classified as a non-prototype category one plant recording Palo Verde Nuclear Power Plant as a prototype plant.

In accordance with the required 1.2 vibration measure on the program can be omitted if the non-prototype category one reactor if the inspection program is fully implemented.

In APR1400 DCD Chapter 3.9, there is some

information about the inspection program and assessment program. So implementation of the vibration measurement program is not necessary in APR1400.

So this is final slide. Currently Chapter 14.1 and 14.2 are completed. And sixteen open items, there was this identified in Phase 3 is all resolved. And changes in Chapter 14.1 and .2, and markup, and during the response to the RAI will be revised in the revision with DCD left to February of this year. Thank you for your listen.

MEMBER BROWN: I just wanted to clarify a couple of things. Number one, you said ITAAC will still, they'll deferred. That's Section 14.3, so that'll come later, okay. But there were some items in the SER relative to response time testing. And it goes back, I'm trying to get back into the actual 14.2, which was Section 14.2.12.1.24, which is the PTS testing.

And between, I was trying to decipher what was going on, because there it says you're supposed to, to do time response, you're supposed to inject signals into the appropriate sensors or terminals and measure the elapsed time to achieve tripping of the circuit, trip circuit breakers, or to initiate an ESFAS signal. And it can be tested by overlapped testing

method.

And that was also mentioned in the SER. However, it was in a section that was only talking about the CPSC, the core protection -- no, CTCS, calculator system. Whereas it talked about a modular system in the SER. And I guess right now I'm kind of confused as to what's the difference between modular and overlapped. Does the modular apply to the regular trip part of this, or just the CPCS?

So the response time is kind of confusing to me in terms of how that's done. I have a number of comments on the ITAACs part of it, but that's, they're relative to Section 2.5 and Tier 1. And I guess if we do ITAACs later, I guess I ought to defer those questions. Am I correct on that?

CHAIRMAN BALLINGER: Yeah.

MEMBER BROWN: Okay. I hate that, I'll forget it by then. Okay, any, I guess maybe I ought to address this to the staff when we get to the staff section so that I can try to get a feel for what you're talking about? Okay.

MR. WARD: Yes, we'll do our best to answer it then.

MEMBER BROWN: Okay, let me -- there were also questions relative to, there's just single

statements relative to the WD, the watchdog timers in this same section, as well as a section on acceptance criteria. I guess I can't comment on the, acceptance criteria don't seem to see, have the same type of delineation or detail that they have in the Tier 1, Section 2.5. They're just statements that you verify.

And there are some differences between 2.5 or lack of actual reference to them, even. So I'll bring that up when I talk to you, I guess. It's a matter of things that are missing right now.

MR. WARD: Okay.

MEMBER BROWN: Okay? I'm sorry, that's all I had right now. I guess it's just a statement in there. I guess I'll have to get it clarified with the staff as where we go with that.

MEMBER KIRCHNER: I have a question on the C, the Comprehensive Vibration Assessment Program. Now if you're using, maybe I don't know the Palo Verde plant, but they don't have your accumulator design, do they, the APR1400 accumulators? So how much of a prototype is Palo Verde when you have a much different accumulator injection system for APR1400?

Something when we had reviewed last year, and questions about vibration, when that discharges, was something I remember us discussing at great length.

So will you test the accumulators in the pre -- I guess you would do that in the initial Phase 1 and measure the vibration?

MR. SISK: For my help, but to clarify for me, when you're talking about the accumulator, you're talking about the SIT tank?

MEMBER KIRCHNER: Yes, with the fluidic device.

MR. LEE: We have SIT with the fluidic device, but Palo Verde only have a SIT. But SIT is safety related component. CVAP test is for the vibration of the reactor vessel internals. And the normal operation component. So --

MEMBER KIRCHNER: I thought it included the RCS as well, our primary coolant system.

MR. LEE: Yeah, in -- for example, the reactor vessel and the main piping and fuel design is very closely related to the CVAP test. And it is very close to the Palo Verde and our reactor.

But the difference is, as you mentioned, the fluidic device is not installed in Palo Verde. But that might affect the vibration, but it might be very small or negligible effect can be. We assume that that's not a important design barriers to the CVAP vibration test.

MEMBER KIRCHNER: Yes, okay, thank you.

MEMBER CORRADINI: I guess just to make sure, I think what Walt was asking you is are you going to test it in this test sequence. That's what I thought you were going, in the initial testing.

MR. LEE: We do the SIT test as a different procedure. Yeah, but independent to the CVAP, we do some safety injection tank test. But measuring data is different. We have turn-down time and flow rate of high flow and low flow, but in accumulator, all the cases, they only have a flow rate. So data measurement is different for the Palo Verde and our reactors.

MEMBER KIRCHNER: Okay, thank you.

MEMBER BROWN: Excuse me, I did have one other comment. When I went through the objectives, this is in 14.2, that same section that I referenced, there is no objective in there. There's no objective in there to, no test or inspection verifies that there are no communications between divisions, other than those that exist between the function processor, the bias table processors, and the voting processors, which are generally referred to as LCL processors.

So there's no verification. The only thing you can do is check wiring diagrams to ensure there are no connections. And there's nothing in even

an inspection to do that within this particular section. It's also lacking in the ITAACs, but I mean it's lacking in this particular PTS test verification section, 14.2.

UNIDENTIFIED SPEAKER: Which would be different than your preoperational tests.

MEMBER BROWN: These are preoperational tests.

MR. SISK: This is Rob Sisk. I don't think we have a comment on that right now, Charlie.

MEMBER BROWN: Okay, I'm just saying it's an observation.

MR. SISK: We'll take a look.

MEMBER BROWN: It's a lack right now, Chapter 14 doesn't have anything that verifies communications independence in that particular section. And I presume that's the section where it should go, based on what I saw. Even though you refer to ITAACs later in this document that are in Tier 1.

MR. SISK: Thank you.

CHAIRMAN BALLINGER: Switch out again.

MS. FERGUSON: Good afternoon, I'm Ashley Ferguson. I'm representing the Quality Assurance Vendor Inspection Branch, and doing the presentation on Chapters 14.1 and 14.2., the staff's review.

So Tanny was the project manager. And

myself along with 32 other technical, 38 --

UNIDENTIFIED SPEAKER: Are you actually qualified to --

MEMBER POWERS: I was actually going to ask that. We're very suspect of him.

CHAIRMAN BALLINGER: He has a history.

(Laughter.)

MS. FERGUSON: Okay, so I performed a review of Chapters 14.1 and .2, along with 38 other technical review staffs from the NRC. So in this presentation, I will discuss some follow-up items regarding prototype plants, specifically NuScale's reference of Palo Verde Unit 1 as the prototype plant in regards to performing vibration and natural circulations tests.

Additionally, I will discuss the staff's conclusion of the review of Sections 14.1 and 14.2, as well as a closeout of the 16 open items during the Phase 4 review. So I won't spend a lot time on the closeout of those 16 open items, just because KHNP covered all of those in their presentation.

MEMBER BROWN: With the exception of the one I asked about.

(Laughter.)

MS. FERGUSON: Okay. So there was some

discussion during the last of Phase 3 ACRS meeting regarding the staff's position on allowing foreign plants to be referenced as a prototype plant for US design certification. So currently there is no formal documented NRC position regarding the use of foreign data when referencing domestic licensing applications.

However, in regards to the initial test program, the staff has determined that it is acceptable to reference a foreign plant as a prototype plant, provided that the applicant can demonstrate that the quality assurance program for construction and performance of the initial test program is consistent with the applicant's approved quality assurance program.

And so this question was raised in regards to performing vibration and natural circulation tests. And so specifically, for the comprehensive vibration analysis program as discussed in Reg. Guide 1.20, it states that if a valid prototype CVAP was conducted on a reactor outside of the United States, the details and results of the program would need to be included in the application related to the non-prototype plant. And it has to of course meet the criteria in the reg guide.

So there was a question asked in regards

to the analysis done for the dimensions of the APR1400 in Palo Verde Unit 1, in regards to the CVAP program. And so the particular table that was mentioned was DCD Table 1.3. However, the comparison of Palo Verde Unit 1 data for the reactor internals is located in DCD Tier 2, Tables 3.9-16 and 3.9-17.

So for the review of Section 14.1, the staff concluded that information provided adequately addressed the specific information to be included in the ITP and is acceptable.

So the next couple of slides go over the open items. There were 16 of them. All 16 have been posed. Nine, or eight of those, I'm sorry, remain confirmatory items. So we can kind of go through these. Mr. Brown, which specific one did you want to?

MEMBER BROWN: Excuse me, are you done with everything else? You zipped right through.

MS. FERGUSON: Yeah, which specific open item?

MEMBER BROWN: It is 198-8208, I think. Let me look again.

MS. FERGUSON: Okay.

MEMBER BROWN: 198-82082, question 14.02-21.

MS. FERGUSON: So that's open item number

seven.

MEMBER BROWN: And your part of the SER is page 14-39 and 40. And so it begins with 14.2.12.124 with plant protection system test. And then comma 14.212.1.138 CPCS system. And then it seems to be all jumbled, the discussion. I can't segregate it.

It implies, you talk about the CPCS testing and that you can't do a beginning to end, insert a signal, and test it, because of the large number of sensors you have. I'm trying to remember why, but I think that's where you agglomerate a whole bunch of in-core sensors.

And then you do an analysis if there's an algorithm that calculates stuff. And how you input data into one sensor and run a time response test, I can kind of maybe understand that. And you have to do something on an analysis basis, and you talk about modular versus, it's on page 39 of your thing here.

You all asked the question why is overlap testing required. The response time test should include each safety system from sensor to actuated equipment as practical in a single test. Where it's not practical, you can do it piecemeal and add them up.

And their answer was they don't want to

do a response time testing in a single test because it would be more efficient and beneficial for maintenance purposes to have a modular testing method rather than a single test. And I presume all that applied to the CPCS, not to the rest of the PPS system. But it's all jumbled up.

MS. FERGUSON: Okay, so your question is the response, the answer on the response time, does that apply to the other INC systems outside of the CPCPS?

MEMBER BROWN: Yeah, the lead-in paragraph is not, because it, the first part of the lead-in talks about Subsection .24. And then as you continue, you talk about 138, and you mix the stuff up. The rest of the PPS system can easily be tested with an input to output. So what we're, I don't, what we're using a different methodology for is not clear.

MS. FERGUSON: Okay.

MEMBER BROWN: I wasn't able to get a hold of, I don't have the RAI on that one, so I was unable to see any of the details. But that's my question on that.

MS. FERGUSON: Okay, so I'm going to take your question back. The reviewer is not present at the moment. But from what was included in the safety evaluation, we identified that they didn't include

testing for the core protection calculator system, and they proposed to include redundancy in independents, specifically for the CPCS.

So as far as the other systems on the PPS, I will have to take that back.

MR. CHOI: Could I answer? My name is Woongsoek Choi, KEPCO E&C SC Engineer. So we provided RAI response to answer for the question. So CPCS response time testing is performed by similar method with as a PPS modular.

I think the modular terminology cause a little confusion. So CPC consists of CPP processor, CH processor, and CPC processor. So the processor phase to response time testing is performed.

So our testing overall diagram in Chapter 7.2 shows the PPS testing diagram. We will include with all the included CPC. So for likely is PPS. So the response time testing is performed by testing injection signal injecting. And then to verify the result on the output.

MEMBER BROWN: That's for the CPCS?

MR. CHOI: Yeah, right.

MEMBER BROWN: Okay, so you're saying that you do it the same way that you do the rest of the PPS system.

MR. CHOI: Right.

MEMBER BROWN: There was very little definition. I didn't see the RAI, so I couldn't find it. So I have no problem with looking at that. But I also, in reading your SER, it doesn't come across as there's no discussion of the PTS testing. It's all lumped together, so it gets confusing as to what applies, is there a difference or not.

MS. FERGUSON: Okay.

MEMBER BROWN: I'm just trying to make sure we understand how that is done. Okay?

MS. FERGUSON: Okay.

MEMBER BROWN: Now the other, I guess the other question I had on this is that, and this is just from looking at the ITAACs, as well as this particular section talks about testing of the watchdog timer. When I looked later in the Tier 1 stuff, it was not clear. They say -- it was not clear how that, it's not even mentioned in the ITAACs, that the watchdog timer is tested.

So it was not, and how you do that should have at least, there should have been some type of reference or acceptance criteria in this thing. And I presume it's not in this RAI relative to that either.

MS. FERGUSON: No, it isn't.

MEMBER BROWN: That's for processor lockup. Okay. The next question or comment I had, there's no, in this particular let me find the, where's the slide? Oh. There is no -- oh, here it is.

Right now there is, included in this objectives here, there are no tests to verify, no tests or inspections that verify that there are no communications between the divisions that exist, other than the function processor trip data, which is an on-off data, to other division voting processors, which you have to have to be able to vote. But that should be the only communication.

And there's no verification of communication independence in this section, 14.2.12.1.24 rather. Which would, there's no discussion of it anywhere relative to that.

MS. FERGUSON: Take that back as well.

MR. CHOI: So can I answer?

MEMBER BROWN: Sure.

MR. CHOI: For your concern. My name is Woongsoek Choi, KEPCO E&C. So your second question is about watchdog timer. So watchdog timer was added in ITAAC. That was integrated with entire common-cure watchdog timer issue. So ITAAC requires that the watchdog timer shall not be dependent on the internal

CPU. So --

MEMBER BROWN: Oh, I understand that. I've seen your other piece of, the data that you all, you know, the paper that you all put out. If you look at, staying out of the ITAAC, the watchdog timer is, if you added it to the ITAAC, that's fine. I don't have a version of the ITAAC that shows that.

I'm looking at Rev. 1 of the Chapter 14. So I, okay, if that's, if you've done something with that, I guess we'll see that at some point.

MR. CHOI: Okay.

MEMBER BROWN: The other question relative to communication independence, by the way, in Rev. 1, the watchdog timer is mentioned, but it's not mentioned in the ITAACs. It wasn't in Rev. 1, so that's all I'm talking about there.

The communication independence is talked about in the ITAACs, but it refers to only basic of the communication within a processor, like the bias table process talks about the processing and the communication part, and with the dual port RAM. It doesn't talk about sending data and not doing it in the processing part but only sending it to the voting units.

And you make sure there's no other, you

know, intercommunications between the divisions, other than that particular communication. It's not talked about either in the 14.2 chapter or that particular feature in the ITAACs, so. Or at least in the Rev. 1 ITAACs.

MR. CHOI: Chapter 14.2.212.1.24, PPS include the testing requirement for Y interface between other systems and our safety assessment technical report.

MEMBER BROWN: Are you talking about Section 1.6?

MR. CHOI: 14.2.12.1.12 -- 24.

MEMBER BROWN: Yeah.

MR. CHOI: The section include --

MEMBER BROWN: Section which? I'm looking at it and I couldn't find it in the objective section. It talks about testing functions between the, whatever the test, the maintenance test processor and the interface test processor and the interface. But not, it doesn't talk about communications between divisions.

At least, I couldn't interpret the words to make it come out that way. Under the objectives.

MR. CHOI: I understood your comment. So the communication independence shall be added in the

section, in Chapter 14.

MEMBER BROWN: Okay.

MR. CHOI: Okay.

MEMBER BROWN: All right. And then fundamentally, that's not something you test, unless I'm wrong, it's not something you can test for. You have to make sure there's no connections between the divisions, other than the signal that goes from a processing bias table unit to a voting unit.

Other than that, there should be no communications, other than when you're in the test mode. I think I have -- I think --

MR. CHOI: I think objective 1.7 check to verify the validity of using manual testing. That is testing for, test interface. And the communication independence is not described in detail in Chapter 14.

MEMBER BROWN: That's right.

MR. CHOI: However, in this section describe all the interface, and our technical report, safety ISTR, describe about communication independence in detail.

MEMBER BROWN: I understand that, it's just that we're not verifying that the design meets those requirements that are specified in the safety technical report. And they're not, that purpose of

this, all the requirements that are listed in there, a good, most of them are listed right in here that you're going to verify those at some point in the initial test program. So that's where it's missing right now.

MR. CHOI: Thank you for your comments, and we will consider them.

MEMBER BROWN: Okay, thank you.

CHAIRMAN BALLINGER: I'm actually not sure where we are.

MEMBER BROWN: I'm finished. Does that confirm where we are?

MS. FERGUSON: We jumped to open item number seven. As I said earlier, the other open items were addressed during KHNP's presentation. So we can now jump to the last slide.

So the staff has determined that all of the open items associated with Sections 14.1 and 14.2 have been adequately addressed and resolved.

And the staff includes that the information presented in the DCD, pending the confirmation of the remaining eight confirmatory items that the applicant has determined compliance with NRC regulations and guidance. So that concludes this presentation. Are there any further questions?

CHAIRMAN BALLINGER: No questions?

MEMBER BROWN: Only to make sure that, I'm still a little unclear on the response time part of it.

MS. FERGUSON: Okay.

MEMBER BROWN: It'd be nice if that was clarified in the SER.

MS. FERGUSON: Okay.

MEMBER BROWN: That response time is done in a manner in which we, your question asked that ought to be done in. Or at least the, so that all these words about modular and add them up and beginning to end don't get all messed up, that's all.

MS. FERGUSON: Right.

MEMBER BROWN: I don't see anything for KHNP to do, other than you all to make sure the SER is clear.

MS. FERGUSON: Will do.

CHAIRMAN BALLINGER: Again, again? Okay, let's take a 15 minute recess. Long overdue.

(Whereupon, the above-entitled matter went off the record at 3:30 p.m. and resumed at 3:45 p.m.)

CHAIRMAN BALLINGER: Okay, we're back in session. So we're up to chapter, yes, 16.

MR. SISK: Without any further delay, I'm going to pass it over to Mr. Sanwon Lee.

MR. LEE: Hello, my name is Sanwon Lee. I will talk about the Chapter 16 technical specification.

CHAIRMAN BALLINGER: Can you move that a little closer. I can't --

MR. LEE: Yes. Chapter 16, technical specification. This is the contents, first overview of the Chapter 16. And I will talk about the major open items and finalize with the summary.

This is overview of Chapter 16. APR1400 technical specifications were developed based on the standard tech spec for formerly CE plant. And there are some differences between the APR1400 tech spec and the standard tech spec, mainly the unique design feature of APR1400 including the RCS system and safety injection system, IRWST and aux feedwater, et cetera.

And this kind of deviation was summarized in the Deviation Report between NUREG-1432 and APR1400. That one was submitted 2015, December.

There's a section or overview of 16. Our main section is the Section 3, our limiting condition for operation and the surveillance requirement for every nine sub-sections.

Basically, in Phase 3, there are 223 question was raised, and there are lots of sub-question

just included. So actually, there are over --- lots of questions were raised. And in Phase 3, there are 135 open items were issued.

And then, we have some communication with the NRC staff, technical staff. And right now, all the item was reserved, and there is no -- no open item was remained currently.

So open item was 135. So lots of open items related to the expression, and some expression was some --- some exact expression on the technical specifications. So I will now talk about major technical issues related to the open items.

So first one is disposition of the NRC approved the TSTF report. The issues that --- that's on TSTF report, something is issued before the standard tech spec was issued. And something is issued after the TSTF was published.

So all NRC approved the TSTF Travelers, including those approved since NUREG-1432 was fully reviewed. And we summarized that something is included, something is not included in our tech spec. So we summarized that table and some rationales and just reflected on the Deviation Report. And right now, it's reserved.

Second thing is limiting condition for

operation selection criteria. Basically, it has -- 10 CFR 50.36 has four different category for the LCO selection criteria. But the issue is how to select the LCO for the APR1400.

So we systematically evaluate the LCO selection criteria that is related to the other chapters which are Chapter 5, 6, 7, 15, and 19. So we have compared all of that and some with, oh, a different a table for each LCO selection criteria, so met the LCO selection criteria.

And as a result, we add some LCO that is not reflected in previously DCD. So, for example, CPS aux-three function and charging flow is included with the LCO. And right now, it is also reserved.

And the third one is safety injection system diagonally operable is issued during the Phase 3 ACRS meeting also. The full clarity, the LCO condition is two separate, two different loads. And the diagonal and Train 1 and 3, well, Train 2 and 4 is identical. But we showed two different expression at the same time to remove the full clarity of the operator.

Finally, auxiliary feedwater system for conventional NRC plant and APR1400 is --- that's a different design. Because conventional NRC plant has

two motor-driven pumps and one turbine-driven pump. But we have two motor-driven and two turbine-driven. And water source is different.

So this system is not directly compared to the conventional NRC plant auxiliary feedwater system. So we communicate with the NRC staff on which one is the appropriate LCO and accomplish a time of our plant. And this was reflected, so current status is it is also resolved.

This final slide, all RAIs on Chapter 16 were resolved and all responses were decided to be acceptable. And the DCD Rev. 2 will be published in February of 2018. And also the Deviation Report between standard tech spec and APR1400 tech spec is being updated based on the DCD Rev. 2 and will be submitted at the DCD submission. Thank you for your listening.

CHAIRMAN BALLINGER: Questions?

(No audible response)

CHAIRMAN BALLINGER: Thank you. The staff ready to go?

MR. HARBUCK: My name is Craig Harbuck. I work in the technical specifications branch in NRR. And I'm one of the principal reviewers for the tech specs. And when we were here for the SER with open

items, we discussed at some length all the different issues that we were discussing with the Applicant.

And we came up with a round number of identifying around 135 issues among the 223 questions. And so it's been a long exercise in trying to resolve all of those. But fortunately, we've done that. And what I would like to do is go over those issues which are technical.

From a tech spec reviewer standpoint, clarity is important, so some of the issues we had we're trying to achieve a level of clarity and unambiguity that, if you don't settle now, it can become more difficult to fix at later times, such as through license amendments, or exemptions, that sort of thing. It's better to fix it now. And so that was our motivation.

And I think we've come to a very high quality set of tech specs. Now, project managers are Bill Ward and Jessica Umana, who I guess could not be here.

Slide 3 lists all the reviewers. This slide is identical to what we showed you last March. So there were a lot of people who had issues that overlapped into the tech spec area. And we appreciate their efforts.

Okay, so going on to Slide 4, and there's

basically six slides listing these items, and I'm going to speak to each one. So the first area where we had some issues were in defined terms. They had proposed a number of terms which we thought were not needed, so they were withdrawn.

Some definitions were revised based on the design analysis and terminology in APR1400. Some of the definitions were related to specific water levels during shutdown conditions. And we generally just replaced those definitions by using the actual elevation that corresponded to it.

The next big issue was the shutdown risk mitigation. And we've concluded that an action to raise a water level to above about three feet below the reactor vessel flange is an acceptable and adequate action in MODEs 5 and 6 following a loss of shutdown coolant, considering that LCO 3.5.3 on safety injection requires two operable SI trains, and because this level is consistent with the guidance in Generic Letter 8817 regarding shutdown risk.

Specific LCOs I would like to mention related to this is LCO 3.4.8, RCS loops, MODE 5 with loops not filled. This LCO requires two shutdown cooling trains, and one containment spray pump to be operable, and one shutdown cooling train to be in

operation.

This is a lot of requirements for mitigating an event if you're going to lose your shutdown coolant. So the one thing that was not clear between this LCO and the one preceding it in MODE 5 was what constitutes loops not filled.

And so we discussed this with the Applicant, and we finally came to the conclusion that, at about four feet above the reactor vessel flange when you're draining down the pressurizer, you start to form voids in the top of the steam generator tubes. And as you lower level more you get more voids in more of the tubes.

And this interferes with natural circulation flow which, when you're in the loops filled condition, you're supposed to be able to use secondary heat sink with natural circulation.

So since the discussions that were originally provided seemed to imply that you could go down to the top of the hot leg, in terms of draining down the surge line, that did not seem to address this issue.

So we did come up with it so that the base is now clearly explained, what constitutes entering a loops not filled condition and also what you have

to do to go back to the loops filled condition. And that's important, because you need to know when these requirements apply.

And that's an improvement over what's in the current tech specs for most PWRs which don't really discuss this very much. And in contrast, the AP 1000 simply says a reactor coolant system intact or not intact. That's how it separates these two different MODE 5 conditions.

MEMBER SKILLMAN: Craig, how is that addressed when the fuel has been removed? At 241 fuel assemblies, if there's a reason --

MR. HARBUCK: You mean if you don't have any fuel in the ---

MEMBER SKILLMAN: Correct. Is there a caveat that says this only applies when there's ---

MR. HARBUCK: There's no LCO that applies to the RCS when you've removed all the fuel.

MEMBER SKILLMAN: Are those words in there?

MR. HARBUCK: Well, it's contained in the applicability requirements.

MEMBER SKILLMAN: But those words are in there, if there's no fuel these don't apply?

MR. HARBUCK: Well, there's no definition

for totally, you know, vessel on fuel. MODE 6 is you have any fuel in the vessel with the head detentioned, okay, and so if there's no fuel then you're no longer in a defined MODE.

MEMBER SKILLMAN: Is that defined?

MR. HARBUCK: Only to the extent that I've just explained it.

MEMBER SKILLMAN: Wait a minute, wait a minute.

MR. HARBUCK: I'm not sure what you're asking ---

(Simultaneous speaking)

MEMBER SKILLMAN: Hundreds and hundreds of hours in a control room with tech spec, and here we sit. We're going to do some steam generator work. We've chosen to de-fuel. And I've got these tech specs. And we all look around and say these don't apply. And then I have an inspector come in and say, well, I think you're right. They don't apply, but that's the way they're written no matter where your fuel is.

So my only point is, with your discussion of clarity in terms, it seems that there ought to be a term that says if fuel's not in the vessel these don't apply. And there are conditions where you do, in fact,

de-fuel.

MR. HARBUCK: There are requirements for the spent fuel pool.

MEMBER SKILLMAN: I'm not talking about the spent fuel pool.

MR. HARBUCK: And there's requirements when you're removing fuel, irradiated fuel assemblies. So at all times there's going to be some requirements that address protecting the fuel.

MEMBER SKILLMAN: Well, certainly. I understand that.

MR. HARBUCK: Right. And so I'm not sure I understand your question.

MEMBER SKILLMAN: The point I'm making is you made a very strong point of making clarification of terms. And I'm asking you for, when fuel has been removed from the reactor vessel, if it is clear to the operations personnel that these, say these three bullets right here, are non-applicable. Is there something that lets them point to the tech specs and say these don't apply because my fuel is over in the spent fuel pool?

MR. HARBUCK: Well, if your vessel's empty, you're not in MODE 5. And that's what LCO 3.4.8 addresses.

MEMBER SKILLMAN: And is it clear?

MR. HARBUCK: Yes, MODE 5 with reduced inventory is what we're addressing here.

MEMBER SKILLMAN: Okay.

MR. HARBUCK: And the next one addresses MODE 6 with reduced inventory, okay, but also MODE 5 with reduced inventory in terms of an extra --- an additional requirement that's not in the standard for having containment closure when you're in this condition, or the ability to have your purge system automatically close, or if you lose shutdown coolant. So the provisions that have been added to the tech specs, compared to the standard to address shutdown risk, are a plus for this application.

MEMBER SKILLMAN: Okay.

MR. HARBUCK: And I don't --- beyond this --- Oh, I just wanted to point out that this is one of the issues we had. And these are some of the details of how these requirements apply.

MEMBER SKILLMAN: Okay.

MR. HARBUCK: Okay, next slide. There's a pretty thorough set of requirements that address the boron dilution event. The basic difference between these requirements is there's one group that requires demineralized water sources or unborated water sources

to be isolated. Therefore, you preclude the event.

And the other is to either have an alarm to give adequate warning to the operator or some other notification to let them know that there's something going on with reactivity.

The reason for having LCOs, and one of the new ones is LCO 3.1.2, is that if you don't have adequate mixing then your instrumentation to detect a change in the activity would not necessarily detect it. And so instead of trying to provide some analysis to support that particular situation, we have an LCO that says if your reactor coolant pumps are all idle, then we're going conclude a dilution event.

So the next item is going back to LCO 3.6.7. This is modeled on what normally has been an LCO in the refueling section. And in the refueling LCO, which is 3.9.3, there's a provision that says you can either isolate your purge system or you can have an operable means of isolating it. And that could mean automatic or manual.

The way it's interpreted in these specifications is that it includes the automatic. But the difference is, in what's required during re-fueling, is that the applicability is during movement of irradiated fuel or during core alterations.

And in order to do either of those, LCO 3.9.6 requires the level to be 23 feet above the flange, reactor vessel flange.

In 3.6.7, it addresses the situation where you're in MODE 5 with the loops not filled or MODE 6 with a level below 23 feet above the flange. And we just collectively call this, you know, low inventory condition or reduced inventory condition.

And what you're concerned about there is being able to mitigate a loss of shutdown cooling, since a loss of shutdown cooling could result in a boiling and perhaps, if the RCS is open, it could have steaming into containment.

You're not allowed to use a provision that is allowed in 3.9.3 which is designed just to mitigate a fuel handling accident where the principle mitigative feature is the water in which the fuel assembly has been damaged. The activity release gets reduced by passing through the water. And you don't have a threat of a pressurization or steam forming in the containment.

And so you can get by with what's termed an equivalent isolation method. And that has to be something the staff has pre-approved. And that's explained in the bases.

The Chapter 19 reviewers had based some

of their findings on the adequacy of the shutdown risk assessment on being able to mitigate an event that resulted in steaming into containment. And they wanted to make sure that you didn't have this equivalent method option. And so that's been removed, and we've made this distinction. So that was something that came out just right at the end of the review.

So, let's see. Okay, next slide. We were previously talking about core protection calculator system. And there's an LCO 3.3.3. on the core element assembly calculators. These take -- every control rod has two rod position indications, and they feed into some processors which are positioned processors for the control rods.

And there's redundancies built in and what have you, but they end up providing core element assembly position calculators which are input into the CPC calculations to provide penalty factors in the output of the CPCs regarding the low DNBR or high linear power density trips.

And so this LCO is provided to address what do you do if you have an invalid signal coming from your CEACs. Like Palo Verde, the APR1400 has two CEACs per channel of CPCs. And the older designs you had just two CEAC computers that supported all four

channels.

So the action requirements that we developed are largely based on what had been established for Palo Verde with some slight enhancements to clarify what we think is the best practice depending upon how many CPC channels are affected.

Essentially what it does, it says if the CEAC is inoperable, you can either implement manual measures that ensure the CEACs are getting appropriate inputs for that condition, and you're doing manual verifications of oppositions. And that's a kind of repetitive thing that you do to justify continuing to operate with this downed piece of equipment.

Or alternatively you can say, well, this whole channel of LPD high and DNBR low is out of service. So I'm going to consider them to be inoperable and enter my instrumentation LCO. And if it's just one channel affected, I have the option of either putting that instrument channel in trip or bypass, okay.

If two channels were affected, then I would have the option of putting one in trip and one in bypass. This still leaves adequate protected capability from the automatic trip system for these two functions. But you don't have as much margin to an inadvertent trip occurring. So it may or may not be advisable to

operate for any length of time. But generally, if you've just got one channel affected, it's something that you can possibly live with.

Now, the thing that we wanted to make clear was that once you get, you know, multiple channels affected, that it's probably better just to not declare your CPC channels inoperable. And it's better just to take the actions that are provided. And since they're manual and kind of onerous, probably would provide good incentive to get these things fixed right away. So we'll make clear that's what we would prefer to do.

The other point was that -- and this is not something that's very clear in the tech specs, because we don't really have this arrangement anywhere else. But if the action said declare the CPC inoperable, then causes you to enter the instrumentation spec, what if I had another CEAC go out, or something changed, and so it looked like it would be advantageous for me to un-declare that channel inoperable and simply take those manual actions.

And since that involves saying that we just don't have any real rules for the tech specs, we clarified in the bases that the preference is --- or the intent is that, until you've restored the CEAC that

sent you to the instrumentation LCO in the first place, you're not going to be able to undo that declaration of the operability. And that's something that the Applicant agreed to. And so that's what we decided.

Again, this is over and above what's in the Palo Verde explanations for their very similar LCO actions. But we think this is an improvement and needed clarification.

Instrumentation testing, we looked at the list of testing that's provided in Chapter 7, Section 72 and 73, and could not figure out how they correspond with the instrument test in the tech specs. And so we asked them to help us do that.

In the process of trying to get this clarification, we ended up being able to make such a correlation. We were able to improve an existing figure in Chapter 7, Figure 72-11, and add a new figure, 7.3-24.

And where before we had tried to address both RPS and SFAS, now the 72 figure addresses it, just the RPS logic testing, and shows overlap and indicates the names of all the tests that are described in the chapter. And then same thing for the SFAS. So we've made an improvement. So where we're trying to clarify how we implement the tech specs, we resulted in

improving Chapter 7 as well.

Let's see. There is an --- for the SFAS, for its actuation logic, you have the coincidence logic, initiation logic, actuation logic, and then there's the name of the function.

Well, for these logics, there's testing. And they're covered by an LCO, 3.6, yes, LCO 3.3.6 covers the logic for SFAS. And there's a surveillance requirement which is focused on testing the actuated devices. And there's a note that says that you'll test this on a staggered test basis by testing groups of actuated components associated with Channels A, and C, and B, and D. And we found the language of that note to be a bit confusing and not very clear.

And we were able to verify that, how the equipment is, these actuated devices are arranged into subgroups such that when they're tested it doesn't cause any unusual or unexpected plant transient. We were able to verify that that's all been adequately determined. So that was the result of that exercise.

Slide Number 4, or seven, I guess, seven, okay. Auxiliary feed water system, you heard previously that there were issues with auxiliary feed. And I'll just briefly talk about some of the highlights of that, how that came out.

In the standard tech specs, and tech specs in general, we typically allow 72 hours to correct a loss of redundancy situation. In the AFW system, this would correspond to having one steam generator with one of its AFW trains inoperable or both steam generators with one AFW train inoperable.

The event that you're thinking about when you're establishing the times to, you know, where you'd have loss of redundancy or not, is where you have one steam generator with its AFW pumps affected by an inoperable train. And then the other generator is the one that has the accident, so it's not available for AFW.

So if you have just one generator affected, you still have capability even with that kind of a failure. If you have one of the two trains for each generator affected, you still have capability for that failure. But if you have one steam generator with both of its trains out, and you lose the other generator, then you have no aux feedwater.

So we do sometimes provide time for a potential loss of function in cases where the scenario for which the condition would mean not having the function, because the event contributed to not having it. Sometimes we give time for that.

The CE standard incorporates TSTF that we had where, if you had lost one of your steam supplies to your auxiliary feedwater pump, your turbine driven pump, that you could get some time provided the decay heat load wasn't that great, or it's not starting up or something. And you were going to get seven days for that. And originally it was proposed by the Applicant that they could get that too, even though the systems don't really compare very well.

And so --- but that was the case that I just mentioned where there's a small, not that likely set of circumstances for which that action could result in you not having a function. But we gave it a little bit more time for that. I think for that particular case, it also involved failure of another motor driven pump.

Okay. So what we did was that we established Condition C where it was one steam generator with two trains inoperable. And because this could lead to a loss of function, we figured a time shorter than 72 hours would be appropriate. Whereas, if you don't have that event, then you would have the whole --- you wouldn't have loss of redundancy.

So we came up deterministically with a 24-hour time. And we put it in brackets indicating

it's a COL item. And we believe that the 24-hour time, deterministically, was acceptable, because this event we're concerned about would have a low probability of occurrence.

And you do have the availability of safety injection and then a water relief path through the pilot operated safety relief valves to, one, to remove decay heat. So with that capability there, 24 hours is adjudged to be acceptable.

Now, we also put the 72 hours that we allowed for the other two conditions where you just have one pump out for each generator or just one pump for one generator. We allow 72 hours for that, but we also put in brackets indicating that if, in both cases, indicating that if you can do a risk evaluation of a longer time, and you can justify it to the staff for a COL application, then you would be able to do that. And so that's how we resolved that issue.

The other issue related to aux feedwater was allowing seven days for one of the water supplies to be inoperable and, of course, the water tank to be inoperable for a number of reasons.

But from the tech spec point of view, we look for the most severe reason. And if you have no flow path from your tank, it's obstructed in some way,

then the ability to open a valve between the bottoms of the tanks to the other divisions is not going to really help you in the division each tank is blocked.

And so we were having a hard time understanding how we could say you have seven days if you're saying that you have to verify availability of the other tank.

But then, we came to understand that each division in aux feedwater has a condensate storage tank. It's not as big as the regular tank, but it has a pretty good size volume that all you have to do is open up a manual valve, and you have access to that water through the suction of the pumps in that division.

So we figured seven days would be okay as long as you verified the availability of this non-safety tank. And this is consistent with the standard which is based on having one tank only for both trains or both divisions. And you simply verify an unspecified back up water source. So that's how we agreed to keep the seven days for having an operable tank, again, LCO 3.7.6.

CHAIRMAN BALLINGER: Yes?

MEMBER KIRCHNER: Can I ask a question just ---

CHAIRMAN BALLINGER: Okay.

MEMBER KIRCHNER: Philosophically, how do you approach these tech specs? I know you just talked us through a few scenarios. And then you come up with round numbers which feel good and probably bracket the time that a deterministic calculation would say you've got two low a level, or you've got unacceptable fuel condition, or you're got whatever the upset is. But it seems like it always comes back to 24, 72, seven days. Is this just a --

MR. HARBUCK: This has been the practice of tech specs since their inception. We have these standard times. And I would hazard a guess that there's reasons for that. I'm don't know if I go into all of them, but they have to be based on perceptions of what's an acceptable period to be vulnerable to a single failure --

MEMBER KIRCHNER In this construction of tech specs, then there's no risk informed, so to speak ---

MR. HARBUCK: Right.

MEMBER KIRCHNER --- quantitative ---

MR. HARBUCK: There are number of ---

MEMBER KIRCHNER --- assessment that would allow you -- I'm not recommending, by the way, you go to 12.5 hours, and 50 hours, and so on. So in this

case, where you've made these decisions, these were not based on risk informed?

MR. HARBUCK: No. No, no they weren't. They're based on --

MEMBER KIRCHNER Thank you.

MR. HARBUCK: -- the deterministic.

MEMBER STETKAR: I wouldn't call it --- Craig, be careful.

MR. HARBUCK: Okay.

MEMBER STETKAR: They were made up 40 years ago by people saying, well, we could probably get it fixed in seven days.

MR. HARBUCK: Yes.

MEMBER STETKAR: It wasn't deterministic. There was no technical basis whatsoever. They are simply historic numbers that people have used. And if you want to differ with that, I'd be really thrilled to hear where the basis is. There isn't any.

MR. HARBUCK: No, I sense that.

MEMBER STETKAR: They're just made up.

MR. HARBUCK: I think over the years people have come up with wishful thinking reasons for why these are okay from a technical perspective.

MEMBER STETKAR: The problem is we've listened now to half an hour of, well, this ought to

be 12. And this ought to be 24. That's just saying this ought to be red, or it ought to be purple. Because we've always used purple for this condition. There's no basis for it.

This whole notion of, well, we looked at this plant design, and it's different from anything else. But we're going to try to force fit it to things that people have used in the past.

I've seen plants that have two trains of auxiliary feedwater. Your whole notion of, gee, if we have one steam generator not available, and the other steam generator gets into a problem, you don't think about that stuff for other plants --

MR. HARBUCK: Well, that's because --

MEMBER STETKAR: -- that are currently operating, do you?

MR. HARBUCK: Because both pumps can feed both steam generators.

MEMBER STETKAR: Not all plants.

MR. HARBUCK: But you're right, there must be some out there.

MEMBER STETKAR: There must be some.

MR. HARBUCK: There must be some. I know that ANO Unit 1 didn't originally have it.

MEMBER STETKAR: Right.

MR. HARBUCK: But they modified their system to do so.

MEMBER STETKAR: But the point is that you spend a lot of time trying to force fit people into a mold that has had no technical basis for it. And that's why people want the option to go to the new risk-informed tech specs that are tailored to their plant design. They don't come up with 12.273 hours. Because, you know, that doesn't make sense to try to get something done in a day.

MR. HARBUCK: Well, as you can see, what we've done here is try to stick with numbers that are consistent with what we've deterministically ---

MEMBER STETKAR: Don't say deterministically. You have traditionally based on the accepted story involved. It's not deterministically. There's no deterministic basis.

MR. HARBUCK: We say we follow precedent.

MEMBER STETKAR: Precedent would be a good word.

MEMBER KIRCHNER So, yes, I wanted to test that then. So if the Applicant in this case, KHNP and company, have put extra systems in and such, do you find that you're changing the time window that you're allotting them? Or do you just fall back to what has

been precedent?

MR. HARBUCK: Well, our general approach is to try and approve what is consistent with the standard, since that is something that we have found acceptable. And one could argue with the basis for that if you wanted to, I suppose.

But if the system is designed with a certain capability and a certain lack of flexibility, as this system is, you're kind of limited in what you can allow, given the conventions for thinking about these things and the need to be able to minimize how long you're going with potentially not having a function.

MEMBER KIRCHNER Maybe a different way to ask my question is that, as a result of your review of tech specs, and we're going to hear about human factor engineering, I assume that factors into response times to fix equipment and such, to make decisions on time windows.

Are there any major changes in the tech specs for this plant versus a Palo Verde or the others? Or are you finding you're falling back on that precedent from that ---

(Simultaneous speaking)

MR. HARBUCK: Well, Palo Verde has the standard tech specs.

MEMBER KIRCHNER Yes.

MR. HARBUCK: I believe they were licensed with the old standards, and then they adopted the CE standard, keeping whatever, more flexibility, probably, that they already had, which was allowed. And therefore, by comparing and, in part, reviewing this application against the standard, I think we're fairly consistent. For those systems that are the same, we're consistent.

Where this plant differs is in the addition of these other LCOs because of deficiencies. And there are now evaluation boron dilution event with no reactor coolant pumps running, or inadequate mixing, or because they are choosing to provide additional margins of conditions of LCO, the conditions to address shutdown risk. Those we have to look at separately.

But typically, the actions that we come up with are consistent with what we do. You know, each mode has its own set of places you can go to to try to minimize the potential hazards associated with being in the condition. So I wouldn't say there's any major differences with the existing CE ---

MEMBER KIRCHNER Thank you.

MR. HARBUCK: -- digital plants.

Okay, the next thing, next slide is, let's

see, okay, control of heating, ventilation, air conditioning system. They have --- this is one of the exceptions. Their design is pretty, well, I'll say it's got a lot of capability. But it does have some, the way it's set up to operate automatically, has led us to ask about, well, what is required for this system.

For an existing plant, typically you initiate control of emergency ventilation, that is you divert flow into the control room using various filters. And it's essentially what happens. And that's done based on radiation monitors you have in the air intakes.

And this plant has two separate air intakes separated by some distance. And one of the things they do is they compare the radiation signals, and whichever one has the higher signal, that intake gets isolated. So all the airflow is coming in through the one with the lower signal.

But during the course of the event, every so often it resets and compares them again. And the possibility exists that it could switch to the air intakes.

Another thing is that when --- normally you have one air handling unit with a fan, and a cooler, and a heater that's providing normal control room ventilation from the outside. And this is what they

call a control room supply and return system.

And when they get the actuation signal, and let me just backup. There's two divisions, and each division has two of these air handling units. So when you get the actuation signal from the radiation monitors to initiate the filtered ventilation, only the components associated with that running AHU fan, in terms of its electrical power, are actuating. And so you basically have one-fourth of your system is doing the work.

Now, if for some reason it is determined by the instrumentation available that some aspect of that emergency ventilation is not working, it will start the other train in the same division. If that train fails, it will start another train in the opposite division and so forth.

And so we were wondering, well, if it did fail, and you're not allowing, by what's stated in Chapter 15, that you need 30 minutes before you can allow operators to do anything, does your dose calcs allow you to have 30 minutes of unfiltered ventilation if you're relying on operators to manually start the standby train, since you're not taking credit for or requiring operability as an automatic feature?

And all the, you know, all the fan dampers

and stuff that direct flow are all tied to the operation of the fans. And the filtration train has a fan too, and there's two of them. But there's only one filter train in each division.

And so we ended up requiring, for operability of each control room HVAC train, that all these interlocks and automatic start features, even if some of them are not safety related, would be needed to be available in order to establish operability.

So that's something that goes beyond what we normally require. But in this case, it seemed like an appropriate thing to do, absent some other evaluation that would make it unnecessary.

Okay, on accident monitoring instrumentation, originally the list that was provided in Chapter 7 and the list that was provided in the tech specs were not the same. And Chapter 7 was the lead on the selection of variables for the post-accident monitoring. And they ended up adding a number of new functions. But the end result is that we now have identical lists. And that was the goal.

And we're confident from the Chapter 7 review that all the functions that were needed to be there by the applicable regulatory guidance and industry standards has been met.

Okay, let's see, Slide Number 8. Briefly on --- and I hope it's okay that I'm going over. I just wanted to --- and this is just a highlight of the big issues.

Normally in your AC sources, you have a requirement to do a check of the opposite division that's unaffected by an inoperable source to make sure that there's not something that's supported by your electrical in the division with the inoperability, that the other division, that the redundant component's not inoperable or degraded to some extent so that you no longer have a real good assurance of there being --- that you're maintaining the capability to perform the function.

So calling that a cross train check, the only difficulty in this case is that you've got two diesels in each division have electrical power. And the bus is supplied by the diesels. They don't have identical sets of loads on them.

To the extent you have a four train system, such as a safety injection system, yes, that's true. But for other systems like the containment spray, or shutdown cooling, or chilled water, you don't --- it's not, you know, you may not have four trains of that. So generally you have to, in order to say that you're

meeting redundancy, you know, loss redundancy means that you've lost one or both diesels on one division.

The question that we had was, well, how do you know what is the redundancy in the other division? And so we asked them to clarify that, and they did, and so just to make sure that the action, as written and as described in the bases, could be accomplished.

An interesting thing is that, during the Condition C of LCO 3.8.1, it's two offsite circuits inoperable. And this could lead to having inoperable, well, this could lead to buses in both divisions not having onsite power.

And so the cross train check in this case would require you, one, you have a shorter time to do it and, two, you would have to check both divisions. And we've clarified that in the basis.

Now, next slide has to do with some general things, some that --- the first two were touched on by the Applicant in their presentation. And just briefly, we added the auxiliary trips for the core protection calculators. Because there were a number of events in Chapter 15 which inexplicably choose to credit those trips instead of the normal trip that is equivalent to them.

But the end result was, instead of trying

just to pick out those that were associated with events, they decided to just require all of them, since it's all really done in software. And it's kind of hard to separate them out within a channel. So that's required.

So if you were to have these auxiliary trips out, you would declare the LPD high and the DNBR low trip channels inoperable. And that would then take you over to LCO 3.3.1.

For the case of where you still have reactor coolant pump running so you have adequate mixing, you needed to have a protection of the flow limit on charging system of 180 gallons per minute.

So we revised LCO 3.1.8 which had originally been focused on a dilution event when you were in a mid-loop operation. And we changed it so it applies in MODEs 1, 2, 3, 4, and 5 with at least one reactor coolant pump running. And so that was an addition to what we normally have in the standard.

And then there was LCO 3.1.12 which, like LCO 3.9.6, requires you to isolate your shutdown, I mean, your unborated water source. And that covers MODEs 4, 5, and 6.

And then the evaluation of the LCO selection criteria resulted in changing some of the

selection criteria that were referenced in the bases for LCO 3.6.7 which was changed to Criterion 4. And 3.9.6 was changed to meet Criterion 3 as well Criterion 2.

Just with Travelers, they provided a list which is contained in the Deviation Report, that addresses all the Travelers included in the standard that they chose not to adopt, all the Travelers approved since the standard and whether they adopted it or not.

They did not adopt any of the -- what's called risk informed tech spec initiatives. However, they did add LCO 3.0.8 which addresses inoperability of snubbers. And there's a risk component to that, but it's more of a --- if you, you know, it allows you to go for a period of time provided you're managing the risk. That's essentially what it boils down to.

If you have a snubber affecting, say, one division of something, or in some cases where systems share piping or whatever, a snubber could potentially affect more than one division. And therefore, you get less time. LCO 3.0.8 addresses that.

And then LCO 3.0.9 does a similar thing for safety related barriers. But we left this one as a COL item with reviewers' notes to explain what you had to do to adopt that. And that would be left to

the COL applicant.

Now, one thing I'll just mention about the risk assessment, I understand that the PRA that was originally provided with the application has been or is being redone using a different set of tools or software. I'm not sure what the details are.

But in the beginning, we thought, well, should this impact anything, you know, related to risk arguments that are used in the tech specs. And we decided that we could address those kinds of things by making the assumption that the risk would be adequate to support whatever argument that was being made. And there aren't very many.

MEMBER STETKAR: Craig, didn't you talk to your PRA branch and ---

MR. HARBUCK: Oh, yes.

MEMBER STETKAR: Okay.

MR. HARBUCK: Yes, yes.

MEMBER STETKAR: Because it --- the changes are not --

MR. HARBUCK: I haven't caught up with him lately. I've been busy.

MEMBER STETKAR: Well, you ought to keep in touch with him. The changes are not just whether I'm using an HP or a TI calculator which is the platform.

They've made substantive changes to the risk assessment.

MR. HARBUCK: Okay. Well, my hope is that those are --

(Simultaneous speaking.)

MEMBER STETKAR: It made substantive changes to the risk assessment.

MR. HARBUCK: Improving -- an improving trend there. And that -- so we'll be -- so we're okay in our assumption is what I am wanting to say. And then last thing, COL action items, it's important to have those clearly defined, marked and, if needed, suitable guidance or reviewers' notes provided so that the COL applicant can very straightforwardly know how to complete them and -- and whether or not to -- if it's an optional kind of an item, whether they want to adopt it at all.

So that concludes the major issues on open items that -- that I wanted to discuss with you. And maybe a little bit of information about how tech specs work. And so based on our review, and pending completion of the considerably large number of confirmatory items we have, we find that the generic tech specs, the bases, are acceptable because they -- they meet 50.36 and 50.36(a).

MEMBER STETKAR: Craig, it's kind of interesting because for this meeting we have your SER with us -- a substantial number of confirmatory items. Then we have Rev. 1 of the tech specs. For -- and I've been kind of trying to follow a few things. Your -- your long discussion about all of the stuff on auxiliary feedwater is not reflected in Rev. 1 of the tech specs. So for --

(Simultaneous speaking.)

MR. HARBUCK: You're right.

MEMBER STETKAR: Our purposes -- yes, I know.

MR. HARBUCK: Right.

MEMBER STETKAR: So for our purposes that means we're going to have to take a close look at Rev. 2 of the tech specs, aren't we?

MR. HARBUCK: Yes, you will.

MEMBER STETKAR: Yes.

MR. HARBUCK: And I've been -- to do my work I've been relying on a living mark-up of Rev. 1 that's going to eventually be Rev. 2. But it -- the last update I have available was posted on the 8th of November. And -- and -- so there's been a lot of things happening since then.

MEMBER STETKAR: The -- my only point is

that eventually the ACRS, the committee, will need to write a letter on the design certification. And getting closure on exactly what is the final design certification document that has been indeed reviewed and accepted by the NRC staff in some areas is a bit challenging.

MR. HARBUCK: Yes. Well, in this case, we anticipate having Rev. 2 by -- by next month?

MEMBER STETKAR: Yes, but we hear time schedules -- part -- part of the reason -- when I read through the tech specs, I don't care about whether it's 10 or 12 or 18 hours or that kind of -- I look for philosophical consistency. In -- if I look through a set of systems and I understand how the systems are configured, are the tech specs philosophically consistent? In other words, am I applying 12 hours here? Am I being excessively -- this -- this whole notion, if I have both -- I'll call them trains of auxiliary feedwater out to one steam generator, I have a 24 hour with a bracket -- well, that doesn't show up here. So I -- I can't even think about all I hear about it -- is what I can see in your SER or the draft of the tech specs, which I don't have. So I can't even think about that to even ask questions about.

MR. HARBUCK: I have the same problem.

MEMBER STETKAR: Okay.

MR. HARBUCK: And -- so it's been a -- you know, there's quite a volume of -- of paper, or documentation of all these changes and -- and arguments and -- and that's sort of is what's behind the size of the SER. Once you start out deciding there's plenty to describe your open items, if you have a large number of them it's going to result in a lot of writing. But --

MEMBER STETKAR: Well, but -- but the other -- the other trap that people fall into is one of the functions that I think the ACRS provides is that we try to stay -- step back from things and take an integrated look at stuff. And if you get into the schedule-driven focus on an open item or a -- a question about a particular condition within a particular system in a particular operating mode, sometimes you'll lose the bubble on this integrated perspective. And it's really hard to step back from all of that without --

(Simultaneous speaking.)

MR. HARBUCK: I know if you don't have --

MEMBER STETKAR: That coherent document.

MR. HARBUCK: If you don't have the end product --

MEMBER STETKAR: If you don't have the end

product it's hard to --

MR. HARBUCK: Kind of hard to know -- hard to --

(Simultaneous speaking.)

MEMBER STETKAR: Hard to do that due diligence. Yes.

MR. HARBUCK: Hard to fully grasp what the -- what the overall resolution is. And I appreciate that. And -- so I hope that -- I -- there's a lot of things we have to confirm. We couldn't really do a lot of it in the Rev. 1 version because that was put out, what, last -- last March. And that's about the time we were meeting with you with our 135 issues. And so -- so we've got a -- you know, we've got a lot of work left to do just to get the confirmatory items closed. But if it -- but if -- if they -- the final product matches what they have indicated in their responses, then should be -- that should be fine. And I think we've -- we've -- we've achieved a pretty good set of tech specs, then. Does anyone else have any questions?

CHAIRMAN BALLINGER: Any questions? Against all odds, we have managed to get way behind.

(Laughter.)

CHAIRMAN BALLINGER: So we would -- I think

the committee would appreciate some expeditious presentations. So -- thank you.

(Pause.)

MR. SCAROLAR: I am actually not known for being expeditious, but I'll do my best. My name is Ken Scarolar.

CHAIRMAN BALLINGER: Can you speed it up a little bit?

MR. SCAROLAR: Yes, I will. Sorry.

(Simultaneous speaking.)

MEMBER STETKAR: Ron, we're going to take as much time as we need. Okay? So they can present what they have to present. And if -- if you have to leave early, I will stay till 8:00.

MR. SCAROLAR: My name is Ken Scarolar. I've been working on human systems interface design, human factors engineering and digital INC since the mid '70s, and working with KHNP and KEPCO since the late '80s -- including this APR 1400 project.

I will overview the contents of Chapter 18. I intend to discuss the RAIs since the last ACRS subcommittee meeting and then summarize the current status of Chapter 18. Chapter 18 provides a summary of the basic HSI design. It also provides a summary of all the HFE program elements which govern the design

processes that will be executed after the design certification. So there's both a mix of design in Chapter 18 and design process.

The details -- excuse me -- there's an HFE program plan that administratively governs 11 technical program elements, the program plan as well as each one of the program elements is part of Chapter 18. And Chapter 18 references more detailed documentation -- go to the next page -- that describes the details of the program plan, the details of the HSI design and the details of each one of these HFE program elements. This is what we call implementation plans.

For example, the details of the HFE program plan include things like the resolution of human engineering discrepancies. Although we have a design and we have a design process, as we go through the implementation of each one of these program elements, we will engage licensed U.S. reactor operators, senior reactor operators. We'll engage INC digital design experts. We'll engage human factors engineering experts. As they go through the implementation, they may find issues. So the program plan says here is how you document an issue and here is how you track that issue through resolution.

The details of every program element, for

example task analysis, are documented in separate implementation plans. And there is an implementation plan for each one of these program elements. The IPs not only say what needs to be done, they define the qualifications of the people that need to do it, they define the format and content of what we call result summary reports where you document the results of those program elements. So the IPs are pretty extensive.

In things like the verification and validation IP, even though we have not yet conducted what we call integrated system validation, that IP does define the scenarios that will be executed -- the minimum scenarios. We will use -- it says that we'll use a full-scope simulator, we'll use licensed U.S. operators and as a minimum, these are the scenarios that we will encounter during that. In addition it goes on to say that if we need more scenarios to encompass all of the important human actions -- such as those that are defined by the PRA, those that are defined by the transient and accident analysis, more scenarios will be added to encompass all the important human actions. So the ISV, the IPs are very comprehensive.

MEMBER STETKAR: Ken, let me -- let me stop you right there.

MR. SCAROLAR: Sure.

MEMBER STETKAR: Because you don't have a -- a further slide that I can see on -- on what you were just talking about. And I have to be careful because all of the implementation plans are -- are proprietary. So I can't speak too much about details. That being said, from what you -- you just mentioned, there -- there is -- there are specific scenarios that have been defined for the integrated verification and validation process. And they're listed. And they're -- there's quite an extensive description in the implementation plan of those scenarios. And I don't even know -- I don't even know if the number of scenarios is proprietary, so I won't say the number.

There is also an implementation plan that identifies those important human actions that you just mentioned. That particular implementation plan has similarly a list of specific actions. And -- and some of those are so-called deterministic actions that have been derived from the Chapter 15 transient and accident analyses and the so-called diversity, defense in-depth analysis of the protection and control systems.

And then there are those risk-informed human actions -- the RIHAs. There's a list of those in that implementation plan. That list is both

incomplete and inconsistent with the current version of the risk assessment. So now my question is, since the implementation plans are referenced in the certified design, therefore they are part of the certified design, how do you reconcile two parts of the certified design that are inconsistent with one another? Or -- or are we going to see new changes?

MR. SCAROLAR: The implementation plans govern the execution of the program element. The very important part of that is to illustrate the outcome of the program element, the list of important human actions that is in the IP is flagged as preliminary. It's only there to illustrate the output of that program element, not to define today the list of important human actions. That list of important human actions will be defined when KHNP actually executes that program element. So this list that you see is only illustrative. It is not intended by any means to be the final list. The final list will be determined when this particular program element is executed.

Now, that may be a year from now, five years from now, ten years from now. The DCD doesn't define that. It simply says when you do it, these are the things you have to do. So yes, I agree, there may be some inconsistency because the IP is an illustrative

example of the list. The PRA may still be evolving. They're the transient and accident analysis in Chapter 15 may still be evolving. The list is only an example to illustrate the outcome of that program element.

MEMBER DIMITRIJEVIC: But in the same document you have -- sorry -- but what will happen -- the same document you're going to have it -- the Chapter 19 showing one list of important human actions and then your chapter showing a different list. In the same document, which is FSAR.

MR. SCAROLAR: Well, actually in Chapter 18 there's a list of human actions.

MEMBER DIMITRIJEVIC: Right.

MR. SCAROLAR: Whether they become important human actions or not is based on the extraction process that's defined for the HFE program element. So in the end, that long list of human actions may be pared down to important human actions based on the HFE analysis. So that can happen also. Again, the PRA documents risk. The human factors -- IP documents process with illustrative output. It is not intended to document the output.

MEMBER DIMITRIJEVIC: I understand that, I'm just saying -- I completely understand what you're saying.

MR. SCAROLAR: Okay.

MEMBER DIMITRIJEVIC: And you have -- you -- when you defined the program, define -- but -- what is going to happen is then the same document will say -- because Chapter 19 also provide list of important human actions.

MEMBER STETKAR: What's the purpose in -- let me try it this way. What specifically is the purpose of that list of risk-important human actions in the implementation plan document? What purpose does it serve?

MR. SCAROLAR: It serves to establish the minimum set of scenarios that will be conducted during integrated system validation. Because there is a commitment that those scenarios encompass all those human actions. It also is used to establish rigor in other -- in the other program elements. For example, task analysis will go deeper for the important human actions than it will for other actions.

MEMBER STETKAR: But -- but, Ken, you didn't answer my question. What's the purpose of this specific list? I have a list of things here that I'm not going -- it's -- I don't want to go into a situation where we close this meeting. We don't have time. But I have a table of a list of specific actions. They

-- they've got names, they've got times, they've got places where I extracted them from. That list --

(Simultaneous speaking.)

MR. SCAROLAR: They're only there -- it's only to illustrate the output.

MEMBER STETKAR: Nowhere does it say that. It just says this is it.

MR. SCAROLAR: Well, it says preliminary.

MEMBER STETKAR: No, it doesn't. I'm sorry, it does not. I haven't found that word anywhere here.

MR. SCAROLAR: In the title of the list?

MEMBER STETKAR: Can I read the title, since it's a proprietary document? Probably not. That's -- up in the Appendix, it says. Not in the table.

MEMBER MARCH-LEUBA: And that's not proprietary. You can read it.

(Simultaneous speaking.)

PARTICIPANT: Yes, it is. The whole document.

PARTICIPANT: You probably could have done a better job clarifying this point.

MEMBER MARCH-LEUBA: Only a bracketed --

MEMBER STETKAR: That's true. It does say Appendix C. The problem is that that list comes only

from an outdated version and it -- of the PRA, and it only has operator actions that are important from level one, meaning core damage frequency, internal events at power. The current PRA identifies many more, and I can say this because they are identified in the non-proprietary version of Chapter 19. Human actions that contribute to large early release frequency during -- or, large release frequency during power operation. Human actions that contribute to fire during power operation, to large release frequency from fire during power operation. Core damage shut down -- during shut -- core damage during shut down. Large release frequency during shut down.

All of those are about equal contributors, and they're a much larger list. So if this is supposed to be an example of how people are supposed to think about the process, this is a very poor example. So I don't know why I have this appendix. Why do I have these lists?

(No audible response.)

MEMBER STETKAR: Why do I have this list?

MR. SCAROLAR: As I said, it was only intended to be illustrative of the output, not to attempt to defend that the output is complete.

MEMBER STETKAR: Okay.

MR. SCAROLAR: Even if we updated that list today to reflect the current PRA --

MEMBER STETKAR: It would change.

MR. SCAROLAR: It would change.

MEMBER STETKAR: That's right.

MR. SCAROLAR: And it would still not reflect things like site specifics --

(Simultaneous speaking.)

MEMBER STETKAR: That's exactly right. The final list is final when you have the COL PRA.

MR. SCAROLAR: So I think in hindsight one might argue that it was a mistake to put any list here. But again, it was well intentioned to illustrate the output.

MEMBER DIMITRIJEVIC: Why cannot you reference tables which have a specific number since Section 19 and its example? And then you're all set?

MEMBER STETKAR: I understand --

MR. SCAROLAR: That was not -- yes, we probably could have done that. But that was not the method that was selected.

MEMBER STETKAR: I understand what you were trying to do. The problem is is that the two parts of the -- the -- the certified design reports with its supporting technical reports have gotten out of synch

with one another. And there is information in this technical report compiled in a way that is useful for the human factors engineering that is not immediately available in the tables and tables and tables of stuff in the DCD. I will -- you can -- you can figure it out, but --

So I -- I understand kind of where you were trying to get. It's just that my fear -- because of the way that the existing V&V scenarios have been defined -- the V&V scenarios are a -- what I'd call a fairly standard set of scenarios that fortunately capture all of these actions that are in this list from the core damage during full power operation they -- those -- those V&V scenarios that you've defined don't capture several of the other actions like -- as far as -- for example fire-related actions. Certainly actions during shutdown.

MR. SCAROLAR: But again, the V&V scenarios were never intended to be the complete list of V&V scenarios.

MEMBER STETKAR: Yes.

MR. SCAROLAR: The V&V IP says we will have scenarios encompassing all the important human actions.

(Simultaneous speaking.)

MEMBER STETKAR: All the -- yes.

MR. SCAROLAR: So if the list of IHAs expands, the task analysis is going to expand, the HSA design is going to expand because we handle the HSA for the IHAs in a unique manner. And of course, ultimately, the V&V scenarios will expand. So -

MEMBER STETKAR: Okay.

MR. SCAROLAR: There's a lot of hip bones connected to the shin bones here.

MEMBER STETKAR: I just wanted to -- to kind of probe this because it -- it -- you know, obviously I am pretty heavily invested in the -- the PRA side of things. And I get -- I get concerned about people having lists of specific things in something that then becomes a rule. And the certified design is a rule. Now, this is -- admittedly it's not tier-one information. It's tier-two and it's in the technical report. So you can change things. But, it's here --

(Simultaneous speaking.)

MR. SCAROLAR: Okay, on this list of documentation I wanted to specifically point out the last two items -- the basic human system interface and the style guide. I think there is a certain misconception about the content of Chapter 18 being only process oriented. And these two documents are clearly not process oriented. These documents show

the what -- no, excuse me -- they show the how of the HSI. Basically says this is how we're going to display information inside the control room.

For example, the large display panel is the how of how you display the information that is important to the critical safety functions and the critical power production functions. This is large screen, spatially dedicated, continuously visible information because it's the most important information that the operators are going to deal with. There are other parts of the HSE design that describe how we're going to handle things like reactor trip initiation and engineered safety features initiation. Again, this is the how we're going to do things in the control room.

The what of what we're going to do -- like, what are we going to display for every critical function? What is the HSI needed to complete the tasks for any important human action? The what comes out of the design process documentation. So there is a mix of both what -- process oriented -- and how, design oriented.

MEMBER STETKAR: There's even some what in -- in your vernacular, there's even some what in these documents.

MR. SCAROLAR: Sure.

MEMBER STETKAR: Because you describe certain types of -- again, trying to stay away from proprietary stuff. You describe certain types of controls and the way they're implemented, let's say.

MR. SCAROLAR: Right. But the what, again, is really illustrative. For example, the critical safety functions and the systems that support those critical safety functions that are in the HSI -- the basic HSI document -- are really illustrative. The actual functions and the actual success paths will come out of the FRAFA, the functional requirements analysis and function allocation.

So if everything was process oriented, I think we would all feel uncomfortable. So there's illustrative information in the design documentation as well.

MEMBER STETKAR: Ken, are there going to be a Rev. 2 of these technical reports issued?

MR. SCAROLAR: Yes, I believe there will -- right? We have RAIs without standing commitment --

(Simultaneous speaking.)

MEMBER STETKAR: Yes, that's -- okay, I just wanted to make --

MR. SCAROLAR: So all the commitments in the RAIs will ultimately become documented in these IP revisions. Or the design document --

(Simultaneous speaking.)

MEMBER STETKAR: Because here, too, I've learned things between Rev. 0 and Rev. 1 about both how and to some extent what the changed -- that I didn't necessarily expect. So being a Bayesian, I would say that I might learn things between Rev. 1 and Rev. 2 that might not necessarily be expected. I am just trying to think about, you know, the effort that -- that we're going to have put forth to -- to read -- there's 11 of them. They're -- well, 12 of them. And some of them are pretty big.

MR. SCAROLAR: Yes.

MEMBER STETKAR: Okay.

MR. SCAROLAR: Here, let me go on to the next slide. So since the last subcommittee meeting there were five RAIs that were issued by the staff, worked through jointly with the staff and KHNP and KEPCO. And all these RAIs have now been resolved. I will go through each of them to highlight the key points.

The first one was related to the treatment of important human actions. And for this one the staff

identified that the extraction was a snapshot. And it does not necessarily reflect ongoing PRA changes and then potential site-specific changes. So the IP was clarified that the -- that the implementation program execution would in fact encompass these changes. So that's what we talked about before.

MEMBER STETKAR: The thing -- if you go back to this slide, the reason -- I brought the previous discussion up for two reasons. One is to try to get it on the record. The other is, on that first checkmark bullet there that says the whole list of RAHIs supports the basis for the initial HSI design. That's what's -- bothers me. It's -- if -- if that list in Appendix C -- you've identified it as Appendix C -- supports the basis for the initial HSI design, I am going to have to do a lot of redesign work. Because there's a bunch of other things that I need to think about.

I -- I would not feel comfortable designing my initial HSI based on that particular list of things in Appendix C because I might miss a bunch of stuff. And that's -- that's really where I'm trying to come from is -- is if you want to put lists of things together, then put the list of everything that you can identify from the PRA, which will give me a much better feeling for the basis for the initial HSI design that I might

later refine a bit -- a bit is the key -- compared to an abbreviated list that I might be faced with thinking about a lot of additional design decisions.

MR. SCAROLAR: Yes, I understand your point.

MEMBER STETKAR: So I don't -- we don't -- I don't need to discuss anymore. I mean, that's the thing that I am kind of hanging up on is --

(Pause.)

MR. SCAROLAR: Go to the next slide. Okay, the next RAI pertain to the responsibility for completing the analyses and design activities that are defined in the IPs. And for this one we need to understand that all the HFE program elements will be completed after design certification. And this is a prerequisite to conducting verification and validation. So we added a table -- as you see on this slide -- into this -- into the HFE program so that it was very clear that the result summary reports are in fact prerequisites for verification and validation. And this was considered acceptable to the staff. Go on to the next one.

In the next one the staff identified that for the integrated system validation we had a limited number of operating procedures that we committed to

prepare. Well obviously if you only have a certain number of operating procedures and the operators are going through an event, they're kind of swayed to diagnose the event based on the operating procedures they have. Well, that was deemed to be unacceptable, so we agreed to add more operating procedures so that we don't sway the operator's decision making based on the inventory of procedures. That was resolved to the satisfaction of the staff.

(Simultaneous speaking.)

MEMBER KIRCHNER: Could you clarify that -- what you just said? That befuddles me a little bit. Maybe it's late in the day. Why add more procedures? You impugn the existing ones and then -- well, we'll give the operator more options.

MR. SCAROLAR: Well, let's say --

MEMBER KIRCHNER: That doesn't sound like a rational approach to --

(Simultaneous speaking.)

MR. SCAROLAR: Well, let's say that the only --

MEMBER KIRCHNER: Operator's under duress.

MR. SCAROLAR: The only emergency procedure we had was for a steam generator tube rupture.

Now we have an event. The first thing the operators have to try and do is diagnose the event. Well, if they know they only have a steam generator tube rupture procedure of this simulator --

MEMBER KIRCHNER: I understand that.

MR. SCAROLAR: That's -- that was the only point.

MEMBER KIRCHNER: Oh, all right.

MR. SCAROLAR: So we added more procedures so we don't guide them to the answer.

(Simultaneous speaking.)

MEMBER STETKAR: Because part of this --

MR. SCAROLAR: Based on the procedure inventory.

MEMBER STETKAR: Is how -- how well do the alarms and computer-based procedures work with one another? In other words, can -- can the operators be led astray? And -- and without having the stray path available, they can't.

MR. SCAROLAR: Next slide. This RAI pertained to the operating experience review which is another one of these program elements. The original OER did not discuss getting operating experience from Shin Kori 3 and 4. And it didn't because KHNP felt that the experience from Shin Kori 3 and 4 was already

reflected in the basic HSI design and already reflected in the implementation plans.

But in hindsight it was recognized that the OE criteria in NUREG 07-11, Revision 3, is different than what was used for Shin Kori 3 and 4, which was 07-11, Revision 1. So the IP was revised to say that we would revisit the OE from Shin Kori 3 and 4 using the selection criteria from 07-11, Revision 3.

Next RAI was specifically related to task analysis, but it -- it's really representative of all the IPs. In this particular IP it identifies explicitly that there will be site-specific assumptions made so that you have a complete plant to conduct the tasks analysis against. And the staff asked why do you need assumptions? Why can't you use the specific site information -- or, the actual site information? Well, the answer is that the way the IPs are written you can execute the IPs before you have a COL applicant. You don't need a site. You make site-specific assumptions and you execute the IP. And you can actually complete the IP based on that. So you can complete the IP generically.

Later on, when you actually have a COL applicant and you have a site, the design implementation IP -- which is down the list of IPs and there's an ITAAC

for it -- requires that you go back and validate any of those assumptions that you put into your previous IP executions. So when you look at those assumptions you can say they're valid, I don't have to do anything else. Or you may look at the assumptions and say no, they're not valid. They've actually changed. Based on that, the design implementation IP requires that you go back and reassess the impact on all the previous IPs that you've executed.

So that's the intent. The wording was revised and the staff and KHNP have reached agreement on that wording. So in summary, Chapter 18 is complete with no outstanding RAIs. The content, in my opinion, is the right mix between design information and design process. If we only had design process information, very frankly, I'd not feel comfortable about Chapter 18.

But there's a good mix of design information and there's a process that requires qualified U.S. senior reactor operators, human factors engineering experts, plant design experts as well as digital design experts. And through the execution of that process there's an HED process -- human engineering discrepancies -- that's governed by the IPs that allows these qualified personnel to identify problems and make

sure that those problems are tracked through resolution. So Chapter 18 is complete.

MR. SISK: And I believe -- this is Rob Sisk, Westinghouse -- I believe that would conclude KHNP's presentations for today.

CHAIRMAN BALLINGER: Well, I am still recovering from the surgery from Stetkar, but this current status worries me. Because we have to write a letter at some point, and the schedule is rough. We went -- we went through that this morning. And if there's substantial changes in Chapter 18 through Rev. 2, we have to look at that, right? Am I losing -- losing the bubble, as Charlie would say?

(Pause.)

CHAIRMAN BALLINGER: I am looking at the Chairman over there.

MEMBER CORRADINI: I have an opinion, but I guess I'm not a human factors all --

MEMBER STETKAR: It isn't just human factors because if you're listening to what I said on the record for Chapter 16, for example --

(Simultaneous speaking.)

MEMBER CORRADINI: I was occupied in a different meeting for Chapter 16. So I am sorry.

MEMBER STETKAR: But they're -- at least

two of the chapters that we heard about today, there will be a Rev. 2 -- and Rev. 2 of the -- in this particular instance supporting technical reports for the final design certification document. Now, again, it's dangerous to expect that there will not be any new information because I have been surprised between Rev. 0 and Rev. 1 in some places where I didn't expect new information and there was new information.

(Simultaneous speaking.)

MEMBER CORRADINI: Can I just summarize? What you're telling me is similar to Chapter 19. We're still in a revision mode which means --

(Simultaneous speaking.)

MEMBER STETKAR: We're not quite -- no, no. This is much more stable. Don't bring Chapter 19 into it.

(Laughter.)

(Simultaneous speaking.)

MEMBER STETKAR: This is not Chapter 19.

MEMBER CORRADINI: But -- but if I'm -- but make sure -- I want to make sure I understand. Maybe this is the wrong time. Shouldn't we have the staff up first before we discuss this?

MEMBER STETKAR: We probably should.

MEMBER CORRADINI: Okay.

MEMBER STETKAR: But again, Mike and -- and Ron, we -- I believe the ACRS is planning to write a letter on the phase -- whatever this is. Four?

MEMBER CORRADINI: No, five.

MEMBER STETKAR: Five? We still have to write a final, final letter on the certified design, right?

MEMBER CORRADINI: Yes.

MEMBER STETKAR: At some time in the future. That letter might have to capture differences between Rev. 1 and Rev. 2.

MR. SCAROLAR: Yes, but I'd like to clarify what the differences are going to be. The revisions between the IPs that we have today and what will become Rev. 2 are the commitments in the RAIs. These are confirmatory items.

MEMBER STETKAR: Ten?

MR. SCAROLAR: Now KHNP does not intend to make design process changes or design changes that were not already documented in the RAI responses.

MEMBER STETKAR: I don't want to go into proprietary information. I will tell you I -- I have identified at least one, and in fact there's more than one, change from Rev. 0 to Rev. 1 of the IP that had substantive stuff changed that was not a result of an

RAI. And therefore, given that experience, I have no reason to believe that it might not also occur between Rev. 1 and Rev. 2 when people take a look at it and say, oh, we'll make this other change. People can shake their heads -- and yes indeed, all the best intentions -- but -- but indeed, it could occur. And -- and we need to be cognizant of that.

MR. SISK: I just would like to say, I appreciate the comment. It's something that we take very much to heart as we look to what happened between Rev. 0, Rev. 1. Rev. 2 that is coming forward -- the intent, I am going to say -- and I think the purpose and the effort being applied to Rev. 2 is -- there is no change to Rev. 2 that has not been seen and approved by the staff as a part of a RAI response such that the changes between Rev. 1 and Rev. 2 is to incorporate the changes that were identified such that the staff has now identified those changes as confirmatory items. And those were the only changes that are intended.

The only place that I guess that always comes up is the Type D finding. If there are errors or other things that come about unintended, our intent is to minimize that to the maximum possible. But there are no -- there is no intention to make any change other than what the staff has reviewed. So I just want to

go on the record with that.

CHAIRMAN BALLINGER: But we're on the record, so that's -- that's good.

MEMBER CORRADINI: But I'm still not sure -- I still think we should want to have the staff come up and then discuss this.

CHAIRMAN BALLINGER: Yes.

MS. KENT: Good afternoon/evening. I am Lauren Kent and I'm representing the HFE staff performing the review of Chapter 18. We just heard Mr. Scarolar talk about the responses to the RAIs that we issued following the Phase 3 subcommittee. So the majority of my presentation discusses those issues and their -- their resolution.

I would like to ask the committee if you'd like me to review those slides, or if we would like to start with some questions? Or I could start with a portion of the presentation I had prepared that touched on a different issue in Chapter 7 related to accident monitoring instrumentation? Any preferences?

(Simultaneous speaking.)

PARTICIPANT: You should just proceed.

MS. KENT: Carry on. I will do so. Okay. As we heard previously from KHNP we had issued some

RAI questions after the Phase 3 subcommittee from issues that came out of that meeting. One of the issues -- we can go to the next slide, please -- was what KHNP discussed with the completeness of the test bed. And there was some discussion about procedures. And I think that that was addressed as I saw here at the table. So we'll go on to the next.

Again we asked the Applicant to provide some revisions to the operating experience review implementation plan. Really the intent here was to make sure that relevant operating experience wasn't excluded from the review when it is performed in accordance with the implementation plan. And they made sufficient changes to alleviate that concern. Let's go to the next slide. And then we can go to the next as well. Thank you.

When performing the task analysis and the function requirements analysis and function allocation, again, we discussed with the Applicant that it would be prudent as well as more efficient to have site-specific information that is known at the time if the COL performs these activities addressed to be addressed. Again, they did provide changes to the implementation plans to address this issue. Next slide. And next. Thank you.

Okay, so this brings me to the treatment of the risk-important human actions. So I -- I'd like to start with the topic that was discussed, which is the preliminary list that is in the implementation plan. So I'd like to give a little bit of history and some context as to how that information came to exist in the DCD. And this may alleviate some concerns about surprise information coming to light in subsequent revision of the DCD.

I've been on staff for about three and a half years now and KHNP was the first project that I ever worked on as a technical reviewer here on staff. So to say that learning has occurred between three and a half years ago and now would be an understatement. One of the first RAIs that I wrote when I started reviewing the application was to ask why, if you've submitted important human actions in Chapter 19 with the DCD, why are you deferring the development of such a list to the COL applicant? I had no appreciation at that point for the iterations and subsequent changes that would come about in the PRA and the need to basically leave the implementation plan as they had it, which is -- there is a table in the implementation plan which will be completed by the COL in accordance with that implementation plan when that activity --

when it's time to complete that activity.

So I actually had issued an RAI requesting that the -- the information be provided because I thought that it existed. And it -- it did not. So the RAI was issued to the Applicant. They provided the list. Issued a second RAI requesting that they then remove it, which -- they decided to retain the list in the implementation plan. So we've run into the problem that was discussed at the table about having -- having two lists that have different sets of information in addition to the fact that this is not even the list that is to be ultimately developed as a result of this element.

So the list is described as Mr. Scarolar said, as preliminary information to support previous design work that has been done. My understanding was that that list supports the conceptual HSI design that is reflected in the Korean design that is the -- the conceptual design -- the foundation for this HFE design that has to be developed through the process. So that is how -- that is the back story on how that information came to be.

Let's go to the next slide. Ultimately, with respect to treatment of important human actions we have -- now we're at a point where the implementation

plan says that personnel with a certain level of expertise -- that expertise has been clarified in the implementation plan. We'll work with the iteration of the PRA that exists at the time. This activity is performed to complete this activity. Next slide.

And next, please. We just covered that. And the next. Okay. And we can move on from here. Again we -- KHNP discussed in the previous presentation, the -- the relationship between the results of the implementation plans and -- completing the activities, the implementation plans and how they are inputs ultimately to the integrated system validation test -- and how that has been illustrated in the application to illustrate the scope of work that will need to be completed. And next.

Okay, and finally, during the subcommittee meeting there was some discussion about post-accident monitoring instrumentation and the adequacy of the variables selected to monitor the status of some of the critical safety functions. At the time that we had this subcommittee meeting for Phase Three, we were participating in an audit -- that has subsequently been closed -- of the accident monitoring instrumentation. So the issue that was specifically raised at the subcommittee meeting has since been sufficiently

resolved -- as well as the other -- identification of other accident monitoring instrumentation variables needed to monitor the safety functions. And the next slide?

And our finding at this point is that the Applicant's HFE design does conform to our NRC human factors related guidance, and therefore provides reasonable assurance that requirements will be satisfied for providing a control room design that reflects state of the art human factors principles. That's the conclusion of my pared remarks. So I'd like to turn it over to the Chairman. Thank you.

MEMBER SUNSERI: I guess I would have just one question regarding this table that's there for illustrative purposes that -- it was requested to be out, but left in. So how confident are you that the information as contained in that table won't be misconstrued as plant-specific design information that a future applicant might pick up on? So in other words, is it clear enough in there that it's an example -- it's illustrative? It is not plant-specific, it's there just to --

MS. KENT: Well here's where my confidence comes from. First of all the -- the implementation plan itself has a detailed set of steps that -- not

just one person, but more than one individual that meets a certain level of qualifications that are described in that plan, which requires a certain specified level of PRA and HRA expertise. It directs looking at site-specific probabilistic risk analysis information to develop a table. And the table is there. Each of the headings -- it tells you what to put into the output that goes into this -- to generate this table. So it needs to be completed, first of all. What needs to go into the table is specified and who needs to complete it is also specified.

Those individuals have a level of expertise, and my judgment, that they would know that also by having this information labeled as preliminary and not having -- the Applicant doesn't have any guidance in the implementation to use that preliminary output in the appendix. It says to go use information from another source -- the period exists at that time. So that's where my confidence comes from.

MEMBER SUNSERI: Right, and so they would not be -- this team of people that would be doing the real work, would not be misled by looking at this table and misled in a way that something in this table now would be construed as important and should be included in -- in their work going forward? Which -- when it

may in fact not be important at all?

MS. KENT: Well, there might be some -- there might be some overlap between what exists as a preliminary product and what comes out as a final product. But I have reasonable assurance that the ultimate product will follow the -- it should follow because they should be following the implementation plan. And that tells you to go look at a specific set of source of information. And with -- the team is having a specific set of expertise I -- I am not. I think that they will be able to identify that table for what it is, which is preliminary information from a older version of the PRA.

MEMBER SUNSERI: Yes, all right. Thank you.

MEMBER CORRADINI: What you just said -- would such a note or warning should be there? In other words, warning, this is a preliminary list. It's from five years ago, ten years ago. Do not use this directly. You must check A, B and C. In other words, a user's guide to a preliminary list.

MS. KENT: I don't think it's important. I mean, I --

MEMBER CORRADINI: Okay.

MS. KENT: I think it -- the way that it

is and the way that the process is set up and the implementation plan -- the fact that it's there is not very important. It's just not very important information and I --

MEMBER STETKAR: The problem is that indeed that list appears in -- and we've had presentations today that identify it. One table that Lauren is referring to is a Table 4-1 -- and that appears in your slide, so I can say that -- in the implementation plan. And Table 4-1 is just -- is just a -- a blank table. It just says you need to fill in this stuff. And as Lauren said, you need to go to the following sources. One of the sources is the PRA and you need to have the right kind of people and all that stuff. Good. Fine.

There -- and this was also in the presentations. There is this mysterious Appendix C -- Charlie. It is not referred to anywhere in the text. It simply appears. It's simply there.

MEMBER CORRADINI: What good does it do?

MEMBER STETKAR: And it's there as the -- and -- and this is not bracketed -- so it's the preliminary treatment of important human action output for risk-informed human actions. That's the title of that appendix. And it is this table that lists a bunch

of scenarios, specific actions, times, and sources in the PRA supporting documentation.

MEMBER CORRADINI: But I remembered this from your previous --

(Simultaneous speaking.)

MEMBER STETKAR: And they don't want to take it out is the problem. The staff in fact asked them to --

(Simultaneous speaking.)

MEMBER CORRADINI: But your concern -- let me make sure I understand your concern. Your concern is that if left there the natural human reaction is to take that as gospel and run with it.

MEMBER STETKAR: Right. And they've already said on the KHNP slides that that table forms the basis for the initial design. And that's the troubling thing.

MEMBER CORRADINI: So then, in a letter -- if we choose to write a letter, we should identify that. If we feel collectively that that's important.

MEMBER STETKAR: I mean, my personal concern is exactly somewhat of what Matt said -- is that it's too easy to misconstrue this table because --

(Simultaneous speaking.)

MEMBER CORRADINI: The one you're speaking of?

MEMBER STETKAR: Appendix Charlie Table.

MEMBER SUNSERI: And in fact they already have been because Lauren wrote an RAI and she was supported in it by her whole management team.

MEMBER STETKAR: That's right.

MS. KENT: Lauren is not -- does not have the PRA expertise that these people completing this element have --

(Simultaneous speaking.)

MEMBER CORRADINI: Common sense is allowed.

MEMBER SUNSERI: The people on your team, though, that reviewed your RAI supported it as well, though. So I mean, it was a team effort, not just an individual.

MEMBER STETKAR: I just don't -- I don't know what positive purpose that table serves. I can see an awful lot of potential negative applications. An awful lot of pushback that says, well, the table is in the certified -- you know, in a report that supports the certified design and we've already based our initial HSI design on these things and my God, I am a COL applicant. How -- how should I be forced to

change my design based on new things?

CHAIRMAN BALLINGER: There's a certain amount of inertia that develops when these things start going. And it's awful hard to turn around.

MEMBER STETKAR: Now the -- there's two other appendices in this particular -- technical report. And I am assuming I can quote the -- yes. Those -- I am sorry. There is an Appendix B that has -- it's also called preliminary treatment of important human action output for deterministic important human actions. Remember, the deterministic ones are the ones that come out of the Chapter 15 analysis and the diversity and defense in-depth analysis which -- which are clearly part of the certified design.

And it's -- you know, there are two. There are a list of specific actions, times. You know, if I were a betting person -- and I don't -- I would bet that there's not much chance that they will change. I haven't found any discrepancies. So whether that Appendix B needs to be excised or, you know, what purpose it serves is questionable. But -- but it's not nearly as -- it's also quite abbreviated compared to the Appendix Charlie table. Anyway, we -- we've talked enough about those tables.

MR. OH: This is Andy Oh, KHNP, Washington

Office. The reason one for the IP, there's no -- the description for that Appendix B and C. But during a RAI response where we incorporated some of the mark-up of the IP, identified that in support the IHA from the -- each document will be updated actively as design process including site-specific PRA. So we clearly identified that -- the Table 4-1 will be generated incorporating site-specific PRA.

And also for Appendix B is we identified that is for -- will be updated correctively as a design process. So as the staff said in a -- in a future one is implementation plan is implemented that it -- those -- those words and -- will be interpreted to the person who will implement it that that is -- as a preliminary information that is -- Appendix B and C is only preliminary purpose. But ultimately, in order to generate for Table 1 and 2 the -- the implementation performer have to incorporate for site-specific PRA and also the incorporated some of design process. So I think from now on is it -- those two table -- the statement is very -- becomes very clear.

MEMBER STETKAR: We'll have to -- it's like -- you know, when Rev. 2 comes out we'll see what the words say because right now there's no discussion of those appendices.

CHAIRMAN BALLINGER: Okay, I think we're okay. I think we're all set. Unless there are other questions?

(No audible response.)

CHAIRMAN BALLINGER: I think we're getting the line open. And while we're getting the line open are there any public -- any members of the public that would like to make a comment? The public looks a little vacant.

(No audible response.)

CHAIRMAN BALLINGER: Is the bridge line open? I don't hear any cracking or popping or anything.

MR. BROWN: The bridge is open.

CHAIRMAN BALLINGER: I guess the bridge is open.

MR. BROWN: The bridge is open.

CHAIRMAN BALLINGER: If there's anybody -- any members of the public that would like to make a comment out there, please identify yourself. In the comment.

(Pause.)

CHAIRMAN BALLINGER: Hearing none, we'll close the bridge line. And now are there any -- is there any discussion around the table from members that we need to address?

MEMBER CORRADINI: I'm not sure -- I wasn't here for part of the -- the afternoon. But I think, at least with Chapter 4, which I was listening to, a lot of my questions were answered. I guess I want to bring up how you want to handle a potential letter. Are you going to accumulate all of these subcommittee meetings to a -- a rolled-up letter? In other words, we've heard now part -- in Phase 5 we've heard a number of chapters. You -- are you looking as -- as Chair to write something out at this point to let staff know where we sit?

CHAIRMAN BALLINGER: The -- I -- we had a -- we had part of that discussion this morning at a meeting that the most likely scenario is that we'll write a letter on these chapters. And then Chapter 19 kind of has to be discussed.

MEMBER CORRADINI: Yes, but I mean -- we have a number that we yet to have. We haven't heard about long-term cooling. We haven't heard about the LOCA -- large-break LOCA yet, even in Phase 2.

CHAIRMAN BALLINGER: But we're required to write a letter on long-term cooling.

MEMBER CORRADINI: Right.

CHAIRMAN BALLINGER: That's a rule. And so we'll definitely write a letter on that.

MEMBER CORRADINI: But -- so your thinking is to write a letter on this group of chapters, and we're still going to have Chapter 15 and long-term cooling to appear and talk to us?

MEMBER STETKAR: Let me -- let me ask this, though. Because if we write a letter on what we heard today -- which is the SER written against Rev. 1 that still has confirmatory items to be incorporated into a known Rev. 2 -- where does that put the ACRS in terms of finality on the certified design? Do we then write yet another letter later on?

MEMBER CORRADINI: If you don't have it in front of you and you want to look --

MEMBER STETKAR: No, that -- but -- but my question is, do we then write -- do we get Rev. 2 or not?

CHAIRMAN BALLINGER: Rev. 2 is scheduled for February 2018. Next month.

(Off-microphone comment.)

MEMBER CORRADINI: You need your green light on.

MEMBER STETKAR: Yes, but my point is, the final -- we don't have the final DCD today.

MEMBER POWERS: Then you're not going to write a letter on the final --

MEMBER STETKAR: We can't write the final DCD.

(Simultaneous speaking.)

MEMBER POWERS: That's right.

MEMBER STETKAR: And then my point is -

MEMBER POWERS: He's just writing a letter on these chapters that says we haven't identified anything that is a major roadblock. But whoa, remember, eventually we have to look at the whole integrated things. And knee bones do get connected to thigh bones here, and there can be a difference. He's not writing -- he's just saying to the staff, so far we haven't found anything that --

MEMBER STETKAR: But I want to make sure that -- that the staff is clear that any letter that comes out of us in response to Rev. 1 of the DCD and the SER written against that Rev. 1 is not the ACRS's final letter --

(Simultaneous speaking.)

MEMBER POWERS: I think the staff is very aware of that. These are interim letters. It says so right up at the top of them.

MEMBER STETKAR: They have so far.

CHAIRMAN BALLINGER: And they will -- this one will, too.

MEMBER POWERS: And there's no reason for that process to change. And then this was understood when we agreed to do it chapter by chapter rather than as an integrated whole because there's a problems that knee bones are connected to the thigh bones and that what you see about one part of it may look benign until you find out how it interfaces with the other part.

MEMBER CORRADINI: The only letter -- I mean, I am just harkening back to a lovely eight years ago when we wrote the one on ESBWR and this -- in December of '09 is when we wrote that. That was the only final letter where we expected to see finality in the documentation.

MEMBER STETKAR: Yes, but what I don't remember, Mike, is we didn't have three iterations on ACRS letters there, did we? We only had two.

MEMBER CORRADINI: You're asking a detail I don't remember. I know -- I know there were -- particularly in digital I&C we did have some interim back and forth with the staff because there wasn't enough detail for functional diagrams. And I seem to remember at least a couple letters on digital I&C. Don't ask me what phase it was in, but I remember a couple of letters. More than -- more than one, and then a closed with all the open items.

MEMBER BROWN: Which design?

MEMBER CORRADINI: ESBWR.

MEMBER BROWN: Oh -- oh, yes.

MEMBER SUNSERI: So has it been -- has it always been the ACRS protocol to review the SER with open items prior to reviewing the one with no open items?

MEMBER POWERS: Originally the design certifications were done as an integrated whole.

MEMBER CORRADINI: Yes, so there was a letter.

MEMBER POWERS: And that -- that produces headaches all the way around when you do it that way. There -- first of all, you -- I can remember when the -- the ABWR was wheeled in and said, okay, here are ACRS -- it was a cart of documents that you have to review in some finite period of time. And that was formidable for us. It was formidable for the staff because they got it as close to final form as they possibly could.

We went to this other system to try it out. It's -- it has its pluses and it has its minuses. One of the minuses that we knew immediately is, again, knee bones connected to thigh bones. And so we built that into the system that -- we put out these interim letters mostly just to say here's a rough spot that

you, staff, need to work out. If we haven't identified any of those things, then focus on the things that -- all the other stuff you have to get done because we -- we haven't identified any -- it doesn't mean there isn't something. It just means we haven't identified it yet.

CHAIRMAN BALLINGER: So far we've only written Phase 2 letters.

MEMBER STETKAR: Well, but that's --

CHAIRMAN BALLINGER: This is really a Phase 5 letter.

MEMBER STETKAR: Well, but what is Phase 5? Right.

CHAIRMAN BALLINGER: No open items.

MEMBER STETKAR: Well, but it's not the ACRS. My only question is --

(Simultaneous speaking.)

MEMBER POWERS: Over and over again, how many times do I have to tell you?

MEMBER STETKAR: You don't have to tell me anymore, Dana. I'm questioning whether this apparent requirement, as it's being cast, to write a Phase 5 letter right now makes any sense at all. Does the ACRS need to waste our time and the staff's time and the Applicant's time to go through a full ACRS

meeting because somebody believes that we need to write yet another interim letter right now? Or do we just wait until the end?

MEMBER CORRADINI: I don't think there's a requirement to write the letter.

MEMBER STETKAR: No, there isn't.

MEMBER POWERS: Right. The interim letters are not required.

MEMBER CORRADINI: Yes.

MEMBER STETKAR: No, there not.

MEMBER CORRADINI: To the extent -- to the extent that the -- if I might -- to the extent that the staff has gotten good -- have taken good notes and have communicate -- understand the communication of what we're worried about -- and it's not a show-stopper. It's rough around the edges that need to be smooth. It's up to us if we want to decide to write something at this point. Whether we want to document it in black and white or essentially communicate it by conversation.

CHAIRMAN BALLINGER: You see, the way I would look at it -- and I have never done this before, so there are people around this table who have done it multiple times. And that is if it's part of our review with Phase 5, we suddenly discover something

which is pretty major. Then we write a letter.

MEMBER CORRADINI: But I think -

CHAIRMAN BALLINGER: If we don't see anything, then there's no reason to do that.

MEMBER CORRADINI: Right. I think that's what -- that's I think where Dana was coming from.

MEMBER POWERS: I mean there -- there's always some -- I mean the -- the interim letters have been proved of some use in that it forces us to -- to codify our thinking and write things down. They serve as the basis of what you're going to write in the final letter. Are there things to bring up there? I mean, they serve some function, but if you don't want to do them, you don't have to do them.

Here are my recommendation -- these are diverse chapters. I would go ahead and write something. If I were doing that --

(Simultaneous speaking.)

MEMBER CORRADINI: Particularly -- something in 16 or 18 that really concerns you that you want to get on the record that they need to fix before you see a Rev. 2. A final version of whatever --

MEMBER POWERS: Even if there was nothing. Just -- just to get down okay, here's what we did here

-- here's what our thinking is. Does everybody agree that this is our thinking? That's -- that's all I want. So even if there was nothing important, I would go ahead and do it just because here's a block of work. You can decide how much you're going to go back to it.

CHAIRMAN BALLINGER: I mean, I have no problem writing -- writing a letter. You know, just -- has to serve some purpose. And it sounds like it would serve a -- would serve a purpose. What are other opinions around the -- around the table here? This is normally the kind of discussion we have at a full committee meeting, right?

PARTICIPANT: No, this is fine.

MEMBER STETKAR: This is a subcommittee meeting because we typically will poll the members to see whether or not we feel that it should be before the full committee. And that could or could not prompt a letter. So it -- no, we typically have this discussion.

CHAIRMAN BALLINGER: So let's ask Vesna what she thinks before the drugs wear off and she realizes what she's gotten herself into.

MEMBER STETKAR: Turn your mic on.

MEMBER DIMITRIJEVIC: So that was pretty

good. And I got my badge. It's -- this was very interesting discussion for me. My concern is if we are going to write final like the -- and we identify something important, that's not right. I mean, it -- we should identify the full -- this before we wrote the final attempt. So.

CHAIRMAN BALLINGER: Oh, yes. That's for sure.

MEMBER DIMITRIJEVIC: So if we have something important our definition of what is important -- if we have addressed concern. I mean, I don't know. It depend on what the politics was before.

CHAIRMAN BALLINGER: What's important is up to the members, right? I mean, we have some diverse chapters and stuff like that where individuals have different expertise. So we have to leave it up to individual members to voice a concern if it's a concern. I think.

MEMBER SKILLMAN: My thought is that the -- not the concerns. The items that we raised, KHNP has acted on.

CHAIRMAN BALLINGER: That's from Phase 2 to Phase -- to now. Yes, sure.

MEMBER SKILLMAN: Yes, so -- so I think similarly as Dana, probably good policy to say these

are the chapters we reviewed, the items that we raised in past months have been addressed. And we're -- we're waiting for the next round. But this is the work that we've -- that we've accomplished.

CHAIRMAN BALLINGER: So that's a pretty straightforward letter.

MEMBER SKILLMAN: Bingo. So I think there's value in basically creating a work log or a -- our collectively communicating we've done this work and this is the status. But I'm impressed at how many of the items that we raised, they've really acted on. They've taken them to heart. They changed documentation. They changed the DCD. So I say salute. Let's tell them great, thank you.

CHAIRMAN BALLINGER: Okay.

MEMBER DIMITRIJEVIC: Did -- did we document those concerns in the letter?

CHAIRMAN BALLINGER: Earlier letters, yes.

MEMBER DIMITRIJEVIC: How many letters we wrote on this?

CHAIRMAN BALLINGER: Chris, three?

MR. BROWN: On this topic, it's about --

(Simultaneous speaking.)

PARTICIPANT: No, not on this topic. No, no. Generally. For Phase 2 -- how many Phase 2

letters? I forgot. Three I think?

MR. BROWN: It's about three. Every about four or five chapters.

MEMBER DIMITRIJEVIC: So we wrote just Phase 2 -- for example, let's choose this human factors. We only wrote one letter so far. That was in Phase 2 and we wrote Phase 1 and Phase 2, right?

MEMBER CORRADINI: No, this is the second time around for all the chapters. This is the -- the start of the next round.

MEMBER DIMITRIJEVIC: So we only wrote one letter so far?

CHAIRMAN BALLINGER: We wrote three letters, but one on -- only one on these chapter.

MEMBER DIMITRIJEVIC: Right. On different chapters. Three letters on different chapters.

MEMBER BROWN: We can also -- if we had an issue or an item that we think wasn't addressed, I did have a couple of -- I can try to write something up for you for if you decide to try to write a letter. On the chapter -- whatever it was, 14 items.

CHAIRMAN BALLINGER: Much appreciated.

MEMBER BROWN: If and when we're going to do it. Just let me know when we're going to do it.

CHAIRMAN BALLINGER: Soon. There's a --

(Simultaneous speaking.)

MEMBER BROWN: Well, is it going to be -- is it going to be in the February meeting? Is it going to be at the March meeting? It's kind of late for the February meeting.

CHAIRMAN BALLINGER: Probably March. Well, Chris, we'll have to go through and see what --

MR. BROWN: It's late for March, also. We have to work on schedules. The agenda is already out. We're not going to do March. Long-term cooling and --

CHAIRMAN BALLINGER: A large-break LOCA?

MR. BROWN: No, PLUS7 is in March.

CHAIRMAN BALLINGER: That's -- yes. Okay, well that's a logistics issue. A big one, but --

MEMBER BROWN: Well, just inform me before my allocator bits disappear.

(Laughter.)

CHAIRMAN BALLINGER: Anybody else? Walt seemed like he was about ready to push the green button --

(Simultaneous speaking.)

MEMBER KIRCHNER: Well, I was. A little

levity. Hossein can add another data point to the letters that are on the bar charts for the history of the ACRS.

CHAIRMAN BALLINGER: Oh, that's important.

MEMBER KIRCHNER: So that's important as well. But no, seriously, I think I agree with Dana in that we should -- we reviewed this material. We didn't find -- well, maybe. Maybe I shouldn't say --

(Laughter.)

MEMBER KIRCHNER: For everyone. But we reviewed it. If we have a problem we should say so. If we don't then we've done it and check the box and it's -- I think the appropriate thing to do.

CHAIRMAN BALLINGER: Okay. Okay, so we will just have to figure out the logistics.

MEMBER SKILLMAN: I'd like to say, I was kind of impressed at Lauren's having raised the RAI, the staff having moved on the RAI and then John points out the table on which the RAI was written isn't recognized anywhere else. That, to me, is a substantial finding. That's one that -- it says, gee whiz, something kind of fell through the cracks.

MEMBER CORRADINI: But I -- but if I might just interject. If I heard what KHNP gave us at the

very end, in their Revision 2 of --

(Simultaneous speaking.)

MEMBER STETKAR: That's sort of what I heard, there might be more explanatory text around that thing. Because right now it's just -- it's -- it's just there.

MEMBER CORRADINI: But we have not seen Revision 2 or --

(Simultaneous speaking.)

MEMBER STETKAR: But we have not seen Revision 2.

MR. OH: I would like to explain a little bit of history --

PARTICIPANT: And you are?

MR. OH: Yes, this is Andy Oh, KHNP, Washington Office. We got us under the RAI from the staff about -- the staff says and please remove Appendix B and C. So we agree with that basically. So from now on, we think it's Appendix B and C, there's no value. However, because --

MEMBER CORRADINI: Can you say that again? I guess --

MR. OH: Yes, for --

(Simultaneous speaking.)

MEMBER STETKAR: It's on the record.

(Laughter.)

MEMBER CORRADINI: You just gave us a piece of information that may have saved us a whole lot of --

MR. OH: Appendix B and C, that is for -- if you see the RAI -- 18-133 is -- actually staff is request for those Appendix B and C is have to be removed. I think for -- I have some RAI for that. So --

MEMBER CORRADINI: But you've given us a piece of information that we then have to check on. I think that's appropriate.

MR. OH: Staff is in 18-133 is for Question C is remove Appendix B and C from the TIHAIP. Yes, but we all says it don't have much value. So however that is referenced in some other RAI, so that's the reason we just -- but then we also made some of statement. Because those information will be provided in the -- the site-specific PRA. Because the -- this is only for the preliminary for -- for the table. We state very clearly about that. So we 0 I think the staff is also agreeing with that. From now on, because that -- the answer for the RAI, from now on, there's no value for the Appendix B and C. That is just for the preliminary -- kind of -- as the Ken said is -- it is kind of, you know, example or something. So

that's the -- the common understanding from the staff and KHNP for B and C.

CHAIRMAN BALLINGER: But not having them solves the problem.

(Simultaneous speaking.)

MEMBER STETKAR: Speculation is speculation. We have to see what they come out with Rev. 2. Period. I mean it -- speculation is speculation.

CHAIRMAN BALLINGER: Anybody else?

MEMBER SUNSERI: I would just say, you know, words are important. And if the tables are characterized as preliminary versus illustrative, then preliminary connotes that this is some important piece of work that is going to be built upon, not irrelevant. So just be careful on how you describe that table when you clarify it.

CHAIRMAN BALLINGER: Any more?

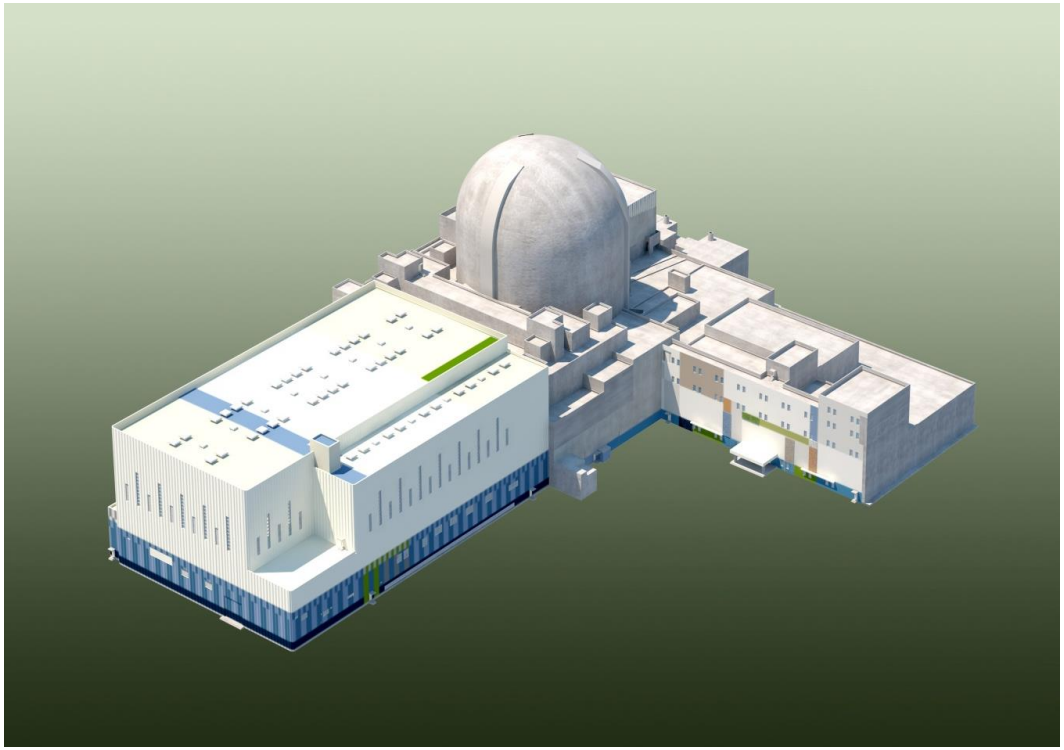
(No audible response.)

CHAIRMAN BALLINGER: Well, thank you very much. It's been a long day, but we were warned. And I was admonished. We are adjourned.

(Whereupon, the above-entitled matter went off the record at 6:08 p.m.)

NON-PROPRIETARY

APR1400 DCA
Chapter 4: Reactor



KEPCO/KHNP

January 24, 2018

NON-PROPRIETARY

Contents

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  - Section Overview
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Overview of Chapter 4

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4.2	Fuel System Design	• Design Bases • Description and Design Drawings • Design Evaluation • Testing and Inspection Plan
4.3	Nuclear Design	• Design Bases • Description • Analytical Methods • Changes
4.4	Thermal-Hydraulic Design	• Design Bases • Description of Thermal-Hydraulic Design of the Reactor Core • Description of Thermal-Hydraulic Design of the Reactor Coolant System • Evaluation • Testing and Verification • Instrumentation Requirements
4.5	Reactor Materials	• Control Rod Drive System Structural Materials • Reactor Internals and Core Support Materials
4.6	Functional Design of Reactivity Control System	• Information for the Control Rod Drive System • Evaluation of the Control Rod Drive System • Testing and Verification of the Control Rod Drive System • Information for Combined Performance of the Reactivity Control Systems • Evaluation of Combined Performance of the Reactivity Control Systems

Overview of Chapter 4

❖ List of Submitted Documents for Chapter 4

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier 2: Chapter 4 REACTOR	1	DCD	-
APR1400-F-M-TR-13001-P & NP	PLUS7 Fuel Design for APR1400	1	TR	ML17237A025
APR1400-Z-M-NR-14010-P & NP	Structural Analysis of Fuel Assemblies for Seismic and Loss of Coolant Accident Loading	2	TeR	ML17228A787
APR1400-F-C-NR-14002-P & NP	Functional Design Requirements for a Core Operating Limit Supervisory System for APR1400	1	TeR	ML17094A132
APR1400-F-C-TR-12002-P-A & NP-A	KCE-1 Critical Heat Flux Correlation for PLUS7 Thermal Design	0	TR	ML17115A556
APR1400-F-C-NR-12001-P & NP	Thermal Design Methodology	2	TeR	ML17181A052
APR1400-Z-M-NR-14017	Evaluation of Irradiation Assisted Stress Corrosion Cracking and Void Swelling on Reactor Vessel Internals	0	TeR	ML16096A280

❖ Summary of RAIs

No. of Questions	No. of Responses	No. of OI
62	62	0

* There were 4 open items at phase 3.

Overview of Chapter 4

❖ List of Open Items

No.	Related RAI	Topic	ADAMS Accession #
1	RAI 5-7954 (Q 11, 12, 16 & 18)	Impacts of Thermal Conductivity Degradation	ML17335A069 ML17223B387
2	RAI 275-8294 (Q 4.2.5 - 7) RAI 425-8405 (Q 4.2.9 - 14)	Fuel Assembly Structural Response	ML17082A416 ML17080A138
3	RAI 301-8280 (Q 7.1.45)	CPC Setpoint Analysis Methodology	ML17214A221
4	RAI 523-8684 (Q 4.5.1.15 & 16)	Versa Vent classification and experience	ML16309A074 ML16335A465

Summary of Open Items

❖ Open Item: Impacts of Thermal Conductivity Degradation

- Related RAIs : 5-7954 (Q 11, 12, 16, and 18)
- Description of issue
  - NRC Staff noted that FATES3B does not account for the effect of thermal conductivity degradation (TCD) and requested a TCD impact on fuel rod design and safety analysis.
    - ✓ FATES3B is used for fuel rod performance analysis and generation of interface data for safety analysis.
- Resolution:
  - TCD penalty was conservatively determined based on the analysis of comparison to the experimental data at various burnups.
  - KHNP responded that the evaluation results for the fuel rod design were satisfied with consideration of TCD.

Summary of Open Items

❖ Open Item: Impacts of Thermal Conductivity Degradation

- Resolution (Cont'd):
  - KHNP responded that as a result of the safety analyses with consideration of TCD, all the TCD-affected areas were satisfied.
  - Topical Report and Technical Report were revised to reflect the impact of TCD.
    - ✓ Topical Report : PLUS7 Fuel Design for APR1400 (APR1400-F-M-TR-13001)
    - ✓ Technical Report : Criticality Analysis of NFR and SFR (APR1400-Z-A-NR-14011)
  - TCD-affected DCD Tier 2 sections were revised to reflect the impact of TCD as followings.
    - ✓ Section 4.3.2.3.8 : Impact of Thermal Conductivity Degradation on Reactivity Coefficients
    - ✓ Section 6.2.1 : Containment Functional Design
    - ✓ Section 9.1.1 : Criticality Safety of New Spent Fuel Storage
    - ✓ Section 15.0.0 : General Information for Safety Analysis
    - ✓ Section 15.4.8 : Element Assembly Ejection Accidents
    - ✓ Section 15.6.5 : Loss-of-Coolant Accidents

Summary of Open Items

❖ Open Item: Fuel Assembly Structural Response

- Related RAIs : 275-8294(Q 4.2.5 - 7), 425-8405(Q 4.2.9 - 14)
- Description of issue
  - KHNP provided Technical Report for the PLUS7 Seismic/LOCA analysis (APR1400-Z-M-NR-14010-P, Revision 0)
    - ✓ The report contains PLUS7 Seismic/LOCA analysis results at EOL condition to consider NRC IN 2012-09*.
    - ✓ The EOL PLUS7 fuel assembly model for the analysis was developed based on BOL PLUS7 test data and BOL&EOL test data from CENPD-178-P**.
  - Staff requested to provide the followings:
    - ✓ Seismic/LOCA Analysis results for the BOL conditions
    - ✓ Applicability of the EOL test data from CENPD-178-P
    - ✓ Methodology used to obtain frequency of fuel assembly
    - ✓ Justification for the critical damping ratio used for Seismic/LOCA Analysis
    - ✓ Justification for the crush strength of grid

* IN 2012-09, Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength
** CENPD-178-P, Structural Analysis of Fuel Assemblies for Seismic and Loss of Coolant Accident Loading

Summary of Open Items

❖ Open Item: Fuel Assembly Structural Response

- Resolution:
  - KHNP performed Seismic/LOCA analysis based on the new test to response the RAIs
    - ✓ New tests for PLUS7 fuel assemblies and grids were performed using Westinghouse Columbia facility at BOL and/or EOL conditions to define the fuel assembly dynamic characteristics.
      - ➢ Fuel Assembly Mechanical Tests

        Load Deflection Test, Free Vibration Test, Pluck Impact Test, Forced Vibration Test,
      - ➢ Fuel Assembly Flowing Water Damping Test
      - ➢ Grid Crush Tests

        Static Compression Test, One-Sided Impact Test, Through-Grid Impact Test
    - ✓ Fuel assembly model for the Seismic/LOCA analysis was developed.
    - ✓ Seismic/LOCA analysis was performed at BOL and EOL conditions.
    - ✓ The analysis results show that the PLUS7 fuel assembly maintains structural integrity for Seismic/LOCA events at BOL and EOL conditions.

Summary of Open Items

❖ Open Item: Fuel Assembly Structural Response

- Resolution (Cont'd):
  - The methodology used for the tests, model developments and analysis is based on the CENPD-178-P, Revision 1 (ML14122A087) which was approved by NRC.
  - KHNP provided the followings:
    - ✓ Revision of the Technical Report for Seismic/LOCA analysis (APR1400-Z-M-NR-14010-P, Revision 2)
    - ✓ Responses for the RAIs

Summary of Open Items

❖ Open Item: CPC Setpoint Analysis Methodology

- Related RAIs : 301-8280 (Q 7.1.45)
- Description of issue
  - Provide the basis for using one-sided tolerance limit factor of 1.645 in the Technical Report APR1400-F-C-NR-14001.
  - Discuss this factor is consistent with Regulatory Guide 1.105, “Setpoints for Safety-Related Instrumentation,” Revision 3.
- Resolution:
  - KHNP responded that the application of the setpoints for the CPC is inherently one-sided so that the value of 1.645 is the 95/95 one-sided tolerance limit factor for an infinite number of data points.
  - KHNP will revise the DCD Table 1.9 -1, Table 7.1-1, Chapters 7 and 15 with exceptions to compliance with Regulatory Guide 1.105, Revision 3.

Summary of Open Items

❖ Open Item: Versa Vent classification and experience

- Related RAIs : RAI 523-8684 (4.5.1.15 and 16)
- Description of issue
  - The staff did not agree that the Versa Vent is not a pressure boundary component since it replaces pressure boundary housing nut.
  - KHNP was requested to provide data/operational experience that demonstrates venting works in practice.
- Resolution:
  - KHNP provided explanation of functional differences between the Versa Vent as a venting device and the housing nut as a pressure boundary component with seal weld.
  - KHNP provided relevant data and operational experience.

Current Status

- **Chapter 4 is complete.**
  - KHNP continues to monitor Chapter 4 to assure any conforming changes are addressed.
  - 4 open items, that were identified in Phase 3, have been resolved with adequate and sufficient discussion with the staff.

- **Changes in Chapter 4 as reviewed and marked-up in response to the RAIs will be incorporated into the next revision (Rev.2) of the DCD.**

Attachment: Acronyms

BOL	Beginning of Life
CPC	Core Protection Calculator
EOL	End of Life
DCD	Design Control Document
IN	Information Notice
KHNP	Korea Hydro and Nuclear Power Co.
LOCA	Loss of Coolant Accident
NFR	New Fuel Rack
RAI	Request for Additional Information
SFR	Spent Fuel Rack
TCD	Thermal Conductivity Degradation
TeR	Technical Report
TR	Topical Report

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Presentation to the ACRS Subcommittee

Korea Hydro Nuclear Power Co., Ltd (KHNP) APR1400 Design Certification Application Review

Safety Evaluation with No Open Items:

Chapter 4 REACTOR

January 24, 2018

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U.S.NRC
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Technical Topics
Section 4.2 – Fuel System Design

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Open Item 04.02-1 (Fuel assembly mechanical design analysis)

Issue: DCD fuel system design analysis was dependent upon PLUS7 topical report APR1400-F-M-TR-13001-P, which was still under review. This open item had potential implications on DCD Sections 4.2, 4.3, and 4.4, depending on the path for resolution.

Resolution: The staff completed review of the topical report and concluded that (1) the fuel system is not damaged as a result of normal operations and AOOs, (2) fuel system damage is never so severe as to prevent control rod insertion when it is required, (3) the number of fuel rod failures is not underestimated for postulated accidents, and (4) coolability is always maintained. By ensuring that fuel and cladding integrity is maintained, the thermal design margin calculations in DCD Section 4.4 are unaffected. No nuclear design limitations or changes were necessary based on the resolution path, so DCD Section 4.3 is not impacted by this issue.

Open Item Closure: Based on the completion of the staff's review of the referenced topical report, the staff concludes that this open item is now closed.

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Open Item 04.02-2 (Structural analysis of fuel assemblies for seismic and loss of coolant accident loading)

Issue: The applicant needed to revise technical report APR1400-Z-M-NR-14010-P (now Revision 2) in order to address staff concerns, but was not completed in time for Phase 2 review.

Resolution: Revision 2 of the technical report was completed in July 2017. The staff's review of the information has been incorporated into the latest version of the Section 4.2 SER, and the review is summarized in the following slides.

Open Item Closure: The staff reviewed the information provided by the applicant and determined that the PLUS7 fuel assembly will meet the requirements of GDC 2 in terms of fuel assembly structural response to externally applied loads.

Fuel Assembly Structural Analysis

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Analysis of Loads

- Application is based on previously approved CE codes and methods:
  - CENPD-42 was used to determine the dynamic response of the reactor vessel internals (RVI)
  - CENPD-178-P, Revision 1, was used for the structural analysis of the fuel assemblies based on the RVI dynamic response
  - CENPD-252-P-A was used for the analysis of blowdown loads from pipe ruptures
- Fuel assembly response characteristics were determined by testing. The tests covered:
  - BOL and EOL conditions (to address IN-2012-09)
  - Air, still water, and flowing water conditions
- Staff reviewed the tests and analyses and concluded that the referenced methodology was correctly followed and that the seismic damping credit was supported by the test results. Therefore, the fuel assembly loading values are acceptable.

Fuel Assembly Structural Analysis

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Determination of Strength

- Application follows the methodology of topical report CENPD-178-P, Rev 1, for the strength calculations
  - One-sided drop test is used to determine one-sided grid crush strength (representing grid-to-barrel impacts).
  - Through-grid long pulse test is used to determine the through-grid crush strength (representing grid-to-grid impacts).
  - Acceptance criteria for fuel assembly components other than grids are based on ASME Boiler and Pressure Vessel (BPV) Codes Section III
  - Acceptance criteria for grids are developed from grid crush test data
- These limits follow the staff guidance provided in SRP Section 4.2, Appendix A, and are therefore acceptable.

Fuel Assembly Structural Analysis

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Acceptance Criteria and Analysis

- APR1400-A-M-NR-14010-P, Revision 2, presents the analysis of the PLUS7 fuel assembly in the APR1400 and provides the acceptance criteria by which the PLUS7 fuel assembly is evaluated.
- The staff's review concluded that the applicant adequately demonstrated that fuel rod fragmentation would not occur as a direct result of LOCA blowdown and safe-shutdown earthquake loads and that control rod insertability is ensured.

Technical Topics
Section 4.3 – Nuclear Design

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ACRS Question: Why was Shin-Kori data allowed to be used to validate MCNP to calculate shape annealing functions (SAFs) when the staff did not accept a foreign plant as a prototype plant during the Phase 3 review?

- As discussed in the Chapter 14 presentation, the staff's position on referencing foreign plants as prototype plants is that it is acceptable provided that the quality assurance (QA) program for construction and testing is consistent with the applicant's approved QA program
- In this case, Shin-Kori data was being used to show that MCNP is an acceptable tool for calculating SAFs, not as a means to exempt the design from testing
- Power ascension test "Verification of Core Protection Calculator Power Distribution Related Constants Test" verifies SAFs
- Standard Review Plan Section 4.3 states that critical experiments and operating reactors should be used to validate codes and analysis procedures, but no guidance exists on the use of domestic vs. foreign data for core calculations
- Validation technical report went through KHNP's QA process before being submitted

Technical Topics
Section 4.3 – Nuclear Design

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ACRS Comment: The staff did not document the issue of load following in the SER, which could lead to confusion or problems in the future.

Resolution:

- The staff revised SER Section 4.3 to discuss the related RAI (RAI 8332, Question 04.03-4) and to explicitly state that the APR1400 is approved for baseload operation only
- The staff ensured that any references to load following throughout the DCD were removed, with the exception of a pending revision to Chapter 10 that is still being tracked as Confirmatory Item 4.3-1

Technical Topics
Section 4.4 – Thermal-Hydraulic Design

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- **Chapter 7 Open Item, RAI 8280, Question 07.01-45**

Issue: Single versus double-sided confidence level in setpoint methodology

Resolution: Applicant provided statistical justification for key safety-related setpoints and modified DCD and technical reports to indicate exceptions to Revision 3 of RG 1.105. Chapter 7 reviewers have approved these changes.

- **COL Information Item 04.02-1**

Issue: A COL Information Item is needed to develop the specific plant procedures necessary to ensure that Core Protection Calculator constants are correctly and consistently implemented.

Resolution: The applicant added a COL Information Item to accomplish this.

- **ACRS Question from Phase 3 Meeting:**

How is the 3 percent core bypass flow fraction in the RELAP model validated?

Resolution: The bypass fraction cannot be directly measured in the plant, but can be indirectly confirmed by calorimetric balance calculations performed during plant startup and periodically during plant operation. It is treated as an uncertainty in the RELAP model.

Technical Topics

Section 4.5.1 – Control Rod Drive Systems
Structural Materials

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Open Item - RAI 523-8684, Questions 04.05.01-15 and 04.05.01-16

Issue: DCD lacked sufficient information of why the Versa-Vent is not considered reactor coolant pressure boundary and also did not provide operating experience of the Versa-Vent to reduce dissolved oxygen levels.

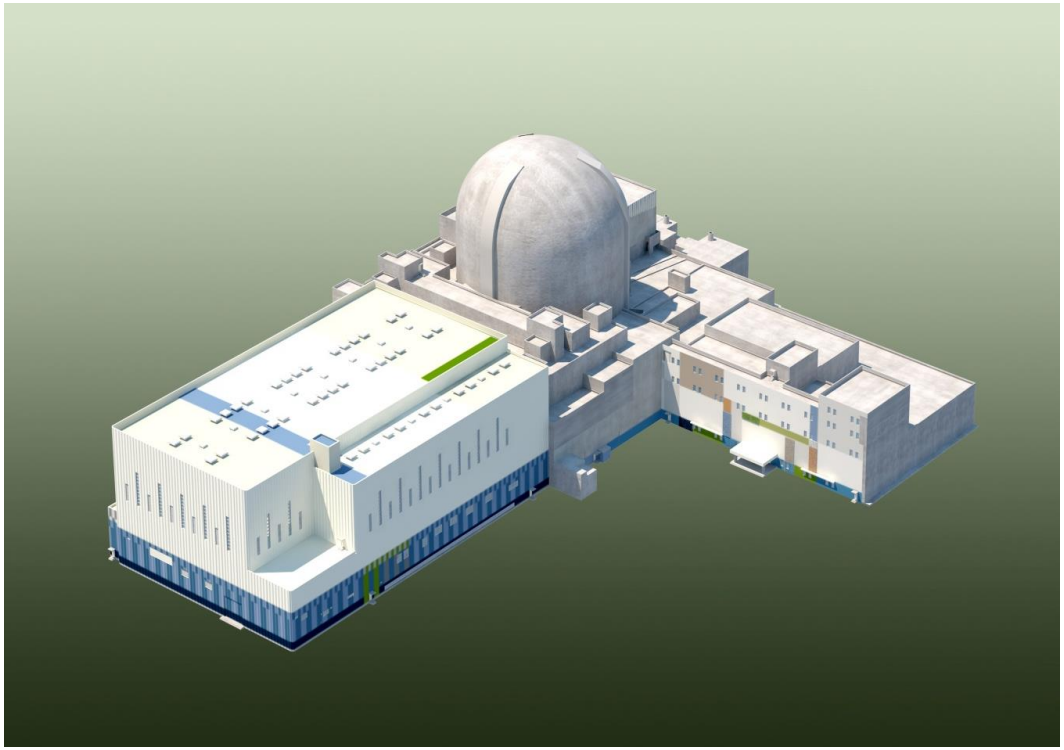
Resolution: A response to RAI 523-8684 was provided and included:

- justification for classification of the ball and vent stem (and the housing nut if installed and welded) as pressure boundary components, and therefore the Versa-Vent is not credited as a pressure boundary component.
- operating experience of the Versa-Vent (approximately 20 years of satisfactory operation) with no history of cracking in the Versa-Vent or the CRD components.
- APR1400 CRD upper housing and vent stem are at low temperatures, 57°C (135°F), which also minimizes the occurrence of stress corrosion cracking.

Open Item Closure: The staff reviewed the information provided by the applicant and determined that the Versa-Vent is not credited as a pressure boundary component, and the use of the Versa-Vent reduces the dissolved oxygen levels to minimize stress corrosion cracking to satisfy the SRP guidance and therefore meets the intent of GDCs 1, 14, and 26, as well as 10 CFR 50.55a.

NON-PROPRIETARY

APR1400 DCA
Chapter 14: Verification Programs



KEPCO/KHNP

January 24, 2018

NON-PROPRIETARY

Contents

- **Overview of Chapter 14**
  - Section Overview
  - List of Submitted Documents and Summary of RAIs
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- **Attachments:**
  - Acronyms
  - List of COL Items related to Open Items

Overview of Chapter 14

❑ Contents of Chapter 14

Section No.	Description	Remark
14.1	Specific Information to be Addressed for the Initial Plant Test Program	
14.2	Initial Plant Test Program	
14.3	Inspection, Tests, Analyses, and Acceptance Criteria	To be discussed at future ACRS

Overview of Chapter 14

❑ Contents of 14.2 Initial Test Program

Section No. (14.2.X)	Description
1	Summary of Test Program and Objectives
2	Organization and Staffing
3	Test Procedures
4	Conduct of Test Program
5	Review, Evaluation, and Approval of Test Results
6	Test Records
7	Conformance of Test Program with NRC Regulatory Guides
8	Use of Reactor Operating Experience in the Development of the ITP
9	Trial Use of Plant Operating and Emergency Procedures
10	Initial Fuel Loading and Initial Criticality
11	Test Program Schedules
12	**Test Description**
13	Combined License Information
14	Reference

Overview of Chapter 14

❑ 14.2.12 Test Description consists of four phases

Phase	Test Description	No of tests (DCD Rev.0)	No of tests (DCD Rev.1)	No of tests (DCD Rev.2) -To be submitted-
I	Pre-operational testing	135	153	154
II	Fuel loading and post-core hot functional test	11	10	11
III	Initial Criticality and low-power physics testing	6	6	7
IV	Power ascension testing	26	26	27
Total		**178**	**195**	**199**

Overview of Chapter 14

❖ List of Submitted Documents for Chapter 14

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier 2: Chap 14 Verification Programs	0	DCD	ML15006A041
		1	DCD	-
APR1400-K-X-IT-14001-P & NP	APR1400 Design Control Document Tier 1	0	DCD	ML15006A039
		1	DCD	-

❖ Summary of RAIs (RAIs directly for Section 14.2)

No. of Questions	No. of Responses	Not Responded	No. of Open Items
71	71	0	0

Overview of Chapter 14

❖ List of Open Items

No.	RAI No.	Question No.	Topic	Resolution	ADAMS Accession #
1	513-8663 (91-7867)	14.02-67 (14.02-08)	Revision of the Startup Administrative Manual (SAM) in accordance with SRP 14.2.II.3	Revised SAM	ML17155A002
2	91-7867	14.02-09	Addition of two tests to DCD Table 1.9-1 for conformance with RG 1.20 • Internal Vibration Monitoring System Test • Nuclear Steam Supply System (NSSS) Integrity Monitoring System Test	Resolved with discussion • Not directly related to RG 1.20	ML15240A044
	187-8101	14.02-10			ML16142A017
3	528-8709	14.02-70	Need for Natural Circulation Test (First-of-a-Kind Test)	Resolved with discussion • Performed at PVGNS Unit 1	ML17034A402
4	281-8232	14.02-54	Revision of Steam Generator Blowdown System Test in accordance with RG 1.68	Revised ITP	ML16182A590
	277-8227	14.02-38			ML16182A556
5	524-8697	14.02-69	Addition of Initial fuel load/Inverse Count Ratio Tests	Revised ITP	ML17201Q508

Overview of Chapter 14

❖ List of Open Items

No.	RAI No.	Question No.	Topic	Resolution	ADAMS Accession #
6	281-8232	14.02-49	Radiation signal transmit to Emergency Response Data System	Revised Ch.11 & 12	ML17223B359
7	198-8208	14.02-21	Redundancy and independence test of Core Protection Calculator System	Revised ITP	ML16354B590
8	198-8208	14.02-23	Addition of prerequisite to Fixed In-Core Nuclear Signal Channel Test for clarification of ICI functions and location	Resolved with discussion • Confirmed by In-core Detector Test	ML17082A454
9	198-8208	14.02-37	Revision of Remote Shutdown Console Test to verify manual controls in the MCR	Revised other ITP • ESF Component Control System Test	ML16174A467
			Need for integrated test of the MCR manual controls	Resolved with discussion • Confirmed by individual tests	
10	529-8711	14.02-71	Revision of Alternate AC Source System Test in accordance with RG 1.68	Revised ITP	ML17006A397

Overview of Chapter 14

❖ List of Open Items

No.	RAI No.	Question No.	Topic	Resolution	ADAMS Accession #
11	283-8229	14.02-63	Identification radiation source in testing • Liquid Waste Management System Test • Gaseous Waste Management System Test	Resolved with discussion • Related to PERMSS test (Item No. 10)	ML16279A543
12	283-8229	14.02-64			
13	281-8232	14.02-50	Use a radiation check source to verify that radiation monitors are functional • Process and Effluent Radiological Monitoring System Test • Area Radiation Monitoring System Test	Resolved with discussion • Radiation check source will be used as part of an ITAAC	ML17212B046
14	192-8180	14.02-15	Revision of Gaseous Waste Management System Test in accordance with 10CFR50, App. I	Revised ITP	ML18167A249
15	195-8182	14.02-18	Revision of Process and Effluent Radiological Monitoring System Test in accordance with 10CFR50, App. I	Revised ITP	ML16089A516
16	198-8208	14.02-35	Justification of the deletion of Post-Core Ex-Core Neutron Flux Monitoring System Test	Resolved with discussion • ENFMS test is conducted in pre-operational testing	ML17201Q513

Technical Topic

❖ Exemption of CVAP

- **Why is CVAP not included as part of the ITP? The design of the RCS should be verified to be identical to the prototype plant in order to exempt CVAP.**

  - The APR1400 is classified as a non-prototype category I plant referring Palo Verde Nuclear Generation Station (PVNGS) Unit 1 as the prototype plant.
  - In accordance with the guidance of RG 1.20, the vibration measurement program can be omitted for non-prototype category I reactors if an inspection program is implemented.
  - Since an analysis program and an inspection program are being implemented as described in APR1400 DCD, Section 3.9 and the results are being assessed in those programs, implementation of a vibration measurement program is not necessary.

Current Status

- **Chapter 14.1 and 14.2 are complete**
  - KHNP continues to monitor Chapter 14.1 and 14.2 to assure any conforming changes are addressed.
  - 16 open items, that were identified in Phase 3 have been resolved with adequate and sufficient discussion with the staff.

- **Changes in Chapter 14.1 and 14.2 as reviewed and marked-up in response to the RAIs will be incorporated into the next revision (Rev.2) of the DCD.**

NON-PROPRIETARY

Attachment: Acronyms

AAC	alternate alternating current
ARMS	area radiation monitoring system
COL	combined license
CPCS	core protection calculator system
CVAP	comprehensive vibration assessment program
ENFMS	ex-core neutron flux monitoring system
ERDS	emergency response data system
GTG	gas turbine generator
GWMS	gaseous waste management system
HFT	hot functional test
ITAAC	inspection, test, analyses, and acceptance criteria
ITP	initial test program
IVMS	internal vibration monitoring system
LWMS	liquid waste management system
MCR	main control room
NIMS	nuclear steam supply system integrity monitoring system
NSSS	nuclear steam supply system
SGBS	steam generator blowdown system
SAM	startup administrative manual
PERMSS	process and effluent radiation monitoring and sampling system

Attachment : List of COL Item related to OIs

COL Identifier	Description
COL 14.2(14)	The COL applicant is to perform the appropriate interface testing of the gaseous PERMSS monitors with ERDS.

Attachment : List of Changes in ITP

No.	Status	Title
14.2.12.1.136		RCP Vibration Monitoring System
14.2.12.1.137		NSSS Integrity Monitoring System (Pre-core)
14.2.12.1.138		Core Protection Calculator System Test
14.2.12.1.139		Diverse Indication System Test
14.2.12.1.140		Pre-Core Pressurizer Surge Line Stratification Test
14.2.12.1.141		Location of vital equipment
14.2.12.1.142		Access to vital equipment
14.2.12.1.143		Equipment to permit observation of abnormal presence or activity of persons or vehicles
14.2.12.1.144		Vehicle barrier system to protect against the design basis threat vehicle bombs
14.2.12.1.145		Vital areas with active intrusion detection systems
14.2.12.1.146		Security alarm annunciation and video assessment information
14.2.12.1.147		Location and equipment of the central and secondary alarm stations
14.2.12.1.148		Secondary security power supply system
14.2.12.1.149		Intrusion detection and assessment systems
14.2.12.1.150		Equipment and emergency exits
14.2.12.1.151		Security communication systems
14.2.12.1.152		Bullet-Resisting Barriers
14.2.12.1.153		Security Alarm Devices and Transmission Lines
14.2.12.1.154		Plant Communication Systems
14.2.12.2.1		Initial Fuel Loading
14.2.12.2.11	Deleted	Post-Core Ex-Core Neutron Flux Monitoring System Test
14.2.12.3.1		Initial Criticality Test
14.2.12.4.22	Deleted	Natural Circulation Test (First-of-a-Kind-Test)
14.2.12.4.26		Fatigue Monitoring System Test
14.2.12.4.27		Ex-core Neutron Flux Monitoring System Calibration

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Presentation to the ACRS Subcommittee

Korea Hydro & Nuclear Power Co., Ltd (KHNP)
APR1400 Design Certification Application Review

Safety Evaluation with No Open Items:

CHAPTER 14 VERIFICATION PROGRAMS

January 24, 2018

Staff Review Team

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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  - Project Manager: Cayetano Santos, NRO/DNRL/LB2

- Technical Staff
  - Lead Reviewer: Ashley Ferguson, NRO/DCIP/QVIB
  - Supporting Reviewers: 38 Technical Reviewers from 11 NRO Branches and 1 NRR Branch

Technical Topics

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- Prototype Plants
- Comparison of APR1400 with Palo Verde Unit 1
- 14.1 Specific Information to be addressed for the Initial Plant Test Program
- 14.2 Initial Plant Test Program

Technical Topics

Prototype Plants

- What is the staff's position regarding allowing foreign plants to be referenced as the prototype plant for a US design certification?
  - The staff finds that referencing a foreign plant as a prototype plant is acceptable provided the applicant can demonstrate that the quality assurance (QA) program for construction and performance of the initial test program for the foreign plant is consistent with the applicant's approved QA program.

Technical Topics

Comparison of APR1400 with Palo Verde Unit 1

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- DCD Table 1.3, “Comparison of NSSS components” compares the APR1400, System 80+, and SKN3&4. Where is the comparison of the Palo Verde data included in DCD Table 1.3?
  - For the reactor internals comprehensive vibration assessment program (CVAP), KHNP referenced Palo Verde Unit 1 as prototype. DCD Tier 2, Table 3.9-16 lists the comparison of dimensions of major reactor internals components for APR1400 and Palo Verde, while Table 3.9-17 lists the comparison of operating conditions for reactor internals for APR1400 and Palo Verde.

Technical Topics

Section 14.1 - Specific Information to be addressed for the Initial Plant Test Program

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- The NRC staff concludes that the information provided in Section 14.1 adequately describes the specific information to be addressed for the ITP, and is thus acceptable.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #1 (RAI 513-8663, Question 14.02-67)

- **Issue:** The applicant did not address the administrative control responsibilities listed in bullet items A through D of SRP Section 14.2.II.3, "Initial Test Program Administrative Procedures," for completing the Startup Administrative Manual (SAM). Additionally the applicant did not reference all of the ITP test abstracts for the preoperational, post core hot functional, low power physics, and power accession test phases in the SAM.

- **Resolution:** The applicant updated the SAM to include the administrative control responsibilities referenced in SRP Section 14.2.II.3 for the applicant. Additionally the applicant updated the SAM to reference all the ITP abstracts that have been incorporated into the APR1400 DCD, Revision 1, Section 14.2.

- **Staff Conclusion:** The staff determined that the proposed change provides that the SAM meets the guidance in SRP Section 14.2.II.3 for administrative controls, and includes all the test abstracts of SSCs that will be tested in the ITP per the guidance in RG 1.68, Appendix A, Section A-2, "Initial Fuel Loading and Pre-Critical Tests," and Section A-3; "Initial Criticality."

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #2 (RAI 91-7867, Question 14.02-9 and RAI 187-8101, Question 14.02-10)

- **Issue:** The applicant did not reference RG 1.20 for the Internal Vibration Monitoring System (IVMS) Test (14.2.12.1.41), Loose Parts Monitoring System (LPMS) Test (14.2.12.1.42), Acoustic Leak Monitoring System (ALMS) Test (14.2.12.1.43), Baseline Nuclear Steam Supply System (NSSS) Integrity Test (14.2.14.4.18), which contain test objectives, prerequisites, methods, and acceptance criteria related to compliance with RG 1.20.

- **Resolution:** The applicant stated that it will satisfy the commitment for CVAP by implementing an inspection program that provides for inspection of the reactor internals as described in APR1400 DCD, Section 3.9.

- **Staff Conclusion:** In accordance with the guidance of RG 1.20, the vibration measurement program can be omitted for non-prototype category I reactors if an inspection program is implemented. The NRC staff determined that although the IVMS, LPMS, ALMS, and Baseline NSSS Integrity tests include some vibration monitoring activities, these tests are not required to meet the guidance in RG 1.20.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #3 (RAI 528-8709, Question 14.02-70)

- **Issue:** The applicant did not include testing to demonstrate that boron mixing and natural circulation can be used to cool down the reactor from hot standby to hot shutdown conditions with suitable test acceptance criteria to place the shutdown cooling system (SCS) inservice.

- **Resolution:** The applicant stated that testing to verify the design heat removal, boron mixing plant cool down/depressurization, and stable natural circulation conditions are maintained was performed at PVGNS Unit 1, which is the prototype plant for the APR1400 design. The DC applicant collected operating experience data from PVGNS Unit 1.

- **Staff Conclusion:** The staff determined that comparison of the plant's reactor coolant system hydraulic data to a reference prototype plant of similar design and configuration is an acceptable means for verification of natural circulation.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #4 (RAI 277-8227, Question 14.02-38 and RAI 281-8232, Question 14.02-54)

- **Issue:** The applicant did not address testing of (1) the isolation features for the Steam Generator Blowdown System (SGBS), based on the presence of radioactivity and (2) thermal protection of the demineralizer beds.

- **Resolution:** The applicant updated the DCD to include testing of the SGBS valves used to control the temperature in the resin beds and the potential release of radioactivity.

- **Staff Conclusion:** The staff determined that testing of the automatic isolation function due to high temperature will be performed consistent with the regulatory guidance in RG 1.68, Appendix A, Section A-1.k, which states that the temperature of the SGBS should be monitored to protect resin beds from excessive temperature, which could damage them and result in an unacceptable radioactive release or contamination event.

Technical Topics

Section 14.2 – Initial Plant Test Program

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Open Item #5 (RAI 524-8697, Question 14.02-69)

- **Issue:** The applicant did not include tests for initial fuel load and initial criticality to conform to the guidance in RG 1.68.

- **Resolution:** The applicant proposed to update the DCD to include two new tests for initial fuel loading and initial criticality. These updates to APR1400 DCD, Section 14.2 are being tracked as a confirmatory item.

- **Staff Conclusion:** The staff determined that the proposed initial fuel loading and initial criticality tests provide assurance that the facility is in a final state of readiness to achieve initial criticality.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #6 (RAI 281-8232, Question 14.02-49)

- **Issue:** The applicant did not specify that the containment upper operating area monitors transmit a signal via the emergency response data system (ERDS).

- **Resolution:** The applicant proposed to revised the DCD to specify that all radiation process and effluent monitors (gaseous and liquid), the containment air monitor, the main control room (MCR) air intake monitors, gaseous radwaste system exhaust monitor, main steam line monitors, and containment upper operating area monitors, transmit radiation signals to the ERDS. The proposed change is being tracked as a confirmatory item.

- **Staff Conclusion:** The NRC staff determined that the applicant's response provided that the radiation monitoring system parameters, as required per 10 CFR Part 50, Appendix E, Section VI, will be transmitted to the ERDS.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #7 (RAI 198-8208, Question 14.02-21)

- **Issue:** The applicant did not include testing for redundancy and independence of the Core Protection Calculator System (CPCS).

- **Resolution:** The applicant proposed to revise APR1400 DCD, Subsection 14.2.12.1.138 to provide the details relating to the CPCS redundancy and independence testing. The proposed changes are being tracked as a confirmatory item.

- **Staff Conclusion:** The staff determined the proposed changes meet the guidance of RG 1.68 for the CPCS system.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #8 (RAI 198-8208, Question 14.02-23)

- **Issue:** The prequisites of the In-core Detector Test (APR1400 DCD Section 14.2.12.4.16) do not specify that the proper location of each in-core detector are verified.

- **Resolution:** The applicant clarified that after the in-core detectors are installed, there is no credible means to check the mis-positioning of the detector before the Power Ascension Test (PAT) stage. During the PAT, mis-positioning of the detector can be found by the In-core Detector Test using the neutron flux signals from the in-core detectors. Therefore, verifying the proper location of each in-core detector is not a prerequisite for the In-core Detector Test.

- **Staff Conclusion:** Based on the clarification provided and the identification of other initial tests to verify that in-core detectors are aligned, the staff finds that the verification of proper location of each in-core detector does not need to be a pre-requisite for APR1400 DCD, Subsection 14.2.12.1.26.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #9 (RAI 198-8208, Question 14.02-37)

- **Issue:** It was not clear to the staff which test verifies the operation of the diverse manual engineered safety features (ESF) actuation (DMA). Further, there was no integrated test of the MCR manual controls.

- **Resolution:** The applicant proposed to add a test objective to verify the interface of the DMA switches, for each ESF component with a DMA interface, including correct ESF component response. Additionally, the DC applicant provided clarification as to why an integrated test of the MCR will not be performed. The proposed changed is being tracked as a confirmatory item.

- **Staff Conclusion:** The staff determined that although the DC applicant will not perform an integrated test of the MCR manual controls, the controls for each system and component are tested from MCR individually as specified in APR1400 DCD, Tier 2, Section 14.2.12. In addition, the integrated system design (i.e., hardware, software, procedure and personnel elements) is evaluated in accordance with NUREG-0711, Human Factors Verification and Validation.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open item #10 (RAI 529-8711, Question 14.02-71)

- **Issue:** The DC applicant did not address how the initial test program demonstrates that the alternate ac (AAC) gas turbine generator (GTG) and its supporting systems can be started, controlled, and monitored from the remote shutdown room (RSR) to cope with an station blackout (SBO).

- **Resolution:** The applicant proposed to add tests for the AAC GTG and the AAC GTG support systems to APR1400 DCD, Subsection 14.2.12.1.89 and 14.2.12.1.90. The proposed changes are being tracked as a confirmatory item.

- **Staff Conclusion:** The staff determined that this response meets 10 CFR 50, Appendix A, GDC 17 and 18, and RG 1.68, Appendix A, Section A-1.g, Item 3, “Emergency or Standby AC Power Supplies,” because the proposed change provides that testing will be completed to demonstrate that the AAC GTG and supporting systems can be controlled and monitored from the RSR.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #11 (RAI 283-8229, Question 14.02-63)

- **Issue:** The applicant did not note that the liquid waste management system (LWMS) radiation monitors are tested with a radiation check source under both the ITAAC and the ITP preoperational test; therefore, testing of the monitors should be performed and counted once under both the ITAAC and the ITP preoperational test.

- **Resolution:** The staff originally determined that LWMS radiation monitors should be tested with a radiation check source under both the ITAAC and the ITP preoperational test. However, after further discussion with the applicant, the NRC staff determined that it was acceptable to use a simulated source during preoperational testing as long as the LWMS radiation monitors are tested with a radiation check source prior to fuel load.

- **Staff Conclusion:** The staff determined that since the LWMS radiation monitors are tested with a radiation check source as part of an ITAAC, it is acceptable to use a simulated source during preoperational testing.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #12 (RAI 283-8229, Question 14.02-64)

- **Issue:** The applicant did not note that the gaseous radwaste system (GRS) radiation monitors are tested with a radiation check source under both the ITAAC and the ITP preoperational test; therefore, testing of the monitors should be performed and counted once under both the ITAAC and the ITP preoperational test.

- **Resolution:** The NRC staff originally determined that GRS radiation monitors should be tested with a radiation check source under both the ITAAC and the ITP preoperational test. However, after further discussion with applicant, the NRC staff determined that it was acceptable to use a simulated source during preoperational testing as long as the GRS radiation monitors are tested with a radiation check source prior to fuel load.

- **Staff Conclusion:** The NRC staff determined that since the GRS radiation monitors are tested with a radiation check source as part of an ITAAC, it is acceptable to use a simulated source during preoperational testing.

Technical Topics

Section 14.2 – Initial Plant Test Program

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Open Item #13 (RAI 281-8232, Question 14.02-50)

- **Issue:** The applicant proposed to used simulated signals to test radiation monitors instead of using a radiation check source.

- **Resolution:** The staff originally determined that each channel of the process and effluent radiation monitoring and sampling system (PERMSS) and area radiation monitoring system (ARMS) should be tested with a radiation check source under both the ITAAC and the ITP preoperational test; therefore, this test would be performed and counted once under both the ITAAC and the ITP preoperational test. However, after further discussion with the DC applicant, the staff determined that it was acceptable to use a simulated source during preoperational testing as long as each channel of the PERMSS and ARMS are tested with a radiation check source prior to fuel load.

- **Staff Conclusion:** The staff determined that since each channel of the PERMSS and ARMS are tested with a radiation check source as part of an ITAAC, the applicant's response is acceptable.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #14 (RAI 192-8180, Question 14.02-15)

- **Issue:** The DC applicant did not include verification of manual and automatic response to normal control, alarms, and indications in the Gaseous Waste Management System (GWMS) Test (DCD Subsection 14.2.12.1.105).

- **Resolution:** The DC applicant proposed to revise the test method and acceptance criteria for the GWMS to: (1) verify the operation of the GWMS equipment as described in APR1400 DCD, Section 11.3; (2) verify automatic valve operation upon the receipt of a low flow signal from the Gaseous Radwaste System (GRS) discharge line; (3) verify automatic valve operation upon the receipt of low-low Air Cleaning Unit (ACU) exhaust flow signal; and (4) verify automatic drain valve operation upon the receipt of low and high GRS header drain tank level.

- **Staff Conclusion:** The NRC staff determined that the proposed revisions provide for verification of manual and automatic response to normal control, alarms, and indications as it relates to monitoring and complying with the effluent concentration limits specified in Appendix I of 10 CFR Part 50.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #15 (RAI 195-8182, Question 14.02-18)

- **Issue:** The applicant did not test the PERMSS monitoring and signal generation when the radiation level detected exceeds the preset levels in accordance with the system design criteria and the description in DCD Section 11.5.

- **Resolution:** The applicant revised the DCD to expand the description in the acceptance criteria for the PERMSS to address the system's monitoring and signal generation when the radiation level detected exceeds the preset levels.

- **Staff Conclusion:** The staff determined that the proposed response provides that verification of radiation monitor and isolation valves to monitor and control effluent discharge to the environment are addressed as required by 10 CFR Part 50, Appendix I.

Technical Topics

Section 14.2 – Initial Plant Test Program

Open Item #16 (RAI 198-8208, Question 14.02-35)

- **Issue:** The staff disagreed with the applicants assessment that the Post-Core Ex-Core Neutron Flux Monitoring System (ENFMS) test (DCD Subsection 14.2.12.2.11) could be deleted because the applicant would not be verifying initial fuel loading/initial criticality testing of ENFMS neutron monitors when first loading fuel. Additionally, the applicant did not include testing for both in-core and ex-core neutron detectors, the core protection calculator system (CPCS) and any other digital I&C systems needed to support initial fuel load/initial criticality testing.

- **Resolution:** The applicant provided a table of how operability verification of the ex-core and in-core detector systems with actual neutron sources or by plant startup conditions after the systems' pre-operational tests will be conducted. Additionally the applicant proposed to revise the DCD to incorporate the ex-core tests of safety linear power channel and control channel. The proposed change is being tracked as a Confirmatory Item.

- **Staff Conclusion:** The staff found the that the proposed provides for adequate testing of the ex-core neutron monitoring system within the power ascension tests, and conforms to RG 1.68. As such, the NRC staff determined that deleting APR1400 DCD, Subsection 14.2.12.2.11 is acceptable.

Technical Topics

Section 14.2 – Initial Plant Test Program

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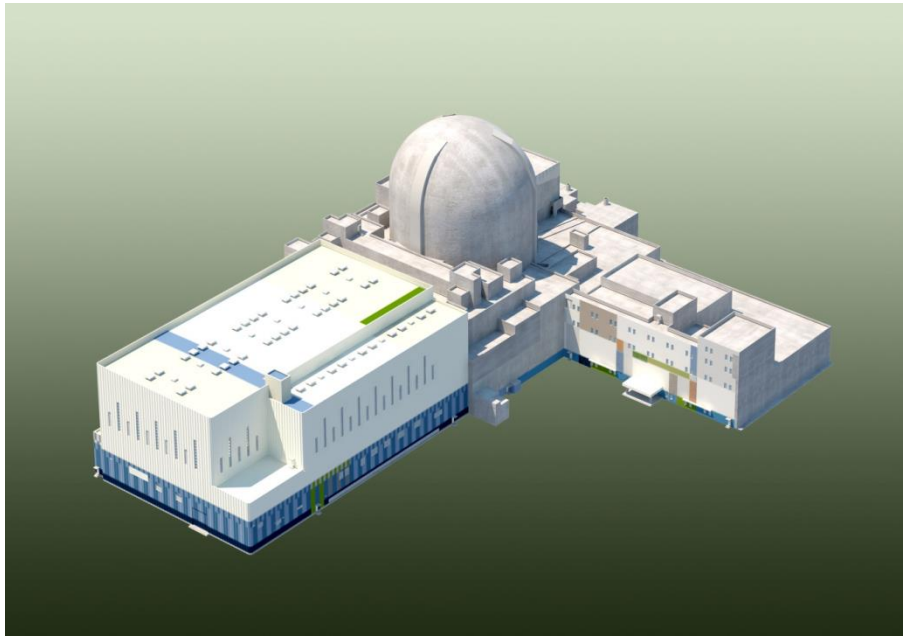
- The staff has determined that all open items associated with Chapter 14, Sections 14.1 and 14.2, have been adequately addressed and the responses meet all applicable regulatory criteria.

- The staff concludes, using the information presented in the DCD, and pending the confirmation of the remaining confirmatory items, that the applicant has demonstrated compliance with NRC regulations and guidance.

NON-PROPRIETARY

APR1400 DCA
Chapter 16: Technical Specification



KEPCO/KHNP

January 24, 2018

Contents

Overview of Chapter 16

- **APR1400 Technical Specifications were developed based on NUREG-1432 Rev.04('12.04), "Standard Technical Specifications- CE plants"**

- **Differences between APR1400 TS and STS are the unique APR1400 design features related to**
  - RCS, SIS, IRWST, AFWS, etc.
  - Technical Report submitted, "Deviation Report between NUREG-1432 Rev.4 and APR1400 TS, Rev01" ('15.12, ML15338A328)

Overview of Chapter 16

❑ Section Overview

Section	Contents
1.0	**USE AND APPLICATIONS**
2.0	**SAFETY LIMITS**
3.0	**LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY SUREVEILLANCE REQUIREMENT (SR) APPLICABILITY**
3.1	REACTIVITY CONTROL SYSTEMS
3.2	POWER DISTRIBUTION LIMITS
3.3	INSTRUMENTATION
3.4	REACTOR COOLANT SYSTEM (RCS)
3.5	EMERGENCY CORE COOLING SYSTEM (ECCS)
3.6	CONTAINMENT SYSTEMS
3.7	PLANT SYSTEMS
3.8	ELECTRICAL POWER SYSTEMS
3.9	REFUELING OPERATIONS
4.0	**DESIGN FEATURES**
5.0	**ADMINISTRATIVE CONTROLS**

Overview of Chapter 16

❖ List of Submitted Document for Chapter 16

Document No.	Title	Revision	Type	Issued Date
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier 2: Chap 16 Technical Specifications	1	DCD	2017.03
APR1400-K-X-IT-14001-P & NP	APR1400 Design Control Document Tier 1	1	DCD	2017.03
APR1400-K-O-NR-14001-NP	Deviation Report between NUREG -1432 Revision 4.0 and APR1400 Technical Specifications	1	Technical Report	2015.12

❖ Summary of RAIs

No. of Questions	No. of Responses	No. of Open Items
223	223	0

Summary of Major Open Items – (1/4)

1. Disposition of NRC-approved TSTF (RAI 154-8064)

- **Issue : Verify TSTF Travelers that are not included in APR1400 TS**

- **Resolution:**
  - **All NRC-approved TSTF Travelers including those approved since NUREG-1432 Rev.4 were reviewed**
  - **The TSTF Travelers list with rationale for not including, or including were reflected in the Deviation Report.**
  - T

- **Status : Resolved**

Summary of Major Open Items – (2/4)

2. LCO selection criteria (RAI 154-8064)

- **Issue : Provided results of evaluation to apply LCO selection criteria to APR1400 design and safety analyses**

- **Resolution:**
  - **Systematic evaluation of LCO selection criteria was completed against related DCD Chapter 5,6,7,15,19**
  - **Submit four tables for each LCO selection criteria**
  - **Additional LCO included**
    - ✓ **CPC auxiliary trip function, Charging flow..**

- **Status : Resolved**

Summary of Major Open Items – (3/4)

3. SIS diagonally operable (RAI 509-8591)

- **Issue : Diagonally oriented safety injection trains inoperable – use two separate Condition rows**

- **Resolution:**
  - **For clarity, statement revised**
  - **Two trains inoperable and diagonally oriented with respect to the reactor vessel (Trains 1 and 3, or Trains 2 and 4)**

- **Status : Resolved**

Summary of Major Open Items – (4/4)

4. AFWS (RAI 498-8595)

- **Issue : Improve LCO statement and modify the NOTE of TS 3.7.5 to highlight the distinguishing features of APR1400 compared to STS(NUREG-1432)**

- **Resolution:**

  - **Auxiliary Feedwater (AFW) System Required Actions & Completion Times appropriate to the APR1400 design were reflected**

- **Status : Resolved**

Summary

- All RAIs on Chapter 16 were resolved and all responses were decided to be acceptable.
- DCD Rev.2 will be published in February of 2018.
- Deviation Report between NUREG-1432 Rev.4 and APR1400 TS is being updated to match Rev.2 of DCD.

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Korea Hydro Nuclear Power Co., Ltd (KHNP)
APR1400 Design Certification Application Review

Safety Evaluation with No Open Items: Chapter 16

GENERIC TECHNICAL SPECIFICATIONS AND BASES

JANUARY 24, 2018

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Technical Staff Presenters**
  - Craig Harbuck
- **Project Managers**
  - Bill Ward – Lead Project Manager
  - Jessica Umaña – Chapter 16 Project Manager

Staff Review Team

U.S.NRC
United States Nuclear Regulatory Commission
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  - **Plant Systems Branch** ..... Rick Scully, Hien Le
- **Secondary Reviewers**
  - **Containment and Ventilation Branch** ..... Nan Chien, Raj Goel, ... Anne-Marie Grady, Syed Haider, Boyce Travis
  - **Mechanical Engineering Branch** ..... Tuan Le, James Strnisha
  - **Radiation Protection and Accident Consequences Branch** ... Michelle Hart
  - **Reactor Systems, Nuclear Performance, and Code Review Branch** .... Matt Thomas, Carl Thurston, Alexandra Burja
  - **Instrumentation, Controls, and Electrical Engineering Branch** .... Joe Ashcraft, Ken Mott, Jack Zhao
  - **Plant Systems Branch** ..... Angelo Stubbs
  - **Probabilistic Risk Assessment Branch** ..... Marie Pohida
  - **Electrical Engineering Branch**** ..... Swagata Som
  - **Materials & Chemical Engineering Branch** ..... Greg Makar

* Center of expertise NRR/DSS/STSB ** Center of expertise NRR/DE/EEEB

Chapter 16 Review Results

(1 of 6)

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- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas:
  - Defined terms
  - Shutdown risk mitigation
    - Action requirements to raise RCS water level upon losing shutdown cooling system flow while in reduced RCS inventory condition (RV level ≤ 127 ft, 1/4 in; 3 ft below top of RV flange)
    - Requirement for two operable safety injection system trains (diagonally oriented) in MODES 4 and 5; and in MODE 6 with RV level ≤ 130 ft (1/4 in below top of RV flange)
    - Requirement for containment spray pump to backup the running shutdown cooling pump in MODE 5 with RCS loops not filled, and in MODE 6 while in reduced RCS inventory condition

Chapter 16 Review Results

(2 of 6)

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- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas (continued):
  - Requirements to prevent or mitigate inadvertent reactor coolant boron dilution
  - Using an NRC-approved "equivalent isolation method" for containment penetrations that provide a direct flow path from the containment atmosphere to the outside environment, is allowed for fuel handling accident mitigation, but not for loss of shutdown cooling mitigation

Chapter 16 Review Results

(3 of 6)

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- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas (continued):
  - Control Element Assembly Calculator (CEAC) and Core Protection Calculator (CPC) Action Requirements
  - Clarified correspondence between instrumentation SRs & RPS and ESFAS testing described in DCD Sections 7.2 and 7.3
  - Verified that actuated components in each subgroup of each channel of ESFAS Actuation Logic have been identified (SR 3.3.6.2)

Chapter 16 Review Results
(4 of 6)

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- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas (continued):
  - Auxiliary Feedwater (AFW) System Required Actions & Completion Times appropriate to the APR1400 design

Chapter 16 Review Results

(5 of 6)

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- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas (continued):
  - Operability, Action, and Surveillance requirements for CRHS active component actuation logic and interlocks
  - AMI Functions and number of channels required for each Function
- Performing a cross train verification of operability of redundant subsystem upon loss of an AC Source – What constitutes the redundancy?
  - Applicant provided list of divisions, trains, or subsystems to check for operability upon discovery of an inoperable offsite AC source or onsite AC source

Chapter 16 Review Results
(6 of 6)

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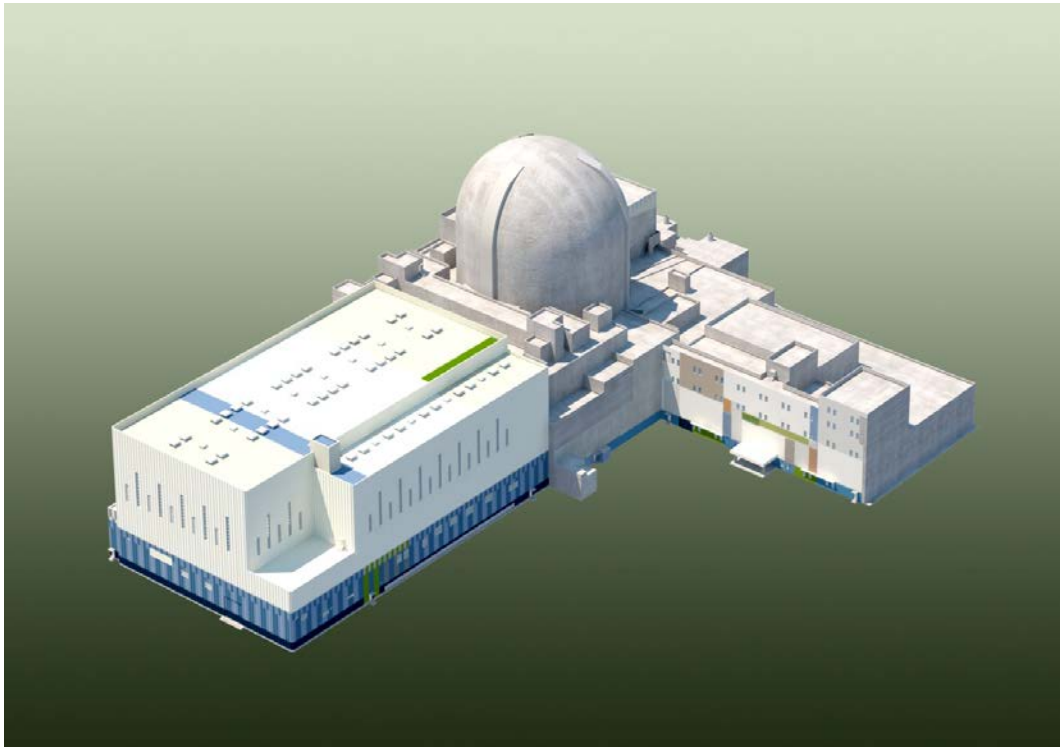
- This safety evaluation chapter describes the staff's review of the GTS and Bases and the resolution of the approximately 135 open items in the following areas (continued):
  - LCO selection criteria are met
  - TSTF disposition is complete
  - All COL action items are appropriate and clearly identified

➢ Pending completion of confirmatory items, staff finds that GTS and Bases meet §50.36 and §50.36a

NON-PROPRIETARY

APR1400 DCA
Chapter 18: Human Factors Engineering



KEPCO/KHNP

January 24, 2018

NON-PROPRIETARY

Contents

- **Overview of Chapter 18**
  - Section Overview
  - List of Submitted Documents
- **Summary of RAIs after Phase 3 ACRS SC Meeting**
  - List of RAIs
- **Current Status**
- **Attachments:**
  - Acronyms

Overview of Chapter 18

❖ Section Overview

Section	Title
18.1	Human Factors Engineering Program Management
18.2	Operating Experience Review
18.3	Functional Requirements Analysis and Function Allocation
18.4	Task Analysis
18.5	Staffing and Qualifications
18.6	Treatment of Important Human Actions
18.7	Human-System Interface Design
18.8	Procedure Development
18.9	Training Program Development
18.10	Human Factors Verification and Validation
18.11	Design Implementation
18.12	Human Performance Monitoring

Overview of Chapter 18

❖ List of Submitted Documents for Chapter 18

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-P and NP	Design Control Document TIER 2 Chapter 18, Human Factors Engineering	1	DCD	-
APR1400-E-I-NR-14001-P and NP	Human Factors Engineering Program Plan	1	IBR	ML17094A192
APR1400-E-I-NR-14002-P and NP	Operating Experience Review Implementation Plan	1	IBR	ML17094A193
APR1400-E-I-NR-14003-P and NP	Functional Requirements Analysis and Function Allocation Implementation Plan	1	IBR	ML17094A191
APR1400-E-I-NR-14004-P and NP	Task Analysis Implementation Plan	1	IBR	ML17094A195
APR1400-K-I-NR-14005-P and NP	Staffing and Qualifications Implementation Plan	1	IBR	ML17094A202
APR1400-E-I-NR-14006-P and NP	Treatment of Important Human Actions Implementation Plan	1	IBR	ML17094A200
APR1400-E-I-NR-14007-P and NP	Human-System Interface Design Implementation Plan	1	IBR	ML17094A147
APR1400-E-I-NR-14008-P and NP	Human Factors Verification and Validation Implementation Plan	1	IBR	ML17094A198
APR1400-E-I-NR-14009-P and NP	Design Implementation	1	IBR	ML17094A203
APR1400-E-I-NR-14010-P and NP	Human Factors Verification and Validation Scenarios	1	TER	ML17094A201
APR1400-E-I-NR-14011-P and NP	Basic Human-System Interface	1	IBR	ML17094A197
APR1400-E-I-NR-14012-P and NP	Style Guide	1	IBR	ML17094A194

Summary of RAIs after Phase 3 ACRS SC Meeting

❖ List of RAIs

No.	Related RAI	Title	ADAMS Accession #
1	553-9084 (Q.18-133)	Treatment of Important Human Actions	ML17271A188
2	553-9084 (Q.18-135)	Procedures for ISV	ML17317A397
3	553-9084 (Q.18-134)	HFE ITAAC	ML17271A188
4	553-9084 (Q.18-136)	Operating Experience Review	ML17271A188
5	553-9084 (Q.18-137)	Site Specific Information	ML17271A188, ML17321A017

Summary of RAIs after Phase 3 ACRS SC Meeting

❖ RAI 553-9084 Question 18-133: Treatment of Important Human Actions

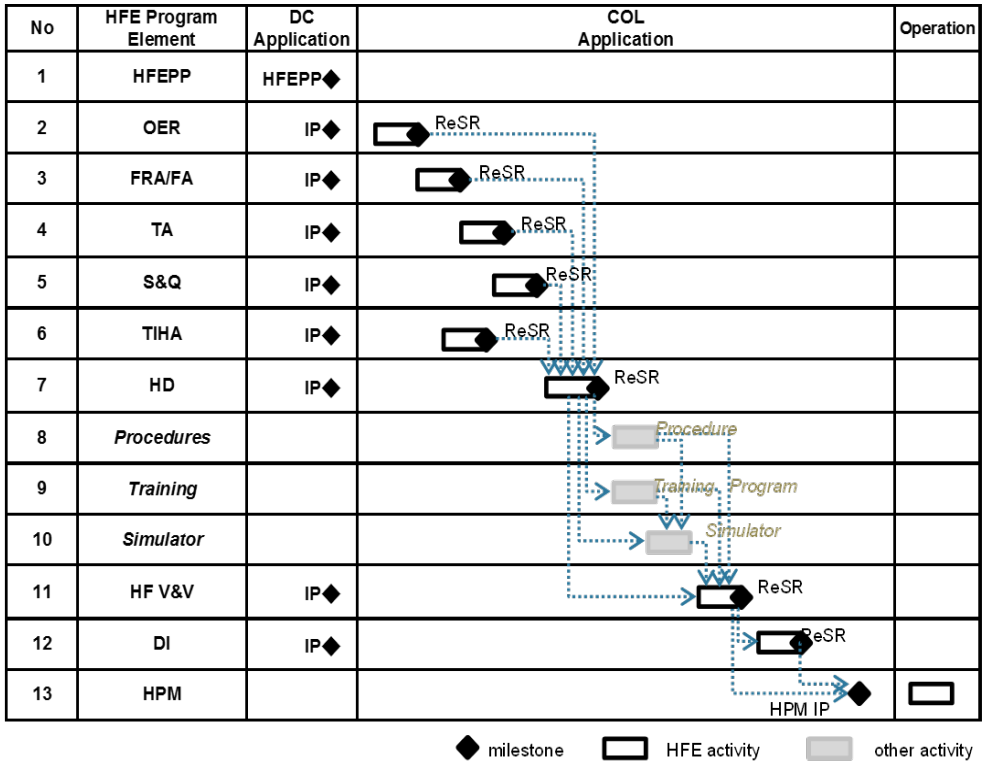
- **Description of issue**
  - The application does not address how the Risk Important Human Actions identified from the site-specific PRA (e.g., seismic PRA) are implemented in the HFE program
- **Resolution**
  - The TIHA Implementation Plan (IP) has been revised to indicate the followings:
    - ✓ The preliminary TIHA output for RIHAs is addressed in Appendix C. The list of RIHAs supports the basis for the initial HSI design.
    - ✓ The IHAs from TIHA IP will be updated iteratively as the APR1400 detailed design progresses, including the site-specific PRA.

Summary of RAIs after Phase 3 ACRS SC Meeting

❖ RAI 553-9084 Question 18-134: HFE ITAAC

- **Description of issue**
  - The COL will need to complete the activities in the HFE IPs, but it was not clear how the COL will know it is the COL's responsibility to complete these activities

- **Resolution**
  - The HF V&V IP has been revised to state the following:
    - ✓ The APR1400 HF V&V assures that each HFE program element is conducted in accordance with corresponding IP, and the result of each HFE program element is documented in the corresponding ReSR and supports closure of the ITAAC, as illustrated in the figure below.



Summary of RAIs after Phase 3 ACRS SC Meeting

❖ RAI 553-9084 Question 18-135: Procedures for ISV

- **Description of issue**
  - The testbed used to conduct the ISV will only include the procedures that will be used during the ISV scenarios.
- **Resolution**
  - The HFE Program Plan and HSI Design IP have been revised to indicate the following:
    - ✓ The inventory of Computer-based Procedures (CBP) for the ISV scenarios includes additional procedures that are related to the ISV scenarios to ensure the operator decisions are not influenced by the CBP inventory.

Summary of RAIs after Phase 3 ACRS SC Meeting

❖ RAI 553-9084 Question 18-136: Operating Experience Review

- **Description of issue**
  - Operating experiences (OEs) with dates before the SKN 3&4 construction are assumed to be included in the APR1400 and are not screened again
- **Resolution**
  - The Operating Experience Review (OER) IP has been revised to indicate the following:
    - ✓ OEs that occurred before the SKN 3&4 close date will first be evaluated to determine whether they were included in the SKN 3&4 OER.
    - ✓ If they were included in the SKN 3&4 OER, then they may be screened out only if the lessons learned were identified and determined to be adequately addressed using the guidance in NRUEG-0711, Revision 3.

Summary of RAIs after Phase 3 ACRS SC Meeting

❖ RAI 553-9084 Question 18-137: Site Specific Information

- **Description of issue**
  - Why it is necessary to use generic assumptions for site-specific information when the COL applicant will perform the activities in the HFE implementation plans.
- **Resolution**
  - The Task Analysis IP has been revised to indicate the following:
    - ✓ The TA is based on generic assumptions that are made to establish a plant design that is reflected in the initial APR1400 HSI design. As site specific information is known, the generic assumptions are modified.
    - ✓ When the COL applicant performs the HFE activities, the site specific information that is applicable to develop the APR1400 HSI design at the site is updated accordingly.

Current Status

❖ **Chapter 18 is complete.**

- KHNP continues to monitor Chapter 18 to assure any conforming changes are addressed.
- Five RAIs after Phase 3 ACRS SC Meeting have been resolved with adequate and sufficient discussion with the staff.

❖ **Changes in Chapter 18 as reviewed and marked-up in response to the RAIs will be incorporated into the next revision (Rev.2) of the DCD.**

Attachment: Acronyms

COL	combined license
COLA	COL applicant
DAC	design acceptance criteria
DI	design implementation
FRA/FA	functional requirements analysis and function allocation
HF	human factors
HFE	human factors engineering
HFEPP	human factors engineering program plan
HSI	human system interface
ITAAC	inspections, tests, analyses, and acceptance criteria
ISV	integrated system validation
TIHA	treatment of important human actions
V&V	verification and validation

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Presentation to the ACRS Subcommittee

Korea Hydro & Nuclear Power Co., Ltd (KHNP)
APR1400 Design Certification Application Review

Safety Evaluation with No Open Items:

Chapter 18 HUMAN FACTORS ENGINEERING

January 24-25, 2018

U.S.NRC
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Staff Review Team

- **Technical Staff**
  - Lauren Kent and Brian Green – HOIB
  - Former HOIB staff
  - John O'Hara and Jim Higgins – Brookhaven National Laboratory
- **Project Managers**
  - Bill Ward – Lead Project Manager
  - Cayetano Santos – Chapter 18 Project Manager

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Issues Addressed with the Applicant in Phase 4

RAI 9084, Questions 18-133, -134, -135, -136, -137

- Completeness of ISV testbed
- Scope of OER
- Use of generic assumptions instead of site-specific information
- Treatment of RIHAs
- COL activities

RAI 7878, Question 07.05-1

- AMI Variables

Completeness of ISV Testbed

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RAI 9084, Question 18-135

Issue: NUREG-0711 says the ISV testbed (i.e., the control room simulator) should represent completely the integrated system. Although the V&V IP conforms to the guidance, other portions of the application did not because they indicated that only the procedures used during ISV scenarios will be available.

Resolution: The applicant revised the portions of the application that were not consistent with the V&V IP.

Staff Conclusion: The other portions of the application will be consistent with the V&V IP, which conforms to regulatory guidance for testbed interface completeness.

Scope of OER

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RAI 9084, Question 18-136

Issue: The OER IP said the OER starts with the OER conducted for SKN 3&4. Events that occurred before the SKN 3&4 close date will be assumed to have been included in the SKN 3&4 OER. However, there was insufficient basis to conclude the SKN 3&4 OER conformed to guidance for OER in NUREG-0711 and to assume lessons learned from relevant and significant industry events have been addressed in the design.

Scope of OER (continued)

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Resolution: The applicant revised the OER IP to say events that occurred before the SKN 3&4 close date will first be evaluated to determine whether they were included in the SKN 3&4 OER. If they were included in the SKN 3&4 OER, then they may be considered resolved only if the lessons learned were identified and determined to be adequately addressed.

Staff Conclusion: The revisions help ensure lessons learned from relevant and significant OE are evaluated and considered in the design.

Use of Generic Assumptions

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RAI 9084, Question 18-137

Issue: The FRA FA IP and the TA IP said generic assumptions for site-specific plant systems will be made during FRA, FA and TA, and changes will be made during design implementation, which occurs before fuel load, to address site-specific information.

However, when a COL performs the activities described in the IPs, site-specific information will be available.

Use of Generic Assumptions (continued)

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Resolution: The applicant revised the application to say that when the COL performs the HFE activities, the site-specific information will be used.

Staff Conclusion: The revisions help to ensure that FRA, FA and TA is performed using current design information.

Treatment of RIHAs

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RAI 9084, Question 18-133

Issue 1/3: The TIHA IP said the list of RIHAs that will be included in the HFE design program activities will be developed using the PRA developed for the generic APR1400 DCD instead of the site-specific PRA.

However, when a COL performs the activities described in the TIHA IP, site-specific information will be available.

Treatment of RIHAs (continued)

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Resolution: The applicant revised the TIHA IP to say the list of IHAs will be updated iteratively as the design progresses. To correctly identify the RIHAs and assumptions about performance of these actions from the PRA/HRA, the HFE design team will coordinate with the personnel who have been involved in the development of the site-specific PRA to complete Table 4-1 of the TIHA IP (i.e., the list of important human actions that will be included in the HFE design program activities).

Staff Conclusion: The revisions help ensure the COL uses current sources of information to identify the IHAs that will be addressed in the HFE design process.

Treatment of RIHAs (continued)

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Issue 2/3: NUREG-0711 says the HFE design should pay special attention to those plant scenarios, risk-important HAs, and HSIs that the PRA/HRA highlights as vital to plant safety and reliability. As such, personnel familiar with the PRA/HRA should be involved in developing the list of RIHAs that will be included in the HFE design program activities.

Although the TIHA IP said personnel with PRA knowledge will help develop the list of RIHAs, other portions of the DCD said that personnel with PRA knowledge were not needed for this activity.

Treatment of RIHAs (continued)

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Resolution: The applicant revised the DCD to be consistent with the TIHA IP. Also, the applicant added detail to the TIHA IP to explain how PRA expertise will be used to compile the list of RIHAs that will be included in the HFE design program activities.

Staff Conclusion: The changes help to ensure that Table 4-1, which provides input to the other HFE elements in the HFE design program, will be completed by personnel with sufficient expertise to reliably and correctly identify the RIHAs and their associated HFE characteristics.

Treatment of RIHAs (continued)

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Issue 3/3: The PRA evolves over time and becomes more refined. For example, COLs need to quantify seismic risk prior to fuel load. It was not clear how any IHAs identified from subsequent revisions to the PRA will be addressed in the HFE program.

Resolution: The applicant's response explained that IHAs identified after V&V may be evaluated during design implementation, and IHAs identified after design implementation will be addressed by the COL's corrective action program.

Treatment of RIHAs (continued)

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Staff Conclusion: The HFE program elements, except for human performance monitoring, must be complete to close HFE-related ITAAC. All ITAAC must be closed prior to fuel load. Subsequent revisions to the PRA may occur after the HFE-related ITAAC are closed.

Human performance monitoring continues for the life of the plant by implementation of operational programs including the operator training program and the corrective action program. Such programs provide a means for identifying new operator tasks, updating training programs and procedures, and making design changes.

COL Activities

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RAI 9084, Question 18-134 (Addressed in SER Chapter 14)

Issue: The COL will need to complete the activities in the HFE IPs, but it was not clear how the COL will know it is the COL's responsibility to complete these activities.

Resolution: A design ITAAC verifies successful completion of the ISV in accordance with the V&V IP. The HFE PMP contains a figure that illustrates that the results from the other HFE elements are inputs to V&V. The applicant also added the figure to the V&V IP. Also, COL Item 14.3(2) says the COL is to provide a schedule for implementing the design ITAAC.

Staff Conclusions: The application illustrates the activities that need to be done to close the design ITAAC.

AMI Variables

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RAI 7878, Question 07.05-1 (Addressed in SER Chapter 7)

Issue: Some variables used to monitor CSFs were not identified. For example, indication of hydrogen concentration was not identified as a means of assessing the combustible gas control CSF.

Resolution: The applicant revised the list of AMI variables to include hydrogen and other AMI variables needed to monitor the CSFs.

Staff Conclusions: The AMI conforms to regulatory guidance and requirements for AMI.

Staff Finding

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The applicant's HFE design process conforms to NRC HFE-related guidance and therefore provides reasonable assurance that HFE-related NRC requirements will be satisfied.

Acronyms (1/2)

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AMI: accident monitoring instrumentation
COL: combined license (applicant or holder)
CSF: critical safety function
DAC: design acceptance criteria
FA: function allocation
FRA: functional requirements analysis
HFE: human factors engineering
HOIB: Human Performance, Operator Licensing, and ITAAC Branch
HRA: human reliability analysis
HSI: human-system interface
IHA: important human action
INPO: Institute of Nuclear Power Operations
IP: implementation plan
ISV: integrated system validation
ITAAC: inspections, tests, analyses, and acceptance criteria
MCR: main control room

Acronyms (2/2)

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OER: operating experience review
PMP: program management plan
RAI: request for additional information
RIHA: risk-important human action
SER: The Safety Evaluation Report for the Standard APR1400
SKN: Shin-Kori
TA: task analysis
TIHA: treatment of important human actions
V&V: verification and validation