UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 7, 2016

MEMORANDUM TO: ACRS Members

FROM: Christopher L. Brown, Senior Staff Engineer **/RA/**
Technical Support Branch
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS ARP1400 SUBCOMMITTEE MEETING ON OCTOBER 4, 2016, IN ROCKVILLE, MARYLAND

The minutes for the subject meeting were certified on October 31, 2016. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc with Attachment: A. Veil
M. Banks

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

MEMORANDUM TO: Christopher Brown, Senior Staff Engineer
Technical Support Branch
Advisory Committee on Reactor Safeguards

FROM: Ronald Ballinger, Chairman
APR1400 Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS APR1400 SUBCOMMITTEE MEETING ON OCTOBER 4, 2016, IN ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on October 4, 2016, are an accurate record of the proceedings for that meeting.

/RA/ **October 31, 2016**

Ronald Ballinger, Chairman Dated
APR1400 Subcommittee

Certified on: October 31, 2016
Certified by: Ronald Ballinger

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

APR 1400 SUBCOMMITTEE MEETING

October 4, 2016

ROCKVILLE, MD

Open/Closed

The ACRS Materials, APR 1400 Subcommittee held a meeting on October 4, 2016, in T2B1, 11545 Rockville Pike, Rockville, MD. The meeting convened at 8:30 a.m. and adjourned at 5:00 p.m.

No written comments were received from members of the public.

ATTENDEES

ACRS Members/Staff

Ron Ballinger, Chairman
Charlie Brown, Member
Joy Rempe, Member
Margaret Chu, Member
Matthew Sunseri, Member
Dana Powers, Member
Gordon Skillman, Member
Steve Schultz, Member
Pete Riccardella, Member
John Stetkar, Member
Harold Ray, Member
Jose March-Leuba, Member

Christopher Brown, Designated Federal Official

NRC Staff

Jeff Ciocco, et.al.

KHNP

Andy Oh, et.al.

SUMMARY

The members will review the Korea Hydro & Nuclear Power Co. (KHNP) submitted design control document (DCD) (Tier 1 and Tier 2 FSAR) and NRC staff (staff) Phase II safety evaluation report (SER) related to the APR1400 PWR design certification application (DCA). Chapters 10 and 11 and Section 2.3 (see September status report for 2.3) are scheduled for this meeting, and as staff review of the DCA progresses, additional briefings of the APR1400 Subcommittee will follow.

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
1. The T/G has a turbine control and overspeed protection system to control turbine action under all normal and abnormal conditions to ensure that a full load turbine trip will not cause the turbine to overspeed beyond acceptable limits. Discussion by KHNP and members concerning about the flexibility in the design versus design specific requirements. Further discussion on the turbine generator valves and two figures in the DCD	22-48

that show two different configurations of the main steam stop valves and control valves and uninterruptible power supply.	
2. Discussion by KHNP and members on load capability for the APR 1400. It was stated and discussed by KHNP that in Korea, all plants have some capability of load.	51-54, 56-60
3. Discussions by KHNP and members concerning no reactor trip from a turbine trip and vice versa. KHNP said there is a turbine trip from a reactor trip. However, DCD states that there are no safety related components in the turbine building. KHNP could not provide an explanation.	53-56
4. Discussion by KHNP and members on flow accelerated corrosion resistant materials are used for the FAC susceptible piping. In particular, the 40 year design life versus the performance design objective. Confusion on whether some components were designed for 40 or 60 years.	60-65
5. Discussion by KHNP and members on the main steam isolation valves. No drawing in the DCD to show how the valves close hydraulically.	66-74
6. The turbine bypass system is located in the turbine building and is designed to transport up to 55 percent of the total main steam flow at normal full power steam generator (SG) pressure from the SGs directly to the main condenser, bypassing the main turbine. The system consists of two turbine bypass valve headers tapped off of the main steam system piping after the main steam isolation valves and upstream of the main turbine stop valves. Discussion by KHNP and members on turbine bypass valves maximum capacity.	74-76
7. Discussion by KHNP and members on open items related to flow accelerated corrosion and specifications of materials and properties.	80-91
8. Discussion by KHNP and members Concerning SG blowdown system and auxiliary feed-water system. Questions were asked on the emergency blowdown function, size of the piping that goes from the auxiliary feed-water storage tank to each pump, why is the power supply to those valves from train A and train B rather than train C and train D, and raw water storage tank.	97-138
9. Discussion by KHNP and members on the condenser circulating water system and turbine building flooding. Questions and discussion about the statement in the DCD that there is no safety-related equipment in the turbine building.	148-152
10. Discussion by staff and members on APR 1400 turbine control overspeed protection system.	161-170
11. Discussion by staff and members on main steam system.	174-179
12. Discussion by staff and members on the steam and feedwater system materials also discussion on the materials for the blowdown system.	179-184
13. Discussion by staff and members on the auxiliary feed-water system.	184-195

14. Discussion by KHNP and members on the liquid waste management and radioactive source terms. Questions were asked on the detergent waste treatment system and percentage of liquid waste to the plant discharge.	198-215
15. Discussion by KHNP and members gaseous waste management system which collects and processes the radioactive waste gases during normal operations. Further discussion concerning the single isolation discharge valve at the discharge line to the ventilation exhaust, lack of storage/hold up tank in the design, charcoal beds,	215-227
16. Discussion by KHNP and members solid waste management system. Questions were raised concerning spent resin storage tank.	227-235
17. Discussion regarding process and effluent monitoring systems and sampling systems. Questions raised on containment isolation valve.	236-252
18. Discussion by KHNP and members on the radwaste management system.	253-259
20. Discussion by staff and members on the use of the GALE code by the applicant, liquid waste management system.	262-273
21. Discussion by staff and members on the gas waste management system. Questions on operations concerning releases, use of gas stripper term, venting into room, and charcoal beds.	274-289
22. Staff discussed the solid waste management system.	290-294
23. Discussion by staff and members on Section 2.3 (meteorology). Questions were asked concerning wet-bulb temperature and issues that may affect the COL.	296-325
24. Members encouraged staff and KHNP to cover all sections of the SER. Members informed staff and KHNP that the subcommittee does not focus on open-items or RAIs. The subcommittee conducts and independent review of the application and SER and may have other questions not addressed by the staff to KHNP.	

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
APR 1400 Subcommittee Meeting

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, October 4, 2016

Work Order No.: NRC-2653 Pages 1-299

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

APR 1400 SUBCOMMITTEE

+ + + + +

TUESDAY

OCTOBER 4, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:29 a.m., Ronald G. Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

CHARLES H. BROWN, JR., Member

MARGARET CHU, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Chairman

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER L. BROWN

ALSO PRESENT:

DENNIS ANDRUKAT, NRO

LARRY BURKHART, NRO

CHANG JOON BAE, KEPCO E&C

BOB CALDWELL, NRO

SUNG IL CHO, DOOSAN

JINKYU CHOI, KHNP

JOON WAN CHOI, KEPCO E&C

JEFF CIOCCO, NRO

RICH CLEMENT, NRO

CHRIS COOK, NRO

ZACHARY GRAN, NRO

CHEWUNG HA

NICHOLAS HANSING, NRO

BRAD HARVEY, NRO

RAUL HERNANDEZ, NRO

ALSO PRESENT, Cont'd.

JOHN HONCHARIK, NRO

SEOKHWAN HUR, KEPCO E&C

KYEONG MO HWANG, KEPCO E&C

HYEOK JEONG, KEPCO E&C

JAMES SUK JHUN, KEPCO E&C and Bechtel

SANGHO KANG, KEPCO E&C

STORM KAUFFMAN, DOOSAN/MPR

KIMBERLY KEITHLINE, MPR

HAMSANG KIM, KHNP

JOONKON KIM, KEPCO E&C

JUNGHO KIM, KHNP

TAE HAN KIM, KEPCO E&C

YOUNGKI KIM, KEPCO E&C

WILLEM KRIEL, KHNP/DOOSAN

RON LAVERA, NRO

CHOMGIN LIM, DOOSAN

GREG MAKAR, NRO

MICHAEL D. MAZAIKA, NRO

MATTHEW A. MITCHELL, NRO

KEN MOTT, NRO

RYAN NOLAN, NRO

ANDY OH, KHNP

KEVIN QUINLAN, NRO

TARUN ROY, NRO

ALSO PRESENT, Cont'd.

SUNG-JE SEO, KEPCO E&C

ROB SISK, Westinghouse

COURTNEY ST. PETERS, NRO

ANGELO STUBBS, NRO

ED STUTZRAGE, NRO

IRVING TSANG, DERADS

ROBERT VETTORI, NRO

JESSICA VOVERIS, NRO

JASON WHITE, NRO

STEPHEN WILLIAMS, NRO

GEORGE WUNDER, NRO

ANDREW YESHNIK, NRO

DEANNA ZHANG, NRO

*Present via telephone

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

P R O C E E D I N G S

8:29 a.m.

CHAIRMAN BALLINGER: (presiding) The meeting will now come to order.

This is a meeting of the APR 1400 Subcommittee of the Advisory Committee on Reactor Safeguards. I'm Ronald Ballinger, Chairman of the APR 1400 Subcommittee.

ACRS members in attendance today are Margaret Chu, Harold Ray, Dick Skillman, Dana Powers, Matt Sunseri, Pete Riccardella, John Stetkar, Jose March-Leuba, Charlie Brown, and the inestimable -- I'll pronounce it right -- Joy Rempe.

(Laughter.)

The purpose of today's meeting is for the Subcommittee to receive briefings from Korea Hydro and Nuclear Power Company, KHNP, regarding their design certification application, and NRC staff regarding their safety evaluation review specific to Chapters 10, Steam and Power Conversion Systems, and 11, Radioactive Waste Management, as well as Section 2.3, Meteorology, which was a holdover from last meeting.

The rules for participation in today's

meeting were announced in The Federal Register on September 23rd, 2016. The meeting was announced as an open/closed to public meeting. This means that the Chairman can close the meeting as needed to protect information proprietary to KHNP or its vendors. No requests for a statement has been made from the public.

A transcript of the meeting is being kept and will be made available, as stated in The Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. And please make sure that the little green light is on when you talk on your microphone. Participants should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have one bridge line established. We have a bridge line established for interested members of the public to listen in. The bridge number and password were published in the agenda posted on the NRC public website.

To minimize disturbance, this public

line will be kept in a listen-only mode. And I would also suggest that if you are a member of the public and you are listening in, that you put your system on mute when you are listening, or whatever it takes, because we get a lot of crosstalk outside this room, but it is annoying to everybody. The public will have an opportunity to make a statement to provide comments at a designated time towards the end of the meeting.

We request that the meeting attendees and participants silence their cell phones and other electronic devices.

At the end of the discussions on Chapters 10 and 11, staff and KHNP can address any questions that were left unanswered from our last meeting on Chapters 2 and 5.

Also, I believe that Mr. Stetkar -- and he can reiterate -- we do not need the slides listing the numbers of RAIs. The Chapter 9 meeting will not occur on November the 15th.

I now invite Jeff Ciocco, NRO Project Manager, to introduce presenters and start the briefing.

MR. CIOCCO: Yes, thank you.

My name is Jeff Ciocco. I'm the Lead Project Manager for the APR 1400 Design Certification New Reactor Project.

We would like to thank the Subcommittee Chair, the members, as well as the ACRS staff, for having us back. We were here back in September, and as I said prior, this is a significant milestone in our review project to bring our Phase 2 Safety Evaluation Reports with Open Items to the ACRS Subcommittee as well as the full Committee. Today we will present Chapters 10, 11, and Section 2.3, as will the applicant.

So, thank you very much.

CHAIRMAN BALLINGER: Okay. The floor is yours.

MR. SISK: Thank you, Mr. Chairman. This is Rob Sisk, Westinghouse, just speaking on behalf of KHNP. Thank you for the opportunity to continue in our series of discussions on the APR 1400 design certification application. As Jeff indicated, this is our second of a series. Today we will be talking Chapter 10 and 11.

I would like to introduce Mr. Sung-Je Seo from KEPCO E&C to lead us through Chapter 10 at

this time.

MR. SEO: Good morning.

My name is Sung-Je Seo. I'm a Chapter leader, Chapter 10 leader. I am KEPCO E&C's EOP mechanical system engineer. Nice to meet you. Thank you.

(Mr. Seo begins his presentation over.)

Good morning. Let me introduce myself to you. My name is Sung-Je Seo. I work in KEPCO E&C as an EOP mechanical system engineer since 1996.

My presentation consists of three parts, like shown on this slide, an overview of Chapter 10, Steam and Power Conversion System, and Summary. Overview of Chapter 10 is for to submit our document and RAI summary.

Steam and Power Conversion System includes Subsection 10.1, Summary Description; 10.2, Turbine Generator; 10.3, Main Steam System, including key review items: flow accelerated corrosion, and 10.4, Other Features, and Summary.

This slide shows the list of submitted documents and the RAI summary. KHNP has submitted two documents regarding this Chapter 10, APR 1400,

Tier 2 and Tier 1.

The RAI summary for Chapter 10 shows below the slide there. KHNP has 71 questions that were issued by the NRC. All questions have been responded. KHNP has 17 open items for DC Chapter 10.

This slide shows the subsection outline for the Steam and Power Conversion System. Subsection 10.1, the function of the Steam and Power Conversion System is to convert heat energy generated by the nuclear reactor into electric energy. This part will be presented by myself.

Subsection 10.2, the turbine generator converts the energy of the steam produced in the two steam generators into the tanker's shaft power and, then, into electrical energy. This Chapter will be presented by Mr. Storm Kauffman.

Subsection 10.3, the main stream system is to transport the steam generated in the steam generators to the high-pressure turbine during normal power operation. The main steam system extends from the steam generators up to the turbine stop valves. The main steam system has two steam generators and the two main stream lines from each

steam generator to the main stream common header. This part will be presented also by myself.

As the key review item, Dr. Kyeong Mo Hwang will present the flow accelerated corrosion.

Subsection 10.4, the steam generator blowdown system, which is a system that maintains the chemical characteristics of the second side water within permissible limits, and the whole steam system is to provide an independent safety-related means of supplying auxiliary feedwater for the decay heat re3moval to the steam generators. This part will be presented by Mr. Choi Joon Wan.

This slide is for the summary description for the Steam and Power Conversion System, including the following major process systems: turbine generator, main steam system, condensate and feedwater system, turbine bypass system, circulating water system, steam generator blowdown system, and the auxiliary feedwater system. In this presentation only some subsystems with an open item will be presented.

MR. KAUFFMAN: I'm Storm Kauffman. I will be discussing Section 10.2, which pertains to the turbine generator system.

Repeat for the microphone.

I'm Storm Kauffman. I will be presenting Section 10.2 regarding the steam generator and its control system.

I have been in front of the ACRS a number of times. The last time was when I was with Naval Reactors. So, I welcome the opportunity to renew the discussion in a new venue or on a new subject.

The outline for this section will be to discuss the approach taken for the turbine generator design and control, specifically, the control system and overspeed protection system. In the interest of brevity, I will not cover turbine rotor design and integrity, but, of course, we will welcome any questions that you may have.

Turbine missile probability analysis will also be briefly discussed. And then, we will talk about the COL items and how we are using them as a mechanism to assure that the future turbine generator design is appropriate. And finally, discuss the staff's open items.

The turbine generator system does not perform any safety-related functions, but it does

represent a potential hazard to the plant. Therefore, the NRC has developed a number of criteria that are applied to the turbine generator design to minimize those hazards.

In the case of the APR 1400, KHNP has decided to not specify a specific turbine generator design; instead, to allow the COL applicant to select the design. The reason for this is, one, that it facilitates selecting an optimum design from a safety and reliability standpoint at the time that the COL applicant actually intends to proceed with building a plant and has the design information available to show how the NRC criteria are met; and it, also, allows commercially for competitive procurement for the applicant.

To do this, we have developed a number of COL items to ensure that the turbine generator system satisfactorily meets the NRC acceptance criteria. Those COL items provide direction to the applicant on how to procure a satisfactory turbine generator system.

I believe that most of the discussion we have had with the staff regarding Section 10.2 has been in regard to the staff's concern about

availability of enough detailed information to assure that the review could be completed satisfactorily. We believe that we have provided that information. I will explain the approach that we have taken in the next few slides.

Basically, what we have done is to assure a satisfactory turbine generator control system overspeed protection, turbine rotors, and inspection, probability analysis, is provided by the COL applicant by including in the DCD basic functional requirements and design principles that must be adhered to. We have provided an overarching architecture and discussed the need to comply with the extant, the existing-at-the-time regulatory guidance for turbine generator design and control.

I will go through a number of specific portions of the turbine generator control system and, then, talk about the design principles we have specified to assure that the system behaves properly and provides overspeed protection.

In the case of the turbine generator valves --

MEMBER SKILLMAN: Storm, Storm, before

you proceed, on this slide and on the slide that follows you have identified very specific items.

MR. KAUFFMAN: Yes.

MEMBER SKILLMAN: And as you just said, you are developing a set of requirements, I believe, for the COL, for the applicant. But, as you work your way through these items and the ones on the next slide, the specificity is so great that it would appear that, unless those are codified, then this presentation is really for an imaginary governing system, perhaps from a system that has been used in the past that would be applied to a future plan.

And so, my concern is, how do you ensure that this level of detail is communicated as a set of requirements for that vendor that will ultimately supply the turbine generator?

MR. KAUFFMAN: As I understand the question, you are asking how do we assure that these fairly detailed, specific requirements are, in fact, met by the COL applicant?

MEMBER SKILLMAN: That is accurate.

MR. KAUFFMAN: Our approach has been to provide functional requirements, basically, a

functional specification, as part of the DCD and, then, refer to those in the COL items as actions that have to be performed by the COL applicant at the time they select the turbine generator design.

I believe this will be clearer by the time I get to the end of the presentation. If we can return to that question, if you still need additional information, I would like to wait until the end.

MEMBER SKILLMAN: Thank you, Storm. That is fine.

MR. KAUFFMAN: Thank you.

MEMBER BROWN: Before you go on --

MR. KAUFFMAN: Yes?

MEMBER BROWN: -- I would like to voice a similar concern that Dick spoke. I notice the staff had mentioned something about including some type of schematics or some type of thing in the DCD to provide clarity of the words. I must have read the section on overspeed trip protection two or three times trying to see if I could draw a diagram, came up with three or four different layouts, not all of them clear as to how they would meet the specific requirements.

Now you provide a little bit of a schematic, if you call it a one-line block diagram, but that is all I would have thought you would provide, where you identify or show what you mean by some of these specific requirements in the DCD. That has been done in some of the other design centers that we have worked on in the past. I noticed it was absent, just almost a total reliance on the COL to go off and figure out what the words mean in total.

There are some examples when you look at how the -- you have certainly got two different overspeed trips, for instance, the mechanical and the electrical. So, that provides some diversity, redundancy, et cetera, et cetera. So, there is no quarrel with that.

But you like to make sure these other systems work properly and that these specifics you call out are actually incorporated into the design; you don't have to fight over them.

So, I understand the staff's concern relative to the lack of functional one-line diagrams, not detailed schematics -- that's impossible at this stage -- but functional diagrams

similar to what I would expect on the reactor trip and engineered safeguard systems, which we will face at some later date, to illustrate how you are actually accomplishing the functions.

So, I just wanted to echo Dick's comments relative to my own review. I will let you go ahead, but I looked at the rest of the slides and I really don't see anything that really serves up most of that. But I would just like you to know that in advance.

MR. KAUFFMAN: Okay. Well, I appreciate the comment. We have provided an updated DCD section fairly recently for the staff review to try to address some of those concerns. We are continuing to figure out what is the appropriate level of detail when you don't have a specific design selected.

MEMBER BROWN: Well, the schematic, a beginning of a functional block diagram that you show in your presentation could be used with a little bit of expansion to make it clear how you do things. For instance, are you voting on all the sensors when you go into the primary and backup? Are they independently evaluated independently in

each of the two systems? And how are they voted on then? That is all non-technology, non-specific final design from any vendor, but it shows what your intent is on how you want to maintain the diversity, redundancy, and independence. Power supplies weren't even specified, at least in the version of the DCD I saw, were not specified as being for each one. I think I read some words in the SER, one of the SERs, that said they each have independent power supplies, but it wasn't specified in the version of the DCD that I read.

Anyway, I will let you go on, but --

MR. KAUFFMAN: I understand the comment. I, hopefully, will address at least a large portion of it.

And our latest revision of the DCD, which the staff has yet to complete review, again, we have tried to address those same questions from the staff.

MEMBER STETKAR: Storm, I was going to wait since you asked us to wait, but I might as well get mine out the table.

I had the same comment. I can't understand how you intend the system to work. In

particular, I have no concept of how you intend the emergency trip fluid system to work. And yet -- and yet -- in the DCD you have very specific design requirements.

I will quote: "It consists of an unbalanced string" -- this is a mechanical trip -- "that is activated by centrifugal force" -- I got that -- "against a spring" -- I got that -- "when the turbine overspeeds; thus, causing an eccentric movement that strikes the trip finger on the emergency trip valve." Okay, I kind of understand that.

"This action causes a depressurization of the emergency trip system hydraulic fluid and, via an interface relay, the common hydraulic safety system closing all stop and control valves." So, your design very specifically has some sort of interface relay on it. That is unusual. I haven't seen many of them in mechanical trips, but you specified it in your Certified Design. So, I would really like to see how that works. And that's in writing in your design certification, very specific.

MR. KAUFFMAN: Okay.

MEMBER STETKAR: So, on one hand, you are trying to stay very loose and very flexible, and yet, you have very specific design requirements here in writing. And I can't understand how your system will work.

MR. KAUFFMAN: Okay.

MEMBER STETKAR: And I need to do that.

MR. KAUFFMAN: Understand. I would say that we are --

MEMBER STETKAR: So, just keep that in mind as you continue your presentation.

MR. KAUFFMAN: Okay. We are trying to stay flexible, but we are loose.

MEMBER STETKAR: Well, you know, you're trying to stay really loose until the points where you get very, very, very specific.

MR. KAUFFMAN: All right. Well, let me try to go through some of those specifics and see if that addresses any --

MEMBER STETKAR: If you want to stay loose, just say somebody's going to buy a turbine and they have to do the analysis. Otherwise, tell us how you intend it to work.

MR. KAUFFMAN: Okay.

MEMBER STETKAR: Because it is a design specification.

MR. KAUFFMAN: All right. Well, I will go through that. Thank you.

Regarding the turbine generator valves, the approach is that both the high- and low-pressure turbines have redundant in-series valves such that any failure --

MEMBER STETKAR: Let me stop you right there. There's two figures in your Certified Design that show two different configurations of your main steam stop valves and control valves. Which configuration is the Certified Design? I will give you the figure numbers, so that you can reference them.

MR. KAUFFMAN: Right.

MEMBER STETKAR: One figure number is figure 10.2.2-1 and one figure number is 10.1-2. One of those shows something that is similar to the words you have up here. The other one shows an intermediate crosstie header between the stop and control valves. If you do the math, one has a four times higher likelihood of failing to trip the turbine, given a successful turbine trip signal,

compared to the other.

So, I am curious about which principle you have in your design, because you have two figures in your Certified Design document.

MR. KAUFFMAN: Yes, I know about that inconsistency.

MEMBER STETKAR: Okay. All right.

MR. KAUFFMAN: The intent is to follow the figure that is in 10.2. I believe the figure in 10. --

MEMBER STETKAR: So, the intent is to follow -- make sure I have that on the record -- in 10.2.2-1?

MR. KAUFFMAN: Thank you.

MEMBER STETKAR: I want to make sure we have it on the record.

MR. KAUFFMAN: Correct.

MEMBER STETKAR: Okay. That's the one that has four times higher likelihood of failing to trip the turbine. That's fine, if that is your intent. I can show you the math, and that is without common-cause failures.

MR. KAUFFMAN: Okay. Thank you.

Regarding the valves, to pick up, the

in-series valves assure that any single failure in any of the steam control values to the main turbines will not prevent a turbine trip. We have functional requirements that specify the maximum shutting time for the turbine valves and the non-return valves in the extraction lines.

MEMBER SKILLMAN: Storm, on that point, the non-return valves in the extraction piping, I'm not sure that reverse-flow is widely understood. At least I have experienced kind of a deer in the headlights when I have raised that question. What set the 1-second closure time for non-return, particularly for preventing against reverse-flow?

MR. KAUFFMAN: One, it is the common practice. Two, the reverse-flow where the valves have the capability to shut that quickly. And three, preliminary analysis would show that only a small amount of steam returns during that period.

So, it is achievable. It has been sufficient in past designs and was considered a suitable criteria.

MEMBER SKILLMAN: Thank you, Storm.

MEMBER BROWN: Can I mention one other thing relative to times? I notice you had a table

with the turbine valve closure times.

MR. KAUFFMAN: Yes.

MEMBER BROWN: Of 0.3 seconds, but I went off to look to see how that was. Is that just because those are what standard designs are or is there a design, the valves that say that is suitable for tripping the turbine fast enough that it won't overspeed, regardless of what you do?

MR. KAUFFMAN: We have not yet, because we don't have an established design, done the --

MEMBER BROWN: Well, who is going to do the analysis? I mean, you have got it specified in the DCD that that is what is required for the closing time for all four sets of valves.

MR. KAUFFMAN: Correct.

MEMBER BROWN: I think it is all four sets.

MR. KAUFFMAN: Yes.

MEMBER BROWN: It is all four sets of valves?

MR. KAUFFMAN: That is the maximum shutting time.

MEMBER BROWN: Right. And I was trying to figure out where did the analysis come from to

say that is satisfactory based on the dynamics of whatever you are doing. You have left everything else up to the COL, based on the turbine generator design, and you don't know what the turbine generator design is. But, yet, instead of specifying a time that is going to be consistent with protecting it, you specify the specific time. So, it seemed to be a little bit inconsistent in terms of the detail there.

MR. KAUFFMAN: It may be overly-specific. Our view is that the COL applicant will need to complete the analysis showing that the criteria that the NRC applies for acceptance of turbine generator overspeed protection at the time are met. And therefore, the .3 seconds, again, is an achievable value and has worked in the past. But, if for some reason it is insufficient, they would have to do better.

MEMBER BROWN: So, you have to come back to the NRC with a DCD change to make it shorter?

MR. KAUFFMAN: No, because --

MEMBER BROWN: Well, it is in the DCD. So, that is a design document requirement.

MR. KAUFFMAN: It is a design document requirement, but you can be better than it without having a DCD change.

We can come back to that.

MEMBER BROWN: I will bet you a vendor says, if that is what you are giving from a design standpoint, then it is kind of like what he has to meet. Somehow he has got to set his parameters when he starts the designs.

MR. KAUFFMAN: Correct.

MEMBER BROWN: That is my only concern, is an inconsistency of what he starts with and what he ends with. And the overspeed designer, is it going to be the same guy that designs the TGs, TG set himself, the way at least I used to do it when we bought them?

MR. KAUFFMAN: Yes, the intent is, well, it is up to the COL applicant. But the way we have specified it is that there are overspeed criteria that have to be met and there is direction on specific attributes of the system to assure that diversity, separation, redundancy are met.

CHAIRMAN BALLINGER: Go ahead.

MR. KAUFFMAN: Thank you.

MEMBER SUNSERI: I would just be cautious with statements like "We can be better than the DCD requirements" because, if the COL applicant finds out that they have to be better to meet the safety requirement or the specification, then the DCD is inadequate. Then, it would have to be revised to show the improved necessary performance, I think. No?

MEMBER STETKAR: No.

MEMBER SUNSERI: If you have to be better than what is stated to make it work --

MEMBER STETKAR: The DCD is the law. They don't change the law. If the COL applicant can't meet the criteria in the DCD, the COL applicant doesn't get a COL.

MEMBER SUNSERI: Yes, but that is not what I am saying. I am saying, if the COL applicant finds that the DCD requirement is not sufficient to meet performance requirements --

MEMBER STETKAR: That is one of the reasons why we question the DCD requirements now.

MEMBER SUNSERI: Right.

MEMBER STETKAR: But the COL applicant, if they can't meet the DCD requirements with

anything that they can buy, then --

MEMBER POWERS: I think the legality is that the licensee had be better than the COL required, would have an exemption. It would be part of his license, and the license is part of the regulations.

MEMBER STETKAR: But they don't go back and change the DCD. I mean, that is really onerous.

MEMBER POWERS: That is not the situation he was asking about.

MEMBER STETKAR: Oh, okay. Right.

MEMBER POWERS: The one he is asking about, they would have an exemption.

MEMBER STETKAR: Yes.

MEMBER POWERS: It would be part of their license. The license becomes part of the regulation.

MEMBER STETKAR: Right.

MR. KAUFFMAN: Thank you. Okay. Thank you.

On the one figure that Mr. Brown alluded to, I will very quickly just go through this to explain what it is intended to convey.

There is a normal speed turbine generator speed control system that uses active speed sensors.

MEMBER BROWN: Excuse me. You said active speed sensors as opposed to passive for the TG --

MR. KAUFFMAN: Yes.

MEMBER BROWN: -- the TG control system?

MR. KAUFFMAN: Yes.

MEMBER BROWN: As opposed to the, quote, "passive" speed sensors?

MR. KAUFFMAN: Correct.

MEMBER BROWN: I'm trying to remember whether I saw "passive" or "active" in the DCD when I was reading it.

CHAIRMAN BALLINGER: Use your mouse.

MEMBER BROWN: You would use your mouse? Okay. Thank you.

John, do you remember seeing "active" or "passive" when you looked at it for the sensors? I just saw independent sensors.

MEMBER STETKAR: I don't recall, Charlie, but I'm not sure that I searched for that.

MR. KAUFFMAN: That is one of the

specifics that we have added in the --

MEMBER BROWN: But it is added? Then, I obviously don't have a copy --

MR. KAUFFMAN: Correct.

MEMBER BROWN: -- of the new DCD --

MR. KAUFFMAN: Yes.

MEMBER BROWN: -- at this point.

MR. KAUFFMAN: It wasn't that we didn't intend to do that. We didn't explain it adequately.

MEMBER BROWN: Why go with active?

MR. KAUFFMAN: Diversity.

MEMBER BROWN: Have two different passes after you've got diversity.

(Laughter.)

It just seems inconsistent, I'm sorry, to use active sensors anywhere when they are totally unnecessary when passive ones work and you can get alternate designs of passive sensors if you want diversity from that standpoint. That is just a question.

MR. KAUFFMAN: I understand. I understand the comment.

MEMBER BROWN: Thank you.

MR. KAUFFMAN: The active speed sensors feed three normal turbine generator control system controllers that do a load, two out of three, and close the main turbine valves on an overspeed. In addition, there are separate passive sensors that are used for the electrical overspeed trip system. Those feed the overspeed protection controllers as a primary and backup that are a different technology, which I will get to in a minute. Those, then, trip the emergency trip system, which I will describe on a subsequent slide. Finally, the mechanical overspeed trip that Mr. Stetkar described also provides an alternative means of tripping all of the valves.

MEMBER STETKAR: Storm, go back to that previous. I think a little bit of what Charlie and I and Dick, and perhaps others, are asking about is this level of information provides some functional requirements. It shows different numbers of controllers and primary and backup and mechanical. And they all go into that little box there that says "emergency trip system". And out comes the magic thing that dumps hydraulic fluid and all the valves go closed.

What I was questioning in my comment about the specificity of an interface relay in the text, and the absolute lack of any information whatsoever about what is inside that box that actually trips the turbine, is kind of the dichotomy in the Design Certification Document about level of detail. I don't know whether you have redundant trip valves, whether you have series, parallel. I don't know whether they fail open, they fail close on loss of power. I have no idea what they do.

And yet, in my experience, that little box there is typically the most important thing about failing to trip the turbine. So, if I don't know what the Certified Design kind of wants functionally in that box, I don't know what the worth of all of that other stuff is.

MR. KAUFFMAN: I, again, understand the comment. The approach we have taken is to impose or describe functional requirements regarding what is in that box and how it works.

MEMBER STETKAR: Okay. I hope you explain those in the slides that are coming up because I couldn't find them anywhere in the DCD.

MR. KAUFFMAN: I will attempt to do that, and we can come back to your question in a few slides.

Normal control system performs the usual functions for speed and acceleration control, loading, and load limits, monitoring of performance of the turbine generating system, and testing of the valves and controls. And also, the normal control system provides an overspeed limit or protection to assure that the valves are fully closed at 103 percent. It uses the three active speed sensors we have previously discussed and applies to out of three loading and three control processors. Failure of two inputs would cause a trip.

The turbine generator overspeed protection system is separate from the normal turbine generator control system. The emergency trip system itself has the mechanical and electrical overspeed trip system as separate and diverse features. The mechanical trip occurs at approximately 110 percent of full speed, in which rotational acceleration actuates the trip linkages. And then, a manual emergency trip is also failure

from the front standard and the control room.

The electrical overspeed trip system trips at 111.5 percent, approximately full speed, by de-energizing master trip solenoids. It uses three passive magnetic sensors. In this case we also have two speed-calculating modules that do a two-out-of three vote on the sensors. Those are diverse technology. One module, the primary module, uses software logic, and the backup module is independent and uses firmware.

MEMBER BROWN: This is close to the last slide. I am trying to recall my memory right now, in that when there is a trip of the TG sets, I thought there was a comment that you also get a reactor trip?

MR. KAUFFMAN: No. The reactor trip causes a turbine trip, but you don't necessarily get a --

MEMBER BROWN: You don't get the inverse?

MR. KAUFFMAN: Correct.

MEMBER SKILLMAN: Of course, it backs up very quickly, the reactor coolant system, because --

MR. KAUFFMAN: There are other reasons why the reactor may trip.

MEMBER BROWN: But I got that inference when I said that it dissipated part of the main steam system; it dissipates heat from the RCS following a turbine and a reactor trip. And I didn't see a connection. I didn't see the forward connection or the reverse connection referred to. That is why I asked the question.

MR. KAUFFMAN: Right.

MEMBER BROWN: So, a trip of the TG set does not cause a reactor trip?

MR. KAUFFMAN: Correct. But a trip of the reactor causes a --

MEMBER BROWN: Okay. Thank you.

MEMBER SUNSERI: So, I saw in the SER someplace the mention that there are technical specifications associated with the turbine generator system. And sure enough, I went and looked through all the technical specifications and didn't see anything. But my experience is on these overspeed trip devices, both the mechanical and the electrical, there are surveillance requirements to make sure that these things are going to work,

since you are relying on them for protection. Any comment on why no technical specifications?

MEMBER BROWN: The specific surveillance requirements, in-service inspection and in-service testing, are intended to come out of the probabilistic evaluation, probabilistic missile evaluation. That is probably the -- well, I don't own the technical specifications. So, I can't specifically talk to those details.

MEMBER STETKAR: Storm, with regard to that, I understand that, typically, as a result of the turbine missile analysis, you derive testing intervals for the stop and control valves and the hydraulic system, you know, all the electronic goodies and all that sort of stuff. And yet, in the DCD in Section 10.2.2.3.4 on inspection and testing, it says, "The main steam stop valves, control valves, intermediate stop valves, and intercept valves are exercised at least once within quarterly intervals by closing each valve and observing the remote valve position indicator for fully closed position status."

So, in the Design Certification we now have a quarterly test interval on those valves.

Why does the Design Certification specify a quarterly test interval on those valves? Suppose that my turbine missile analysis says that I can justify a six-month test interval on those valves. So, what is the basis for your designed-certified quarterly test interval?

MR. KAUFFMAN: That is a good observation. We will take it under consideration.

MEMBER STETKAR: Thank you.

MEMBER RAY: Does the COL applicant not have the ability to -- you talked about a turbine trip causing a reactor trip, but is there no ability to put in a bypass that would allow the reactor to remain critical?

MR. KAUFFMAN: Yes. Well, I cannot speak to the rest of the protection system.

MEMBER RAY: Well, it sounded like you were saying you would get a reactor trip from a turbine trip.

MR. KAUFFMAN: I did not mean to say that.

MEMBER RAY: Okay. John, you wanted to say something?

MEMBER STETKAR: I think we will hear

about that. They do have a big bypass and runback to the reactor.

MEMBER RAY: Yes. I misunderstood, then, what was being said. I thought, or maybe it was Dick who said, if you get a turbine trip, you are going to get a reactor trip. And it raised the question.

MR. KAUFFMAN: That is not intended, it is not necessarily true.

MEMBER RAY: Fine. Thanks.

MR. KAUFFMAN: This just summarizes the trips that I have already referred to.

Hydraulic control oil system, we specified that -- well, first of all, draining of the oil or relieving pressure in the hydraulic control oil system allows springs to shut the turbine steam valves and trip the turbine. A failure of any of the piping between the trip lock and the valve actuators will trip the turbine, therefore.

The drain headers are sized and independent to assure that the required valve stroke times are met. In-series valves drain to separate stainless steel headers and, then, to a

common drain line.

The hydraulic fluid in the turbine generator control system is separate from that used for lube oil to prevent cross-contamination that might affect the reliability of the trip system.

And then, the non-return valves and extraction lines are held open by instrument error, but close as non-actuated swing check valves.

The next few slides talk about the design principles that we discuss and provide examples of how we have met them. So, we address diversity, separation, testability, and ability to meet single failure criteria. I will go through each of these briefly.

Diversity, we have a mechanical overspeed trip versus both the emergency electrical overspeed trip and the normal turbine generator control system. The electric overspeed trip and the turbine generator control system use different technology speed inputs.

Separation is provided by having the emergency trip system valves in the front standard away from the areas that might be affected by it, main steam and other hazards.

Whereas, the electrical overspeed trip and the turbine generator control trips are in different cabinets with their own uninterruptible power supplies.

Hydraulic control headers are separate from each of the series main steam valves, each side. Redundancy is provided by having series valves in each of the main steam inlet lines.

MEMBER STETKAR: I'm sorry, you said each of the electrical trips has its own uninterruptible power supply? I didn't see that in the Certified Design description.

MR. KAUFFMAN: The staff asked for clarification of that.

MEMBER STETKAR: So, when you say "its own," you mean its own? It is not an uninterruptible power supply that supplies DC power, non-safety-related DC power that is fed to other equipment? This is its own?

MR. KAUFFMAN: That level of specificity is not intended.

MEMBER STETKAR: I'm sorry, this says "with its own".

MR. KAUFFMAN: "With its own," meaning

that it is not shared between the electrical -- it is a failure of an uninterruptible power supply to a portion of the turbine generator control does not affect other portions of the turbine generator control system. It does not necessarily mean that it cannot be shared with other equipment.

MEMBER STETKAR: See, this is what we are talking about, is the words make a difference. And without drawings to explain the words, people can interpret that a lot of different ways. So, if I saw those words that I see on this slide, I think, my God, I would have to have a cabinet with my own little uninterruptible power supply in that cabinet. And without a drawing to better elaborate that -- and I'm thinking about this as a combined license applicant going out for bids on something.

MR. KAUFFMAN: Okay. I understand the comment.

Redundancy, I think I was in the middle of this. Two out of three sensors trip the turbine generator control system. Two out of three different sensors trip the electrical overspeed trip system. And that means that we have a total of three different automatic trips plus a manual

trip available.

Independence is provided by having different sensors for turbine generator control and mechanical overspeed and electrical overspeed. A failure of one overspeed trip system does not affect the others. Failure of one valve to close will not affect the others.

Single failure criterion is met or is applied such that no single failure will cause the turbine to overspeed, and that no single failure will prevent an overspeed trip.

We have applied principle of failsafe operation such that loss of power will cause a turbine trip, and a failed speed sensor is removed from logic, but two failed sensors in the same portion of the system will initiate a trip.

MEMBER BROWN: Is that in both the EOT, the emergency trip system, as well as the TCGS?

MR. KAUFFMAN: Yes.

MEMBER BROWN: Is there a difference in detecting a failed sensor? Is there any idea how you are going to protect a failed sensor in here? You have got an active one and you have got a passive one, two different --

MR. KAUFFMAN: No, we have not gone to that level of detail.

MEMBER BROWN: Interesting. Okay.

MR. KAUFFMAN: Provisions are provided for testability during operation for any of the turbine main steam valves for overspeed sensors, controllers, and trips. However, the mechanical overspeed system is not testable during operation to maintain the simplicity, so that there are not bypasses that could inadvertently block the mechanical speed trip from functioning.

MEMBER BROWN: Based on an earlier comment you made and John's question, the mechanical overspeed trip, its actuation is mechanical, but I got the inference -- and I guess I got this out of the reading as well -- has an end-product of some electrical system; it is talked about a relay context or relay actuation?

MR. KAUFFMAN: That is a mechanical relay.

MEMBER BROWN: Well, I know that, but what kind of, when you say "mechanical relay," what do you mean, a switch that is operated by a spring or is it a powered relay with electrical power?

Mechanical to me means mechanical.

MR. KAUFFMAN: It does to me, also. And the term "relay" may need to be clarified, but the intent is that there is no electrical component to the mechanical overspeed trip.

MEMBER BROWN: So, it will trip the turbine -- which ones are they?

MR. KAUFFMAN: The valves.

MEMBER BROWN: Yes, which ones? You have got --

MR. KAUFFMAN: It trips all of the valves.

MEMBER BROWN: All of them?

MR. KAUFFMAN: Right.

MEMBER BROWN: So, it sounds like it is a mechanical setup that goes and does something in terms of the hydraulics going to the valves.

MR. KAUFFMAN: Correct.

MEMBER BROWN: Draining to the valves.

MR. KAUFFMAN: Right. That is the intent. Again, we don't have the detailed --

MEMBER BROWN: Not clear at all.

MR. KAUFFMAN: Okay.

MEMBER BROWN: Thank you.

CHAIRMAN BALLINGER: But, then, somebody mentioned, and John brought up the fact, that there is an interface relay.

MEMBER BROWN: That is what I was just talking about.

MEMBER STETKAR: That is all that it says; it is a block relay.

CHAIRMAN BALLINGER: Yes, I just looked it up, yes.

MEMBER STETKAR: And I don't want to speculate on what it is or how it works. It is just, on the one hand, they are saying they don't want to be very specific about the design. And yet, in the text they have this thing called an interface relay which, you know, we have now spent probably 10 minutes about curiosity about what that thing might be or whether it really is a relay or whether it is some sort of other mechanical device, or something or other.

CHAIRMAN BALLINGER: But the implication is that it is mechanical.

MEMBER STETKAR: Well, no. The implication is this is via an interface relay. That is the only implication.

CHAIRMAN BALLINGER: Okay, but he just said that it is all mechanical.

MEMBER STETKAR: I don't care what he said. It is not in the DCD.

CHAIRMAN BALLINGER: Okay.

MEMBER STETKAR: It is an oral presentation. It is not in the rule.

MR. KAUFFMAN: Again, understand --

MEMBER STETKAR: The rule right now only says "via an interface relay".

MR. KAUFFMAN: Again, I understand the comment on the clarity in the DCD.

MEMBER MARCH-LEUBA: Going back to the failsafe, when you say the failed sensor is removed from logic, do you mean that you go back to a two-out-of-two logic or do you reduce half of it? "Removed from logic" implies like you go two out of two.

MR. KAUFFMAN: The DCD does not specify.

MEMBER MARCH-LEUBA: That would be really bad, right?

MR. KAUFFMAN: Yes.

MEMBER MARCH-LEUBA: It probably

should.

MEMBER BROWN: So, your intent is one out of two, not two out of two?

MR. KAUFFMAN: No, I didn't say my intent.

MEMBER BROWN: It does not say what it doesn't say. Okay, sorry, another inconsistency; that's all.

MR. KAUFFMAN: Okay.

MEMBER MARCH-LEUBA: And I think the system in two out of two -- I mean, that is one of the functional requirements that you can specify.

MR. KAUFFMAN: Yes. But, now that you bring it up, I realize that it is not specified.

Turbine missile probability analysis is required to be performed in accordance with specific guidance in the DCD. It would use as-built material properties, evaluate the actual turbine generator control system and emergency trip system design.

Although the orientation of the turbines is favorable, we are applying a 1 times 10 to the minus 5th per year criterion, which would normally be applicable to an unfavorable

orientation. So, that provides some margin.

We also establish the acceptability of overspeed protection and in-service testing and inspections via the probabilistic analysis performed at the time the COL applicant selects a turbine design.

To implement the functional requirements that we have identified, there are four COL items. They are to identify the turbine vendor and model, identify how the functional requirements in the DCD section are met, and provide the detailed schematics, provide a turbine missile probability analysis, and describe how it conforms with the guidance in the DCD section, and specify turbine rotor material properties, and specifically identify any deviation from the Standard Review Plan at that time.

MEMBER REMPE: Excuse me. Is the APR 1400 the first Korean plant design that load follows or did the OPR also have that capability?

MR. KAUFFMAN: I do not know the answer.

MEMBER REMPE: And the reason I'm asking that is I am wondering if any changes were

implemented in the turbine generator design to accommodate the ability to load follow, or is this something that you -- I mean, we have been told that the APR 1400 builds on existing plant designs. And so, I am just wondering if the existing plants load followed or if you did have to make some changes to allow it to load follow. Because in the Section 10 it said, hey, it has the capability to load follows, and that is where the question is coming from.

MR. KAUFFMAN: I do not know what the practice on the other Korean plants are.

MEMBER STETKAR: Does anybody from Korea Hydro and Nuclear Power know what the practice is?

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

Actually, in Korea all the nuclear power plants have some capability for the load to follow up with the turbine design. However, the practicing operation does not load the power at all. All the power plants and nuclear power plants base load 100 percent operation. That is the practice for there.

MEMBER REMPE: Okay. Because I'm curious about that not only for today's discussion, but upcoming discussions on the fuel design.

Thank you.

MEMBER RAY: Well, I just have to say the practice may be base load, which is an economic issue. But do they have the capability to load follow is the question. And if we don't have an answer, that's fine.

MR. OH: Yes, in terms of turbine design it has some capability, but the load upon load, not only for the turbine design, we also have to consider for the reactor design, the fuel, and a lot of things should be considered.

MEMBER RAY: We are very well aware of that. The question is, is it? And I can only infer from your answer that, no, it is not a design capability of existing plants.

MR. OH: Andy Oh again.

And I can answer simply for load. For the turbine design, we have some type of lid for the load power, but we don't fully for the reactor design and everything.

MEMBER REMPE: So, did you make any

changes? I mean, you said you had that capability in prior plants, even though you didn't implement it. So, I think the answer is we didn't make any changes to the design.

MR. OH: We didn't make any changes to the design for the single APR 1400.

MEMBER REMPE: Thank you.

MR. KAUFFMAN: To try and finish up this section, I would just briefly summarize that there are four open items regarding the Section 10.2. They, in general, all deal with the level of detail provided that the staff is looking for more information in order to complete their review. We have provided a markup and some additional information recently, which I believe the staff has yet to complete their review.

I have no other comments at this time. Any other questions?

MEMBER STETKAR: Yes, I had one. I think we established that there is no reactor trip from a turbine trip, but you said that there is a turbine trip from a reactor trip. There are statements in the DCD that says there's no safety-related systems or components located in the

turbine building. Are the signals that come from the reactor protection systems to trip the main turbines safety-related signals?

MR. KAUFFMAN: I do not --

MEMBER STETKAR: Okay.

MR. KAUFFMAN: -- know the answer to that question.

MEMBER STETKAR: If they are, then the assertion that there's nothing safety-related in the turbine building seems curious. Because if I have breaks in the turbine or the piping, or however those signals get from the reactor protection system to -- however they interface with that mystical box, could those effects have some sort of feedback on the reactor protection system? So, the simple statement of nothing safety-related must mean that those signals are not safety-related. And then, if they are, then it seems to be not a correct statement.

MR. KAUFFMAN: All right. So --

MEMBER STETKAR: I would like some follow-up on that.

MR. KAUFFMAN: I do not think we have the right people here to answer your question.

MEMBER STETKAR: Okay. No, that's fine. I just wanted to get it on the record because it is a very distinct statement, and it is made a few places in the DCD, that there is nothing safety-related in the turbine building.

MR. SISK: This is Rob Sisk, Westinghouse.

I do want to go back to the question on load follow, because there was some discussion on that. I want to separate the idea of capabilities versus what it is being licensed for or what certification is being requested.

Load follow is not part of the certification application capability or licensed for the claim. We are not asking right now --

MEMBER STETKAR: Are you on (referring to microphone)?

MR. SISK: Oh, I thought I pushed the button.

(Laughter.)

Yes, we are not -- part of the certification is not asking to approve load following in the U.S.

MEMBER REMPE: So, when we look at the

section on fuel, I will keep this statement in mind, right? Thank you.

MEMBER SKILLMAN: Rob, it appears as though, with the amount of energy dump that is available from your turbine bypass valves, 55 percent, there has been an intention to enable to this plant to run back from very high power levels. And hence, that appears to be your leading indicator of load following.

MR. SISK: The capability is there. I think that is what everybody is saying.

MEMBER STETKAR: Well, but the capability, let's be clear, the Certified Design is being certified with the ability to handle a complete load rejection without a reactor trip and turbine trip. Is that correct?

MR. SISK: That is correct.

MEMBER STETKAR: And that is the Certified Design?

MR. SISK: That is correct.

MEMBER STETKAR: And that is not a load follow. That is --

MR. SISK: That is correct. That is not a load follow, though.

MEMBER STETKAR: Okay.

MEMBER RAY: That is not load following. That is trying to keep the reactor --

MEMBER STETKAR: That is understanding the basis for the turbine bypass valve capabilities, right?

MR. SISK: Right. I just wanted to make that distinction, so we didn't confuse -- maybe I didn't do it well. You did it much better, John. We didn't want to confuse that with the idea of load -- you said you are following it on fuel.

MEMBER STETKAR: Yes, the fuel, load follow fuel issues are different than --

MR. SISK: Yes.

MEMBER STETKAR: -- being able to handle 100-percent load rejection without turbine trip or without reactor trip anyway.

MR. SISK: Exactly. Thank you. I just wanted to clarify that.

CHAIRMAN BALLINGER: But somewhere in the DCD, either in Tier 1 or Tier 2, there is a discussion about a load following, a control rod movement automatically, and things like that. So, there is a pretty detailed discussion, yes.

MEMBER REMPE: The high-level summary document, it mentions that, and I can find the statement. But, yes, it is something that we need to make sure we understand because it was mentioned that way; you could do this for load following.

MR. SISK: Anticipations for the future.

MEMBER REMPE: Yes.

MEMBER RAY: But hold on. The anticipation for the future, that is not an answer to the question. You know, it either is or it isn't.

MR. SISK: For the certification being sought right now, it is not reviewing and approving the design for load follow capability.

MEMBER RAY: Yes, I thought that's what you meant. It is just the anticipation comment you made --

MR. SISK: Okay.

MEMBER RAY: -- made it sound confusing.

MR. SISK: My mistake then. I didn't mean to cause confusion. It is just things can change in the future, but the certification --

MEMBER RAY: Well, yes, obviously, they can. All right.

MR. SEO: I will explain domains consistent in terms up to the turbine stop valves and consistent with safety-related drivers and the

So, the figure shows the major components that remain consistent, that a first steam generator over APR 1400, it just steams and it has a two main steam lines to the main steam header. Each main steam line has one MSADB and five MSSV and one MSIV, one MSIV driver from the steam header to the turbine that pull the main steam stop levers. And the main steam header condenser, there are eight steam bypass drivers.

The main steam system is designed to deliver the steam from the steam generator to the turbine generator, dissipate heat and it handles it when the main condenser is not available by using the mSADB.

Provides the steam to the feedwater pump turbine, auxiliary feedwater pump turbines, the second stage reheater of the MSR, turbine steam seal system, and the auxiliary steam system.

Also, this system provides adequate

overpressure protection for the steam generator and the MSS by using the main steam safety valves.

The main steam system is designed in the following term: main steam piping in the safety-related portion are designed in accordance with the requirement of ASME Section III, Class 2 and 3. The remaining steam piping, in accordance with the ANSI/ASME, are B31.1.

FAC, flow accelerated corrosion-resistant materials are used for the FAC-susceptible piping.

The additional pipe thickness is applied for the carbon steel piping in consideration of the 40 years of design life.

MEMBER SKILLMAN: Could we talk about 40 years --

MR. SEO: Yes.

MEMBER SKILLMAN: -- for a minute, please?

The certification is for a 60-year design, and it is clear in your documentation that the Section 1 systems, Class 1 systems, are 60 years. But the systems that are not Class 1 are designed for 40 years. And that seems to be a

major change. Why is part of the NSSS or the island designed for 60 years and part of it designed for 40 years?

MR. SEO: I understand. APR 1400 in Korea was considered 60 years, one reactor and reactor pressure, and so on. However, some components were replaced during the plant operation. In that case, those components are considered the 40-year design life because some components can be replaced or have some required replacement.

MEMBER SKILLMAN: This seems peculiar because in your Tier 2 documentation and the DCD, at Section 1.2.1.1.2, your performance design objective communicates 60 years without the need for extended refurbishment. It would seem changing out secondary site piping, piping that is susceptible to FAC, would be an extended refurbishment. So, it seems as though you have got guidance for 60 years in your Design Control Document. Yet, you are advertising at least some systems are designed only for 40 years.

So, I would just like that on the record, but that seems inappropriate. It would

seem that the entire machine should be designed for 60 years.

CHAIRMAN BALLINGER: Moreover, there is a detailed discussion of the FAC evaluation margins and things like that, and a comparison with an earlier Korean design, the 1,000-megawatt version. And near as I can tell, if you extend that analysis from 40 to 60 years, you don't meet the FAC -- you don't have any margin.

So, I'm curious as to how that works. What I am saying is that the FAC design was okayed and the staff eventually agreed for 40 years. But, if you apply the same, extrapolate the rates, and stuff like that, for the 60 years, you find out that you can't meet 60 years with the FAC design. So, there are some specific questions I have, but I guess there is a specific discussion of the FAC system. So, we can wait for that.

MEMBER SKILLMAN: Well, the documentation that Dr. Ballinger is referring to is Tier 2, Chapter 10.3.6.3. That is on page 10.3-26 and 27 in the Design Control Document.

And this again points to 60-year life for the plant, except 40 years for certain systems,

and particularly systems that are susceptible to flow accelerated corrosion. So, it seems that this difference needs to be well-explained.

MR. HWANG: Yes. Okay, I will answer.

CHAIRMAN BALLINGER: Give your name.

MR. HWANG: Yes, my name is Hwang Kyeong Mo. I work with KEPCO.

I will answer so you will get a picture. As previously Mr. Seo mentioned, the secondary site piping and component is a changeover. However, when I calculate the corrosion allowance, I can see that it is 60 years. However, just I describe in the DCD for the 40 years of design. I consider 60 years for corrosion allowance. The corrosion allowance of 60 years and 40 years, they are similar. If you want, I can show you my material after this discussion.

CHAIRMAN BALLINGER: Okay.

MR. HWANG: Yes.

CHAIRMAN BALLINGER: Okay. Thank you. Yes. Because I understand that there is a leveling-off, which means the implication is that there is not much of a difference. But I am not sure. I would like to see that.

MR. SEO: This slide shows the open items. There are three open items for this Chapter 10.3. Open item 10.3-1 is to provide the tabulation and the descriptive text of all flow paths between MSIVs and the turbine stop valves. This issue is related to the RAI 4570, Question 10.03-5. This question was responded with a new table, including information required for the main steam tests, that branch of the main steam lines.

This slide, open item 10.3-2, is to provide how the site piping with a Seismic Category 2 classification. This section on piping can perform its safety-related function of the discharging steam to the atmosphere during a seismic event.

This is related to RAI 8570, Question 10.03-4. This question was also responded on June this year. The response was described while performing the safety-related function of the discharged steam to the atmosphere with the seismic classification during a seismic event.

Also, it demonstrated the ability of the main steam valve house structures to adequately handle the discharged steam from MSADVs and MSSVs

during a seismic accident. The compartment accident pressure due to the main steam line break is considered for the main steam turbine house's structure design, as stated in DCD Subsection 3.8.4.3.2.

This slide on 10.3-3 is related to the list of items to be incorporated into the operating and the maintenance procedures, consistent with NUREG-0927. This is related to the RAI 8575 or Question 10.3-6. This question was also responded on June of this year. The response included the items to be incorporated into the operating and maintenance procedures necessary to address the steam hammer specified in NUREG-0927.

MEMBER STETKAR: Before we get to flow accelerated corrosion, I have a few questions on what we just discussed. The first one is that the main steam isolation valves are safety-related and they are certainly within the scope of the Certified Design. And yet, I cannot find any drawing that will tell me the design principle that shows how those valves are closed hydraulically.

In particular, I find drawings that show how the pilot-operated safety-relief valves on

the pressurizer are closed. I understand how they work. But I do not understand how the main steam isolation valves work. I need to understand that.

I don't know how many solenoids there are. I don't know whether they are series or parallel. I don't know whether they are designed to fail open or closed. I have no idea how they work. So, I can't understand how those valves work without that information. I will just put that on the record.

MR. SEO: The main steam isolation valve is installed, its main steam lines. The main steam isolation valve is electric hydro-type. Therefore, this MSIV has a power electric or now power pairs. At the case this MSIV will be closed.

MEMBER STETKAR: I understand those very high-level discussions. I don't understand how it works.

And this is something where it is part of the Certified Design and it is a very safety-related piece of equipment. So, there ought to be clear specification in terms of power supplies to solenoids, series/parallel configurations of those solenoids. And that information typically is

supplied in Certified Designs.

The main steam atmosphere dump valves in Section 10.3.2.2.4 -- and I only give the specificity so that you can go look it up later -- it says, in table 10.3.2-1 -- I understand what the steam relief capacity is of each MSADV as 1.1 times 10 to the 6th pounds per hour. Forgive me for using English units. But in the table this further indicates that there is a controllable capacity per valve of 63,000 pounds per hour, much, much less than the total relief capacity.

What is that controllable capacity? What is the intent of that? Is that the amount if I am trying to manually control the valve, the maximum amount of steam relief? Or what is it? I don't understand what is meant by the controllable capacity per valve. That is very important if there is some limitation on how I can use those valves to perform what I call an active cooldown.

MR. SEO: Yes. The function of an MSADV is to remove the decay heat from the secondary site or incinerator during the hot standby to shutdown the cooling system accident condition. Therefore, the incinerator pressure

will be decreased from the hot standby condition to shutdown the cooling system. Therefore, the incinerator, the pressure is decreased. However, the atmospheric pressure is the same. I think it is the different pressure between the secondary site to the atmosphere. Therefore, the rating capacity will be changed due to the pressure.

MEMBER STETKAR: I understand that. That is just physics if the valve is completely open. I get that. What I am asking about is, what do you mean by the controllable capacity of the valve?

MR. SEO: The controllable capacity, yes, I understand the controllable capacity is provided and rests with the designer. However, as far as I know, the controllable capacity of an MSADV is during the removal of heat decay without pure, only RCP operation.

In this time condensers are not available. I think it is they remove the heat, produced the RCP operation, have to remove them to atmosphere. In that case, the heat can be removed by MSADV.

MEMBER MARCH-LEUBA: So, you are trying

to control the pressure of the secondary with that valve? During shutdown conditions and decay heat, you want to control the pressure of the secondary with the MSADV?

MR. SEO: Shutdown condition?

MEMBER MARCH-LEUBA: Yes.

MR. SEO: MSADV only controls until shutdown cooling system ancillary condition. After the shutdown cooling ancillary condition, decay heat from the steam generator the secondary side will be removed, the shutdown cooling system, not the main steam system.

MEMBER STETKAR: Let's just put this on the record and get back to us on this. I understand that one of the functional requirements from the MSADVs is to remove steam while the MSIVs are shut or the turbine stop valves are shut, while we are heating up the primary system on the reactor coolant pumps. Great. I got that. They have got to relieve steam somewhere.

I am curious about there is a specific line item in a table in the Design Certification Document that says the MSADVs have a controllable capacity per valve of 63,000 pounds mass per hour,

and I don't know what that means. I don't. If I am going to build the thing, I don't know what that means in terms of how I'm supposed to design the control systems.

MR. SISK: I understand. This is Rob Sisk, Westinghouse.

We have captured the comment and we will be --

MEMBER STETKAR: Yes. Thanks. I just wanted to get that on the record.

MR. SISK: Thank you.

MEMBER STETKAR: Now, also, in the description of the atmospheric dump valves -- and again, I will point you to Section 10.3.2.2.4 -- it says each MSADV can be operated manually with a hand wheel in the event of total loss of power. Where are those hand wheels located? Are they inside the main steam valve house? And if they are, are they accessible and operable during conditions when personnel would need to go stand there and turn those hand wheels?

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

The hand wheel is kept inside of MSADV,

the valve box.

MEMBER STETKAR: Inside the valve box? Okay.

MR. OH: Yes.

MEMBER STETKAR: So, I, as an operator, need to go stand there and manually control this thing while we are dumping a lot of steam. Is it pretty hot in there?

MR. OH: It is not very pretty hot.

MEMBER STETKAR: It's not?

MR. OH: In the valve room, actually, all the valves are insulated, so the condition for the valve room is the operator can access that valve and do some -- they are using tools and --

MEMBER STETKAR: Do you have any experience doing that?

MR. OH: Yes, the operators in Korea as a regular basis do some practice for that.

MEMBER STETKAR: Good. Thank you. That helps.

We had a valve room in our plant that you could live in it for a while before you became Louis the Lobster. Louis the Lobster is my analogy for somebody who is roughly boiled alive.

Perhaps you have better insulation and better access. But I am glad to hear that you actually have experience. That helps me a lot.

CHAIRMAN BALLINGER: Can anybody hear after operating that valve?

MEMBER STETKAR: Yes, yes, your ear protection is a lot better than Louis the Lobster protection.

(Laughter.)

MR. SEO: Let me provide additional information for MSADV. MSADV is located in the main steam valve house. The main steam valve house can be controlled by an HVAC system. Therefore --

MEMBER STETKAR: Yes, I was careful to say during the scenarios when I need to do this. Typically, during those scenarios I may not have that HVAC system. If I had it, I might have electric power and I might be able to operate those valves remotely. So, I'm thinking about what types of conditions in the plant would actually require someone to go there and stay there and control that valve locally. And those types conditions I suspect you may not have ventilation for that valve house, if you look at a risk assessment, for

example, the scenarios that would require local operation.

I had one last question, and we didn't talk about the turbine bypass valves. There's a statement in Section 10.4.4.3. And before I get to that statement, I understand that the total turbine bypass capacity is 55 percent of the full-rated steam flow or full power. I also understand you have eight turbine bypass valves. And in table 10.3.2-1 -- let me make sure I have my references correct here.

I'm sorry. In Section 10.4.4.2.2.1, it says, "No single turbine bypass valve has a maximum capacity greater than 9.07 times 10 to the 5th kilograms per hour," which is 2 times 10 to the 6th pounds per hour, "at normal full-power steam generator pressure."

Then, in Section 10.4.4.3, it says, "In the unlikely event that one of the TBVs opens inadvertently, the maximum steam flow through one valve at full-load main steam pressure is less than the maximum permissible flow to limit a reactor transient."

When I read that, I don't understand

what those words mean. So, if I take the maximum flow through one valve of about 2 million pounds per hour, that is about 11 percent of full-rated steam flow. And if one of those valves opens, in this design there are no automatic isolation valves on the turbine bypass valves, at least none shown in any drawings I could find.

So, that says that I am going to increase steam flow by about 11 percent. What does this statement that that steam flow increase is less than the maximum permissible flow to limit a reactor transient, what does that mean? Don't I get a reactor trip on high power under those conditions if I start from 100-percent power and increase it to 111-percent power, or not?

I will just put that on the record because I found that statement curious and I didn't know what it meant.

MR. SEO: I'm sorry, I don't answer --

MEMBER MARCH-LEUBA: I am not designing it, but opening the valve reduces the pressure. That does not increase the power. That is the answer you should have given.

MEMBER SKILLMAN: I have experience of

this event, and power increases rapidly due to moderator temperature coefficients. That is what happened in my plant.

MEMBER STETKAR: You go out on overpower to beyond where your high nuclear power trip setpoints are.

MEMBER SKILLMAN: I would like to ask about this 55-percent steam dump capability on your condenser. Two things. What provision do you have to protect your tubes at that very high steam flow rate, because that is relatively-high steam? And second of all, how do you protect the condenser boot that is the sealant between the condenser shell and the low-pressure turbine when you initiate this massive steam dump?

MR. SEO: In the APR 1400 design, it has an energy-dispersion device outside of the steam, the steam pipe, just the line downstream of the steam bypass turbine. Therefore, in an energy-dispersion device, it will be hard to maintain the turbine integrity. And then, the turbine condenser manufacturer also considered the location of the turbine bypass, based on the heat exchange in the designs. Therefore, in our experience, in Korea

experience of the OPR-1000 and APR 1400, there are no adverse impacts due to the steam bypass line to the condenser tube.

MEMBER SKILLMAN: Thank you.

MR. SEO: The condenser tube design is considered. However, two loads has a thickness. Tubes are used to prevent damage of our tube by steam. That is our practice for designing a condenser.

MEMBER SKILLMAN: Thank you.

MEMBER REMPE: I'm sorry to bring this up again, but I am a little curious about this load following and that you are not asking to have the load following be part of the Design Certification, because it is discussed in this Section 10. It is discussed in Section 4. There is a section about load following characteristics. The staff's draft SE talks about the term generator; it is designed for load following capabilities.

Where is it said explicitly, even though we have all this description about the fuel, the load following, and the turbine generator can do load following, that it says, "But we don't want to be approved for load following."? And where

does the staff say, "No, we are not reviewing this stuff," even though it says it does that. I mean, I don't get how somebody knows that this approval will not be for load following.

MR. SISK: Rob Sisk, Westinghouse, again, to support KHNP.

But load following, core operations is going be a COL issue. How they manage the load or the core will be a COL item.

What we are talking about today in the design is load rejection capabilities and what the plant design is capable of. And we have heard that there is a lot of capability in this plant. They have a lot of flexibility going forward. But we are not today talking about a load following program.

MEMBER REMPE: Okay, but the staff, I mean their response back doesn't say -- it says that the turbine generator has the capability to load follow. Did they review that explicitly and say, "Oh, yeah, it can do it."?

MR. SISK: I would defer to the staff on that.

MEMBER REMPE: Okay. We will be asking

that question. Because, I mean, I think somewhere that it kind of gives a false impression that the NRC staff is reviewing it and that you have submitted information for that capability.

MR. SISK: For the capability.

MEMBER REMPE: Okay, and they have reviewed that capability?

MR. SISK: I have no idea. I defer to the staff.

MEMBER REMPE: Okay. Thank you.

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

And that issue is asked by the RAI question for 297-8332. So, we clarified that the APR 1400 will be operated as base load plants in Section 4.4.3.3.4. We addressed that.

MEMBER REMPE: In Section 4, but in Section 10 was that also asked? Was that also asked in Chapter 10 also? Did the staff have an RAI on it in Chapter 10 also?

MR. OH: No. It is only asked by the Chapter 4.

MEMBER REMPE: Okay. Thank you.

MR. HWANG: Good morning, everyone. My

name is Hwang Kyeong Mo for KEPCO E&C. My experience of flow accelerated corrosion is about 25 years.

Today I present open items which is already the flow accelerated corrosion. The first open item was issued May 24th of this year. We responded several days ago.

The first description of the issue is right at this sentence. The NRC staff requested to revise the whole 10.3(3), right? I agree with the opinion. So, I have changed COL item 10.3(3). All right. This sentence, "The program shall incorporate the (real) condition of 10 CFR 50.55(a)(b)(5) on ASME Code Case N-597, Revision 2.

The second open item, the description of the issue is right in this sentence. NRC staff also requests to revise the COL item 10.3(3). I also agree with the opinion. So, I have revised the COL item like this. "The COL applicant is to provide a description of the flow accelerated corrosion monitoring program. The description is to address consistency with Reg Guide 89-08 and NSAC-202L, Revision 3, and provide a milestone schedule for implementation of the program."

CHAIRMAN BALLINGER: As long as we are going in I guess numerical order for the RAIs, this may have been resolved, but there is an RAI question 10.03.06-5 and 7 where they are talking about the extraction steam lines using a so-called weathering steel. That is ASTM 8588, Grade C.

MR. HWANG: Yes.

CHAIRMAN BALLINGER: Well, first, there is no Grade C in the current specification for 588. There is an A, B, and K. Those grades are all what are called COR-TEN steel, which gets their corrosion resistance from the addition of copper. And so, there is .5 or so percent copper, in addition to the chromium. And copper in the secondary system is a bad thing.

MR. HWANG: I know. Yes, I know. Yes.

CHAIRMAN BALLINGER: So, I am curious. I don't see that that was resolved, but, obviously, you are up to 10.03-6-25. What is going to happen with respect to this weathering steel use? It just seems to me just out of place.

MR. HWANG: You mentioned A588 material.

CHAIRMAN BALLINGER: Right.

MR. HWANG: Yes, which is related to the turbine generator system. So, I did not describe in this 10.03-6. So, I don't know what the material related to A588 describes as COL items. Could you explain the A588 material? Yes, the material is not related to this section. So, I turn over the answer.

CHAIRMAN BALLINGER: Okay. I guess I'm still not understanding. Is that material going to be used in the extraction lines? That is the question.

MR. HWANG: Extraction lines?

CHAIRMAN BALLINGER: Yes, the steam extraction lines are constructed from ASTM A588 Grade C.

MR. HWANG: A588?

CHAIRMAN BALLINGER: A588 Grade C. Well, first, there is no Grade C in that specification, the latest one. There might have been one in an earlier one. But those specifications are for weathering steel, and the weathering steel adds copper and in some cases phosphorous, but copper to achieve corrosion resistance.

MR. HWANG: I guess there are some mixtures. I understand that the steam extraction lines do not -- are not made of copper material.

CHAIRMAN BALLINGER: Okay. I'm sure they are not copper.

MR. HWANG: Yes.

CHAIRMAN BALLINGER: But the alloy that you are using contains copper. Okay? And over a long enough period of time, with flow-assisted corrosion and general corrosion, that copper would likely end up in the steam generator, some of it. And when it gets in the steam generator, historically, when there is copper in the steam generator and you have sludge and things, it becomes pretty tough to remove. And so, historically, copper has been removed entirely from the secondary system.

MR. HWANG: If we want, I answer after --

MR. SISK: Yes. No, no, no.

We have captured the comment and we will be looking into that. Once we have had an opportunity --

CHAIRMAN BALLINGER: Yes, but it was in

an RAI, and that is not one of the open items. But it says this addition is being tracked as a confirmatory item.

MR. SISK: We need to go back and take a look to see what the status of that is. I don't have it in front, but we are going to take a look at that.

CHAIRMAN BALLINGER: Thank you.

MR. SISK: Thank you.

MR. HWANG: Okay, I will continue my presentation, yes.

The third description of the issue is right at this sentence. The staff noted a configuration of chrome-molybdenum steel to chrome-molybdenum steel in the downcomer line. This configuration is more susceptible to flow accelerated corrosion, as discussed in NSAC-202L, Revision 3.

My answer is like this sentence. In OPR 1000 design, chrome-moly steel is utilized between the main feedwater control valve and the main steam air valve house, right, which contains sharp bending portions susceptible to flow accelerated corrosion, as shown in figure 1.

Figure 1 and 2 I will show you on the next slide.

In the APR 1400 design, carbon steel is utilized between the main fuel control valve and the main steam valve house, right, which does not have sharp bending portions, as shown in figure 2. This slide shows figure 1, 2, 3. As you can see, this figure 1 in OPR 1000 design, there is a sharp bending portion, as you can see in this figure. So, the rule I raised here was installed. On the other hand, in APR 1400 design, there are no sharp bending portions. So, we have changed the material to carbon steel.

Figure 3 shows the three-dimensional configuration between OPR 1000 and APR 1400 design. This slide shows the material comparison between OPR 1000 and APR 1400. As you can see with this figure, these portions that were installed with roll that are still in post-design, OPR 1000 and APR 1400. On the other hand, this portion between the main feedwater control valve to the main steam valve house were installed with roll in just the OPR 1000 design.

I will continue my answers. The carbon steel portion of the downcomer feedwater line

between the chrome-moly steel portions are not subject to augmented in-service inspection. ISI is performed to evaluate the weld degradation on the area of the area of weld.

Also, you can see the UT thickness inspection is performed to evaluate the component wear beyond the toe of the weld. Initial wall thickness is taken in components placed downstream of the main fuel control valve and will be inspected periodically during plant operation.

This slide shows the pre-service measured thickness for flow corrosion management. In this figure, the U/S extension means the upstream pipeline of this. This is the main feedwater control valves. And D/S extension means the downstream pipeline of this.

The fourth description of the issue is like this. Requests the further information on why the economizer line did not require FAC-resistant material, considering that flow is similar to the downcomer line.

So, my answer is like this. The answer can be referred to Question 26. Both the downcomer and the economizer lines are installed with carbon

steel. Accordingly, the FAC susceptibility comparison is not necessary between the two lines.

I skip the next sentence.

The final description of the issue is like this. First, if the removal of fittings, valves, and flanges from tables 2, 3, 4 is intended to provide a justification for the removal of these components from the tables and, as necessary, identify where the materials of construction for these components will be documented in the FSAR.

My answer is like this sentence. FAC inspections are normally carried out using UT thickness measurements. For castings of valves and flanges it is often quite difficult to quantify wear as surfaces are non-parallel and, thus, the UT thickness measurements are not used in this case.

So, visual inspections are more commonly used if wear is localized on valves and flanges. Therefore, material and size for valves and flanges have been excluded in tables 2, 3, and 4. Also, vendor design portions has been excluded in table 2, 3, 4, which are irrelevant to FSAR 10.3.6.

This next description of the issue is

like this: provide an explanation of the proposed changes in pipe size documented in applicant's RAI, response dated January 11th, 2016.

I skip our next slide because it was our mistake. So, we changed the table like this. For example, pipe size 30 and 34 inches was omitted. It was our mistake. Also, indeed, there is no impact onto the other -- the table changes, it is no impact onto the other document because in the design we referred to the design document, such as P&ID and isometric drawing piping design tables.

End of my presentation. Thank you for your attention.

CHAIRMAN BALLINGER: I have just a comment. Going back to slide 30, you are using the NSAC-202-L-R3. There is an R4.

MR. HWANG: Yes, I know.

CHAIRMAN BALLINGER: Okay. So, which one are you going to use?

MR. HWANG: In the document or Reg Guide 1406, 26, that document I cannot exactly remember. However, that Reg Guide describes NSAC-230, Revision 2. However, during maintenance of Korea Nuclear Power Plant, the secondary site

piping, we used the Reg Guide Revision 4, yes.

Reg Guide 1.26 describes Reg Guide Revision 2. However, when I describe this document, I used the Reg Guide Revision 3.

CHAIRMAN BALLINGER: Three?

MR. HWANG: Yes.

CHAIRMAN BALLINGER: But, again, there is a later revision, 4.

MR. HWANG: Yes, a later revision. I know Reg Guide Revision 4. No, no. NSAC Revision 4 was open.

MR. SISK: Rob Sisk.

Relative to the Certified Design, there are times -- and I would have to check the date on these -- but we followed the requirements or the guidelines, I should say, that are in place six months prior to the application. So, I would want to go back and check the date to see when Rev. 4 was released, but right now we're following Rev. 3.

CHAIRMAN BALLINGER: Yes, I could get Rev. 3, but Rev. 4 is EPRI proprietary and I couldn't get it.

MR. SISK: Understand, but, again, it depends. I would have to go look to see the date

on the revision applicability.

CHAIRMAN BALLINGER: It just makes sense, then, if Rev. 4 is a significant change, that it would be incorporated.

MR. SISK: I will say, generally speaking, I know where that sometimes makes sense.

CHAIRMAN BALLINGER: Yes.

MR. SISK: But in the certification world we have to submit the design as of a period of time.

CHAIRMAN BALLINGER: Right.

MR. SISK: And trying to keep current is a challenge.

CHAIRMAN BALLINGER: Right.

MR. SISK: I would like to take this opportunity, too, to just clarify one other point that came up during this session before we change over. The question on A588 --

CHAIRMAN BALLINGER: Yes.

MR. SISK: -- and the RAI 10.03.06, Question 5 and 7, we just did a quick check on that. A588 has been removed. It is not being used.

CHAIRMAN BALLINGER: Oh, okay.

MR. SISK: Okay? So, just to be clear, I wanted to go back and confirm that. But in the revised RAI that you may not have seen yet we have removed A588.

CHAIRMAN BALLINGER: Okay. Thank you.

MR. SISK: And that is why it is confirmatory.

CHAIRMAN BALLINGER: Okay. I have been reminded by the green button police that it is probably appropriate now to take a break, if this is convenient.

MEMBER STETKAR: Before we do that, though, there was a reason why I wanted to mention this. I noticed that we seemed to be in this briefing skipping Sections 10.4.1 through 10.4.7 of the DCD, because we are picking up now with 10.4.8, 10.4.9, and 10.4.10. And I was curious why we are not being briefed on those other sections, because I read them and I have questions on those sections.

MEMBER SKILLMAN: I do, too.

MEMBER STETKAR: So, how do we get those questions on the record, despite the fact that -- let me say, we are going to get those questions on the record, despite the fact that,

apparently, there was no plan to brief us on those. When do you want to do that?

And I'm curious why there was no briefing whatsoever on things like the main feedwater system.

MEMBER SKILLMAN: And the condensate polishing.

MEMBER STETKAR: And the condensate polishing.

MR. SEO: Let me provide the answer for your question. During the beginning of my presentation I mentioned that today the presentation is only considered with the open items. However, 10.4.1, main condenser were steam bypass system or condensate feedwater system, does not have open items by staff. Therefore, we do not prepare --

MEMBER STETKAR: You will find for future reference that the ACRS reviews everything. We do not care about open items or non-open items. We review everything. So, we would appreciate in the future presentations on every section of the Certified Design. That will give us, as a Subcommittee anyway, the opportunity to discuss

that technical information. In many cases, what comes out of these subcommittees are questions that the staff needs to take back. So, that is just for future reference.

Now, Ron, what I would propose is, before we go to Section 10.4 -- well, we have two options. We either let them finish through 10.4.10 and get our questions on the record at the end, which might be more efficient. I do have a hard stop at noon. I have a meeting at noon. Or we can insert them at some other time. What is your preference?

CHAIRMAN BALLINGER: Well, we have inserted Section 2.3 at a later time. And I am wondering whether or not it might be better to allow a little bit of preparation on the part of the --

MEMBER STETKAR: I submit that it is better to have the folks who are directly related to Chapter 10 sitting upfront when we have these questions rather than putting them at the end of the day and bringing them back.

CHAIRMAN BALLINGER: No. No, I agree. But I am just wondering whether or not there has

been enough preparation on the part of the KHNP folks to give us an adequate presentation.

MEMBER STETKAR: It is they won't give a presentation. They are not prepared to give a presentation. If they were, we would have it.

CHAIRMAN BALLINGER: Not today.

MEMBER STETKAR: It is unfortunate that they came unprepared. We came prepared and it is important for us -- this is our only opportunity as a Subcommittee at this stage of the review to give KHNP and the staff feedback on all of Chapter 10 in its entirety, and we ought to have that opportunity.

CHAIRMAN BALLINGER: Okay. In that case, maybe it is better to just get our questions on the record on these sections. And what that may end up doing is resulting in --

MEMBER STETKAR: That may.

CHAIRMAN BALLINGER: Yes.

MEMBER STETKAR: But should we do that -- all I'm asking now is a procedural question -- should we do that? Let them finish their presentation through 10.4.10 and, then, bring up the questions on those other sections at that time,

before we finish Chapter 10? Or should we do it now before they do 10.4.8? It doesn't make any difference. Think about it during the break.

CHAIRMAN BALLINGER: Yes, I'm indifferent. In the meantime, let's talk about that over the break.

So, we would be in recess until 20 minutes until 11:00.

(Whereupon, the foregoing matter went off the record at 10:24 a.m. and went back on the record at 10:40 a.m.)

CHAIRMAN BALLINGER: Earth to everybody, okay, we're back in session. Let's continue.

Well, we have had some discussions during the break, and the path forward will be do the presentations and, then, at the end of your presentations we will get our questions and answers on the record as best we can on the sections that were not reviewed.

But, in the future for future presentations, we want to be sure that we get presentations on every section of every chapter, not just the RAIs.

MR. SISK: Rob Sisk, Westinghouse.

And thank you. I appreciate that. I do just want, as far as on the record, I do want to just be clear. This meeting was originally scheduled for two days, and we had to make some decisions on how to fit everything into the schedule we had. So, we were trying to find where the value was to cover the important topics. We may have missed the boat on some of it, but we definitely want to hear ACRS's questions and concerns.

CHAIRMAN BALLINGER: That just means we need to work a little bit more closely when we schedule things and we make, also, guesses on how long things are likely to take.

MEMBER STETKAR: The other thing is that, quite honestly, this is a Subcommittee meeting and we are not constrained to stop at five o'clock in the afternoon. We have had Subcommittee meetings go until nine, 10 o'clock at night.

CHAIRMAN BALLINGER: Yes, there have been attempted homicides after that.

(Laughter.)

MR. SISK: Appreciate that, and I

think, as you indicate, we do need think about our scheduling time to fit everything in because it is a lot of material.

CHAIRMAN BALLINGER: Okay, continue.

MR. J.W. CHOI: Good morning, everybody. My name is Joon Wan Choi. I have worked in Korea E&C as a mechanical system engineer since 1996.

I present 10.4, other pictures of the system and the system open items will be presented. The first is the generator blowdown system. The generator blowdown system has no safety function except the two functions which are the containment isolation capability and the steam generator secondary side pressure boundary.

It is to assist in maintaining the chemical characteristics of the secondary side water with permissible limits during normal operation and anticipated operational occurrences such as a main condenser tube leak or a steam generator primary-to-secondary tube leakage. It consists of two subsystems, the blowdown subsystem and the wet lay-up subsystems.

The blowdown subsystems is to remove

impurities concentrated in steam generators by continuous blowdown and periodical high-capacity blowdown. In addition, an emergency blowdown can be operated to reduce to the steam generator water level during a multiple steam generator tube rupture event.

The wet lay-up subsystem is to maintain the steam generator water chemistry within the specified ranges during shutdown operation.

MEMBER STETKAR: Can I ask you about the emergency blowdown function? Now I don't know what information is proprietary or what is not proprietary. I know that there are three blowdown lines to the blowdown flash tank, and I won't give the line sizes, but there are two smaller lines and one larger line. Is the larger line the emergency blowdown line? I am looking the DCD at figure 10.4.8-1. Is everything in the DCD non-proprietary? I don't know if it is or not, because I do find some bracketed things.

MR. SISK: I will make a clarification relative to the DCD. There is SRI material which is treated as proprietary.

MEMBER STETKAR: Yes.

MR. SISK: But I believe everything that is in the DCD from a technical proprietary nature is non-proprietary. I will look over to the staff --

MEMBER STETKAR: Okay. I won't specify line sizes because that might be details. But, if I look at that figure, I see three lines, two smaller lines that have the same size and a larger line. Is the large line the emergency blowdown line.

MR. SEO: That's right.

MEMBER STETKAR: It is? Okay.

MR. SEO: Because the emergency blowdown is about 40 percent of the --

MEMBER STETKAR: Turn your microphone on, please.

MR. SEO: I'm sorry. Emergency blowdown proration is designed about 40 percent of emission or steaming ratio.

MEMBER STETKAR: I understand that. This may be too much detail now, but you say that that line is used for rapidly reducing steam generator level during a multiple tube rupture event. My question is, how are the operators

instructed to use that line? In other words, if I'm an operator, how do I know when I should open that emergency blowdown line? Is that included in my emergency operating procedures? And if so, what criteria do I use to open that line? In other words, how do I know when I'm supposed to open the emergency blowdown line? You don't have to answer it now, but that is a specific feature of this design and I would hope that it is reflected in some sort of basis for the emergency operating procedures for this design.

And as part of that question, the steam generator blowdown itself is isolated by a -- I think it is containment isolation signals from safeguards actuation. And therefore, if I get a safeguards actuation, that emergency blowdown line will be isolated, so that if I'm going to use as an operator, I must have criteria to reset the isolation signals so that I can use that blowdown line.

So, in summary, my basic question is, since this is a feature of the design, how are the operators instructed to use it? What criteria for opening the blowdown line? What criteria for

resetting the steam generator blowdown isolation signals? And what criteria for terminating your emergency blowdown? Because this actually is an unusual feature. So, you just can't pick up a standard set of emergency operating procedures and figure out how to use this thing.

MR. SEO: Let me explain your question. Emergency blowdown is used during the emergency seen in a tube rupture. In that case, the steam level will be increased. In that case, the incinerator level is high, is initiated by the main steam isolation signal. Therefore, the main steam isolation signal to isolate the contained isolating variable on the blowdown system.

So, there are two contained isolation variable for each steam generator. Two contained isolation variables receive the containment isolation signal, such as MSIS contains the isolation actuation signal or the auxiliary feedwater actuation signal, and so on. In the case of these variables are closed on receipt of condenser actuation signal. Therefore, an emergency blowdown in that case of containment isolation variable will be isolated by a main steam

isolation signal.

MR. OH: This is KHNP, Andy Oh, of the Washington Office.

Based on EOPs and APR 1400, there is some criterion for the operation of the SBCS Blowdown System, and steam generator levels should be kept between a wide range of 55 to 80 percent. In order to keep that wide range --

MEMBER STETKAR: Fifty-five to 80 percent wide range?

MR. OH: Yes.

MEMBER STETKAR: The main steam isolation signal comes in at 90-percent narrow range. Where is that relative to wide range? It is well below that.

MR. OH: Could you say that again, please?

MEMBER STETKAR: As best as I can tell, the main steam isolation signal, which I am going to ask about later, comes in at 90-percent narrow range level, narrow range. Where is that 90-percent narrow range relative to the wide range levels that you just mentioned?

MR. OH: As far as I know, for MSIV or

a setpoint, there is no reference for the narrow range. It is only for wide range.

MEMBER STETKAR: Well, okay, give me a second here because I was going to ask that question later. Let me find my notes on this.

In Section 7.3.1.3, table 7.3-3, 7.3-5(a), and figure 7.3-7, I find that the main steam isolation signal is actuated by any of the following conditions: No. 1, containment pressure greater than 1.9 PSIG; No. 2, pressure in either steam generator less than 855 PSIA; No. 3, level in any steam generator, narrow range greater than 90 percent, or manual. That is from Chapter 7 of the DCD. So, you should go check to see your statement about narrow range level isolating main steam.

I found in Chapter 10 statements that said that the main steam isolation occurs on high steam generator level, but high steam generator level to me could be any number of different levels. So, that is why I went to go look in Chapter 7 and I found the actual setpoint.

I will also observe that low pressurizer pressure will give me a safeguards actuation which will give me a containment

isolation signal which may occur well before I get to very, very high level in the steam generators.

So, I would like, if the EOPs actually have that guidance for the APR 1400, I would like to see that guidance because that is what I was asking for.

MR. OH: Yes. I think probably this narrow range, 90 percent is --

MEMBER STETKAR: I don't know.

MR. OH: -- a range in the wide range.

MEMBER STETKAR: You know, it would have helped if I could see where the levels were in wide range and narrow range, but I couldn't find any drawing that showed me where the wide range and level range narrow level taps were. So, I couldn't do that correlation.

MR. OH: Okay. We will get back to you with the wide range and narrow range calculation.

MEMBER STETKAR: Good. Well, wide range and narrow range is part of it. But more importantly to me is how are the operators instructed? What criteria do they use? Because it is an issue of timing. How soon do I know, according to the procedures and indications, that I

need to initiate emergency blowdown?

Because there must be some time window there before things -- if you do not require them to reset the isolation signal, that means I must initiate it before the isolation valves go closed. Or, if I am allowed to initiate it after the isolation valves go closed, then what criteria do I have as an operator to reset those isolation signals and reopen the isolation valves? And is it too late by then?

MR. OH: Andy Oh again.

And the EOP specified the criterion very clearly. As you know, this is accident status, that the wide range is the one referenced for the operator. And so, in order to keep that specified wide range, an operator can often, the SBCS operator or SBCS assistant initiated the operation of an SBCS system.

MEMBER STETKAR: And you said, just so I can take notes here, you said, in the EOPs it says between 55 and 80 --

MR. OH: Eighty-eight.

MEMBER STETKAR: -- 88 percent wide range?

MR. OH: Wide range.

MEMBER STETKAR: Thank you.

MR. OH: Sure. Thank you, sir.

MR. J.W. CHOI: The next slide, please. I presented one open item listed there, the blowdown system. The description of the issue is like this. The staff requests to revise the existing actuation signals. However, it is shown, actuation signal and blowdown in DCD figure 2.7.1.8-1 and to provide additional detail in --

MEMBER SKILLMAN: Excuse me. Sir, is your microphone on?

CHAIRMAN BALLINGER: It is pretty much shielded.

MR. J.W. CHOI: Yes. Sorry.

MEMBER SKILLMAN: Thank you.

MR. J.W. CHOI: Yes. Our answer is like this: indicate the actuation signal HRAS and BFTHHLAS in DCD figure 2.7.1.8-1 and provide the detailed description in DCD Chapter 7, Subsection 7.3.1.9.

Now I present the auxiliary feedwater system with one open item. Provide the auxiliary feedwater to the intact steam generators until the

shutdown cooling system entry condition when the main feedwater system is inoperable for the following events: loss of normal feedwater, main steam line break or feedwater line break, steam generator tube rupture, transient condition or postulated accidents such as reactor trip, any incident that results in station blackout, small break loss-of-coolant accident, and anticipated transients without scram.

This shows the flow diagram of the auxiliary feedwater system. The auxiliary feedwater system consists of two auxiliary feedwater storage tanks, two turbine-driven auxiliary feedwater pumps, and two motor-driven auxiliary feedwater pumps.

MEMBER STETKAR: Can I ask a question? If I look at figure 10.4.9-1 in the DCD, that figure shows several different line sizes from the auxiliary feedwater storage tanks to the auxiliary feedwater pump suctions. In particular, sheet 1 of that drawing shows a 12-inch line from each auxiliary feedwater storage tank to pumps, to the train A pumps, pump A and C. It shows that line is reduced to two 6-inch lines, one to each pump. To

the train B pumps, it shows that that line is reduced to two 8-inch lines. And if I go to sheet 2, it shows that each pump has a 10-inch line. So, how big are the pipes? And why aren't they consistent on the drawing in the DCD?

MR. SEO: Let me explain your question. To design the piping sizes, in that case we consider the proration. The proration is considered for determining the pipe sizes. For auxiliary feedwater pump, it has a minimum proration. Therefore, the suction line of the auxiliary pump has regular proration to the steam generator, plus the minimum prorations are considered. Therefore, the pipe size is bigger than the side pipe.

MEMBER STETKAR: Okay.

MR. SEO: And, in addition to the recommended pipe velocity, based on our design standard, the suction line velocity is less than the side pipe, to consider the MPSA, that plastic suction header at the pump suction site.

MEMBER STETKAR: Let me thank you. I appreciate that. I understand piping design. I am simply asking, if I look at the Certified Design

Document drawing, which will become part of the Certified Design, I see that on sheet 1 of that drawing there's a little arrow going out to pump A and pump C. One of those pumps is a motor-driven pump; one is a turbine-driven pump. Those lines are shown as 6-inch lines. I go down to the next page of that same drawing and, suddenly, they become 10-inch lines. I look at the flow drawings on the first sheet and I see 8-inch lines going to pump B and pump D, one being a motor-driven and one being a turbine-driven. They are 8-inch; they are not 6-inch. So, why is it 8 to one set and 6 to the other? And yet, when I go to the second page, they are suddenly 10-inch? If the design is so precise, as you describe, why can't we have a drawing that tells me what those pipe sizes are?

MR. SEO: Let me confirm your question. Pipe size, 8-inch pipe size is on figure 10.4.2; the 9-inch one, over three pages, right?

MEMBER STETKAR: It is on page 1 of 3.

MR. SEO: One of 3?

MEMBER STETKAR: If you look on page 1 of 3, on the righthand edge of that drawing, if you blow it up enough so that you can actually see the

numbers, at the top from AFWST, they go to 6-inch lines, and at the bottom from AFWSTB, they go to 8-inch lines. And yet, if I drop down to page 2 of 3, I see that the suction line to each pump is a 10-inch line, every pump, all four pumps.

I don't need an answer now. I would like to have a DCD that is at least consistent, so that I can see how big the pipes are, since they are apparently designed very, very precisely.

MR. SEO: Let me explain your question. Generally, we design the pipe size based on a recommended pipe velocity.

MEMBER STETKAR: You know, I hear that, but the pipe velocities should be precisely the same in pumps A and C versus pumps B and D, unless for some reason you are designing one train of auxiliary feedwater substantially different from the other train. If there is a design difference, for some reason train B, meaning pumps B and D, need more flow than pumps A and C, I want to understand why. If they need precisely the same flow, I don't know why the pipes would be sized differently.

MR. SEO: I'm sorry. The figure, we

have to revise it --

MEMBER STETKAR: Good. Thank you.

MR. SEO: -- from 8 to 6 inches. I'm sorry.

MEMBER STETKAR: And they're 6 inches?

MR. OH: Yes.

MEMBER STETKAR: Okay.

MR. OH: This is Andy Oh, KHNP.

MEMBER STETKAR: Right.

MR. OH: The Design Document, the pipe size should be corrected. All the pipe sizes should be 10 inches.

MEMBER STETKAR: Ten inches? Yes, well, I was guessing that it would be somewhere between 6 and 8 and 10. They should all be 10? Let's just get it clarified. It is just --

MR. SEO: Let me reconfirm your question. As far as what I am saying, figure 1 of 3, the bottom right, right?

MEMBER STETKAR: Yes.

MR. SEO: The bottom right has 12 inches, 12-inch pipe; the range is to 8 inches.

MEMBER STETKAR: Yes.

MR. SEO: Your concern is this is 8

inches. However, about the two pipes that are 6 inches, what is the inconsistency?

MEMBER STETKAR: And furthermore -- that is part a of the question, if you will --

MR. SEO: Yes.

MEMBER STETKAR: Furthermore, if I go to sheet 2 of 3, the next sheet, if I look at the piping that enters each of those pumps, each pump is shown as a 10-inch pipe. So, as best as I can tell from the drawing, there are three different sizes. Part b is --

MR. SEO: Yes.

MEMBER STETKAR: The basic question is, what is the size of the piping that goes from the auxiliary feedwater storage tank to each pump?

MR. SEO: Please, let me correct that answer. The suction pipe size is 10 inches. Two of the three pages is right. One of the three pages, the 6 inches and the 8 inches should be revised to 10 inches.

MR. SISK: We understand your question. I think the clarification is sheet 1 of 3 needs to be revised to reflect the correct pipe size of 10 inches.

MR. SEO: Ten inches, right.

MEMBER STETKAR: Ten inches is right?

MR. SEO: Yes.

MR. SISK: Ten inches is correct.

MEMBER STETKAR: Thank you.

Part of the reason I bring this up, No. 1 is consistency in the DCD documentation itself, but if, indeed, there was some subtle difference in the design of those trains, such that I needed more flow, if you will, I just wanted to confirm that that wasn't the case.

MR. SEO: It is not the case.

MEMBER STETKAR: I didn't think it was, but I can divine anything when I look at pipe sizes. So, thank you.

MEMBER SKILLMAN: I do have a question on this image. You show the venturi here. It is right at the center bottom of this image. And on sheets 2 and 3 of the document that John was talking about, this is figure 10.4.9-1, the venturis are located inside containment, and they are immediately upstream of the downcomers.

So, my question is, what experience do you have with these venturis? Have they been

tested? And are you fully aware of the downstream conditions that result when these venturis have been in operation for some time period? What is your experience with these venturis?

MR. SEO: Could you explain once more, please?

MEMBER SKILLMAN: Sure. The purpose for the venturi is to limit the flow.

MR. SEO: Yes.

MEMBER SKILLMAN: And what really occurs is, if the downstream pressure drops significantly, the venturi will cavitate.

MR. SEO: Yes.

MEMBER SKILLMAN: And that will produce two very major consequences. One is a large amount of the mechanical and acoustical energy and a large amount of erosion on the downstream piping. So, for short time periods this is not a problem. For long time periods it can be a very large problem. So, my question is, what experience do you have?

MR. SEO: Yes. In Korea we have several experiences, a 1,000-megawatt PWR from YG 3 and 4, about 20 or 30 years' experience there. But the downstream, potentially, material is stainless

steel, and the auxiliary feedwater system can be used only to the accident condition on receipt of aux feedwater actuation signal or after in-service tests every quarter, quarterly, every three months.

Therefore, the design has not used the maximum proration to limit the maximum proration. The maximum proration can occur during the accident conditions, such as a steam line break or main steam line break. The steam generator pressure decreases; in that case, the difference of differential pressure between steam generator tube upstream of captive entry. However, actually, without the accident, there cannot be occurred this condition.

However, at the manufacturing at the shop, the manufacturer's shop, it can be tested if the maximum proration is controlled by captive entry. So, as far as I know, we don't have any adverse detector for downstream of a captive entry. Okay?

MEMBER SKILLMAN: Thank you.

MR. J.W. CHOI: Yes. The auxiliary feedwater system and the supporting systems are designed to provide required flow to the steam

generator with a loss of offsite power event, assuming a single active failure. The auxiliary feedwater system components are located in the auxiliary building, which is designed as Seismic Category 1. All mechanical components and the piping up to the auxiliary feedwater isolation valves are Safety Class 3 and designed to ASME Section III requirements.

All components and piping from and including the containment to isolation valve to the steam generators are Safety Class 2 and designed to ASME Section III requirements.

MEMBER STETKAR: Can I ask, before you go to the next slide, the first bullet on this says that it is designed to provide required flow after a loss of offsite power, assuming a single act of failure. So, in the DCD you say that the turbine-driven AFW pump lines are supplied with battery-backed Class 1E power supplies for 16 hours. So, I looked that up, and that must be trains C and D of the batteries, because those are your 16-hour batteries, because trains A and be are the 8-hour batteries.

And then, I looked at the power

supplies to each component that is listed in table 10.4.9-2, and it was curious to me that the motive and control power for turbine-driven auxiliary feedwater trains C, modulating valve 037, is supplied from electric power train B, which is only an 8-hour battery, and the power for turbine-driven auxiliary train D, dog, modulating valve 038, is supplied from electric power train A rather than train D, dog.

Those are obviously intentional because everything else lines up A, B, C, D, as I would expect it for the four trains. So, I did some of my own analyses to see whether there was some fundamental reliability issue related with that specific allocation of power supplies. And I can't find any. In other words, I don't understand why those specific power supplies are from trains A and B rather than supplies from train C and D. Do you have any quick explanation of that? I mean, we don't have time, nor is it appropriate here, to go through all of the permutations and combinations I went through.

MR. SEO: Let me explain the design basis of the auxiliary feedwater system.

MEMBER STETKAR: Okay, I'll let you do that, but please don't get very high level. I'm asking you a very specific question. Why is the power supply to those valves from train A and train B rather than train C and train D?

MR. SEO: Yes. Train A and B is supplied to motor-driven auxiliary feedwater pumps. So, this power, it provides a diesel generator, both.

MEMBER STETKAR: Let me, just for the record, not both, because the station blackout gas turbine generator can supply train A or train B, but not both.

MR. SEO: Yes.

MEMBER STETKAR: Yes. If you look at Chapter 8, that is what it says.

MR. SEO: Plus, to your question, the difference between the power, available power duration, 8 hours and 16 hours, the turbine-driven system can be used during the station blackout condition. Therefore, as you know, the auxiliary system has to be operated during 8 hours on hot standby condition and within 6 hours to a shutdown cooling system. Therefore, about 14 hours minimum,

14 hours, they have to be operated. Therefore, the 16 hours of battery can be capable of providing the power to the steam generator during the station blackout condition. However, the motor-driven pumps with the 8-hour, a motor-driven pump cannot use that during the station blackout condition. Therefore, we do not consider the 16 hours time duration for A and B battery.

MEMBER STETKAR: I think it is probably in the interest of time if you go back and look at the transcript and see what I'm asking about. In particular, I'm asking about the flow control valve for the turbine-driven auxiliary feedwater pump C, Charlie, turbine-driven pump. The flow control valve receives power from electric power train A, yes, not C, not the 16-hour battery, from train A.

MR. SEO: Yes.

MEMBER STETKAR: And the flow control valve for the turbine-driven auxiliary feedwater pump D, dog, receives power from -- I probably got that backwards here. Let me make sure that I am correct for the record.

The flow control valve for turbine-driven auxiliary feedwater pump C, Charlie, is

supplied from electric power train B, boy. The flow control valve for turbine-driven auxiliary feedwater pump D, David, is supplied from electric power train A, alpha.

MR. SEO: Yes.

MEMBER STETKAR: That, to me, is very curious. It doesn't seem to be consistent with what you're telling me about 16-hour batteries being required for the turbine-driven auxiliary feedwater trains.

MR. SEO: That is based on the diversity. We can control the steam generator later by auxiliary modulating variable or isolation variable. If power pauses, such as station blackout, in that case the modulating variable cannot use, cannot operate through moderating the steam generators. Therefore, these variables are open-type variable. It is the case that this variable will open. However, the auxiliary feedwater isolated variable can control the steam generator level at loss-of-power condition. Because the auxiliary feedwater isolated variable division for turbine-driven auxiliary pump can be operated during the 16 hours with a turbine-driven

auxiliary feedwater pump.

MEMBER STETKAR: Now we are getting to part of the discussion. If I lose DC power train C, so if I have no DC power train C, does turbine-driven auxiliary feedwater pump C remain running? In other words, what happens to the turbine controls when I lose DC power? I'm asking this question so I get to the right table in my comparative analysis.

MR. SEO: Let me remind my explanation. Turbine-driven C received the power C, and the auxiliary feedwater isolation variable connected to turbine-driven C. Also, it received the power C.

MEMBER STETKAR: Yes.

MR. SEO: Yes.

MEMBER STETKAR: I was asking, though, what happens to the turbine controls, the controls for the turbine itself, the turbine speed control, when I lose, when I do not have DC power train C.

MR. SEO: It's right; the turbine-driven C also received the power C to control -- the turbine is controlled by the governor. The governor also receives the power C.

MEMBER STETKAR: Yes.

MR. SEO: Yes.

MEMBER STETKAR: Suppose I do not have power C. Does the turbine governor go closed? Does it go fully open? Or does it stay there?

MR. OH: This is Andy Oh, KHNP.

Hypothetically, if we lost our function of battery C, then we lost -- the turbine control system cannot be powered by the DC battery. So, it is out of control and overspeed is tripped.

MEMBER STETKAR: Okay.

MR. OH: Yes, tripped it. And also, the power for MOB valve, isolation valve, we cannot close or open. So, that means, if we lost the battery C, it means we lost function of C train for the auxiliary water pump.

MEMBER STETKAR: Good. Thank you. That is my case No. 2, in which case your design seems to require more operator intervention or more open/close failure of the isolation valve than a design that would have --

MR. OH: However -- it is still Andy Oh -- however, if the battery is alive, supplied then, the MOB in isolation valve automatically open and close, keep the steam generator level to 25 percent

or 40 percent.

MEMBER STETKAR: Right. I understand that. I understand that. That's my case No. 2 over here that I ran.

And if you look at the entire system design, you see that if loss of DC fails the turbine, that is a specific condition. So, I will take away that whole train if I have no DC power. And that is what you said the design is. Then, with DC power available, and depending on which other combinations of train A and B power failure I have, I can put myself into a situation where I am demanding that isolation valve to go open and closed more often than if I had power to the control valve from its own division. You have to look at all of the combinations.

And I will just put that on the record. It was very curious to me, and it is obvious that somebody made an active decision. I would like to see the rationale for that decision, for why A and B to those control valves. And is that more reliable than having the control valves powered from their own division? If it is more reliable, I would like to see the justification of why.

MR. SISK: For the sake of time, we do have the note and the comment.

MEMBER STETKAR: Yes.

MR. SISK: We will go back and assess that question in more detail. But I do --

MEMBER STETKAR: Yes, yes. No, in the interest of time --

MR. SISK: Yes.

MEMBER STETKAR: -- it is way too detailed. I just wanted to make sure that we had enough clarity on the record, so you could kind of trace back through to see what the genesis was.

MR. SISK: Yes. Okay. We're good.

MEMBER STETKAR: Thanks.

MR. SEO: AC power is reliable. However, we did not consider the DC power failure such as station blackouts. Station blackout is only the total loss of AC power, onsite and offsite power. However, the battery is available during the station blackout condition.

As you know, the auxiliary feedwater system has the unit system to remove the decay heat from the steam generator, the second side from the RCS decay heat. Therefore, the DC power can

provide power to the steam generator during the station blackout condition, even though the gas turbine generator can be used during a severe condition. However, if a gas turbine generator is not available, at that case the battery is available during the 18 hours. Therefore, by using the auxiliary feedwater pump and the aux feedwater isolation cable, it can be supplied, the power, to a steam generator, not effective as a steam generator.

CHAIRMAN BALLINGER: Please move on.

MR. J.W. CHOI: Okay. Continuing through my presentation, the safety-related portion of the auxiliary feedwater system appropriately protected against the possible effect of a postulated high- or moderate-energy pipe failure, including pipe whip or jet impingement. A failure of a non-essential equipment or component does not affect the auxiliary feedwater system safety functions.

Next, please. I printed one open item of the auxiliary feedwater system.

MEMBER STETKAR: Let me stop you. I am trying to write notes and listen at the same time.

You say that the auxiliary feedwater system is protected from turbine missiles. Have you done an analysis of missiles from the turbine-driven auxiliary feedwater pump itself? Turbine-driven auxiliary feedwater turbine missiles?

(Laughter.)

If you haven't, my concern is that if the auxiliary feedwater turbine can generate a missile that penetrates the turbine casing and damages either the suction or discharge piping in that room, you, then, will disable two trains of auxiliary feedwater because you basically will drain that auxiliary feedwater storage tank or you must isolate it. So, even if you say the missile was contained within the room and will not damage the motor-driven auxiliary train, if it can damage the piping in that room, the auxiliary feedwater piping itself, then you effectively functionally disable both of the trains taking suction from the same pump, from the same AFWST.

MR. SEO: Turbine-driven auxiliary pump also have the emergency trip systems, such as the main turbine, electric trip, during the overspeed condition. Also, the motor-driven auxiliary

feedwater pump and turbine room pump are separated, physically separated. Therefore, some failure of the turbine auxiliary pump cannot affect the safety function to supply the auxiliary steam generator.

MEMBER STETKAR: Just to make sure that my question is clear, can you go back to your slide 44? What I'm talking about is, if a missile comes from the turbine-driven auxiliary feedwater pump and damages the blue line, either on the discharge side or the suction side of that pump, I will, then, drain the entire auxiliary feedwater storage tank through that broken pipe and, therefore, disable the motor-driven pump. If I isolate -- there's a local isolation valve at the bottom of the auxiliary feedwater storage tank -- if I close that valve to prevent the tank from draining, the valve is closed and I also disable the motor-driven pump train.

So, I just want to make sure that it is clear. I am not talking about a missile from the turbine-driven pump hitting the motor-driven pump itself. I'm talking about the missile in the room damaging the piping in the room.

MR. SISK: The common suction, common

discharge.

MEMBER STETKAR: The common suction, common discharge. Well, it doesn't have to be part of the common discharge. It is anywhere in the discharge line the water is going to flow through the pump out the discharge. Depending on where it is, I might be able to isolate the discharge. I can't isolate the suction except at the tank itself. There is a manual to help to do that. So, that is my question, not about the --

MR. SISK: We understand the question.

MEMBER STETKAR: Thanks.

MR. J.W. CHOI: Next, please. I print one open item of the auxiliary feedwater system. NRC staff asked to provide a description of the auxiliary feedwater system reliability analysis to be performed in accordance with TMI Action Item II.E.1.1 of NUREG-0737.

Our answer is like this: the results of the auxiliary feedwater system reliability analysis have already been provided in the response to RAI 86-8003. The description of the auxiliary feedwater system reliability analysis will be made available to the staff.

Next, I put in two open items of the auxiliary steam system. The first of two, briefly introduce the auxiliary steam system. It is a non-safety-related system.

MEMBER STETKAR: Let me stop you then. I'm not done on auxiliary feedwater yet.

In the DCD in Section 10.4.9.2.2.5, it discusses -- and in Section 10.4.9.2.2.4 -- those sections discuss control and isolation of auxiliary feedwater. In the isolation discussion it says, "The isolation valves are closed automatically by an SFAS signal at a steam generator level higher than normal operation water level." That is for auxiliary feedwater isolation.

I could not find anything, any discussion of that signal in Chapter 7. So, I am curious what safeguards actuation signal isolates auxiliary feedwater, because it says in the DCD that it is isolated. And all it says is that "at a steam generator level higher than the normal operation water level," which could be a large number of different levels. So, if you could help me understand what that signal is and what the isolation setpoint is, I would appreciate that.

Oh, you have that one. In figure 10.4.9-1, sheet 1 of 3 shows the various alternative makeup lines to the auxiliary feedwater system. I understand those lines.

MR. SISK: Excuse me. Could you give me that figure number again, please?

MEMBER STETKAR: It is the auxiliary feedwater system drawing. It is 10.4.9-1 on the first sheet that shows the auxiliary feedwater storage tanks.

In particular, there is a 10-inch raw water makeup line that comes in kind of in the middle of the page from the righthand side. And then, there is also a 10-inch makeup line from -- I'm sorry -- a 10-inch makeup line that comes in from sheet 2A, it is labeled. And that must be from the condensate storage tanks. That is the only thing that I could figure out, because I kind of traced that line to the condensate storage drawing.

My question is, there is a discussion in Section 10.4.9 about the raw water makeup supply from the raw water storage tank. So, I got curious about that and I went to Chapter 9 of the DCD, and,

you know, I couldn't find anything about the raw water system at all in Chapter 9 of the DCD. No drawings, no discussion, no nothing. So, what is the raw water system? And what is the raw water storage tank? And when is it used? And does it exist?

Condensate storage tanks I found. I know they exist and I'm pretty sure I understand the connection from the condensate storage tanks.

(Pause.)

Again, we don't have to answer it today unless you have a quick answer.

MR. SEO: A raw water system can be supplied only to exhausted aux feedwater storage tank capacity, and the other problem, the condensate storage tank cannot use it. At this case, it only can be used by a raw water system. A raw water system is to use the raw water reservoir. The raw water reservoir is supplied with water during the loss of an auxiliary tank or loss of auxiliary capacity or condensate storage capacity. At this case, another alternative can be supplied in the auxiliary pump.

MEMBER STETKAR: I understand that.

What I am questioning is in the Certified Design you specify, and I quote, "A non-safety-related backup water source by gravity feed to AFW pump suction is also available from the condensate storage tank and raw water storage tank." In the DCD I find documentation of what the condensate storage tanks are, where they are located. In fact, I see a pipe from those tanks that goes to auxiliary feedwater. So, in the DCD I now understand the design concept.

I find nothing in the DCD about a raw water storage tank or any discussion of a raw water reservoir or what the functional requirements are for the raw water storage tank or the raw water reservoir, or whatever you want to call it. So, if, indeed, the DCD functional requirements for auxiliary feedwater specify the need for a raw water storage tank that implicitly must have some capacity and some makeup, then why does the DCD not describe that?

MR. SEO: Because the raw water system is site-specific. Therefore, we cannot decide the feeling that this is the case.

MEMBER STETKAR: Well, I'm sorry, if

you are taking credit for that as a supply for auxiliary feedwater, you must have some volume or makeup requirements. I can't put a raw water system in there with a 2 GPM pump and a tank the size of this coffee cup. So, there must be some specification for the COL applicant to know how much flow from the raw water system is needed and what the tank capacity, if there is a tank, to supply the auxiliary feedwater backup supply. Otherwise, I don't know how to design that system as a COL applicant.

MR. SEO: The raw water has a reliable recommender. So, it says the cooling tower for separating the water system and essential service water system or a demineralized system. Therefore, raw water can supply the water to so many systems. Therefore, you cannot assume or you cannot determine that it dissipates.

(Sound on phone.)

MEMBER STETKAR: Ignore that. That's just our phone system.

MR. SEO: We cannot determine that it dissipates. Therefore, the raw water reservoir is considered by COL frequently. Therefore, we

understand that the raw water reservoir design is a COL site specificity.

MEMBER STETKAR: We don't have time to design the system, nor is it the ACRS Subcommittee's function to design systems. I'm just making the observation that, if the Certified Design includes credit for a raw water supply as backup to a safety-related function, which is the auxiliary feedwater, then there should be some information in the Certified Design that specifies to me, as a combined license applicant, how much water I need to supply for that particular function.

I don't care how much water I supply for the main cooling towers. I don't care how much water I supply for the demineralized water system. I care right at the moment how much water I supply for auxiliary feedwater, and I need to know that as a combined license applicant, so that I know when I specify that system design that I at least have that capacity available as a backup for my safety-related auxiliary feedwater supply. And if I don't, don't show it as part of your Certified Design.

MR. SEO: We don't think that the auxiliary tanker only contains dedicated capacity to perform the safety function during an accident condition. Therefore, the auxiliary storage tank capacity can perform, can remove the decay heat during the hot standby, from hot standby to shutdown cooling system ancillary conditions. Therefore, there is no need, there is no makeup during the accident condition. However, beyond the DBA condition, that case can be provided as an alternative water source.

MR. SISK: We understand the question. There are a couple of places where the raw water is discussed in the DCD. The raw water provides backup to the freshwater system for the fire supplies and as a non-safety-related backup water supply for the AFW. We will provide a more --

MEMBER STETKAR: It is mentioned in words back there in Chapter 9. You found it. But --

MR. SISK: We got you.

MEMBER STETKAR: You understand.

By the way, I understand that the auxiliary feedwater storage tanks are sized such

that I can stay at, I will call it a condition hot shutdown; you might call it hot standby. Anyway, I can stay hot and pressurized for eight hours and, then, I have enough capacity for a 6-hour cooldown for the purpose of aligning shutdown cooling.

How long can I maintain hot shutdown conditions, and only hot shutdown conditions, with the capacity of one AFWST and with the capacity of both AFWSTs, because I can crosstie the tanks? Do you have that? I couldn't find that information anywhere.

Again, that is not a design basis licensing event. It is very, very important, for example, for risk assessment, and it is important for success criteria for these alternative makeup supplies. It may be also important for your coping times for flex mitigation strategies, by the way.

MR. SISK: Can you give me the specific configuration that you are referring to once more?

MEMBER STETKAR: Yes. Specific configuration is no cooldown, just stay at hot shutdown conditions with steam relief through the lowest setpoint main steam safety valve. So, I'm sitting on the main steam safety valves, and

feeding the steam generators with enough, just enough flow to remove heat. How long can I maintain that configuration with the inventory from only one AFWST? And how long can I make it, maintain that condition if I have the inventory of both AFWSTs? Because I can crosstie the tanks. And obviously, I can extend it. It is not linear, you know. So, that is why I am asking the questions about one tank and two tanks.

MR. SISK: Right. I appreciate it. Okay. Thank you.

MEMBER STETKAR: Sure. I'm done with auxiliary feedwater.

MR. J.W. CHOI: Okay. I presented two open items on the auxiliary steam system. The first is break in auxiliary steam system. It is a non-circulating system that supplies auxiliary steam required for plant use during structural cleanup situation and shutdown when the main steam is not available.

The first description of open items is like this. The staff requests to state clearly which option they chose to meet 10 CFR 20.1406 regarding embedded and buried piping. Our answer

is like this. I think embedment and buried piping in the yard shall be minimized to the extent practicable by using concrete tunnels. Where embedded and buried piping cannot be avoided, consideration shall be given to minimize embedded piping lengths and to utilize double-walled piping with the leak detection capabilities on the outer piping. The response to the RAI will be revised as shown above.

The second description of the issue is like this. The staff requests to the applicant to clarify the actual seismic and quality group classifications of the auxiliary steam system components and piping within the reactor containment building. The applicant is requested to modify the DCD figure 10.4.10-1 and table 3.2-1 to clearly depict a consistent design.

Our answer is like this. Containment isolation valves and associated piping are Seismic Category 1 Quality Group B. The piping and valves downstream of the containment isolation valve within the reactor containment building are non-safety-related Seismic Category II and Quality Group D.

Next, the combined license information open item. The staff noted inconsistencies among the Chapter 9 and Chapter 10 in providing operational procedures and maintenance programs to satisfy 10 CFR 20.1406. The staff for Chapter 11 and 12 has decided to take on this issue and ask the applicant to remove all COL items.

The KHNP has considered the removal of all COL items related to 10 CFR 20.1406 in Chapter 9 and Chapter 10. During a teleconference between KHNP and the NRC staff, it was agreed on to keep the current COL items as is. The resolution to this issue was submitted in the revised response to RAI No. 246-8307.

Next, Chapter 10, our Steam and Power Conversion System. Chapter 10 provides information concerning the plant Steam and Power Conversion System. The turbine generator control system, overspeed protection, turbine rotors, inspections, and supporting analyses specified in the DCD as functional requirements, principles and overarching architecture are compliant with the latest and extant regulatory guidance and industry experience.

The Steam and Power Conversion System

removes energy from the RCS via the steam generators and converts it to electric power in the turbine generator. It provides safety-related heat removal via the auxiliary feedwater system and the main steam atmospheric dump.

The next slide is acronyms for this Chapter 10 presentation. This is the end of my presentation. Thank you.

MEMBER SKILLMAN: I would like to ask this: we did not talk about the condensate polishing system, which is an integral part of your feedwater system. Why didn't we talk about that? I understood your earlier answer that there were no open items. But what provision do you have in condensate polishing to ensure that a failure in that system does not lead to a loss of feedwater? I see that it is online. The description in your Tier 2 documentation suggests that it is full flow all the time. So, it is downstream of your booster pumps, and from the polishers you get into your condensate pumps. So, I'm curious. I may have that backwards, condensate and booster. But I'm curious why we didn't talk about condensate polishing today.

MR. SEO: The condensate polishing system has seven cation vessels and seven mixed units in vessel. During the normal operation, six are cation and six are mixed vessels, are operated at full to purify the condensate. Sixty percent to 10 percent are condensate flow ratio.

So, the condensate polishing system also can be treated. Some leakage of condensate in the tube. So, to condense tube leakages, therefore, the condensate polishing system, the functional condensate polishing system is --

MEMBER SKILLMAN: Will the condensate polishing system be automatically bypassed if there is an upset in the system that prevents full flow?

MR. SEO: That's right.

MEMBER SKILLMAN: In the bypass?

MR. SEO: And the bypass is --

MEMBER SKILLMAN: Allows full flow to the rest of the system?

MR. SEO: Yes.

MEMBER SKILLMAN: Okay. Why is the condensate polishing system in your DCD blocked out with double lines?

MR. SEO: Because the condensate

polishing system, the basic concept can be performed by DC, the Design Certification case. However, the condensate polishing system is designed by the manufacturer, the condensate polishing system manufacturer. Therefore, there are so many variables. So, we cannot consider the manufacturing design scope. So, we just only consider the concept. Double bracket means concept design information. Therefore, we provide only conceptual design. There is a basic concept. However, the detail of the design is performed by the manufacturer. Therefore, we consider it for only --

MEMBER SKILLMAN: Okay. I thank you for that answer. Why isn't the turbine overspeed system conducted that same way?

MR. SEO: Turbine overspeed system --

MEMBER SKILLMAN: Well, you just explained the reason the polisher system is double bracketed is because it is a concept and there are many ways to purchase this system, which I agree that's accurate.

Why isn't the turbine overspeed governor system treated the same way in your DCD?

Because it is the identical concept that we spoke about two hours ago.

MR. SEO: I cannot explain the answer.

MEMBER SKILLMAN: Rob, do you understand what I'm saying?

MR. SISK: I do. I'm just checking with our turbine control expert.

MEMBER SKILLMAN: Storm, please identify yourself. You have to come to the microphone.

MR. KAUFFMAN: Storm Kauffman.

As part of trying to assure to the staff that the turbine overspeed system, which we understood the staff viewed as highly important, we felt that it was necessary to provide some detail. As the ACRS has pointed out, we may have gone beyond what is fully necessary, but we were trying to address what thought was a highly important, although non-safety-related system.

MEMBER SKILLMAN: Okay. I understand the spirit of your answer. Thank you.

MEMBER STETKAR: I've got to get this on the record in terms of this is not the ACRS. These are individual members' comments. The ACRS

communicates only through our written letters from the full Committee. So, don't characterize these as ACRS questions or ACRS recommendations or ACRS comments.

MEMBER SKILLMAN: One more question, Rob. This gets to probably an obscure system, the steam generator blowdown system. But on your DCD -- this is table 10.4.8-3 -- is a succinct presentation of the codes and standards, the materials, and the inspection testing requirements for that relatively obscure system. I am not suggesting it is not important. I am saying it is relatively obscure in the overall context of NSSS.

I can dig that same information out of the DCD going paragraph by paragraph for main feedwater, for condensate, and so on. And so, I would ask, why aren't the codes and standards for the various major components for main feed, aux feed, condensate polishing, presented in a table such as 10.4.8-3? That table presents in one glimpse the critical information about that system. To get that same information for main feed, for main steam, one has to go paragraph by paragraph and interpret it. That is not necessarily

inappropriate, but it seems as a tabular form, it actually keeps everybody honest and keeps everybody focused on a set of parameters that is, at least in my judgment, extremely helpful, healthy.

MR. SISK: Rob Sisk, Westinghouse.

And I do appreciate the comment. It is something we will take back and consider as we look at future revisions to the DCD. So, thank you.

MEMBER SKILLMAN: Thank you. Yes, sir.

That finishes my comment. Thank you.

MEMBER STETKAR: I have a few.

CHAIRMAN BALLINGER: Well, we have a little bit of a quandary, in that you indicated that you have a meeting now.

MEMBER STETKAR: Yes, but it is my meeting and I'm God.

(Laughter.)

CHAIRMAN BALLINGER: Okay. Okay. All right.

MEMBER STETKAR: So, if I'm not there, the meeting isn't going to happen until I'm there.

(Laughter.)

CHAIRMAN BALLINGER: In that case, the quandary does not exist.

MEMBER STETKAR: And I will try to make this as brief as I can. I'm dyslexic and I might be a dog.

(Laughter.)

Seriously, the main feedwater system, does the startup feedwater pump receive any automatic signals to start or is it only manual?

MR. SEO: No, manual.

MEMBER STETKAR: Only manual? Thank you. That was quick.

I am curious about the main steam isolation signals. We had some discussion about this earlier. So, I won't reiterate that part of the discussion. The DCD, at least in Chapter 10 and Chapter 7, indicates that main steam isolation signal, MSIS, is activated by high-level, greater-than-90-percent narrow range in either steam generator. Now the main steam isolation signal closes the main steam isolation valves for both steam generators, as you would expect, the main steam isolation valve bypass valves, which are normally closed for both steam generators, it closes the main feedwater isolation valves for both steam generators. So now, if I have high level in

one and only one steam generator, I isolate all main feedwater to both steam generators. That is an unusual design. And I was curious about why the design does that.

I'm more familiar with having separate main steam isolation and main feedwater isolation signals, such that if I have high level in a steam generator, I isolate main feedwater to that steam generator and retain main feedwater for the other steam generator.

So, this is obviously an active decision. And I would like to know what analyses were done to justify that decision. Because, from a risk perspective, it may not be the most prudent decision, especially because you only have two steam generators. So, I will just make that comment.

Talk about circulating water, and I have two questions about that. If I look at figure 10.4.5-1, which is sheet 1 of 2, which is the circulating water system, I understand that whether the applicant decides to use cooling towers or whether they decide to take suction from a river or the ocean, that is their business. The number of

circulating water pumps is their business.

However, if I look at that drawing, outside of the bubble on that drawing shows the individual lines to each section of the condenser. And on sheet 2 of that drawing it shows the connections to the turbine generator building open cooling water system and the return from that system, because the circulating water system, the driving head for the circulating water system provides cooling, provides flow for the turbine generator building open cooling water system, which, in turn, removes heat from the turbine generator building closed cooling water system, which basically cools everything in the turbine building.

My question about the figure is that there is on that figure, I think, a crosstie line shown downstream from the discharge isolation valves for each circulating water pump. It is that horizontal line on the figure that has the two things labeled as "manhole" on them.

Is that, in fact, a crosstie header that connects all the discharge from all six pumps?

MR. SEO: Yes, all six pumps for --

MEMBER STETKAR: Microphone.

MR. SEO: All six pumps, since six pumps operate, given the normal plant operating conditions, therefore, the condenser water box, these other lines are connected with a common line.

MEMBER STETKAR: Good. The size of that line is not so important for the main condenser cooling. It could be important for the turbine generator building open cooling water. Because if I have one particular pump available or two pumps available, I still have to have enough flow through that crosstie header to get to the turbine generator building open cooling water system, which is connected to a specific line.

So, is there anything, despite the fact that that is within the COL applicant's scope of supply, is there anything that the COL applicant needs to be concerned about in terms of the size of that header? Or is it just implied that it is a very large header?

MR. SEO: You understand the size of our common line, common header lines are based on our APR 1400 experience and the diagram. So, yes.

MEMBER STETKAR: Okay. I'll have to

think about that. Let me ask the last question I have. I'm not sure that I understand that answer, but I have to think about it.

In the discussion about the condenser circulating water system, there is some discussion about turbine building flooding. The statement is made that there is no safety-related equipment in the turbine building. I know the staff had some questions about the turbine building flooding, and I know that the nominal grade level of the turbine building is 100 feet.

In the response to one of those questions, you said that the maximum flood height was determined to be 104 feet. So, you can get some elevation above that grade level.

Now, again, I have to be careful because I don't know what information is proprietary or potentially security-related. So, let me try to keep this general.

I know that there is a non-safety-related switchgear room at an elevation below grade, substantially below grade. Are the doors to that switchgear room watertight? In other words, if I flood, first of all, if I flood the turbine

building up to an elevation of 100 feet, will that switchgear room be flooded?

The second part of the question is that at grade level there are non-safety-related battery rooms, at least one, and another switchgear room. And if I flood up to the nominal 104-feet elevation, will those rooms be flooded? So, I am asking, basically, questions about watertight doors for those electrical rooms in the turbine building. And I know they are not safety-related electrical rooms, but sometimes non-safety-related electric power can be relatively important.

MR. SEO: You understand the flooding condition in the current generator building is the extant condition, such as the breakover, separating water, water rain, or something such as extant. However, the switchgear, non-safety switchgear room, also non-safety, therefore, the provisions cannot perform, does not perform the safety function. So, the extant condition, these provisions are not used. However, the safety-related building or safety-related system can be considered to prevent the damage of flooding. However, I'm not sure the non-safety-related

switchgear room door is watertight or not. We have to check the doors, what type or not.

MEMBER STETKAR: Thank you.

I'm done.

CHAIRMAN BALLINGER: Do I perceive that the questions of the additional sections that weren't discussed have been asked? Good.

MEMBER SKILLMAN: I would like to ask one more. The circ water pumps, there are proposed to be six. And each one of the six pumps has a capacity of 16.6, 6 percent of the design flow of the condenser. That is about 1.4 million gallons a minute divided by 6, plus 25 percent for the turbine generator building closed cooling water heat exchanger. So, the circ water pumps are really dual-function pumps.

What consideration has been given for when you do not need the condenser and you are operating the TBCCW heat exchanger?

MR. SEO: TBCCW system can be used during the plant normal operation, not shutdown condition, not shutdown condition. The circulating water system also can be operated, including the normal operating condition. So, circulating pump,

one circulating pumper can provide some of the TBC system or TBC cooling water. So, that is our design concept.

MEMBER SKILLMAN: Are there provisions in the condenser that the flow passages through the condenser can be isolated from one another, so that you can do tube plugging or condenser maintenance while you are operating TBCCW in a different arrangement?

MR. SEO: As you know, the break line to TBCCW is upstream over condenser, upstream over condenser isolation valve. Therefore, if there is condenser tube leakage or such extant conditions to isolate the condenser water box, in that case the break lines are upstream of isolation, upstream over condenser isolated valve. Therefore, it can be provided, the cooling water, to the TBCCW system. So, the water boxes can be isolated.

MEMBER SKILLMAN: So, yes? Okay. Thank you. Thank you.

CHAIRMAN BALLINGER: Other questions from members?

(No response.)

MR. SISK: If we could --

CHAIRMAN BALLINGER: Yes.

MR. SISK: -- we wanted to give a couple of clarifications to questions that were asked earlier while we are still on Chapter 10. We did have a couple of simple clarifications.

CHAIRMAN BALLINGER: Okay.

MR. SISK: One, I would like to ask, Storm Kauffman, you had a clarification on the figure presented for turbine control?

MR. KAUFFMAN: Yes.

MR. SISK: Please use a microphone.

MR. KAUFFMAN: Storm Kauffman.

In regards to the reference to John Stetkar on the figure that was applicable, I got the figure numbers confused. The one that I had mentioned, 10.2.2-1, is noted as an example where typical. And you are right, it is inconsistent with the others. We should fix that to eliminate the inconsistencies. So, we will look at doing that.

MEMBER STETKAR: Is the intent -- I was more concerned about what the intent is -- is the intent to have a configuration that is shown in 10.1-2 where you have two valves in series --

MR. KAUFFMAN: Yes.

MEMBER STETKAR: -- on four separate lines?

MR. KAUFFMAN: Yes, and that is the higher reliability.

MEMBER STETKAR: That is, indeed, the higher reliability. Thank you.

MR. KAUFFMAN: And just one other item on the questions you asked on excessive detail in 10.2.2.3.2, about the mechanical overspeed trip and the infamous interface relay valve. The markup that the staff currently has, in fact, removed those as being excessive detail.

MEMBER STETKAR: Okay. Thank you.

MR. KAUFFMAN: You're welcome.

MR. SISK: And we had one other question that came up that we wanted to simply answer. On table 10.3.2-1, there was a discussion on the dump valve, on what did it mean by controllable capacity. I would like to ask Mr. Tae Han Kim to provide some insight.

MR. T. KIM: This is Tae Kim from KEPCO E&C.

We got in the controllable capacity for

variable ADS. This variable is an electro-hydraulic modulating variable. So, we can adjust it, pass them by to manage the power. So, this means we try to stand by its moderating; we can adjust a certain amount of the controller.

MEMBER STETKAR: But my basic question, though, is that the maximum steam relief capacity for each valve is about 1.1 million pounds per hour, 1.1 E to the 6 pounds per hour, for each valve. This controllable capacity, whatever that means, is only 63,000 pounds per hour, a very small fraction of the maximum relief capacity.

And I still don't fully understand what that means. Does it mean I can only -- is it the band or is it the maximum -- I don't understand. Let me start again. I don't understand what that smaller capacity means in terms of controllable flow.

MR. T. KIM: Without detailed information thrown on me, I can't give you the detailed explanation.

MEMBER STETKAR: Okay.

MR. T. KIM: But the meaning is we can control the modulating valve to get the power to --

MEMBER STETKAR: But, see, I understand if I can control it from fully closed to fully open, at any position in there I can control up to 1.1 million pounds per hour.

MR. T. KIM: Yes.

MEMBER STETKAR: It is not 63,000 pounds per hour. And I'm trying to understand that, if these valves open fully for some reason, I understand what they can relieve, but if I can only control them over a short amount of their possible span, that is important for me to understand if I am doing a controlled cooldown at, you know, rates and things like this.

MR. SISK: Thank you for that clarification.

The microphone is on. Hopefully, it is on.

(Laughter.)

But thank you for that clarification on that issue. We did want to get a little bit more further down the understanding, and now I think we have a better understanding. It is the difference between the 1.1 and the 63,000 that --

MEMBER STETKAR: Yes. I mean, it is a

small -- the 1.1 is about 6 percent of full-rated steam flow. So, they are relatively large valves. I can obviously remove decay heat after a plant trip through one of these valves. The 63,000 pounds per hour is about -- I don't know; I did the math here someplace -- .35 percent, you know, about a third of 1 percent, which is not very much. I can, indeed, so something, but it will take me a long time to do it.

MR. SISK: I understand. Thank you.

Those are the only questions we wanted to clarify.

CHAIRMAN BALLINGER: Okay. Thank you.

We have managed to get ourselves quite a bit behind, which is I think normal, unfortunately. So, I would propose that we recess until 1:15, at which point we will pick up Chapter 11.

MEMBER REMPE: The staff on Chapter 10.

CHAIRMAN BALLINGER: Oh, my goodness, yes. We are actually further behind than I thought we were. So, again, we will start up at 1:15, at which point the staff will present.

Thank you.

(Whereupon, the above-entitled matter went off the record at 12:19 p.m. and resumed at 1:15 p.m.)

CHAIRMAN BALLINGER: Okay, we're back in session. We are on schedule if we were in Arizona but we're not in Arizona. We are not on schedule.

So, the floor is yours.

MR. WUNDER: Thank you and good afternoon. I am George Wunder, a Senior Project Manager in the Office of New Reactors and the Project Manager assigned to Chapter 10. Today, I am joined by Angelo Stubbs and Ryan Nolan of the Plant Systems Branch and by Andrew Yeshnik and Greg Makar of the Material and Chemical Engineering Branch. They will be presenting the staff's SER for Chapter 10, Steam and Power Conversion System.

We had a team of ten people working on this chapter and we folks in Licensing are very grateful to all of them for the fine job that they did.

At the end of Phase 1, we lost one of our most experienced reviewers to retirement and I would like to give special thanks to Angelo Stubbs,

Ryan Nolan, and Dennis Andrukat for picking up his section. Sometimes it is more difficult to pick up someone else's work and take it to completion than it is to start from scratch. So, I think these gentlemen all did a fine job.

I would also like to recognize two more project managers, both Jessica Umana and Jim Steckel stepped in while I was out of the office sometimes for several days at a time and they covered meetings and kept things moving. So, my profound gratitude to both of them.

During the course of the staff review of Chapter 10 and the associated audit, we issued some 70 RAI questions. These resulted in the 17 open items at the end of Phase 2 that we will discuss today.

That all being said, I would like to turn it over to the technical staff for their presentation. We will be going through the sections sequentially and we will start with Angelo Stubbs and Section 10.2 on the turbine generator. Angelo.

MR. STUBBS: Good afternoon. My name is Angelo Stubbs. I am the Senior Reactor Systems

Engineer in the Plant Systems Branch. And I will start today's presentation with a brief discussion on information on the APR 1400 Turbine Control Overspeed Protection System, which is described in 10.2 of the DCD. After that, I will summarize the open items that staff identified based on its review and report on the current status of those items.

Okay, on this first slide, it provides some general information on how the turbine overspeed protection is accomplished in the APR 1400. Some of this we went over this morning but I will just summarize here.

In the DCD, the turbine overspeed protection system is described as being made of three independent systems: the normal turbine generating control system, which is assigned to the turbine when it exceeds a rate of speed and two emergency overspeed protection systems, a mechanical overspeed protection system that trips the turbine at 110 percent of rate speed and an electrical emergency trip system which trips the turbine at 111.5 percent of the rate of speed.

The use of the combination of a

mechanical and electrical overspeed protection system is done to provide diversity and redundance needs of overspeed reduction.

In the DCD, there is a significant amount of information discussion in the functional requirements of the turbine overspeed system. But as indicated in the last bullet, which describes the COL item, the applicant included the COL item in the DCD that had the COL applicant address design details and provide them as part of the COL application. This is a first in terms of us reviewing a DCD. When we are looking at turbine overspeed, this is the first time we have had someone come in with a turbine -- describing a turbine overspeed without having selected a turbine and having details on how overspeed protection is accomplished. However, based on the information in the application, there is a lot of information, sometimes pretty detailed information, on how the overspeed was being accomplished. We wanted to be able to take a look at the information and understand how it would be assured that when an applicant came in with a COL application that it would be achieved. Go to the next slide.

MEMBER SKILLMAN: Angelo, may I please ask this question? We spent an awful lot of time on a different application design certification that had I want to say copious -- maybe that is an exaggeration -- it had a lot of information about passive heat removal, all kinds of details. And we later learned that what had been communicated in the design cert would not carry the design. Changes were needed.

That intersection of finding and detail on the design cert caused a lot of turbulence for the applicant and for the staff. What will prevent a redo of an awful lot of busy work if the requirements that are codified in COL 10.2(2) are found to be not adequate with a different turbine design?

And I'm thinking GE has one front standard, Westinghouse has another, Allis-Chalmers had one, Brown Boveri has another. There are variations on the theme. They are all durable and robust machines but they are different.

MR. STUBBS: Okay. I think one of the things -- what we are representing here is what was in the original application. And the original

application was pretty open ended on what the COL -- it basically just said the COL will provide the information on turbine control.

Since then, we have got a little bit better understanding of what it is that we would like to see them provide. It was more like here is the SRP. The COL will meet the SRP and by doing that, we will get a satisfactory turbine control.

One of the issues, questions, problems that we had was whether they actually were satisfying 10 CFR 52.47, since no one else had came in in this way in terms of providing the fleet design. And we are still talking with our Office of General Counsel to try to get clarity on that.

MR. DIAS: May I interrupt a little bit? This is Antonio Dias, Plant Systems Branch Chief, NRO. And I completely agree with Angelo.

We were surprised that they were pursuing a COL item approach for the turbine overspeed protection design. We met with them. We discussed it. We felt that it doesn't really even follow Part 52 because Part 52 is very specific of what should be considered a COL which is basically site-specific. And we don't think this qualifies

as a site-specific.

The applicant said that they still wanted to pursue a COL item. We brought OGC in. OGC heard the two sides of the story. We do not know the final decision of OGC because OGC may say that no, this is not applicable. It doesn't apply.

So, this is a pending issue. We don't know the final solution to this. And it was very interesting because earlier today you mentioned about the double bracket. That is called the CDI. And I mentioned to the applicant why don't you try a CDI, instead of a COL item. And they said that no, they prefer the COL item.

So, this is where we are right now.

MEMBER SKILLMAN: So, the record will show that this is still in a state of flux.

MR. DIAS: We don't have a solution.

MEMBER SKILLMAN: We're not certain. But you are aware of the issue and OGC is.

MR. DIAS: I am aware of the issue, yes. I am waiting for some word from OGC. Because the way we read 52.47(c), it doesn't apply.

MEMBER SKILLMAN: Okay. Antonio, thank you.

MR. DIAS: Thank you.

MEMBER SKILLMAN: Yes, sir. Thank you.

Angelo, thank you.

MR. STUBBS: Okay. Going over to the next slide. I think we are on the next slide. Okay, now we are.

Okay, so when reviewed the DCD, Section 10.2, like I said, we found a lot of information what overspeed protection will be designed to accomplish. There are some system features that were included in there. There were terms such as use of triple redundant speed assessors. They talk about using two different, a mechanical and an electrical, ways to detect the performance speed trips. But however, we were unable to find sufficient information to verify the descriptive information that we found in the DCD. So, we issued a number of RAI questions to try to obtain the needed information.

The first open item was associated with RAI question 10.2-2. And in that question we requested the applicant provide information on the turbine overspeed protection system, including electrical schematics and logic diagrams on the

turbine generator control overspeed protection system, detailed information, functional performance descriptions on control fluid systems in conjunction with the schematics, as well as information on the power source and their locations and how such system components in that single failure consideration is described in our SRP.

The applicant responded to that question by indicating that APR 1400 does not identify a specific turbine generator. It provided a revised wording of the COL item and they expanded the COL item to basically have the COL answer the questions that we asked in the COL item.

The staff felt that the response did not completely address its concerns and since then, we have held a number of public meetings with them on the issue. As a result, the applicant recently submitted to us in the electronic reading room some updated information, additional information about the system and they referred to some of that this morning. And in that information, some of the information they provided to us was actually included in the presentation that they made to us this morning. But also in the information that

they included is markups in the DCD to try to bridge some of the gaps in what was being said and what was being -- well, what was said to us in our actual public meetings and what was actually available in that licensing document.

That was fairly recently that we had received that information. We are trying to take a look at it to see whether the available information addressed all of the concerns that we have and whether it is sufficient so that we, the staff, can make a complete determination on it.

One of the things we noticed in reviewing the information is that lots of times there is a lot of things that are described and there are a lot of things that there are words for but there is one diagram that they showed us today but often it helps to be able to have some graphical representation of what is going on.

So, there doesn't seem to be a lot of that but we are going to take a closer look at what they provided and if the information is complete when they submit on the docket, we will complete our review on it.

Okay, let me go to the next. The

second item associated with this was also associated with the same RAI number but question 10.2-3. And that one we requested that the applicant provide information on manual control or manual trip systems. In that response, they did provide a markup of the DCD that clarified the manual controls and the manual trip system but, again, information that would have been related to actually providing schematics or diagrams, they included -- had that being addressed by the COL applicant by including that and spelling that out in the COL item.

Again, we need to see that the complete response on that and we need to understand what it is that the COL can be put into the COL's plate as far as if we do find that COL item is applicable for this review.

The third item associated with the details or not having adequate details for the turbine trip block and its configuration. Their response to that was to see their response to the previous question, the response to RAI says see the response to RAI 10.2-2. And we are in a similar situation with that.

There may be some additional information that kind of reading over there, based on their last submittal but we haven't had the time to actually evaluate that. We haven't actually evaluated that at this time.

And the last open item, question 10.2-4, we requested that they address details of their hydraulic air system associated with any overspeed such as the electrical flow path and shared components failure modes, CCF vulnerabilities.

Again, they responded similarly and basically say see the original response, which was the response that expanded the original COL item to have the COL applicant address all of those things.

There is more information. They have actually provided more details in the information that was recently submitted to us but it is similar to the information that was presented to the ACRS this morning. And the thing that seems to be lacking is being able to look at the hydraulic system and understanding exactly how it is intended to work, how they expect it to work, and how much it will be -- how much, I guess how much information it will be conveying to the COL

applicant as to what they need to provide.

So, from the review standpoint, we are a lot further than we were originally but we still have a ways to go in terms of sorting out how to have something that we can do a review of and knowing that -- assuring that when the COL applicant comes in, if there is a COL item and they have fulfilled the COL item, that we will actually be able to make a finding that there is enough information here so that once the COL item, then we are going to have a complete application and we are going to be able to review and determine turbine overspeed protection, whether it has adequately been addressed in the COL.

And that's all I really can say about what we have now. If there are questions, I will be happy to answer any questions on that.

MEMBER REMPE: I have a question. It's the question I had this morning for KHNP but it is actually the staff, in your draft SE under Section 10, you do say on page -- it is the second page of the write-up that the turbine generator is designed for base load operation and has load following capability. Today, I guess I heard that there is

an RAI for Chapter 4, which I haven't seen, that basically the staff heck, I guess the conclusion is that KHNP has said we don't want to get this certified for load following.

So, did you do any sort of review for its ability to load follow the turbine generator? And if not, maybe that sentence ought to be modified.

MR. STUBBS: Okay, we didn't do any review and I don't know how this sentence -- this sentence may be saying that the applicant indicated something or something like that.

MEMBER REMPE: Because we are not going to let it load follow here, based on the certification.

MR. STUBBS: Right. Right, I understand. We didn't do any review. And as from a regulatory standpoint, having a regulatory basis to ask that question because it is not something that I see as being affecting safety-related -- well, it is a non-safety-related system but affecting safety or important safety. I don't know whether we had the regulatory basis to ask that question in that chapter.

But you are right, in terms of we don't want to imply that we are backing that statement. It is just a statement that they made and we haven't done a review of it.

MEMBER REMPE: Thank you.

MR. STUBBS: Okay, if there are no other questions, I would like to turn things over to Mr. Ryan Nolan and he will discuss the main steam system.

MR. NOLAN: Thanks, Angelo. So, like Angelo said, I am the reviewer for Section 10.3, Main Steam System.

The main steam system for the APR 1400 is fairly typical for a large PWR and the applicant this morning has already provided overview. So, my one slide here is focused on the open items.

The most significant open item is probably the first one. It is RAI 8570, question 10.3-4. And in this question we requested the applicant to explain how the discharge piping of the main steam atmospheric dump valves and the main steam safety valves can perform their safety-related function of discharging steam to the atmosphere, given that its seismic classification

is seismic category II.

The applicant provided their response and their justification on June 29th. And although the slide says that this is still in evaluation, last week I consulted with our Mechanical Engineering Branch and at this time the staff feels that the classification of seismic category II is not necessarily appropriate for this section of pipe.

And I would like to just read the definition or the first half of the definition of seismic category II. And this is the applicant's definition and it is consistent with previous definitions.

Seismic category II applies to SSEs which do not perform safety-related function and whose continued function is not required. So, in this case, we feel that discharging the steam to the atmosphere is a safety-related function and this discharge piping absolutely is required post-earthquake. So, this remains an open item and further interaction with the applicant will be needed to resolve this.

MEMBER SKILLMAN: Ryan, I would observe

that the downstream piping off of the PORSVs was classified the same way. As I recall in Chapter 5, the downstream piping was not safety and it was not seismic. And it seems to me that this is indicative of a choice of quality classification and safety classification that may not reflect current standard in the United States. So, I think this is one worth hanging onto.

MR. NOLAN: Yes, I appreciate that feedback. I will take a look at it. I know I looked at previous design certifications and this section of discharge piping is safety-related, at least until it gets out of the structure.

Another concern worth discussing with the mechanical engineering branches, seismic category II is used more for seismic interaction where you don't want this non-seismic pipe to rip off of a wall and somehow interact with something that is safety related. That does not preclude the pipe from becoming crimped or something along those lines. And in that case, this system would not be able to perform their safety function, if it were crimped.

MEMBER SKILLMAN: Well, my experience

is this is part of decay heat removal.

MR. NOLAN: Yes.

MEMBER SKILLMAN: And decay heat removal just happens to be Section III, Class 2, Seismic I, at least it has been for many years on a lot of plants.

MR. NOLAN: Yes, I think for this applicant they make the class break at the valve. They just don't include the exhaust pipe.

MEMBER SKILLMAN: The tail pipe.

MR. NOLAN: Yes.

MEMBER SKILLMAN: Okay.

MR. NOLAN: The second open item is question 10.3-5. And this is where we requested the applicant to describe all the flow paths that branch off of the main steam line between the main steam isolation valves and the turbine stop valves. And this is discussed in the SRP.

The response was received on June 23rd. And again, although it says it is under evaluation, I took a quick look at the response and it seems to address the information that was requested in the RAI.

And then the last open item is question

10.3-6 and we requested the applicant to include in the DCD the elements of a procedure that would address the potential water, in this case steam hammer, consistent with NUREG-0927. And this response was received June first and we did find this response to be acceptable. The DCD will be revised to include the specific elements to address water hammer considerations in the operating and maintenance procedures. And that is a COL item, of course.

So, that question is considered resolved and closed.

This concludes my portion of the presentation. If there are no more questions, I will turn it over to Andrew Yeshnik to talk about 10.3-6.

MEMBER RAY: Before Andrew goes on, I just wanted to insert something before I forgot about it. It really has to do with your colleague's prior comments.

It seems to me like we have a responsibility to the agency to be clear about what we have reviewed and not reviewed. And on this issue of load following, there can be safety

implications if you get into xenon oscillation, things having to do with core stability. And if we are not going to review it and if the application says it is a capability that exists, we at least ought to say we didn't review it. So, I want to make that point for whatever value it may have as an individual input.

If we are not reviewing it, fine. We are not reviewing it and it is not part of the certified design. But the application says something and we have to respond to it, it seems to me.

MR. STUBBS: Yes, and I agree with you. I think with the load following there is two different things we are talking about. We are talking about turbine and we are talking about reactor. And we need to make it clear in our section that even if the turbine load following is not something that we review.

MEMBER RAY: Well, yes, whatever we didn't review. In this case, since it is something that has been said and we have heard what the applicant has to say about that description, it is not their intent that it be part of the

certification. But given that it is stated the way it is, we should say we didn't review it, just to be really clear.

MR. STUBBS: Okay.

MR. YESHNIK: Hello. My name is Andrew Yeshnik. I am a materials engineering in the Materials and Chemical Engineering Branch and I am here to talk to you today about the steam and feedwater system materials.

There are five open items on this section. Two of those open items are pretty much confirmatory items at this stage. It was just the timing of the submittal that they were open. So, I would like to just briefly go over these.

The first open item, which is question 10.3.6-24 involves the use of the ASME Code case N-597-2 on the Flow-Accelerated Corrosion Program. The applicant has submitted a response and the response is to add a statement on compliance in the COL item.

The second question, which is 10.3.6-25 regards the pre-screening of systems out of the Flow-Accelerated Corrosion Program. The applicant has responded that they will remove the sentence

that pre-screened them so every system will go into the program.

The third open item --

MEMBER SKILLMAN: Andrew, let me ask this. This is maybe not the exact place to ask the question but it is either this one or the next.

What attention has the staff given to this idea that all the Class 1 systems are 60-year design life and the Class 2 are 40-years design life?

MR. YESHNIK: Well, I did not review it as part of my review. I reviewed the 40-year life that they stated in that section.

MEMBER SKILLMAN: But the document that is the overarching document for the design cert is a 60-year design life. So, why is 40 years acceptable or why wasn't that challenged?

MR. YESHNIK: The reason I did not challenge it is that I did not know that the rest of the system was the 60-year design life. It was not apparent in the document.

MEMBER SKILLMAN: Fair enough. It is on the record. Thank you.

MR. YESHNIK: Okay, so the third

question is related to the use of the chrome-moly steel and the downcomer feedwater control system. We have received a response from KHNP within the last few days and the staff has not had time to review this. Next slide.

Question 27 talked about the use of chrome-moly steel in the downcomer feedwater control line and not in the economizer line. Again, this is another question that KHNP has responded to within the past few days and we have not had a chance to review it.

The final question, which is 28, involves a previous RAI which is question 10.3.5-20, where the applicant removed piping -- why they changed piping diameters and removed fittings, valves, and flanges from a table in the FSAR. And there was no justification provided why they changed that and any effect on any analyses.

They have responded and, again, we have not had time to review it.

So, are there any questions? Okay, if not, I am going to turn this over to my colleague, Greg Makar.

MR. MAKAR: Our review of the steam

generator blowdown system includes a variety of topics on design materials, water chemistry, and instrumentation and controls. And the instrumentation, controls, and electronics engineering branch provides support on the review of instrumentation and controls.

Our one slide is on the one open item we have, which is related to the description of control signals that close containment isolation valves and, specifically, consistency between Tier 1, Tier 2 of the DCD, figures, and tables, and text.

There were two process interlock signals that are described in Chapter 10 of the DCD that were not shown in Tier 1 for the containment isolation valves for the steam generator blowdown system. And in addition, the information in Chapter 7 on these control signals for the containment isolation valve did not fully describe -- did not include these or an adequate description of the actuation of containment isolation valves in general or the signals to actuate them.

So, the applicant has provided a response and has addressed those two items.

However, there were still some things that were unclear to us. Since the SER was sent to you, we have discussed these items with the applicant. And due to the editorial nature of these questions, we expect that this will be -- we will be able to close this and track the changes to the DCD as a confirmatory item.

MEMBER STETKAR: Greg, I'll bring it up. You heard -- were you hear this morning?

MR. MAKAR: Yes.

MEMBER STETKAR: There were the questions about emergency blowdown. Did you pull that string very much? I didn't read RAIs and all that kind of stuff. It is blowdown but they are citing it -- they are citing it in the context of a multiple tube rupture event, which is not a design-basis accident.

On the other hand, if I am an operator, I don't go out and count the number of tubes that are broken when I am trying to respond to an event. So, therefore, it, in principle, might have implications on a design-basis steam generator tube rupture event. Has anybody followed that at all?

MR. MAKAR: Anybody, I don't know. I

can say the question that came to you that you asked about did not come to me. And I was focused more on equipment capacity, design --

MEMBER STETKAR: I mean I don't know where it would be addressed is the problem. It is part emergency operating procedures. It is part accident analysis, I guess, but they tend to be what they are. It, in principle, ought to be in the PRA and we haven't looked at the PRA and we don't have the details of it anyway. So, I was just curious whether you followed it from your part of it.

MR. MAKAR: I did not.

MEMBER STETKAR: Okay, thank you.

MR. STUBBS: Okay, this is Angelo Stubbs speaking and we are going to continue with Section 10.4.9. The auxiliary feedwater system for the APR 1400 is very similar to one that is currently used by large PWRs. However, one difference is that the APR 1400 safety-related water supply provided by auxiliary feedwater storage tanks that you have heard about earlier and they are located in the reactor building. Being that it takes the water line from the auxiliary

feedwater storage tank systems to the condensate storage tanks, there was a need to have technical specifications to address the requirements. And we did find that they included a technical specification in the application for those storage tanks.

This section has one RAI -- well, open item associated with it. And it is related to a question that we asked about the reliability analysis. In the application they indicated that they met certain unavailability targets and referenced an analysis or evaluation that was discussed in Chapter 19 of the application. When we looked at Chapter 19, we couldn't find that information. So, we issued an RAI and asked them to provide us with the information or tell us where it was available.

In response to that RAI, the applicant provided us with a table of reliability numbers but it wasn't -- it still didn't answer our question of how it was developed. And the reference to Chapter 19 was deleted.

So, we have talked to them -- we have let them know since then that there was a problem

with the response and we talked with our PRA group and they have indicated now that the information is available in the electronic reading room and our PRA branch recently begun to look at it. And they confirmed that the reliability study is in the electronic reading room and they are reviewing it and that will be part of the presentation in Chapter 19, when they make their presentation to ACRS.

MEMBER STETKAR: Angelo, why is the staff obsessed with a reliability analysis of the auxiliary feedwater system?

MR. STUBBS: It is not that the staff is obsessed with it.

MEMBER STETKAR: I'm sorry. You asked several RAIs. Why is the staff obsessed -- let me finish -- with a reliability analysis of the auxiliary feedwater system when they don't care at all about the numerical reliability of the component cooling water system, the safety injection system, or any other system in the plant?

MR. STUBBS: The RAI was written because it pointed to information in the application that was not there. There was a

problem with having information that was being referenced that wasn't in the application and the RAIs were written to try to close that loop and provide an application that was complete and correct.

MEMBER STETKAR: You are not answering the question but let me try it one more time. Why is the staff obsessed with a reliability analysis of the auxiliary feedwater system and only the auxiliary feedwater system and not similar reliability analyses of other safety-related systems that might be as important or more important to risk than the auxiliary feedwater system?

MR. STUBBS: Okay, I guess it goes back to our guidance. We have specific guidance in our SRP and in the TMI action items that have us look at that when we evaluate the auxiliary feedwater system but the other systems we don't. And maybe that is something we need to --

MEMBER STETKAR: That is what I wanted to get on the record because everybody after TMI, because auxiliary feedwater happened to be the system that didn't work at TMI, everybody became

obsessed with auxiliary feedwater.

I'm not trying to say it isn't an important system. I'm just saying that it is equally as important or unimportant as every other system in the plant. And to focus so much regulatory obsession with that particular system, especially when I don't understand the boundaries of that system, the failure modes, the types of failures that are supposed to be included within whatever that thing that is called the auxiliary feedwater system reliability analysis, I just don't get it. And to require more scrutiny of that particular system outside of the context of the PRA, where the PRA doesn't look at that level of detail itself, the PRA review doesn't.

So, I'm glad to hear you say it might be something that the staff might want to revisit because it strikes me that this is an awful lot of time being spent on a number for a system that I don't know what we do with it. What do you do with it once you get the number? The number is good? The number is bad? The analysis was okay?

MR. STUBBS: I guess this is one of those numbers that we always get and it generally

falls within the range, you know the ten to the minus four, ten to the minus five range. So, they meet the requirement.

MR. DIAS: If I can say something. This is Antonio Dias again.

Mr. Stetkar, this was something that among the staff and talking to some senior-level management, there was a discussion do we really need it. Unfortunately, we fell into this question, as Angelo described, because it was pointing to something that we couldn't find. That is how the question was initially started. But we think you have a very strong point and we should look into when the revision time for the guidance comes in to question that and probably remove it.

MEMBER STETKAR: Thank you.

MR. STUBBS: Okay, so that's all we have for the open item for Section 10.4.9. We will move to the next slide.

Okay, the last section that we have to go over is auxiliary steam system. And there was, I think, three open items associated with that. The first one was basically to request clarification of actual seismic and quality rule

classifications for the system and its components.

The applicant has responded to that and they have identified what the non-safety -- well, they stated that non-safety-related piping components that was in the reactor containment building will be classified as Seismic II. And they have provided a markup.

So, they basically clarified that the piping in the site reactor building, which its failure might impact safety-related or important safety equipment will be actually designed to seismic category II. And we reviewed that and we found that that would be acceptable and decided we will now be confirmatory, depending on them actually incorporating it into a future revision of the DCD.

The second question on this slide was to clarify. And they spoke to this a little bit earlier when they did their presentation, clarification on the buried piping and embedded piping. There was an inconsistency as far as how do you meet the 2014/06, which allows you to have buried piping as long as you minimize -- or embedded piping but actually to minimize the buried

and embedded piping.

And they discussed that this morning, slightly different from what we had, what was on here. But basically, they are going to use -- they are going to minimize the amount of buried piping and then they are going to use the concrete tunnels and have some leak detection capability, leak collection and detection capability so that they would be aware if there is any leakage through the piping.

And that, too, based on our review, we found to be acceptable and that question will also be confirmatory instead of open now.

Okay, and we go to the next one. Okay, and the last one is an open item that was associated with -- and this is one of those things where they used COL items and they use it quite often. This was looking at COL item in Chapter 10 but it was a COL item that asked them to make sure that there is maintenance and operational procedures for leak detection and contamination control.

In general, they are doing this with a number system. They were somewhat inconsistent in

how they wrote out the wording in the COL item. And in this case I don't think they actually identified what systems are applied to them. When you get into a Chapter 10.4, there is a number of different systems that this could be applied to. And in some of our other sections, they actually say procedures for this system.

So, this is a bigger problem. And the procedures and everything are actually Chapter 12. And when we were looking at the radiological for some of the site-wide procedures and stuff applies to just being able to detect that there is leakage from the plant.

So, they presented this also this morning but I think the end result of this is that they recognized that it was -- I guess it is overkill in presenting it everywhere and there are some inconsistencies in the way they have done it. But the COL information items in Chapter 10, they propose to leave unchanged. And I don't know whether the staff made a final decision on this because it covers more than Chapter 10 but the current -- right now it is currently, I guess not completely resolved. It is open. It is not a big

issue in terms of what is going on but having the application be consistent and having it make sense is the reason that we are looking at this, whether we need to have procedures duplicated in different places or whether it would be sufficient in one place to cover all the programmatic issues for all the systems is what we are looking at.

MEMBER SKILLMAN: Angelo, I would like to make a statement here, kind of in response to your comment that maybe it's not that important. I'm going to hold you accountable just for a second, for an example. John mentioned a couple of hours ago the idea of words matter. Words really matter here. Here's why. We sit around this table, this horseshoe as individuals and later as a committee and consider the totality of this design certification application. And the final application and all of its 19 or 20 chapters plus all of those figures becomes the basis for some future entity to apply to build one of these. And the information comes in three different colors. It is Tier 1, Tier 2 Star, and Tier 2. And the words that we are considering even today are going to end up, in some form, in that final document.

And then some poor applicant, six or eight years from now, is going to come in and say I have to make all these departures because I don't really want to do what that says because normally the process is you incorporate by reference, you IDR. And some applicant is going to say I can't incorporate that by reference because I'm not doing that. And when that occurs, there is a departure.

And so I would just simply like to say that words really matter. It is important because if what is finally embedded in this document isn't pretty close to the mark in terms of quality and thoroughness, then we are setting the staff up and a future applicant up for an awful lot of busy work. So, it is incumbent upon all of us collectively to get this right the first time. We only got a chance to do it right the first time one time.

So, enough of a sermon but you get my point. If we are not careful, we are going to burden the staff and a future applicant with a boodle of work that none of us want to have happen.

MR. STUBBS: Okay, I wasn't implying that words doesn't matter. In this case, I was

saying that duplication of the COL item we were looking at whether it was necessary to have something that is covering it in Chapter 12 also be implemented in Chapter 9.

MEMBER SKILLMAN: But hence, my caution. We need to be circumspect about what these words are, how they are fixed into this document because the final product really matters to someone.

MR. STUBBS: I agree.

MEMBER SKILLMAN: Thank you.

MR. STUBBS: Okay and that covers the auxiliary steam system and I think that concludes Chapter 10.

So, if there is any questions, we are able to answer those.

MR. WUNDER: That concludes the staff's presentation on Chapter 10. Thank you.

CHAIRMAN BALLINGER: Thank you. I guess we need to switch out and pick up Chapter 11.

MR. SISK: Okay, just very quickly, we are making arrangements. We noticed two of our speakers don't have name tags but we will add those in shortly to facilitate communication. But we

will go ahead and start with Mr. Shagho Kang to get us started on Chapter 11.

MR. KANG: Okay, thank you. Good afternoon, everyone. My name is Shagho Kang and am responsible for radwaste system and radiation protection design at KEPCO E&C.

Today I am going to talk about DCD Chapter 11, Radioactive Waste Management for APR 1400.

Before I start, I am so pleased to have this opportunity to present on the Radwaste Management System.

MEMBER STETKAR: Mr. Kang, could you either speak louder or pull your microphone closer to you because all of our transcript comes from what you say? So, we have to be sure that it is loud enough. Thank you.

MR. KANG: Thank you.

Before I start my presentation, I would like to introduce our Chapter 11 team. Sitting on my right is Mr. Irving Tsang, who is from the DERADS Consulting Team. He is a consultant for Radwaste Management System and Radiation Protection. Sitting on my left Mr. Jinkyu Choi is

responsible for waste management systems. And Mr. James Jhun, who is sitting here is from back there and so another consultant for the ISE and RMS design. We have a couple more technical staff sitting in the back and they will help us to answer your questions.

Now, I am going to move on to the next slide. The contents of the presentation, as you can see are in the same order as that of the DCD Chapter 11. After a brief introduction of Chapter 11 and the current NRC staff status, I will introduce the design features of the APR 1400, including radioactive source term, radioactive waste management system.

And Mr. James Jhun, on the right, is going to present Section 11.5, Process and Effluent Radiation Monitoring System. And then I will be back to present the design evaluation part and summarize the presentation.

For the review of the APR 1400 radwaste management system, KHNP summary DCD Tier 1 and Tier 2 Chapter 11. There is no topical or technical report submitted for the review of the system.

We have received a total of 34 RAI

questions. We have responded to 30. If we include the number of revised responses, which is 25, KHNP submitted a total 55 responses.

There are four questions that are being worked on now and all of them are classified as open items. These are items will be addressed and responded by the end of this year.

As all of you know, Chapter 11 of the DCD Tier 2 consists of five sections, excluding the sections for COL items and the references.

Section 11.1 addresses the radioactive source term and the major systems of the event. And the Sections 11.2 through 11.4 provides design basis system description, radiological assessment, test and inspection requirements of the three different radioactive systems, including liquid, gaseous, and solid waste systems.

And the description on the process and effluent radiation monitoring and sampling system is presented in Section 11.5.

So, now I am going to start with the Section 11.1, source term. The first part is the RCS and CVCS and the second part is the other systems, including the radwaste system.

The two kinds of radioactive source terms are developed and used for the design of the plant. The first one is the design basis source term and the second one is the expected source term. And the design basis source term is developed to use for the design of radioactive waste management system and also for determining the lifetime integrated radiation source for the equipment qualification.

We assume one percent fuel defect to determine the design basis source term, based on the SRP 11.2 and 3.

In order to calculate the source term, we use mass balance differential equation as is described in CDC. And the reactor coolant source and activity as calculated in the DAMSAM code which was developed by Westinghouse. For the CVCS source term, we used SHIELD-APR code and the input for this code for the RCS source is based on the DAMSAM code calculation.

And for the expected source term, this is used for the estimation of annual effluent risk to the environment and the expected source term in the reactor coolant system is based on ANSI 18.1,

the version of 1999, which is described in NUREG-0017.

And the RCS activities provided in the ANSI 18.1 1999 version was adjusted using the APR 1400 specific design parameters.

Activity for the CVCS system for the expected source term was already also calculated in the SHIELD-APR code using the expected RCS source term based on ANSI standards.

So, now I am going to talk about the BOP and radwaste source systems. Since the steam generators are assumed to have the leaks and the secondary system is considered to contain radioactive sources. In order to calculate the secondary source system, we assume the simulated leakage rate of 0.6 gallons per minute for both steam generators. And the radionuclide in the secondary system are removed by the ion exchangers in the blowdown system and condensate polishing system, as far as by the decay and the leakage of the main steam from the system.

The source term calculate for the liquid waste management system started with the determination of input stream to those three

different kinds of liquid waste collection pans. The equipment waste tank or EWT collects the leakage from the equipment drains in the auxiliary building and the drains from the component cooling water system. These liquids are relatively clean but their activity is high.

The floor drains collected in the building sumps are stored in the floor drain tank or in short, FDT. These liquids contain higher impurities with lower radioactivity.

The chemical waste tanks collect the other miscellaneous liquid from the chemical waste drain sump and drains from the turbine generator building.

The DIJESTER Computer Code is used to determine the source term in each of the liquid waste management system components, including the pretreatment model and the reverse osmosis and ion exchangers considering the decay and buildup of the radionuclide. The DIJESTER Code was developed by the Sargent & Lundy and used for the licensing of the U.S. plants in the past.

MEMBER SKILLMAN: May I ask you to back up one slide, please to the primary source term?

I am looking at the Design Control Document and I am in Table 11.1-2. And this shows the radionuclides that are considered in the maximum reactor coolant fission product source term. And this indicates that continuous gas stripping is assumed. What that communicates to me is that you have got a constant bleed from your chemical and volume control tank. You are pulling gas or you are pulling gas out of the pressurizer somehow.

My question is what happens if you do not consider continuous gas stripping if, for whatever reason, that stripping capability is absent? What is the consequence on your source term?

MR. KANG: So, you are asking about the source term standpoint, not from the system operations.

MEMBER SKILLMAN: No, your source term includes continuous gas stripping. What if you do not have continuous gas stripping, if that capability is absent?

MR. KANG: If you do not assume the operation of the gas stripper, which is used for

the stripping of the gases in the primary system, there is going to be buildup in the system and most of the normal gases in the product coolant will be accumulated and the downstream of the gas vapor. So, the source term for the normal gases will be higher than, assuming the continuous gas stripping.

But because we assumed the one percent fuel failure, which is higher than the tech spec actual limits for the RCS system, I think that will have sufficient conservatism in our assumption of the fuel failure rate in Chapter 11.

And in Chapter 12 for the design of the radiation shielding and the HBC design, we assumed a more -- a less conservative assumption, which is 0.25 percent fuel failure plus without any gas stripping, in order to make up the unconservative of the fuel failure rate.

So, we have two different kinds of design basis source term. In Chapter 11, one percent plus continuous gas stripping. In Chapter 12, 0.25 percent fuel failure plus no gas stripping.

Did I answer your question?

MEMBER SKILLMAN: You did. Thank you.

Thank you.

MR. KANG: Okay, then I will go to the gaseous system. In Chapter 11, we used the term GRS, gaseous radwaste system for the system which processes the gas vented from the CVCS. And the reason we did GWMS, which it stands for gaseous waste management system, which has wider meaning that includes the HVAC system, which controls the airborne activities in the building.

So, from now on I am going to use the term GRS for Chapter 11.

The GRS system utilizes the charcoal delay beds to provide sufficient decay of the gaseous from the reactor drain tank, volume control tank, equipment drain tank, and the gas stripper, and the CVCS tank. The source term in the GRS components are calculated using the differential rate ratio, considering the decay and buildup.

The high-activity spent resins generated in the CVCS system are stored in the spent resin long-term storage tank, which is a part of the solid waste management system and the low-activity spent resin generated in the liquid waste management system and spent fuel pool cooling and

cleanup system and the steam generator blowdown system, which has low level of radioactivity are stored in the low-activity spent resin tank.

The source terms in these tanks are calculated, consider the decay for up to ten years of storage time.

So, if you don't have any questions for this part, I am going to move on to the second part, which is radwaste management system.

The design requirements apply to the design of radioactive waste management system are shown in this slide. The high-level requirements are provided in GDC 60 and 61 and 10 CFR 50 Appendix A. The concentration limit for the gaseous and liquid affluence at the unrestricted area are defined in 10 CFR 20 Appendix B and those constraints are provided in 10 CFR 50 Appendix I. Details of the system design requirements are provided in ANSI Standard and the Regulatory Guide 1.143 and the requirement to minimize contamination is delineated in Reg Guide 4.21.

In the liquid radwaste system, the objectives of this system is shown in this slide. The first one is to collect, process and hold the

radioactive or potential radioactive leakage generated from the normal equation, including the anticipated operation occurrence. Also, the system provides sufficient processing capacity, redundancy, and the flexibility to treat the liquid waste in a manner to reduce the radionuclide concentration to the levels that do not exceed the effluent concentration limit, which is defined at 10 CFR 20.

The system is classified as a non-saturated system and a seismic category is designed in accordance with Reg Guide 1.143. And the radwaste cert classification for this system are classified as RW-IIa or RW-IIc. Some components are classified IIa some are the other classified IIc. We don't IIb components for this liquid waste system. All of these classifications are based on Reg Guide 1.143.

And this system utilized reverse osmosis technology to improve the performance and it provides the pretreatment to remove the organic matters or the sustained solids.

The system also provides ion exchangers to remove the specific ions such as cesium and

rubidium prior to discharge to the monitoring tank and switches to finer resin tank before discharge to the environment.

Here, you can see the flow diagram of liquid waste system. For the collection and storage of the liquid waste, we provide two 18,000 gallon EWT, which is an equipment waste tank, and two 18,000 gallon floor drain tank, and two 9,000 gallon chemical waste tank.

The sizes of these tanks are determined based on the maximum generation rate of the liquid waste, which is provided in ANSI Standard 55.6. This generation rate includes the amount of the liquid waste generated during the refueling outage.

For each of the two 100 percent capacity, our packages consist of four different modules which are pretreatment, reverse osmosis, demineralizer, and the R/O concentrate feed modules.

The R/O module, followed by the one cation bed and two mixed beds provides a sufficient decontamination factors to meet the design criteria. Each drain has process capacity of 60 gallons per minute.

The process is liquid collected in the monitor tank samples and their priority determines whether the liquids will be reused or discharged. The process radiation monitor located at the downstream of the monitor pump, it monitors after discharging water which meets the risk criteria. Once it exceeds the discharge limit, it reverts around to the RCR, the radwaste control room, turns up the pump and closes the door automatically.

The discharge line with the radiation monitor is the only path that discharges the processed liquid to the environment.

MEMBER SKILLMAN: Before you change this slide, as we view this image, should we be thinking that this is the same system that is in use in Korea today?

MR. KANG: Exactly. We use the same system.

MEMBER SKILLMAN: And what has your experience been with this system?

MR. KANG: Actually for APR 1000, we started to use the system for the Shin-Kori Unit 1 and 2, which is APR 1000. Before the construction of this plant, we are hoping to use different

technology, other than --

MEMBER STETKAR: Can you speak up and make sure that we can hear you?

MR. KANG: Okay, for Shin-Kori 1 and 2 we didn't develop much experience because it was new R/O but based on our previous that the test and operating history of the other plant which used the RO, we think that it has high performance much rather than the evaporators, which has a long period outage time and it also has high decontamination factors to remove the radionuclides. That is why we selected the system, based on previous experience of the other technology.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: I've got a question. Leave it up there for a second. You did not show on this figure the detergent waste treatment system and I noticed that the certified design does not include a laundry facility. You state clearly that depending on site-specific requirements, the COL applicant is to determine whether contaminated laundry is sent to an off-site facility for cleaning or for disposal.

In section 11.4, you say the current design provides for the collection and packaging of potentially contaminated clothing for offsite shipment and/or processing.

Now, if I don't want to package all of the contaminated protective clothing and ship it off site because I don't particularly like to do that and I would rather launder it inside my plant, I couldn't find any space in the compound building for a laundry and I would like to know how the provision of a laundry would affect your storage capacity requirements for things like the size of your detergent waste storage tanks, the flow capacities through your liquid waste system, whether that would affect the design of the reverse osmosis modules because you would be processing more fluid, monitor tank capacity and even layout of the compound building itself.

So, why don't you have a laundry in this facility?

MR. KANG: So, we have a separate system from the liquid waste management system, which is called detergent waste management system which is not shown in this figure. If you look at

the DCD Tier 2 Chapter 11, you will see a figure which shows the diagram of the detergent waste treatment system. That is why we didn't take into account the amount of waste which will be generated by the detergent system.

To tell the truth, for the domestic design, we have a specific boundary system but this detergent waste system which is described in our DCD was actually the laundry system in the domestic plants. So, we have laundry, which is processed on-site, not shipped out for the offsite treatment. So, the detergent waste treatment system is actually was designed to process the laundry.

MEMBER STETKAR: And it is large enough, the tanks --

MR. KANG: Based on our experience, our laundry system has enough capacity to handle all the waste, laundry waste.

MEMBER STETKAR: Okay, including -- you know I understand how the detergent waste system is configured. And that includes conditions where you do have to divert the detergent waste into the reverse osmosis system for treatment or do you typically have low enough contamination that you

can basically dilute it and send it directly offsite?

MR. KANG: Well once we do not exceed the risk criteria from the laundry system, after we sample and monitor it, we send it out.

MEMBER STETKAR: You just send it out?

MR. KANG: Yes and in the existing criteria, it is sent out to the chemical waste tank in the --

MEMBER STETKAR: Right, and it is processed through the drawing here.

I don't know what amount of operating experience you have, especially during outages, where you are probably generating a fairly large amount of low contaminated protective clothing. Do you find that you are diverting a good fraction of the laundry waste to the chemical waste tank and processing through the radioactive waste liquid processing system?

MR. KANG: Even though I cannot give you the exact number how much if there was a waste, I mean the laundry waste is sent to the LWMS system for further processing. I think the amount is pretty much can be processed at the LWMS system.

That is how we designed the size of the system.

MEMBER STETKAR: All right. Where is there space in the certified design compound building for a laundry if I wanted to put in a laundry? And again, I don't want to get into -- the layout drawings are listed as sensitive information. So, I don't need a specific place. But believe me, I looked for floor space and I couldn't find it.

MR. KANG: Can we capture the question and get back to you?

MEMBER STETKAR: Okay, that's fair. That's fair. Thank you.

MEMBER CHU: Question. You know at the end of your flow diagram, you have four places to go: plant discharge, reverse osmosis, reuse, and so on and so forth. Roughly, what percentage of your liquid waste goes to the plant discharge?

MR. KANG: Plant discharge, you are asking the operating experience. The design can accommodate all different four places but --

MEMBER CHU: Yes, from operational.

MR. KANG: Operation standpoint, can you --

MEMBER CHU: I'm just curious to see.

MR. KANG: Okay. Actually for the design evaluation to capture an offsite dose, you assume that 100 percent of the processed liquid is discharged directly into the environment because that is the most conservative. And from the operations standpoint, Irving, can you answer?

MEMBER CHU: Well, from the design perspective, you have all these other paths.

Now, where does the reverse osmosis reuse go?

MR. TSANG: My name is Irving Tsang. At the request from Mr. Kang, I will attempt to answer your question.

Let me just rephrase your question so that I understand where you are coming from.

The first part of your question referred to, in terms of the relative percentage, how much we are discharging and how much we are reusing within the plant. That is the first part of the question.

MEMBER CHU: Yes.

MR. TSANG: The reuse of the radwaste treated effluent highly depends on the plant water

balance, on how much can be reused and it also depends on the quality of the treated effluent.

Once we realized that the water is treated well and relatively free of high-level contaminant and can be reused for flushing pipes or something like that, we will plan to reuse.

But in terms of percentage standpoint, the majority of the waste will be discharged.

MEMBER CHU: Okay.

MR. TSANG: Does that answer your question?

MEMBER CHU: So, this just allows for design options.

MR. TSANG: Yes, this is only a capability we have built into the design to facilitate reuse.

MEMBER CHU: Okay, thank you.

MR. KANG: So, then, I can move onto the next slide.

Now, I am going to talk about the gaseous waste management system, GRS system here in Chapter 12.

The purpose of this system is to collect, process the radioactive waste gases during

normal operation and its ultimate goal is to make the gaseous effluent rate limit during normal operation and AOO. The system is also classified as non-circulated system and its seismic category is same as before.

And all the components in the GRS system is classified as RW-IIa per the Reg Guide 1.143. This systems uses charcoal delay baths for the delay and decay of the radioactive nuclides. It provides the sufficient capability to delay the genome gases from not lasting 45 days and it prevents the radiation of charcoal delay bed using the chilled water control and the moisture removal method. It provides the gas concentration monitor and alarm to prevent hydrogen explosion.

The system also provides isolation barrier in the compound building HVAC doors to close automatically on the receipt of high radiation level indication.

This figure shows the flow diagram of GRS system. As mentioned earlier, the GRS process radioactive gases transfer from the CVCS vents and the gas stripper.

The capacity of this system is 22

standard scfm, which is sufficient to process the inlet flows. The GRS header drain tank collects the condensed liquid in the GRS in the piping and the waste gas dryer controls the moistures and the temperature to assure the performance of the charcoal delay bath. The charcoal guard bed is used to protect the charcoal delay beds from moisture and to capture the iodines.

Of the two 100 percent system, only one frame is operating and the other one is in standby condition or regeneration mode.

The four charcoal delay beds are normally operating in a series a total of 21,000 pounds of charcoal provides 45 days of decay for genome 3.5 days for krypton nuclides. The particulates and charcoal fines are trapped in the HEPA filter before they are discharged to the downstream of air cleaning unit of the compound building HVAC system.

MEMBER STETKAR: Leave that up for a moment. I have a few questions on the gaseous waste system.

As I read the DCD, in some places it acknowledges that there is only a single isolation

valve at the discharge to the ventilation exhaust. In other places, it uses the word valves, plural. I think there is only one valve. Is that correct?

MR. KANG: You mean the isolation valve at the discharge line?

MEMBER STETKAR: That's right. If I look at, in particular figure 11.3-1 in the DCD, it is valve 008 on that figure. And it gets high radiation signals and also low flow signal from the ventilation exhaust.

For the liquid waste system, I confirmed that there are, indeed, redundant and diverse means of isolating a liquid discharge. In particular, high radiation signal closes the single discharge isolation valve and it trips the monitor tank transfer pumps so that if the discharge valve fails to close, at least the transfer pumps are stopped.

If I have a high radiation on a gaseous discharge and valve 008 does not close, how do I stop the gaseous discharge?

MR. KANG: Okay, you want to answer his question?

MEMBER STETKAR: You can take that back

as a question, if you want to. I was just looking as a diverse way.

Also, I noted on that same figure, 11.3-1, that there is a full flow bypass line around that discharge valve with a manual, normally closed manual valve number V-1015. Because that is a manual valve, if that valve is open, I cannot isolate the discharge flow. So, I was curious. When do I open that valve? When during normal or abnormal operations would that valve be open?

MR. KANG: We understand your concern and we will take it back.

MEMBER STETKAR: Okay. Let me just make a note because I don't remember anything.

Another thing that I noticed and you have to forgive me because it has been a long time since I had any direct operating experience but in a lot of the plant designs that I have seen, there is a gaseous waste holdup tank or a storage tank or some collection tank where I can accumulate gas, if, for example, my processing line is down or if I am generating more gas than I can effectively process in the time constants. This design doesn't have one of those. Why? Does it not have a

storage tank or a holdup tank?

MR. KANG: Irving, can you answer this question, please?

MR. TSANG: John, my name is Irving Tsang, again, and I will attempt to answer your question.

And I do agree with you. And I work on the APWR Design Certification. I have sat in front of you and we have the gaseous tanks.

MEMBER STETKAR: And it's not -- I didn't want to bring up another specific new plant design certification. It has been my experience looking at a large number of currently operating plants, regardless of how they clean up the gas, whether it is charcoal beds or whether it is another type of technology. I think pretty much every one that I have seen has some sort of tank there to collect gas.

MR. TSANG: I'm sure you have more experience. I have been working with nuclear power plants and using the Westinghouse technology versus the combustion engineering technology. And similar to the other application that we have, we have surge tanks.

MEMBER STETKAR: Yes.

MR. TSANG: And utility would prefer to have surge tanks. However, this design, the AP1400 design has the capacity is very large in terms of the charcoal buildup -- the charcoal retained in the delay beds.

And Mr. Kang earlier mentioned that the design flow rate is roughly 22 scfm and normal generation rate is around 1.0, 1.2.

MEMBER STETKAR: Do you just essentially rely on the charcoal beds themselves as your surge capacity, if you will?

MR. TSANG: Yes.

MEMBER STETKAR: I mean it is not a surge capacity. It is just increased processing capacity.

MR. TSANG: Right.

MEMBER STETKAR: Okay. Again, the question comes up. Do you have any operating experience to show that that is adequate? I mean from real life.

MR. TSANG: A few of the Westinghouse design plans did not have the surge tanks.

MEMBER STETKAR: Okay.

MR. TSANG: So, I'm sure they rely on the charcoal delay beds --

MEMBER STETKAR: Okay.

MR. TSANG: -- to take care of the surge.

MEMBER STETKAR: I haven't seen those. It has been a long time since I operated and, believe me, I have not seen every plant in the world.

MEMBER SKILLMAN: Let me ask this, please. I'm on Tier 2, Chapter 11, page 11.4-12. And the statement that I am going to refer to is about a third of the way up from the bottom of the page. And the sentence is: Charcoal used in the GRS is not expected to be replaced. Therefore, spent charcoal waste is not generated routinely.

Two questions. Is this a 40-year system or a 60-year system?

MR. TSANG: The design is certified based on the 40 years of operation.

MEMBER SKILLMAN: Forty years, okay. So, then if it was a 60-year system, what I am going to say next is even more important. That is a long time. What confidence do you have that the

charcoal will remain effective for four decades or six decades?

MR. KANG: Mr. Tsang can answer this question.

MR. TSANG: My name is Irving Tsang. You can see from the flow diagram that there are two key pieces of components to protect the charcoal delay bed and the charcoal delay beds, the charcoal is very susceptible to moisture damage and, therefore, in the design, we put in dual safeguard components, meaning the gas dryer and also the guard beds to protect the delay bed.

And so that is the protection that we have implemented in the design to make sure the performance of the delay beds can endure the duration for the plant operation.

The design also has provisions if, indeed, we cannot -- if the charcoal performance degraded into such an extent that it needs replacement, the design included the capability to replace the charcoal.

The delay bed can be isolated and the charcoal can be replaced using a vacuum system and other means for that.

MEMBER STETKAR: Well but the certified design says the COL holder has to figure out how to do that.

MEMBER SKILLMAN: That's not a small task.

MEMBER STETKAR: No.

MEMBER SKILLMAN: But I understand your answer and I thank you. Okay?

CHAIRMAN BALLINGER: Is there any experience in Korea with this kind of arrangement, where you have got historical data that says that at least you can extrapolate this to 40 or 60 years?

MR. KANG: We've been using this technology for many years for the domestic plants.

CHAIRMAN BALLINGER: So what you are saying is you do have experience for long periods of time.

MR. KANG: Yes, for a long period of time.

MEMBER SKILLMAN: I'm just reminded of experience that I've had where to conform with technical specifications, it was necessary to test the charcoal using dioctyl phthalate. And unless

the testing was done very, very carefully, the DOP test or dioctyl phthalate could end up injuring the charcoal. And if you didn't do the test properly, you could end up wasting the charcoal bed and have to replace the charcoal beds. And I'm presuming that there is a tech spec that will require confirmation that the charcoal delay beds are performing the way that they are supposed to be performing but I will leave that to the COL holder to figure out how to take care of that.

MR. TSANG: Again, I'm Irving Tsang. I think your comment is very accurate and we appreciate that. I don't know enough to respond to whether this is a tech spec issue, quote tech spec, but there is technical specs for the procurement of the charcoal to ensure.

MEMBER SKILLMAN: Thank you.

MEMBER STETKAR: Before we switch to solid waste management, I just need to make one comment. It is partially related to gaseous waste management but only partially. I was trying to understand the sources of input to the gaseous waste management system and I think I understand them. I think I know where the sources are. But

while I was doing that, I went to look for some of the usual suspects out in the nitrogen and hydrogen systems. And when I looked for those systems in Chapter 9 of the DCD, I noted that there is absolutely no flow diagrams for the high pressure and low pressure nitrogen systems or the hydrogen system. That is very, very unusual. It is particularly unusual because the nitrogen systems do, in fact, interface with safety-related equipment. They have containment isolation valves.

So, once we get to Chapter 9, I am going to be really curious about those systems. I don't really know. I have never seen a design certification that hasn't had at least a basic flow diagram for those systems.

I couldn't even -- it is difficult to even find a list of the things that are supplied with nitrogen. I have a list but I have no confidence that it is complete.

MR. KANG: So, I don't have the --

MEMBER STETKAR: I did notice, by the way, that you have a diagram of the surface air system, apparently because it has a containment isolation valve. This is a more general comment on

the completeness of the documentation for a certified design and it is not complete.

MR. KANG: I'm not sure why the system is not described in Chapter 11.

MEMBER STETKAR: I'm not sure why it isn't and it is not relevant to today's discussion but will be relevant whenever we get to Chapter 9. It's just I wanted to get it out there so you are aware of the question when we get to Chapter 9.

MR. KANG: Okay, thank you.

For the solid waste management system, the objectives of this system are to provide the storage of spent resins handled and packaged spent filters, dried and packaged reverse osmosis concentrate and to sort and compact the dry active waste. Dewatering and packaging of spent resins will be provided by the COL applicant.

Classification of the solid waste system is similar to the previous two systems, which are non-safety and the seismic classification by Reg Guide 1.143 and the radioactive safety classification with RW-IIa.

The design features were described in the last bullet. The spent resin long-term storage

tank is designed to store high activity spent resins for up to ten years, as I mentioned earlier. And the low active spent resin tank is provided to store the low active spent resins.

The filter handling subsystem is used to remove, move and package the spent filters. The R/O concentrate treatment system dries the R/O concentrate in drums. The system also provides a sorting table and compactor to reduce the volume of dry active waste.

And the DC standard design provides a space and guidance for the COL applicant to process the spent resins.

MEMBER STETKAR: Let me ask you about the -- it has different names in the DCD so I will get a the long-term decay storage tank. You noted that it is designed with sufficient capacity to store high activity spent resins for up to ten years. And the statement in the DCD says that it is high activity spent resin storage tank is designed to provide sufficient storage for ten years but to facilitate long-term decay, parenthesis from zero to nine years, before the resin is packaged and shipped. And zero is a

really small number. So, it is not clear to me how zero years is a long-term decay.

What actual technical basis do you have for the size of that tank? It is 3,185 cubic feet, which is not a small tank but it is not a huge tank. Plus this is an aqueous solution that is before it is dewatered. So, it has got a lot of water in it.

What is the basis for that size? That is the first part of the question.

The second part of the question is how are you characterizing zero to nine years as long-term decay?

MR. KANG: Okay, if I answer the first question, the size of the tank was determined based on the amount of the resins from the CVCS generate for ten years.

So, if you look at the table in 11.4, you can see the amount of generation rate of spent resin, annual generation rate. The size was determined based on that amount. And we assumed that ten years of operation would have that spent resins.

And the question why we used the word

zero to nine years because the shielding of the system should be based on the last years' generation of the spent resin, which it was not decayed at all at the time we generate the resin. We have to have the facility in terms of the source term of the spent resin. That is why we used the word zero to nine years of generation.

MEMBER STETKAR: Oh. I mean it makes sense when I think about it in terms of shielding. It doesn't make sense when I think about in terms of zero years of decay but thanks.

Do you have any operating experience to confirm the fact that you generate less than the amounts of spent resin that you are assuming in your design?

MR. KANG: You are asking how much spent resin we generate compared to the size of the current design?

MEMBER STETKAR: Yes.

MR. KANG: Mr. Irving can answer the question.

MR. TSANG: John, I'll try to answer that question. Again, most of the Korean operating plant, I was looking at Shin-Kori 3 and 4 and also

Shin-Hanul 1 and 2 designs, and they have the same design as this one, except for the fact that they have two long-term spent resin storage tanks with dual units.

So, that is based on their experience.

MEMBER STETKAR: But do you have enough experience in terms of actually processing resin yet to know how much throughput to expect over a ten-year period, let's say?

I only ask this because, again, it is old news but I worked at the Zion Nuclear Plant which, at the time, was Westinghouse's preeminent four-loop, state-of-the-art pressurized water reactor, and I will tell you that we were so constrained on the backend of our waste processing process that it caused real problems for us. We had not enough storage capacity. We had not enough processing capacity. We had getting rid of resins was a real challenge because we couldn't process them.

So that is, from a design and operational perspective is why I am kind of asking these backend questions, if you will.

MR. TSANG: I fully comprehend the

question. This is Irving Tsang again.

I fully comprehend the question.

MEMBER STETKAR: And if you do, indeed, have operating experience, like you mentioned maybe with the charcoal beds and things like that, it would help to provide some confidence when I think about the volumes that you are processing and how you are extrapolating from actual operating experience to this size of a plant and with its commensurate amount of volume.

MR. TSANG: Mr. Kang and I will table this question and discuss with KHNP.

CHAIRMAN BALLINGER: Because Shin-Kori 1 and 2 are half the size of this, right?

MR. KANG: One and two?

CHAIRMAN BALLINGER: Yes.

MR. KANG: One thousand.

CHAIRMAN BALLINGER: Oh, they are 1000. Okay.

MEMBER STETKAR: Yes, they're not --

CHAIRMAN BALLINGER: No, I'm thinking of --

MEMBER STETKAR: I mean you are never going to know until you actually operate how much

stuff you have.

CHAIRMAN BALLINGER: I'm thinking of Kori 1 and 2, not Shin-Kori.

MR. KANG: So, thank you. So, I am going to move on to the flow diagram of solid waste management system. This figure shows a simplified diagram for the system. There are five subsystems, as I mentioned: spent resins, spent filter, DAW, R/O concentrate subsystem, and temporary storage subsystem are shown in this figure.

The spent resin with the low active spent resin from RWMS spent fuel pool cooling and cleanup system and general blowdown system are transported to the low active spent resin tank and those with the high activity from CVCS are sent to spent resin long-term storage tank using the demineralized water.

The spent resin storage tank has sufficient volume to store the resin for up to ten years and the storage in the tanks, after the storage in the tanks, the resins are transported to the mobile spent resin treatment system for dewatering and packaged in the high-activity container or HSE for temporary storage prior to

shipment.

The spent filters are remotely removed through a shielded plug and transferred to the capping in the shielded transport cask. And then the filters are loaded into a 55-gallon drum in an automatic capping station.

The DAW are sorted, compacted, packaged, and stored in the temporary storage area in the compound building. The other concentrates are transported to concentrate treatment system called the CTS. Then, they are dried, packaged in a 55-gallon drum or HIC.

The temporary storage area of the APR 1400 is sized to accommodate the solid waste for six months, which is satisfied 30-day criterion of ANSI/ANS 55.1.

So, now I am going to talk about the key RAI items for the sections 11.1 through 11.5. We have two open items for these sections. The first one is RAI 8201, question 11.2-6. The staff asked to provide the detergent liquid effluent process options. KHNP provided a response recently stating that the liquid in the detergent waste tank is either sent to the environment via the monitored

discharge pipe after result of sampling satisfied the risk limits. If not, it is sent to the SWMS for further processing.

The impact on the effluent concentration limit and the public dose due to the release of the detergent waste were already considered in the calculation of the PWRA to estimate the risk to the environment. This is what we answered in our response.

Another open item for the radwaste system is RAI 8270, question 11.2-7. The staff requested to change the DCD description in the three radwaste systems and the steam generator blowdown system to be consistent.

We have updated the relevant section, including Section 10.4.8, which is steam generator blowdown system such that the descriptions in the system boundary, system classification, and the source terms are consistent. This response was submitted to the NRC in July of this year.

So, now I am going to turn it over to Mr. James Jhun for presenting the section 11.5.

MR. JHUN: Good afternoon. My name is Jim Jhun. I am a technical engineer to KEPCO E&C

working in Korea right now.

And today I am going to present to you on Section 11.5 regarding process and effluent monitoring systems and sampling systems.

Okay, my mission today is first of all I am going to try to facilitate the communication between design engineers and to you so that you can have a better understanding of the design information that we have presented in Section 11.5 and it will help you understand the design and will provide us your informed feedback by which you will help us improve the quality of the design, as well as the improved documentation. That is my mission for today.

And you can stop anytime during my presentation and ask questions. And at times, because coming in here was a long flight for me to come in here and at times I might be -- I still am recovering from the jet lag and I might be groggy and sometimes I may be incoherent. So, I want your understanding. Okay?

With that introduction, let me start with my presentation. First slide, the presentation actually comes in two parts. The

first part is the monitoring system itself and then the second part I will discuss the key review items. Okay?

Okay, the next slide is objective of PERMSS, which is the processing and effluent radiation monitoring systems. The objective or purpose of the system is to measure and record radioactivity levels of liquid and gaseous process system and effluence before they discharged to the environment.

In Chapter 12 actually we discuss part of the radiation monitoring system, which is the area radiation detectors. It will be discussed in Chapter 12.

And the function of the PERMSS is there are three different categories. First function is to provide early warning of the monitoring functions or appropriate operation of the radioactive systems or release of the radioactive effluence.

And second category of the function is to provide monitoring of the liquid and airborne activities in selected locations throughout the plant, as well as the effluent path before they are

released.

Then also third function of the PERMSS is to generate alarms indications and in some cases control functions to limit the release or divert the release of the radioactivity.

The classification of the PERMSS is safety class III. It is in accordance with ANSI Standard 51.1.

Okay, and if you don't have any questions, we can move on to the next slide.

CHAIRMAN BALLINGER: Every one of us has suffered the jet lag that you have. So, we are sympathetic. But the person over there who is recording this is not so sympathetic. So, please try to speak up a little bit.

MR. JHUN: Okay, I will try to speak into the microphone as close as possible.

Okay, the next slides actually list important design requirements or design criterias. And it is pretty much self-explanatory. So, I will not go into details of the requirements.

MEMBER SKILLMAN: James, please back up one slide.

MR. JHUN: Okay.

MEMBER SKILLMAN: The last bullet. Non-safety expect for containment air monitors and main control room air intake monitors. I understand why those two would be safety.

MR. JHUN: Okay.

MEMBER SKILLMAN: But here is my question.

MR. JHUN: Okay.

MEMBER SKILLMAN: Why wouldn't the final release monitor that Dr. Chu asked about, where the liquid waste is discharged from the site, why wouldn't that be safety grade?

MR. JHUN: Okay, the classification, according to ANSI Standards, the safety-related it cannot function as to perform protective functions -- protective actions. And containment air monitor certainly it is a performance protective action because the monitor generates the control and various ventilation actuations signals which is a BOP, SFAS signals. And they do start controlling within this ventilation system, which protects the control room operators from the outside radioactivity during design basis accident. Now, that is the reason why it is classified as safety-

related.

The question you asked about why the liquid radwaste system monitors are non-safety functions, it is important. It is performing important functions but it is not really, according to ANSI standard, it is not really classified as protective. It is not performing protective function. That is the reason why it is not classified as safety class.

MEMBER SKILLMAN: It just seems odd that the toggle for that device is going to be 10 CFR 20, Appendix B, Table 2, Column 1 and perhaps Column 2. Column 2 is unrestricted release.

It just seems that has embedded within the regulation the idea that has safety consequences to the public. So, it would seem to me that that should be safety-related.

MR. JHUN: Well that is, actually, question but if you look at the FSAR Chapter 3, they do have a list of classifications and it lists all those SSEs which are classified as safety-related and which are not safety-related.

Now, for instance, like radwaste systems, they do perform very important functions.

However, they do have a separate categorization and they are different from safety class in accordance with ANSI Standard. That is the reason why.

I'm not saying that it is not performing important functions it just we are following the criteria given in the --

MEMBER SKILLMAN: The ANSI Standard.

MR. JHUN: Right, which is endorsed by the NRC Regulatory Guide.

MEMBER SKILLMAN: Thank you, James.

MR. JHUN: Okay.

MEMBER SKILLMAN: Thank you.

MR. JHUN: Of course I didn't mention about the other safety-related monitor, containment monitor but unless you have questions, I will skip that part.

MEMBER STETKAR: I was going to ask it later but as long as we stopped here, it will save the next couple of slides.

I understand that the containment monitors RE- whatever they are 39A and 40B are used as part of the normal in-containment leak detection capability.

MR. JHUN: That's correct. It is

actually the function is intended to detect RCS leakage in accordance with Regulatory Guide 1.45.

MEMBER STETKAR: I also noticed that those monitors are isolated. The inlet line and the return line from those monitors are isolated by containment isolation signal.

MR. JHUN: Correct.

MEMBER STETKAR: I looked and I could not find any information. Do those monitors provide any other -- do those monitors provide any automatic signals to anything or are they simply --

MR. JHUN: They don't provide any automatic action.

MEMBER STETKAR: That is what I -- I couldn't find any but I didn't know where to look.

The other question I had though is because their containment atmosphere monitors -- are they used by the operators anywhere in the operator's guidance in the emergency operating procedures, the severe accident management guidelines or anything for the operators to monitor containment activity? And if they are, then how are the operators instructed to reset isolation signals and get them operating, if they need them,

since they are isolated?

MR. JHUN: Well, containment isolation signals depends upon which valve that containment isolation valves are receiving these isolation signals. For instance, like the containment air monitor, there is an isolation valve which receives the containment isolation it will automatically closed, based upon containment isolation signals but operators have the option to override that containment isolation signal if they wanted to monitor on a continuous basis after the accident how much radioactivity inside the containment. So, the logic has the provision to allow them to actually unblock that safety injection signals so they can actually have that monitoring capability available.

Does that answer your question?

MEMBER STETKAR: Partially but only partially because I'm searching for what particular guidance is available to the operators for the use of those monitors. And simply saying that I can reset the safety injection signal, and reset the containment isolation signal, and reopen those valves is something that might be achievable

electrically but might not be achievable operationally because there are typically very specific criteria for resetting those safety injection and isolation signals, things like I can't be in a degrading plant condition; I must be in a stable plant condition.

MR. JHUN: But I don't think you are aware this particular monitor samples the containment air and it turns back to the containment air. So, actually the release, the possibility of release to the environment is negligible.

MEMBER STETKAR: Well, if you are saying the possibility of release from the monitoring circuit itself is negligible --

MR. JHUN: That's right.

MEMBER STETKAR: -- then why is it isolated?

See, my whole point is you can't have it always for everybody all the time, that it is isolated, according to the certified design. So, it is actively isolated. And the rationale that I could find said it is isolated because it is a potential release pathway. But if the operators

need it and they are instructed to use it under certain conditions, I would like to know what those conditions are and how they are instructed to un-isolate it, to reset all of those signals and get them back operating again. In other words, I am basically questioning the tradeoff between automatic isolation of that function and the conditions under which the operators would be directed to use those monitors to assess conditions inside the containment.

MR. JHUN: Okay, to answer your question, if you look at Chapter 6 FSAR or SRP, they do have a list of containment isolation valves. And all containment isolation valve has to be closed or you have got this what happens. And this also requires closing under that category and this valve has to be closed.

Now, depending upon assessment of the operators, they can go ahead and open this valve and continuously monitor this function. However, there is actually -- this is just giving you one side of the design. The other side of the design is this particular monitor is listed in the tech spec and they do have an operation requirement for

this particular monitor and operator has to follow that tech spec.

MEMBER STETKAR: But that is for the normal leakage function. That is for the normal leakage detection. That is identified and unidentified leakage.

I am talking about after some sort of initiating event, some sort of developing accident scenario, where I do get an isolation signal. They are isolated and yet there is instructions to the operators to use these particular monitors.

MR. TSANG: So, if I ask some comments that the RE-039 and -040 these are for the leak detection from the reactor coolant system during normal operation, detecting 0.5 gp in less one hour, as a requirement in Reg Guide 1.45.

Like you mentioned, during or after the accident condition we might have a very high level of radiation conditions inside the containment. That is monitored by the other safety-related air radiation monitor which is described in Section 12.3. The operator can get the information how high the radiation conditions are inside the containment.

We have separate saturated area radiation monitor which is used for the loss of coolant condition, which includes the significant cooldown conditions.

MR. JHUN: Actually, there are four sets of two sets in the upper operating area and two sets in the lower operating area.

MEMBER STETKAR: Ah.

MR. JHUN: That is area monitors. It is actually it is discussed in chapter item sections 12.3.

MEMBER STETKAR: Okay. Thank you.

MR. JHUN: Okay.

MEMBER STETKAR: In the interest of time, thank you. I see those. Thank you.

MR. JHUN: Okay, let's move on to the next slide.

Okay, design features of the PERMSS. PERMSS consist of two different types, liquid monitors and gas monitors and they are, depending upon the installation configurations, monitoring could be offline, online, or could be inline. Okay, three different types.

Of course the bulk of them, probably 99

percent of the monitors are offline monitors. There is one inline monitors that I explained to you being control intake monitors that is inline monitors. And there is one online monitor that is a main steam line monitors. Those are the three different types of monitors that we have in the PERMSS.

And detective types are designed to facilitate maintenance and calibration while minimizing the effect of background information and display of the radiation level on alarms are basic functions.

And on top of that base function, there is a radiation detectors. Usually the radiation detectors are located in accessible areas and have sufficient shielding. And safety-related PERMS, they are environmentally qualified and seismically qualified.

So, those two monitors that we have I discussed to you being controlling intake monitors and containment air monitors, they are environmentally qualified and seismic qualified.

Any questions? If not, let's move on to the next slide.

Design features and gaseous PERMS monitors I provide you with a list of gaseous PERMS. Of course, there is a comprehensive list of gaseous monitors in Section 11.5-1 Table 11.5-1 and -2.

And if you look through them, you can see containment air monitors. They are offline and MCR air intake monitors they are inline monitors.

And main steam line monitors, they are online monitors that includes N-16 monitors. N-16 monitor is used to detect steam secondary to -- on the primary-to-secondary leakage.

And all these monitors, with the exception that I described to you are non-safety-related.

And I discussed the other two bullet items.

Okay, if you don't have any questions, let's move to the next slide.

Okay, next slide is design features of liquid monitors. And I provide you with a list of the liquid monitors. And among these monitors, steam generator blowdown monitors, as well as component cooling water and the essential service

water monitors detects the leak detection and steam generator blowdown and CCW monitors provide additional isolation functions.

Okay, any questions? Okay, let's move on to the next --

MEMBER CHU: Quick question.

MR. JHUN: Yes.

MEMBER CHU: You just described your whole waste management system design. Are there things in the whole system, either a concept or design features that Korea hasn't done or is not currently using?

So, I'm trying to differentiate what is new for you in the waste management system.

MR. JHUN: Are you talking about the system not the radiation monitoring system?

MEMBER CHU: Including monitoring system. The whole thing.

MR. JHUN: Okay, I will address the radiation monitoring system first.

MEMBER CHU: Okay.

MR. JHUN: The radiation monitoring system, the list of monitors that you see here, they are probably about 90 percent identical to

what they have in APR 1000 or Shin-Kori 3 and -- Shin-Kori 1 and 2 as well as Shin-Hanul Units 1 and 2.

This list of monitors Shin-Kori 3 and 4 are identical. Does that answer your question?

MEMBER CHU: Yes.

MR. KANG: Okay. For the radioactive management -- three radioactive waste management system, there is the system for the DC application almost identical to those in here.

MEMBER CHU: So, you have to experience the capability.

MR. JHUN: Right. Okay, let's move on to the next slide.

Key review items I list only two open RAIs. Mr. Kang, when he did the presentation, he mentioned three RAIs and we just happen to list two of them.

The first open item is RAI 8087, question 11.5-1 and -2. Okay? The issue is, and I see the staff asked us to provide in text form. We had a comprehensive list in tabulation forms that I mentioned to you, Table 11.5-1 and -2. In addition to that, the staff asked us to actually provide it

in text write-up. So, we have gone through providing a request for information in text format. That was responded back to NRC and it is being reviewed by NRC staff. And it is still an open items.

And resolution, like I explained, request for information have been added and revised in response to RAI with the exception of QA provisions of each monitor and the correlation to operating programs which will be supplemented in the later revisions. And that is still open RAI items.

An open RAI items is staff asked us to provide sensitivity response time alarm limits and primary-to-secondary leakage detection instrumentation. In addition to that, staff asked us to provide additional information regarding steam line flow monitors.

The resolution is we have made changes to the write-ups and we provided the requested information. And it is still be reviewed by the staff and we are waiting for the outcome of this review.

And if you don't have any other

questions, that actually concludes my presentation.

MR. TSANG: Okay, now I'm going to talk about the design evaluation APR 1400 radwaste management system.

This will cover the compliance to 10 CFR 50 Appendix I and 10 CFR 20 Appendix B, liquid and gaseous radwaste system failure analyses, radwaste system safety classification, and the system leakage detection capability.

So, in order to demonstrate compliance to 10 CFR 20 and 50, it is necessary to evaluate the annual gaseous and liquid effluent release to the environment using PWR-GALE Code. Since as I mentioned earlier, this is the current version of the GALE Code incorporates the old version of the default RCS concentration from ANSI 18.1, 1985. We modified the code to reflect the 1999 version of the ANSI standard, as required by Reg Guide 1.12.

These modified GALE Codes were reviewed by the staff during audit. And for the offsite dose calculation, we used the enveloping x/Q value and the position factors, which were recommended by the EPRI UND for the site-enveloping parameters in order to bound most of the U.S. sites.

The liquid waste management system discharge was assumed to be diluted by a cooling water flow of 10,000 gallons per minute, which will be confirmed by the COL applicant. And the computer cads, GASPAR and LADTAP codes were used for the calculation of offsite dose as recommended by Reg Guide 1.109.

And as a result of these calculations, we confirmed that the dose the public meets the limits defined in 10 CFR 50 Appendix I and their concentration of the effluent and risk to area boundary meets the effluent concentration limits defined in 10 CFR 20 Appendix B. The numbers are shown in the slides.

And the next topic is the radwaste system failure analysis. For the liquid waste system failure analysis, we selected the bounding cases as the failure of the boric acid storage tank because it contains the high source in the yard area.

The guidance is provided in BTP 11-6, which requires to make the concentration at the nearest pool of water to meet the 10 CFR 20 Appendix B concentration limit.

In order to meet the concentration limit, the calculation shows that we need to dilute the radionuclide concentration using the factor of 9,340, which is also needed to be confirmed by the COL applicant.

And for the gaseous waste system failure analysis, we assumed the inadvertent bypass of charcoal delay bed operation in the GRS system. In our calculation, we assumed that the iodines and particulates are removed by the pre-filter and the charcoal guard bed. The guidance is provided in the BTP 11-5. And based on this guidance, we assumed a one percent fuel failure and we bypassed the gaseous waste radioactive system.

The calculation was performed by the computer code LADTAP, which is also used for the Chapter 15 radiological consequence analysis. And the x/Q was used with a variable of 1.0 ten to the minus three which is used also for the Chapter 15 analysis.

The calculated dose at the exclusionary boundary and low-population zone are 1.16 millirem and 0.255 millirem, which is much less than the limit of 100 millirem.

Now, I am going to talk about the radwaste classification and steam generator leak detection capability. For the classification of the radwaste system, including liquid, gaseous, and solid, and steam generator blowdown system, we assumed one percent fuel defect source term because we assumed that we are going see if their criteria dose limit, as is specified in Reg Guide 1.143, which is conservatively assumed that we exceed the dose criteria and we went to the original inventory with the limit value is at 10 CFR 71.

As a result of the calculations, as I mentioned earlier for the system description, liquid waste management system components are classified as IIa or IIc. GWMS and SWMS components are all classified as IIa. Blowdown system components are all classified as IIc.

And in NEI 97-6, the applicant is needed to comply with the detection of steam generator leakage rate of 30 gallons per day. In order to demonstrate this requirement, we assumed that the steam generator is a liquid from the power level of zero to 100 percent. And based on the realist geometry of our APR 1400 system and the

location of the radiation monitor of nitrogen-16 monitor at the main steam line, we calculated the concentration of the nitrogen-16 at the point of the detection. It is estimated 3.16 ten to the minus four to 1.68 ten to the minus 1 Bq over cubic centimeters, depending on the power level.

It means that the commercially available nitrogen-16 monitor can detect from the range of ten to the minus four to 100 Bq per cubic centimeters. It means we have sufficient capability to detect 30 gallons per day of steam generator leakage. That is described in DCD Appendix 11-B.

MEMBER SKILLMAN: Before you change slides, at the top of this slide, you show the words in the second bullet under the first block based on one percent fuel defect source term. And if you back up one slide, you use the term, the third bullet under the second block, fuel failure -- one percent fuel failure. Do you mean the same thing?

MR. TSANG: Yes.

MEMBER SKILLMAN: They are the same thing?

MR. TSANG: Yes, I apologize for the --

MEMBER SKILLMAN: That's okay. I was just wondering if you had this little trick up your sleeve where you would say well, we mean this one thing here and we mean this other thing here. You mean the same thing.

MR. TSANG: Some people use the word failure. We tried to be consistent in the DCD with the terminology of defect for the normal operation because we use the term failure in Chapter 15 analysis.

MEMBER SKILLMAN: It would seem that this term should be used consistently. Okay, thank you.

MR. TSANG: So, this is the last slide so I am going to summarize the presentation.

As mentioned earlier, we have five open items but actually we have four open items for Chapter 11, so far. Responses for the three items were already submitted. And now we think that those responses are being reviewed by the staff. Responses for the remaining two items that are related to the correlation to ODCM, PCP, and REMP will be provided by the end of this year.

So, in summary, KHNP believes that their radwaste management system and the process effluent radiation monitoring and sampling system for APR 1400 are designed to comply with the relevant NRC requirements.

And the design evaluation shows that the plant complies with the public dose limit and the effluent concentration limits.

And the analysis which was done for leakage and gaseous waste system turned out to be the limit defined in BTP 11-5 and -6.

This is the end of the presentation. Thank you for your attention. If you have any questions, I will appreciate it.

CHAIRMAN BALLINGER: Questions from colleagues?

I think I would like to take a recess until five minutes until four so that we can change out and take other actions that most of us need to take.

(Whereupon, the above-entitled matter went off the record at 3:39 p.m. and resumed at 3:54 p.m.)

CHAIRMAN BALLINGER: Okay, we're back

in session and it is the staff's floor.

MR. WILLIAMS: Yes, sir. We're going to talk about Chapter 11, Sections -- pardon me?

CHAIRMAN BALLINGER: That was good.

MR. WILLIAMS: We're not?

CHAIRMAN BALLINGER: No, no, the sound was good. He's happy.

MR. WILLIAMS: We're going to talk about Section 11.1, 2, 3, 4, and 5, similar to what you just saw from the applicant.

My name is Steve Williams. I've been in NRO for eight years now, over eight years in the RPAC branch and did the technical review of this chapter, along with Zach Gran in our group also.

And we want to go through our presentation. A lot of it is a regeneration of what you just heard and if you don't mind, in certain sections, I will just ask as we go through the bullets, rather than me reading the whole bullet, if I can speed things up for everybody by asking if there is any questions on this bullet and proceed on to the next one. It may save us all some time, if you don't have any problem with that. And interrupt me at any time for any questions,

unless everybody's not back yet.

CHAIRMAN BALLINGER: Pete's not going to be here but we're good at interrupting.

MR. WILLIAMS: All right. I just want to go through the technical staff for the reviewers, myself and Zach. We also had help from the instrumentation people. That would be Deanna Zhang. I think she is in here the audience. And Rick Scully couldn't make it today because of illness and plant systems. As we use other branches to help us in the review, since it impacts more than just health physics, it is the actual balance of plant and instrumentation and so on.

Project Engineers are Jeff Ciocco and Tarun Roy here, our Chapter Project Manager. Next slide.

Here is basically the same slide that the applicant showed that the breakdown between 11.1 and 5, 34 questions. And we have five questions still open at this time. We will get to a couple of them, since we have written this that we have actually -- they are in confirmatory at that time. So, we are down to actually three and we will look at them.

Okay. The first one is Section 11.1. The expected coolant source terms, based on the modified ANSI/ANS 18.1 for 1999, KEPCO explained how they used that and they also modified the GALE Code. And we had requested an RAI on that and actually requested an audit in the beginning of our review and it hadn't happened for quite some time. What we were looking for was the executable files and the source code files so that we could review and verify their calculations for the source term. We did receive the requested docketed information and then quickly, means within two weeks, determined that the only changes they made to GALE were to update the ANSI 18.1/1999 which was from 1985. They updated it to 1999 RCS standard. And then after we reviewed that, we found that it met the SRP Section 11.1 and Reg Guide 1.112 calculation of releases reg guide requirements. And essentially, there are no COL items in 11.1 listed for this section. And we have closed out all open items and RAIs in this section.

MEMBER REMPE: So, I have a question on this section that is not with an open item. You had an RAI 1568146 because the applicant had

apparently done some calculations where they basically said certain isotopes are present. So, we didn't consider them. And the way I have read your draft SC, it basically said that the reason RAI was issued was because that you couldn't match the numbers generated by the applicant. And so when the applicant came back and said hey, we don't have any contributions from those isotopes, you said oh, okay, you're right.

Is there something wrong with the way the process is? I mean maybe we ought to change the way we review things that -- it's basically related to Reg Guide 1.143 where certain numbers have to be used. And I'm just wondering. What I'm reading here kind of sounds like when the applicant actually -- and I'm not saying this because of what KHNP has done, I am just trying to see if we need to improve our review process so we don't have RAIs going just because an applicant puts zero in because they have no contribution.

Is my question making sense to you?

MR. WILLIAMS: Yes and we find that in some of our reviews, based on the decay of radionuclides. There is some -- and if you look at

the decay scheme of like cesium goes to barium-137m, which actually has the radiation we are looking at and decays down to a stable nuclide, in some calculations people will put in cesium and barium-137m. Other calculations, they will just use the cesium to represent the whole decay scheme and apply all the radioactive materials just to cesium.

And what KHNP was doing, and you can correct me if I am wrong, they were putting zeros for the daughter products.

MR. GRAN: I think for some of those it is just zero because it is negligible not that it doesn't really exist.

MEMBER REMPE: On niobium-95, yttrium-89m, rhodium -- oh, sorry.

Okay, niobium-95, yttrium-89m, rhodium-106m, it basically says the liquid waste management system doesn't contain these nuclei in the source term. And then there were some that were because of their half-life being short.

But I just was wondering. Again, you are saying that -- I guess I'm still -- I will admit I'm not well familiar with this process but

it just sounded like there is something in the requirements that needed to be reevaluated.

MR. WILLIAMS: Well, what you just read is yes, some of them are such a small activity that they are not even used in the reg guides that we used to calculate the dose. In other words, the dose conversion factors will not even be there for certain radionuclides on the list that we get. They are still produced but they are in such small quantities that they are negligible.

MEMBER REMPE: So, shouldn't the staff be aware of this instead of having to issue an RAI is what I am trying to get to is maybe there is a way that we could improve the process. I mean it is only one RAI but it seems like that we ought to be aware of that.

MR. WILLIAMS: Yes, I think you are right but we don't review these every day. We get them in spurts as far as reviewing them and then another six, eight months go by and we get another submittal and we may forget how the process works.

MEMBER REMPE: Yes, okay. Maybe it is something we ought to think about --

MR. WILLIAMS: Right.

MEMBER REMPE: -- with the 50 plus startup companies that are going to be coming through. I just had a question while I was reading it.

MR. WILLIAMS: Sure. Let's see, where was I?

Okay, no COL items in 11.1, essentially, and no open items.

Okay, 11.2 is the liquid waste management system. The staff reviewed the items that I have bolded on the next two pages here. A lot of these items, if I can read them all or maybe just go through and say bullet one, basically, because KHNP has already gone through the design basis. Most of the features, the system description, processing methods, capacities -- we had a lot of questions on that -- the seismic quality group classifications. Anybody have any problem with that as far as going bullet to bullet for questions?

So, bullet one, is there any questions on what we looked at in as far as the summary?

Bullet two, we looked at the basis and development of the liquid process waste streams and

the estimated inputs to the LWMS, and the treatment process performance, and the decontamination factors. These are all inputs that will go later into the liquid dose calculations as the different parameters that we put into our LADTAP program to calculate the dose to the environment.

MEMBER SKILLMAN: Steve, was the failed fuel estimate one percent and the constant decalcification an issue in your review?

MR. WILLIAMS: Yes.

MR. GRAN: So, for GALE it's not. You can't attribute it to any failed fuel percentage. The ANSI standard is based off of just normal operating effluent data. So, it is kind of hard to give it a percentage. But for normal effluent releases, it is based off of normal. For the Reg Guide 1.143 system classifications, it is one percent.

MR. WILLIAMS: All this, Dick, is found in the SRPs that we use and we use that as guidance to go through and when we do the calculations in the reg guides in the SRP.

MEMBER SKILLMAN: Okay, thank you.

MR. WILLIAMS: The KHNP proprietary

version of the GALE Code was used to calculate the liquid effluent releases with the source term during normal operations, including AOOs described by KHNP and their RAI technical responses.

The next page. The staff confirmed the methodology basis and assumptions used to comply with effluent concentration limits, the ECLs in 10 CFR 20 that they mentioned in Appendix B, Table 2, Column 2. And we were also using those limits, using those numbers to do the dose limits in the design objectives of 10 CFR 50 Appendix I, which are the doses.

We also looked at the epoxy coating systems used to line LWMS cells and cubicles and comply with 10 CFR 40.1406 and essentially Reg Guide 4.21 and Reg Guide 1.54, recognizing again that more recent standards may also be used in their design for their LWMS.

We also looked at 10 CFR 20.1406, Tier 1 and ITAAC information. We looked at the tech spec section and preoperational testing and reviewed all those. Wrote, essentially, the RAIs that were needed.

MEMBER MARCH-LEUBA: Can we go back a

couple of slides before learning to change it?

You mentioned the GALE Code and that they had a proprietary version. I read in this that you guys did a review of the code. And my concern is probably going to apply more to other sections than this one. We have COLs that have been approved and used for many years and then the licensee or the applicant goes and makes some modifications to put their own correlations or whatever.

How does the staff guarantee that that COL is still the same that it was before? I mean how do we know it is still approved?

MR. WILLIAMS: That is done by the -- I'm not on the NRR side but that is done by licensing changes and they have to submit I think it is by 10 CFR 50 procedures.

MEMBER MARCH-LEUBA: Yes, but for example, in the case of the GALE Code when they put the proprietary version, did they go through a review and approval?

MR. WILLIAMS: Well, in the cases of the inspectors, yes, they go through the calculations again for any changes that they make

from the original changes.

MR. GRAN: So for the GALE Code for example, we requested the source code and we had the source code for our -- and it is basically you do a window, first of all to see what the change, the deltas were.

And for this case, at least, it is very simple because you see it at the source term library was the only thing that changed. So, I mean if you just do the comparison and see the only changes are to the source term, we had confidence they didn't really change anything else.

MEMBER MARCH-LEUBA: So, in this case, you reviewed it and you are confident these are good. It is going to be a renewing question of mine not just for this subject but for all the other, too.

MR. GRAN: We also had spreadsheet calcs about recompiling the code where we noticed that you could ratio out the old ANSI standards and, for the liquid case, there is a fudge factor tacked on that was weighted based off the contribution for each radionuclide. But we could reproduce it without having the KHNP source code.

But when we received it, we have the ability to do the WinDiff, to confirm that they did not change anything else.

MR. WILLIAMS: Okay, page seven. Additional topics of interest in our review for the COL information items which are required to be provided by a COL applicant in using the design, the DCD. These included mobile and temporary radwaste processing equipment and interconnection to plant systems. We looked at that. We looked at the release points, effluent temperature, shapes of orifices and so on where the release is and where it releases to, hydrological data, and groundwater or surface analysis to comply with the ECLs in 10 CFR 20.

We also looked at the liquid tank failure calculations and ensured that the ECLs were met. We looked at the offsite liquid doses, again, in 10 CFR 20 to comply with 40 CFR Part 190 and 10 CFR 50 Appendix I.

Another thing the COL would have to provide would be the site-specific cost benefit analysis of where they actually physically placed their new plant and, obviously, the piping and

instrumentation diagrams specific to their COL site.

After review of 11.2, as the applicant stated, we have two open items. The first is to provide liquid effluent tracking, providing a liquid effluent tracking process for detergent radwaste tank, liquid effluent releases, including comparisons to 10 CFR 20 and also liquid effluent doses calculated from the LADTAP Code for 10 CFR 50 Appendix I.

That RAI is in review. They have submitted I think it is Rev. 2 of a response. I wrote the RAI and what I am looking for is that that detergent waste tank that you talked about previously with them is ensured to receive the same process that the regular release tanks receive before they release the tank. In other words, sampling analysis, composite sampling required by tech specs, and the dose also included in the total dose for the quarter and the year.

And we are working on that right now. In fact, we are going to schedule a meeting for tomorrow to discuss that. That's why that is still open.

The other item in 11.2 is 11.2.7, the request for consistent changes throughout the sections 11.2, 3, 4, and 10.48 for the steam generator blowdown.

In addition, the staff requested the applicant include the system source terms for the components described in 10.4.8. And what we were looking for there was that the applicant -- well, the applicant did recently update the response they provided consistent changes in 11.2 through 4 and 10.4.8. And we are at the point where we made this a confirmatory item. That is one of the ones that are close. So, just one of them is open.

Any questions?

11.3 is the gas waste management system. The DWMS design basis and features system description processing methods, capacities, seismic and quality group classifications, performance characteristics, instrumentation alarm systems, automatic isolation of gas waste process flow, and effluent release, also looking at hydrogen and oxygen monitoring and the ALARA design features and the actual release points for COL but for the DCD is just where the release point may be, based on

the plant design.

MEMBER STETKAR: Steve, the question I asked the applicant about single point isolation of the gaseous releases, the staff is okay with that?

MR. WILLIAMS: Pardon me? The single point --

MEMBER STETKAR: The single point -- they only have just one isolation valve. It is valve 008 in the gaseous release line. And if they have high activity and that valve doesn't close, it is beyond me to figure out how I do not get an above spec release. So, the staff is okay with that?

MR. WILLIAMS: Well, I was thinking about that when you were going over that with them. The main thing is that when you do a release, you will calculate what the monitor should read. And also, when we get back to 11.5, they have interlock functions. If the function were not to work is what you are alluding to?

MEMBER STETKAR: The valve doesn't close.

MR. WILLIAMS: Doesn't close. The only things that would be available to operations would

be that if they were watching a monitor and maybe somebody noticed the monitor was going high and they notified the man at the radwaste panel to close that.

MEMBER STETKAR: Close what? The valve --

MR. WILLIAMS: Close that valve --

MEMBER STETKAR: I'm sorry, the valve didn't close.

MR. WILLIAMS: Right.

MEMBER STETKAR: It's broke. It didn't close. It can't close.

MR. WILLIAMS: Or stop the release operationally.

MEMBER STETKAR: Well, on the liquid system, I can stop the release and it does automatically by stopping the pumps.

MR. WILLIAMS: Right.

MEMBER STETKAR: There ain't no pump pumping the gas out.

MR. WILLIAMS: Well, in that case, what I remember as far as what we have in our procedures were that they could also close the dampers and turn off the fan in the case of --

MEMBER STETKAR: But what you are saying is the staff is okay relying on all of those operator actions for gaseous releases.

MR. WILLIAMS: I noted another thing when I was sitting in the back, too. We usually had some kind of double and manual backup to the isolation valve and we would close the manual valve. That is another -- I thought I had written RAI on interlocks.

Well, where this comes in is, again, on the monitors, the function of the monitors. And back in Table 11.5 we talk about and we ask them to put in all the monitors that do have interlock functions. And you are right. If that fails, we have to look at if there is any other way to stop the release based on a manual isolation.

MEMBER STETKAR: Thank you.

MEMBER SKILLMAN: Steve, let me follow-up with John. I asked the gentleman from KHNP about why that release isn't safety grade and the answer is because it is not an accident function. I understand that.

But what John was really pointing to is why didn't the staff you have got to have two

valves? You have got to have a redundant valve there. You just can't let that go. I mean I think that was standard practice for some of us at power plants and a lot of places.

So, why didn't the staff say hey, this is dandy but you need a second valve, no matter how you call it, solenoid, manual, something. You have got to be able to stop this thing, if that valve doesn't do what it is supposed to do when the radiation monitor says go closed.

MR. WILLIAMS: Well, let me go back to our past, as far as a plant that has decay tanks or liquid waste tanks. When you are releasing the tank, you always calculate first of all that if you release the tank entirely, you wouldn't exceed 10 CFR 20 limits. And also you calculate the dose on that and you add that to your cumulative dose. And if that doesn't go over the corollary limit or the annual limit, then essentially you could release a tank without knowing that it was going out in that situation that we have been talking about. And you would, obviously, catch it and it would be something that you would report. And those curies in that dose would be then added to the annual

reports. And then maybe they would put in an isolation valve.

But I know the DMI where I worked, we had isolation valves and we had the isolation by monitor. And we had the operator who would monitor the release and then, by the strip charts or whatever, and close the manual valve or turn the pumps off if we had anything above the setpoint limits.

MEMBER SKILLMAN: Okay, thank you.

MR. BURKHART: If I can add. I'm Larry Burkhart, the Branch Chief. We will take a look at that, of course, in addition. So, we will take that as something to look at.

MEMBER SKILLMAN: Thank you.

MR. WILLIAMS: Okay, we are still talking about the gas waste management system. KHNP proprietary version of the GALE Code was used to calculate the gaseous effluent releases during normal operations, including AOOs, similar to the liquid waste management system and described in the KHNP RAI technical responses that we received from the RAIs.

The staff confirmed the methodology

basis and assumptions used to comply with the ECLs and the design objectives for 10 CFR 20 and 10 CFR 50 Appendix I.

We also looked at the methodology basis assumptions to assess radiological impacts due to postulated failure of waste gas surge tank and the charcoal bed leak. Again, we are talking about BTP 11-5, which the applicant described. We have reviewed their process and analysis and we find that acceptable.

We found no mobile or temporary equipment or connections to permanently installed equipment considered in the GWMS design and we also looked at, again, 10 CFR 20.1406 Tier 1 and ITAAC information tech specs and pre-operational testing that they performed.

MEMBER STETKAR: Steve, stay on there for a second. The third bullet addresses their analysis of gaseous releases from a tank failure. In the SER, you apparently asked them about that and you said that the applicant stated that only the results from the gas stripping operation source term would be used in the accidental effluent release calculations. The staff determined that

only using the gaseous effluent source term from gas stripping operations would provide a reasonable approach to the calculations.

So, okay, I went back to Table 11.1-8 in the DCD and, indeed, if I look at the gas stripper source term for tritium, krypton species, and xenon species, they are well above the other sources of input to the gaseous waste processing system. Not so much for iodine. Reactor drain tank is the highest source term by far. And they have factors of three or four or something like that.

So, why are we focusing on the gas stripper and not some other composite source term? Because during normal operation, everything is coming into the gas system. So, if I break, for example, the surge header or whatever the heck they call it, I am going to get the stew of whatever was going in.

MR. GRAN: In essence, from my understanding, that is what is done. So, like they used the GALE Code to develop the source term. And I guess prior to all the treatment through charcoal delay beds and whatnot, they stopped the source

term there and take the curie figure without decay or removal or anything.

MEMBER STETKAR: Right. But -- and I don't do any of this. So, I don't know. I can spell GALE because I can see it up there.

My question is, are they using only the gas stripper source term. In other words, the gas stripper iodine species or are they using an amalgam of the gas stripper and the reactor drain tank, where the gas stripper source term is going to drive the results for tritium and krypton and xenon, the reactor drain tank would drive the results for iodine.

MR. WILLIAMS: We can take that as an item but we would have to go back to BTP 11-5 and go through the process that it describes and what nuclides or source term that it tells us to use.

MR. GRAN: Yes, I would like to take it back, too, because I am tempted to say we primarily use the noble gases.

MR. WILLIAMS: And the reason I think that is only considering the noble gases is anytime you have a release that goes out, the iodines and the particulates normally don't make it out because

they combine or stick to the walls and things like that, where the noble gases basically go out and that was --

MEMBER STETKAR: That might -- as I said, this is not something that I do. I just noticed that it didn't necessarily dominate all species. So, that might be a good answer. Thank you.

MR. WILLIAMS: Well one place that proved that out was during the TMI 2 accident. There was minimal iodine released and particulates because it all adhered to the inside of the reactor building walls and they read high whole body dose rates out of the stack because in helicopters they had and everything else only because of noble gases that were released from the accident.

I'm pretty sure that is the answer but we will check and make sure for you.

MEMBER STETKAR: Okay, thanks.

MR. WILLIAMS: Okay, page 11, the COL information items from the GWMS. We looked at the on-site vent stack design parameters and release point characteristics for the gases, the release points, the effluent temperatures, shape of the

orifice. Again, the offsite gaseous effluent doses need to comply with 10 CFR 20 and 10 CFR 50 Appendix I and also for the COL applicant, they need to do cost-benefit analysis for the gas waste systems and provide PNIDs for site-specific items.

And there were no open items in Section 11.3. Any questions on 11.3?

MEMBER STETKAR: Yes, actually I have a couple more questions. I'm a slow reader and an even slower thinker, these days.

In Section 11, there is a fairly extensive discussion about -- I've lost my place here -- about something -- about the charcoal beds. And it is really important to keep the charcoal beds dry. It is really important not to have fires in the charcoal beds. So, in a lot of places where I have seen people use charcoal, I see people using running fire protection lines to the charcoal beds.

MR. WILLIAMS: Right.

MEMBER STETKAR: I couldn't find any connections to the fire protection system to these particular charcoal beds. And in fact, you asked a question about it and in the response to that question, this is in Section 11.3.4.1.1 of the SER,

to give you a place to look, but the applicant also described the use of inlet temperature sensors that can monitor temperature conditions and stated that the beds can be isolated in the event of a fire.

So, basically, they are claiming you know they are never going to catch on fire and we can isolate them, even if they do.

If I look at Chapter 9 of the DCD, there is a table 9.5.1-2 that describes APR 1400 fire protection program conformance with NFPA 804. It is a 70-page table. On sheet 37 of that table, it says that the design conforms to the fact that fixed water spray systems shall be provided for charcoal absorber beds containing more than 100 pounds, 45.4 kilograms of charcoal. These beds are a check of a lot bigger than that.

Now, if you look at NFPA 804, it is written in the sense of ventilation systems. This is not a ventilation system but it discharges directly to an exhaust form the ventilation system.

So now my question is is it okay that these particular charcoal beds don't have a fire protection water spray. And if so, is that consistent with NFPA 804 guidance?

MR. WILLIAMS: That, again --

MEMBER STETKAR: This is cross-cutting across several areas, I realize that but I am looking at a big chunk of charcoal and I am looking at possible fires and a big chunk of charcoal.

MR. WILLIAMS: Yes, we will go back and revisit that RAI and check back into the use of the moisture instrumentations upstream and the isolation that we talked about.

MEMBER STETKAR: I mean their basic -- I couldn't find any connections but again, I'm pretty sure that there is no fire connection manual automatic, anything to these charcoal beds. And at one level, I am okay with that. On another level, if they are saying they conform to all of the fire protection codes and requirements, it is not clear to me that they do, necessarily.

So, anyway, I have got it on the record. That's all I wanted to do.

MR. WILLIAMS: Right. Again, as you say, we have a lot of cross-cutting items like this. We will talk to fire protection and we will get an answer back to you.

MEMBER STETKAR: Thanks. The other

question that I have is I notice in two areas that both the liquid waste management system tanks, whatever they are, and the gaseous waste management system stuff, because they don't have many tanks, and the solid waste management system tanks, in particular, the spent resin storage tanks, are all vented to their respective rooms, which go to the ventilation system. And in fact, in the DCD, there are quotes that say things like each liquid waste management system tank is provided with vent piping that is terminated at the vicinity of the inlet duct of the heating, ventilation and air conditioning system.

It is unusual, in my experience, to find tanks vented to the room, rather than being vented to the gaseous waste treatment system, especially tanks like high-activity spent resin storage tanks. And I didn't see any questions about that. So, you are apparently okay.

Is that now standard practice? So, my basic question is why -- and I wanted to ask the staff because you didn't ask any questions about it. Did you look at those vents and why it's okay to vent it to the room and to the basic building

ventilation system, rather than venting the gaseous parts of the tanks to the gaseous waste processing system itself, which is the more normal, in my experience, design?

I went back and I looked at all of the tanks in the auxiliary building. And the tanks in the auxiliary building are vented to the equipment drain tank and the equipment drain tank is one of the inputs to the gaseous waste system. So, I got a lot of the tanks in the aux building are taken care of but the tanks in the waste processing building itself, not so much.

MR. WILLIAMS: Well, that's something I may have missed. If you go back and look at their process flow diagram of the GWMS, it shows the RDT nitrogen gas stripper, VCT vent, and the relief, it shows them all going into a common header. That was what I was used to seeing. And we used to call that the vent header and that is what went over to the waste gas tank prior to release.

MEMBER STETKAR: Right but I'm used to seeing stuff from the radwaste system go into that same header back.

MR. WILLIAMS: Yes.

MEMBER STETKAR: And this one doesn't. That's why -- when I first looked at the drawing, I started chasing sources of gas input to the gas waste gas system because I was used to seeing a lot more lines, which is what started me looking at nitrogen and hydrogen systems. And I finally found the fact that basically everything in the aux building goes into the equipment drain tank, which is one of the inputs into the waste gas header here.

So, okay, I have a way of collecting all of that stuff. And reactor drain tank, fine, I've got that. I have got the volume control tank, and I've got the gas stripper from the CVCS system. So, those are big sources that I go look for. And the other places that I'm used to looking for is the actual waste treatment tanks themselves, whether they are hold up tanks, if they have them or whatever they are, whatever process they use and didn't find it.

So, I'm curious whether that is okay.

MR. WILLIAMS: Well, now I'm curious.

MEMBER STETKAR: It is just unusual. And it is explicit. Not only is it shown on the

drawings but there are words in the DCD itself that I just quoted that says no, we just vent it to the room and try to make sure it is close to the ventilation exhaust inlet for the room.

MR. WILLIAMS: Okay, we'll go back and take a look at that.

MEMBER STETKAR: Thanks. That's all I have on the gas systems.

MR. WILLIAMS: Okay. Page 12 is Section 11.4, Solid Waste Management System. Again, we are looking at the design basis and features, system description, processing methods and capacities, seismic and quality group classifications, performance characteristics, instrumentation alarm systems, annual estimated waste generation rates, alarm ALARA design features, capability to move drums and HICs, and provision for mobile or temporary equipment and boundary definitions.

We found no direct liquid and gas effluent releases originating from the SWMS. The associated releases that feed into SWMS were covered in 11.2 and 11.5 sections.

And then we looked for the basis for

design storage capacity for Class A, B, and C radwaste. Next page.

The next thing we looked at was some type of looking for a PCP or process control program that would describe the operational program for processing A, B, and C waste in accordance with 10 CFR 61.55 and 56. And we found in their DCD they said they were going to adopt the NEI PCP template 07-10A until plant-specific PCP is developed to support plant operation. And this approach was acceptable, given staff endorsement of the NEI PCP template 07-10A.

We also looked at 10 CFR 20.1406 Tier 1 and ITAAC information, again, the tech specs and the pre-operational testing for the GWMS. And we also looked at epoxy coating systems that they are using in the SRST rooms and compliance with 10 CFR 20.1406 and Reg Guide 421 and 154.

And for Section 11.4, we also looked at the COL items that are listed. Offsite laundry services is one of those. Again, you guys talked about that with the applicant. Cost-benefit analysis PIDs. PIDs mobile and temporary solid radioactive waste processing and interconnection to

plant systems that they comply with 10 CFR 54(a) -- 10 CFR 50.34(a), 1406 and Reg Guide 1.143.

That concludes 11.4. There is open items in 11.4. Questions?

On to 11.5, Process Effluent Radiation Monitoring and Sampling System, the PERMSS system. We looked at design basis and features, system descriptions, types, numbers, and locations of PERMSS monitors and samplers, seismic and quality group classifications, operational ranges, sensitivity and alarms, systems calibrations and provisions for building check sources, provisions for automatic isolation and termination features and ALARA design features.

This one actually we had a lot of items to fill in on this as far as the number or the types of the monitors, the samplers, and the other thing we required, as the applicant stated, was that not only having the table for all the monitors, but also in 11.5, to give the description and also describe anything as far as any isolational properties that they have or any of the valves, things like that. And we are getting to the point where that is one or two of the open

items for the RAIs and we are evaluating that right now to make sure we are in agreement with everything they provided for all these different requirements.

We also looked at the plant process system, the effluent flow paths monitored by the monitoring and sampling equipment. Again, the 10 CFR 20.1406 and associated ITAAC, tech specs, pre-operational testing.

And the 11.5 we also looked at the ODCM offsite dose calculation manual description. They described that they would have an ODCM and the DCD adopts NEI ODCM template 07-09A. That, again, is endorsed by the staff, which is acceptable for the DCD.

We also looked at the RCS leakage detection and ensured that it complied with or conforms with the Reg Guide 1.45 Rev. 1 and ANSI N 42.18-2004. And we looked at the primary-to-secondary leakage detection and ensured the NEI 97-06 compliance per the tech spec basis.

And the last part of 11.5 was, again, the COL information items required by a COL applicant. We looked at the aspects beyond PERMSS

design in accordance with the Reg Guide 1.12, Reg Guide 1.33, Reg Guide 1.45, again, 10 CFR 50 Appendix I for the offsite doses for liquids and gases, the ODCM, the set points related to the ODCM, the REMP program, the Radiological Effluent Monitoring Program, that is in NUREG-1301 they committed to NUREG-0133 and the ODCM NEI document.

We looked at the analytical procedures and sensitivity for the radioanalytical methods type of sampling media that it was to be included in the COL item. We also looked at the procedures related to radiation monitoring instruments and analytical procedures and sensitivity for radioanalytical methods and sampling media type.

These all would be required of the COL applicant. And except for the three open items, three open questions I guess I will call it, for 11.5, we have been talking about them as we have gone through this section. For 11.5-1, 11.5-2 we requested the applicant to provide additional information in the descriptions of the LWMS and GWMS and not only in the table but also in the verbiage in the text to give us descriptions in 11.5.

One last open item was 11.5-3, which was a request for clarification of the information on the primary-to-secondary leak detection calculation in the DCD, apparently it is 11(b). We have since before we did these slides, the staff has reviewed and revised the response to this question. Their response was deemed to be acceptable and we are tracking this RAI now as a confirmatory item. So, that was the second one of the five.

So, that remains the resolution we have of out of the five open items we had, we are down to three open items left and expect it to be closed in Phase 4 of the DCD review.

Also, just to summarize, as far as the conclusions, the COL items that need to appear in the application, the offsite liquid and gas offsite doses, liquid tank failure analysis, the PIDs, the epoxy coating system, related operational analytical and radiation monitoring procedures, cost-benefit analysis, the PCP, and the ODCM.

And that's the final slide. Any questions?

CHAIRMAN BALLINGER: No questions.

Thank you again.

MR. WILLIAMS: Thank you.

CHAIRMAN BALLINGER: We are finished with what we were supposed to do today except for Section 2.3 from the staff. So, is the staff ready? You're ready.

Recall that KHNP presented 2.3 at the last meeting.

MR. ROY: My name is Tarun Roy. I'm the NRO Project Manager responsible for coordinating staff review for APR 1400 Chapter 2 Design Certification Application. We have presented before 2.1, 2.2, 2.4, and 2.5. Today we are presenting 2.3, Chapter 2, Section 2.3.

And Jason White is our DCD Section 2.3 is reviewing and Jessica Voveris, also.

During this meeting the staff plans to make a presentation of the Chapter 2 Site Characteristics, Section 2.3, SER with an open item.

Staff issued a total of ten questions to the applicant requesting additional information. And twelve initial clarification questions. Presently, we have eight remaining confirmatory

items. There is no open items in this section.

With that, I now turn the presentation over to technical reviewers Jason White and Jessica for Section 2.3. Jason.

MR. WHITE: Good afternoon. My name is Jason White. Jessica Voveris and I are meteorologists in the Office of New Reactors. We are part of the review team for Sections 2.0 and 2.3. And today we will be discussing Section 2.3.

CHAIRMAN BALLINGER: Can you tell me what the weather is going to be like on Friday afternoon?

MR. WHITE: It's still in flux.

MEMBER POWERS: Just tell him it is all clear except for Massachusetts.

MR. WHITE: The review of Section 2.3 involves the five sections of the APR 1400 DCD listed as Sections 2.3.1 through 2.3.5 as shown on the slide. In addition to those sections, we also have combined license information items, which will be discussed later in the presentation.

For each COL application, an applicant will have to provide the site-specific information outlined in these sections and compare it to the

site parameters listed in Tier 1, Table 2.1-1 and Tier 2, Table 2.0-1. Next slide.

As Tarun mentioned, during the course of this review, the staff asked 12 initial clarification questions and 10 RAIs. And currently, the Safety Evaluation Report contains eight SE confirmatory items and zero SE open items.

MS. VOVERIS: As Jason mentioned previously, my name is Jessica Voveris. I am also one of the meteorologists who is involved on the KHNP review of Section 2.3.

So, the applicant identified meteorological site parameters related to both climatic extremes and regional meteorological phenomenon, which includes severe weather and, in addition, atmospheric dispersion, which pertains to both accident and routine releases.

A COL applicant is required to compare its site characteristics to the APR 1400 site parameters, which the staff reviewed under SRP Section 2.0. The staff ensured that the postulated site parameters are representative of a reasonable number of sites that maybe considered for a COL application and that the site parameters are

clearly defined for a potential COL applicant that may reference the APR 1400 design.

MEMBER SKILLMAN: Jessica, how do you define reasonable number of sites?

MS. VOVERIS: That's a good question. It is among -- it is a discussion among our group of how do we interpret a reasonable number of sites. Perhaps one of our other reviewers can add to that.

CHAIRMAN BALLINGER: I mean for example, as I recall with the other sections, we had this long discussion about wet-bulb temperature and concluded --

MEMBER STETKAR: I was going to follow-up on that with the staff.

MS. VOVERIS: We were going to bring it up for you guys.

CHAIRMAN BALLINGER: Good. Okay, so you got it.

MEMBER SKILLMAN: Well, I'm still eager to understand reasonable.

MR. QUINLAN: My name is Kevin Quinlan. I was one of the meteorologists who also reviewed this section. It tends to vary a little bit from

parameter to parameter. Generally, though, in this case it was could it be sited in really two or more sites. They compared it against some of the existing sites in the country and we also compared the parameters against some of the existing nuclear sites in the country. And if it could be sited at really a handful or more of those sites, then that was considered to be a reasonable number.

MEMBER SKILLMAN: With more than -- okay. I'm sorry. Talk about that handful.

MR. QUINLAN: They compared against some of the other sites that the NRC has already reviewed and accepted and then many of the COL and ESP sites we looked at. And it was with the understanding, and KHNP would understand this as well, that should they be outside the balance of the -- if the COL applicant comes in and is outside the bounds of the DCD, then they would need to do a departure analysis.

MEMBER STETKAR: Let's follow-up on that. And I have to be careful because I am staring at something that says official use only, sensitive internal information, which is a draft SER for a particular certified design. So, I have

to be a little bit careful here. But which particular sites? Because for the wet-bulb temperature, the only design certifications that we have seen, and we have seen them all, that have temperatures equal to or lower than the 81 degrees Fahrenheit for this one are the USABWR and the USEPR. And the USEPR was never certified. So, that is what it is. It is not a certified design for any site.

The USABWR, the only one that we have seen a COL is the South Texas site and they had to increase their wet-bulb temperature from 81 degrees to 88.3 degrees to get the darn plant built and designed.

So, I am interested in what sites the staff has approved for any of the design certifications that have this low wet-bulb temperature.

MR. WHITE: In this case -- did you want to handle this or do you want me to?

MS. VOVERIS: I mean based on --

MEMBER STETKAR: ESBWR, you have approved.

MS. VOVERIS: Correct.

MEMBER STETKAR: That had 88 degrees.

MS. VOVERIS: Right.

MEMBER STETKAR: Seven degrees higher. AP 1000 had 86.1 degrees; 5.1 degrees higher.

MS. VOVERIS: Correct.

MEMBER STETKAR: So, I'm curious about how 81 degrees is something that the staff has approved for any site in the United States.

MR. WHITE: In this case the staff -- well, I said it varies a little bit from parameter to parameter but in this case, the staff looked at ASHRAE data from across the country and determined that there were a number of states and a number of sites in the country that this would be able to be sited at.

MEMBER STETKAR: Okay.

MR. WHITE: We did issue an RAI that spoke directly to this issue that I think came short of suggesting that they raise the wet-bulb temperature but certainly pointing out that for many of the sites in the southeast, which is where most of the COL and ESP applicants that we have seen have submittals, it falls short of the wet-bulb temperatures at those sites. And I believe

that we say in the SE that -- or I can't remember if we used the exact words, but that they would need to do a departure analysis, which we have seen for sites such as Turkey Point and Summer.

MS. VOVERIS: If you want enact an exact number of states based on the ASHRAE data, it is about eight.

MEMBER STETKAR: Eight?

MS. VOVERIS: Yes.

MEMBER STETKAR: Out of 50 or about of --

MS. VOVERIS: It is about the third western side of the United States. They are big states but California, Montana, Wyoming, New Mexico, Nevada, Idaho, Utah.

MEMBER STETKAR: Dry states.

MS. VOVERIS: Yes, correct.

CHAIRMAN BALLINGER: States that none of which have nuclear plants.

MS. VOVERIS: California still has one.

MEMBER STETKAR: Arizona.

CHAIRMAN BALLINGER: Arizona.

MEMBER STETKAR: My point is that, and I think Dick is trying to get to this what are we

certifying a design for? Are we certifying a design that can be built anywhere in the United States, as long as it is precisely one specific little area of the United States or are we certifying a design for the United States?

MS. VOVERIS: So, those eight states that I did mention would allow them to remain under that wet-bulb site parameter. Any other state, they would have to do an additional -- a COL applicant would have to do additional analysis in regards to a departure for that.

MEMBER STETKAR: So, we are certifying a design that in -- is that in -- I'm going to exclude Alaska and I'm going to exclude Hawaii for the moment -- that in 40 of the 48 contiguous states we are guaranteeing that the COL applicant will have to take a departure.

MS. VOVERIS: Yes.

MEMBER STETKAR: Okay, thank you. That's what I wanted to get on the record.

MEMBER SKILLMAN: What triggered my interest in this is the idea that this plan used Prairie Island as a surrogate location. Well, that's just dandy until you have been there from

about the first of November until about the 15th of March. Guess what? Heat sink is no problem. There is lots and lots of cooling.

But if you take the plant that you would site at Prairie Island and put it in Southern California, or Southern Florida, Southern Texas, then the heat sink temperature is going to be an issue.

And so this is an economic issue. It is not a safety issue from my perspective. If KHNP wants to offer a design that has limitations, quite candidly, that's their business but some customers might say why didn't you give me three or four more degrees on all of them at heat sink because it will upset my heat exchanger design and, particularly, my air conditioning design where I have the greatest threat to margin for heat transfer area.

So, it just seems like there is an opportunity here on the front end, quite candidly, to make the air conditioning systems with more margin or HR, the well water heat removal systems just fractionally larger so this is not an issue for anybody siting a plant in this country.

And to me, it ties back to this idea

that part of the plant is designed for 60 years and part of it is designed 40 years. That is a mindset that says if we do this right, we really don't have to buy all those big heavy redundant robust equipment. Well, the thing that has kind of held the industry together for all of my career has been big, heavy robust equipment. And the designers that have taken the high ground and said we are going to put a few more feet on these heat exchangers and a few more square feet in the air conditioning are the ones that survive.

So, it just seems like there is an opportunity here that will benefit KHNP, that will benefit the staff and that will ultimately benefit a future applicant and it isn't a big change.

So, that's why I raised the question. I appreciate John's weighing into it.

MEMBER STETKAR: It can be a big change because I'm aware, and I won't mention the plant, of an operating plant situated in the southern part of the United States that was when they looked at their original HVAC system design, they had to increase the HVAC cooling capacity, both safety-related and non-safety-related, by a factor of

three compared to the original design for that plant.

Now, that isn't just more tubes and heat exchangers. They actually had to make room to put compressors, and chillers, and all kinds of stuff in that plant. So, it is not an inconsequential expense on the part of the COL applicant.

MEMBER SKILLMAN: I agree. My point is to do it at this point is really an advantage for everybody, as opposed to waiting until later and trying to argue a departure.

MEMBER STETKAR: If you want to actually build these plants in the United States of America.

MEMBER SKILLMAN: Fair enough. Okay, thank you.

MR. COOK: Mr. Skillman, this is Chris Cook. I'm Chief of the Hydrology and Meteorology Branch that is here. And I guess I just wanted to add on just a little bit. Although it's moving on, so I'm certainly willing to stop if you don't want to hear anymore. And I know it is late in the day.

MEMBER SKILLMAN: I'm happy to hear.

Please.

MR. COOK: Because the questions you bring up about reasonableness was in fact something that the staff, as Jessica was saying, did discuss and debate. And in fact, the staff asked an RAI, it is RAI 2.3.1 -- sorry am I looking at that right, 2.3.1? That was the section number. It is 2.3.1-3. And we asked this particular RAI specifically on this topic because staff, itself, was sort of wondering about that and the reasonableness in the number of sites. And it was something that we sort of came to because it was, in fact, you know the value that we are looking at is how do we define reasonable. It is not could it be sited everywhere.

And this is something that has come up before I know in seismic areas as well because not all the plants are able to be sited in every seismic location because the seismic hazard changes across the United States.

So, we looked at it. In fact, there were a number of meteorologists in the branch that went out and looked at it and found that there were eight different states that this could be sited in,

not just spots but states.

And so based on that and based on a thoughtful consideration, that is where we came to the conclusion that it was reasonable to allow this to go forward but we certainly did feel it was necessary for staff to ask the question and to get the applicant on the record regarding why they selected this value.

MEMBER STETKAR: For the record, since you brought up seismic, the discrepancies in seismic tend to be that they don't need the seismicity of the western United States, which is a small fraction of the land area of the United States of America. We are talking about a large fraction of the land area of the United States of America in the 40 states where they cannot meet, for example, the wet-bulb temperature.

So, we are talking about fractions of the country's land area where you could possibly put one of these things without a COL applicant being forced to take a departure.

And that's okay. As Dick mentioned, if KHNP wants to put this COL applicants at that risk of going through all of the gymnastics that they

need to do to justify departure or make changes to the design because they can't build the plant where they want to build it, that's fine. That's a decision. We just have to be clear that that is apparently their decision.

MR. COOK: Correct. And we looked at the ASHRAE database that was there for the extreme wet-bulb. And out of those, it is approximately one-third of the stations. Obviously, there aren't stations in every single location but it was approximately one-third of the locations that were reporting information allowed us or allowed the -- or were not exceeded by this temperature standard of 81 degrees.

Be careful, by the way, in the SER, in your discussion of that response to question 2.3.1-3 it says the NRC staff concludes that this design parameter -- this is again the wet-bulb temperature -- the NRC staff concludes that this design parameter allows the plant to be sited at a reasonable number of sites across the United States in accordance with SRP Section 2.3.1(IV)(3). And there is some intermediate discussion.

It says because previous certified

designs have used non-coincident wet-bulb temperature site parameter values equal to those of the APR 1400, the staff accepts the basis for which the applicant has derived the site parameter. I believe that only one previous certified design has that, that being the USABWR. And in fact, nobody has built one of those here. And the only one who tried to build it had to take a departure.

MR. COOK: Thank you for that. I agree the language should be --

MEMBER STETKAR: So, be careful about the language in terms of referring back to certified designs. The applicant has referred to the ABWR and EPR as if they are certified designs. EPR certainly is not.

MR. WHITE: We understand the comment. Thank you.

MR. MAZAIKA: This is Mike Mazaika, another one of the meteorologists. I would just like to clarify that it is not just a single value that that zero percent exceedance value is exceeded. And this gets into Chapter 9. But they look at multiple hours, periods of record that they sweep through being able, the ultimate heat sink

cooling system being able to handle that heat load.

So, this is a discrete value and not necessarily a value that has to be met or not. It is a starting point, actually.

MEMBER SKILLMAN: Well, actually, I don't agree with that.

I'm one of the guys that had to sit at a plant and try to justify a change to the temperature for the ultimate heat sink. And I will tell you, working at a 20- or a 30-year-old plant with installed hardware that is moldy-oldie and that is fouled, trying to eke out a few more degrees of the LMTD is A Herculean task. And the way you prevent that from happening is to make sure that the originally installed equipment has margin and a lot of it.

And we are at a point on this application where this designer could conceivably provide a few more degrees of LMTD by changing a couple of big heat exchangers and it will save the day 20 years from now or 10 years from now.

And as John said and as I said earlier, this is their decision and I'm not judging it. I'm just saying please give consideration to what we

are saying because the pain for the change is great and the cost is great later. It does affect building design, square feet, size of the heat exchanger and length, LMPD. It might change flow rates but all of that is involved with these very subtle parameters. That is all I am saying.

MEMBER STETKAR: It also reflects on this whole notion of a Part 52 certified design where the expectation is that people should not be expected to take departures or exceptions to that design.

And this is the whole idea is you certify the design. There are a few site-specific parameters that might need tweaking -- might. But it is not the expectation that people are going to have to take a departure or an exception to that certified design.

So you know in terms of looking at this from the staff's perspective, even, let's say that we are going to have 50 potential applicants come in with this and decide that they want to build this design. It is certainly a possibility, once it is certified.

We are now setting ourselves up in a

situation where is it consistent with the basic premise of a Part 52 licensing process.

MR. WHITE: We understand the comment. Thank you.

MS. VOVERIS: Thank you for the question.

Next slide, please. Thank you.

The climatic site parameters are selected to ensure the facility is being designed such that potential threats from the physical characteristics of a potential site such as regional climatic extremes and severe weather will not pose an undue risk to the facility in accordance with GDC 2.

A COL applicant needs to demonstrate that its meteorological site characteristics fall within the APR 1400 site parameters pursuant to 10 CFR 52.79(d)(1). Should the meteorological site characteristics not fall within the APR 1400 site parameters, the applicant must provide justification that the proposed facility is still acceptable at the proposed site.

The applicant's winter precipitation site parameters are used to determine the winter

precipitation wide loads on the roofs of seismic category I structures, as discussed in Chapter 3 of the DC. The staff compared the applicant's winter precipitation site parameter values against snowfall data recorded at weather stations located throughout the contiguous United States and found that the applicant site parameter values do bound most sites. The staff, therefore, concluded that there is reasonable assurance that the applicant's winter precipitation site parameter values can be expected to be reasonable -- representative of a reasonable number of potential COL sites.

The staff also reviewed the applicant's -- back a slide.

MR. WHITE: Go back, please. Backup slide six?

MS. VOVERIS: Seven.

MR. WHITE: Slide seven, please.

MS. VOVERIS: Thank you. The staff reviewed the applicant's extreme wind speed site parameter value of 145 miles per hour for a 50-year return period 3-second wind gust speed by comparing it to the wind speeds presented in ASCE 7-05, which is the American Society of Civil Engineers Standard

for the minimum design modes for building some other structures.

The staff found that the APR 1400 extreme wind speed site parameter value does bound the ASCE 7-05 wind-loading design criteria for the entire Continental U.S. Consequently, the staff concluded that the applicant's extreme wind speed site parameter is representative of a reasonable number of sites that may be considered within a COL application.

The staff reviewed the applicant's tornado site parameters by comparing them to the design basis tornado characteristics specified in Revision 1 to Reg Guide 1.76. The staff found that the tornado parameters chosen by the applicant are the same as the tornado intensity Region I design basis tornado characteristics specified in Reg. Guide 1.76, where Region I represents the central portion of the U.S. where the most severe tornadoes typically occur with exceedance probabilities of ten to the negative seven per year. The staff finds this acceptable as the applicant followed the guidance.

The staff reviewed the applicant's

hurricane site parameters, by comparing them to the design basis hurricane wind speed contour maps, representing exceedance probabilities of ten to the negative seven per year provided in Reg Guide 1.221.

Staff concluded that the applicant followed staff guidance and finds the hurricane site parameter values acceptable.

MEMBER STETKAR: So, from a wind perspective, I have reasonable assurance that I will not exceed the design basis hurricane or tornado wind speeds for this design, for any location at the plant, at a frequency higher than about one in 10 million per year. And yet, for 40 out of the 48 states, I know that I'm going to have to take an exception for the design of my cooling systems.

Does that strike you as a bit odd? I mean, honestly, they are designing something to ten to the minus seven wind speeds for tornadoes and hurricanes in the United States and just not considering heat removal.

CHAIRMAN BALLINGER: In the interest of time --

MEMBER STETKAR: No, I'm done. I made my point. That's fine.

MEMBER REMPE: Now that that point has been closed out, I had a question I brought up at the last meeting and you guys weren't around. And I would just like to understand a statement that is on page 2-45. It has note that the applicant apparently used the term exclusionary boundary in site boundary interchangeably, although these terms are not necessarily the same for all facilities.

And basically, you didn't really issue, I don't think any requests that they make any changes to the document. So, I guess you decided it was okay. But I just don't understand that sentence and what was done about it because I know I asked the applicant and they said oh, we didn't know that. So, could you explain this?

MR. WHITE: We understand your question and we noted that the term was used interchangeably a few times and we wanted to make that note because we wanted to try and avoid any confusion between the site boundary and EAB.

MEMBER REMPE: I understand that but what was done and why was it not important that

they didn't have to change things? Because to me, they should be aware of the differences. I think they are.

MR. WHITE: Well, that was our conclusion, that they are aware of the differences but we wanted to point it out as a staff to make note of it because when you are calculating x/Q values for the EAB and the site boundary, they are distance-specific. So, we wanted to make note that even though they are using those terms interchangeably, it is important to specify exactly which one you are making the calculations for.

And if you look at their table, their site parameters table where they actually include the values, they do use the terms appropriately.

MEMBER REMPE: But there are no changes. I mean out of the places we see request for changes or anything like that, you made no changes that you requested. But you have some places where you needed to point that there needed to be changes?

MR. WHITE: We did not make any requests. You are correct. We felt that they made the appropriate calculations looking at the values

that they had listed in their site parameters.

But I do understand your point. If we made the statement, you were wondering why we don't request the correction for the actual document.

MEMBER REMPE: Or perhaps maybe in your draft SE you should be more specific and say hey, we didn't make -- that they did use things correctly in the calculations and so no changes were needed or something because it just kind of sounds like well, they messed things up but we went on.

MR. WHITE: Okay. We understand your question. We appreciate the point.

MS. VOVERIS: So, the ambient design air temperatures, the applicant provided zero percent, one percent, and five percent annual exceedance air temperature site parameter values for use in the design of HVAC systems and as zero percent and five percent ambient exceedance temperatures, site parameter values for the operation of the cooling tower.

The staff reviewed the applicant's air temperature site parameters by comparing them against temperature data compiled by ASHRAE for

over 600 weather stations scattered throughout the Continental United States. And by comparing the APR 1400 site parameters to site parameters for previously certified designs and to adjust site characteristics for approved COL applications.

The staff concludes that the postulated air temperature site parameters are representative of a reasonable number of sites that may be considered for a COL application.

Are there any questions regarding the temperatures, I mean additional for the wet-bulb?

MR. WHITE: The next slide addresses the short-term and long-term dispersion site parameters. Regarding bullet one, the exclusionary boundary are EAB and outer boundary are the low-population zone or LPZ atmospheric dispersion x/Q value site parameters are used in DCD Tier 2 Chapter 15 to help demonstrate that the offsite radiological consequences of accidents meet specified radiation dose guidelines are specified in 10 CFR 52.47.

The staff reviewed the applicant's EAB and LPZ x/Q site parameter values by comparing them to the corresponding site parameter x/Q values in

the AP 1000 certified design and to the corresponding site characteristic values provided in COL and ESP applications that the NRC staff has reviewed and approved.

The staff's comparisons show that the APR 1400 site parameter x/Q values bound all the site parameter x/Q values in the AP 1000 DC and the x/Q site characteristic values provided in the approved COL and ESP submittals.

Consequently, the staff finds that the applicant's EAB and LPZ x/Q site parameter values should bound a reasonable number of sites that may be considered within a COL application. On the basis of this, the staff finds the proposed site parameters acceptable.

Regarding bullet two, the main control room and technical support center x/Q site parameters are used in DCD Tier 2 Chapter 15 to help demonstrate that the radiological consequences of design basis accidents in the control room and technical support center meet radiation dose guidelines specified in GDC 19.

The applicant considered using publicly available meteorological or met data from six U.S.

nuclear power plant sites for this analysis. To address the absence of a single site providing limiting x/Q values for the APR 1400, the on-site x/Q values were analyzed using the five-year Prairie Island met hourly data and the resulting x/Q values were increased by 50 percent, such that the model on-site x/Q values became bounding for most of the met data sets considered.

The NRC staff reviewed the overall quality of the met data for Prairie Island and found the data to be consistent with the guidance in Reg Guide 1.23 and, therefore, acceptable for use in calculating the x/Q values.

The NRC staff reviewed the applicant's ARCON96 control room atmospheric dispersion calculations and the resulting x/Q values. The staff did confirm its own confirmatory ARCON96 calculations for the control room. Based on evaluation of the met data, the atmospheric dispersion calculations and the added 50 percent margin to the x/Q values, the NRC staff finds that the applicant's on-site x/Q values to be reasonable for use as site parameters and on-site dose assessments.

Regarding the third bullet on the slide, the APR 1400 DCD utilizes routine release annual average atmospheric dispersion x/Q and deposition D/Q factors in DCD Tier 2 Chapter 11 to calculate the offsite concentrations and dose consequences from normal operations to demonstrate compliance with the offsite radionuclide concentration criteria in 10 CFR Part 20 and the dose criteria in Appendix I of 10 CFR Part 50.

The staff reviewed the applicant's routine release x/Q and D/Q values by comparing them to the corresponding site characteristics in the other NRC review and approved ESP and COL applications, as well as the corresponding site parameter values specified for the NRC-approved AP 1000 plant design.

This comparison shows that the APR 1400 design bounds the site characteristics for most of the COL and ESP sites and equals the site boundary site parameter values for the AP 1000 design.

Consequently, the staff finds the applicant's routine release site parameter x/Q and D/Q values should bound the reasonable number of sites that may be considered within a COL

application.

There are eight FSAR confirmatory items that the staff is tracking and will be looking to close out. The confirmatory items on this slide relate to updating tables in the FSAR to correct the temperature conversion and to identify the dry-bulb temperature values, revising the FSAR to include design ambient temperature exceedance values, and updating tables to identify the ambient temperature exceedance values.

The confirmatory items on this slide relate to updating the FSAR to include x/Q values for the TSC, updating the FSAR to include a definition for effective x/Q, and up the FSAR tables for references to the MCR and TSC x/Q values.

The APR 1400 DCD contains three meteorological-related COL information items. For COL information item 2.01, the COL applicant is to demonstrate that the design meets the requirements imposed by the site-specific parameters and conforms to all design commitments and assistance criteria.

For COL information item 2.31, the COL

applicant is to provide site-specific information on meteorology. For COL information item 2.32, the COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR 50.34 and GDC 19 are not exceeded, if the site-specific x/Q values exceed the bounding values described in the FSAR.

The staff finds the scope of the applicant's COL information items to be appropriate.

In conclusion, all of the regulatory requirements for Section 2.3 have been satisfied. There are no remaining open items and there are eight remaining confirmatory items that the staff will be looking to close out, once we receive Revision 1 of the DCD.

This concludes our presentation. Are there any additional questions?

CHAIRMAN BALLINGER: Questions? Could we get the bridge line open?

While we are getting the line open, are there any questions from members in the room?

Hearing none. I don't hear the normal

crackling and popping. Yes, now we hear it.

If there is anybody out there on the line, would you please identify yourself so we will know that there is somebody on the line out there?

MS. BANERJEE: This is Maitri but I have no questions.

CHAIRMAN BALLINGER: Thank you, Maitri. Are there any other members of the public that are out there that wish to make a statement?

Hearing none, we will close the line. Thank you very much.

As is our custom, we would like -- can we go around the table and get comments from members? We will start with Margaret.

Harold?

MEMBER RAY: No.

CHAIRMAN BALLINGER: Dick?

MEMBER SKILLMAN: Yes, I think that the issue of 60 versus 40 years needs to be addressed on this application. Thank you.

CHAIRMAN BALLINGER: Dr. Powers?

MEMBER POWERS: No.

CHAIRMAN BALLINGER: Matt?

MEMBER SUNSERI: I know it has been a

long day but I appreciate everybody's interaction. Thank you.

MEMBER STETKAR: Nothing more, thank you.

CHAIRMAN BALLINGER: Jose?

MEMBER MARCH-LEUBA: Nothing.

CHAIRMAN BALLINGER: Charles?

MEMBER BROWN: Nothing at this point. I will wait and see what the revisions are for the TG set stuff.

CHAIRMAN BALLINGER: Joy?

MEMBER REMPE: I agree with Dick's point about 60 and 40.

But I would also like to emphasize the point that was raised earlier about when the staff excludes reviewing something such as load following, as Harold pointed out, it is not just the fuel. So, yes, it may come up in the section on the fuel but there needs to be something up front in whatever the staff produces that says that even though -- unless the DCD changes, that even though there are a lot of statements in there in other sections about load following, we did not consider it. Because I can see somebody might come

up with a new fuel and say well, this is ready to go and I think that that should be clarified.

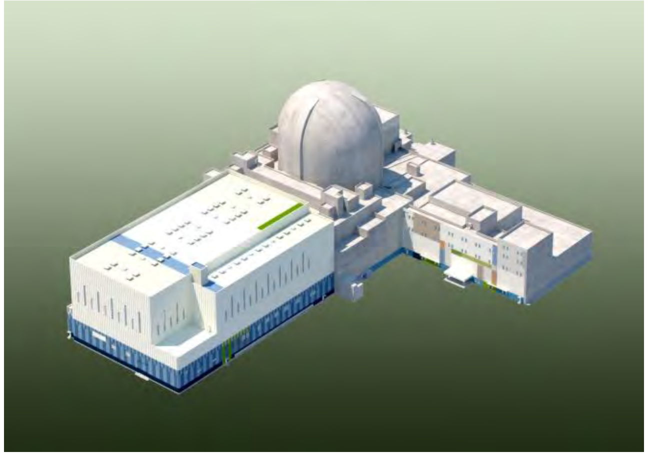
Thank you.

CHAIRMAN BALLINGER: Well, I would like to thank everybody for the presentations. It was a long day. As you realize, we ask questions just about anything. So, I would like to remind everybody that for future presentations, don't just stick to the RAIs. We are going to make presentations regarding every part of the chapters in the future so that we don't have any confusion and additional questions that might get answered.

But having said that, we appreciate everybody's presentations and this meeting is adjourned.

(Whereupon, the above-entitled matter went off the record at 5:24 p.m.)

APR 1400 DCA
Chapter 10: Steam and Power Conversion System



KEPCO/KHNP

Oct. 04. 2016

ACRS Meeting (Oct. 4 . 2016)

Contents

- Overview of Chapter 10
  - List of Submitted Documents
  - RAI Summary
- Steam and Power Conversion System
  - Subsection Outline
    - 10.1 Summary Description
    - 10.2 Turbine Generator
    - 10.3 Main Steam System
      (Key Review Items : FAC)
    - 10.4 Other Features
- Summary

Overview of Chapter 10

- **List of Submitted Documents**

Document No.	Title	Revision	Type
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier2 : Chapter 10 Steam and Power Conversion System	0	DCD
APR1400-K-X-IT-14001-P	APR1400 Design Control Document Tier 1	0	DCD

- **RAI Summary**

No. of Questions	No. of Responses	Not Responded	No. of OI
71	68	0	17

Steam and Power Conversion System

- **Subsection Outline**

Section	Title	Description	Presenter
10.1	Summary Description	The function of the steam and power conversion system is to convert the heat energy generated by the nuclear reactor into electrical energy.	Seo, Sung-Je
10.2	Turbine Generator	The Turbine Generator(TG) converts the energy of the steam produced in the two steam generators (SGs) into mechanical shaft power and then into electrical energy.	Kauffman, Storm
10.3	Main Steam System	The Main Steam System(MSS) is to transport steam generated in the SGs to the high-pressure turbine during normal power operation. The MSS extends from the SG nozzles up to the turbine stop valves. The MSS has two SGs and two main steam lines from each SG to the main steam common header.	Seo, Sung-Je
	Key Review Item (FAC)	Five open items related to FAC are included in this key review items.	Hwang, Kyeong Mo

Steam and Power Conversion System

Section	Title	Description	Presenter
10.4	Other Features of the Steam and Power Conversion Systems		Choi, Joon Wan
	Steam Generator Blowdown System	This system is to assist in maintaining the chemical characteristics of the secondary side water within permissible limits.	
	Auxiliary Feedwater System	This system is to provide an independent safety-related means of supplying auxiliary feedwater for the decay heat removal to the steam generators.	

10.1 Summary Description

- The steam and power conversion system comprises the following major process systems :
  - Turbine Generator(T/G)
  - Main Steam System(MSS)
  - Condensate and Feedwater System
  - Turbine Bypass System(TBS)
  - Circulating Water System(CWS)
  - Steam Generator Blowdown System(SGBDS)
  - Auxiliary Feedwater System(AFWS)

10.2 Turbine Generator

- Approach
- Turbine control and overspeed protection
- Turbine rotor design and integrity
- Turbine missile probability analysis
- COL items
- Open items

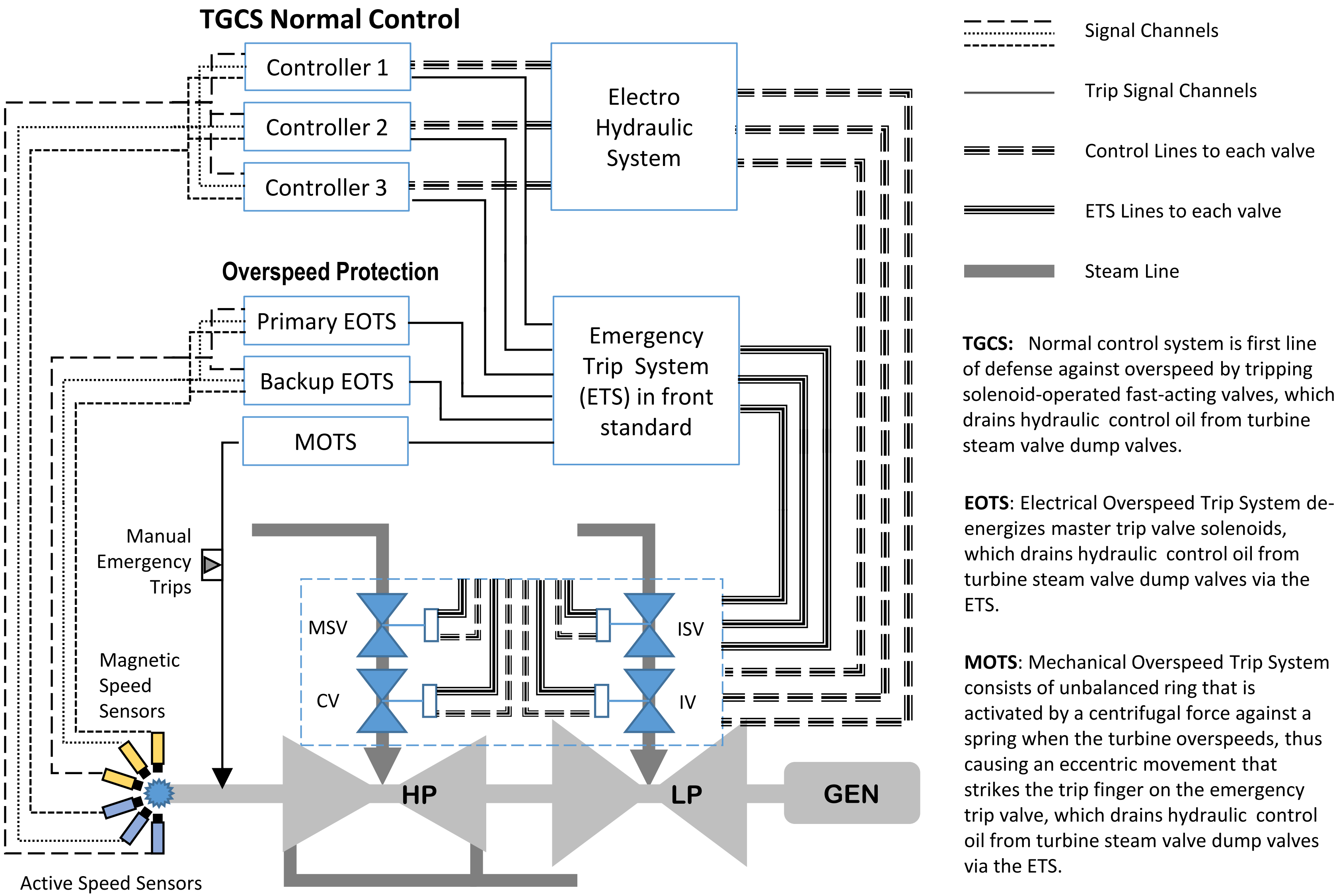
10.2 Turbine Generator – Approach

- **Turbine generator (T/G) does not perform any safety-related function**
- **Selection of a specific design by COL applicant**
  - Facilitates selecting optimum design for safety and reliability, considering latest regulatory and industry guidance and experience
  - Allows for competitive procurement
- **COL items ensure T/G system satisfactorily meets requirements**
  - COL items provide direction
- **Satisfactory T/G control system (TGCS), overspeed protection, turbine rotors, inspections, and supporting analyses specified in DCD as :**
  - Functional requirements and principles
  - Overarching architecture
  - Compliance with the extant regulatory guidance

10.2 Turbine Generator Valves

- **High pressure turbine has redundant in-series isolation valves**
  - Main stop valves (MSVs)
  - Control valves (CVs)
- **Low pressure turbines have redundant series isolation valves**
  - Intermediate stop valves (ISVs)
  - Intercept valves (IVs)
- **All valves shut by spring force when hydraulic control oil pressure relieved**
  - 0.3 second closure time required
- **Non-return valves prevent reverse flow from extraction piping and shut by spring force when air pressure relieved**
  - 1.0 second closure time required

10.2 TGCS & Overspeed Protection Schematic



TGCS: Normal control system is first line of defense against overspeed by tripping solenoid-operated fast-acting valves, which drains hydraulic control oil from turbine steam valve dump valves.

EOTS: Electrical Overspeed Trip System de-energizes master trip valve solenoids, which drains hydraulic control oil from turbine steam valve dump valves via the ETS.

MOTS: Mechanical Overspeed Trip System consists of unbalanced ring that is activated by a centrifugal force against a spring when the turbine overspeeds, thus causing an eccentric movement that strikes the trip finger on the emergency trip valve, which drains hydraulic control oil from turbine steam valve dump valves via the ETS.

10.2 T/G Control & Normal Overspeed Protection

- **Control**
  - Automatic control of speed & acceleration
  - Automatic control of load & loading rate
  - Semi-automatic control of speed
  - Preset load limits based on operating conditions
  - Monitoring
  - Testing of valves and controls
- **Overspeed protection**
  - Valves are fully closed at 103% of rated speed
  - Uses three active speed sensors
  - Applies two of three voting in three control processors
    - Failure of two inputs causes trip

10.2 TG Overspeed Protection

Emergency trip system (ETS) has redundant, diverse means of T/G trip

- **Mechanical Overspeed Trip System (MOTS)**
  - Trips at ~110% full speed
  - Rotational acceleration actuates trip linkages
  - Emergency manual trip from front standard & control room
    - De-energizes solenoid to drain hydraulic control oil
- **Electrical Overspeed Trip System (EOTS)**
  - Trips at ~111.5% full speed by de-energizing master trip solenoids
  - Uses 3 passive magnetic sensors
  - Either of 2 speed calculating modules trip on 2 of 3 sensors
    - Primary module uses software logic
    - Backup module is independent and uses firmware

10.2 Control & Overspeed Protection Setpoints

Device	Function	Set point (% rated speed)
TGCS	Control of CVs	100
TGCS	MSVs, CVs, ISVs, and IVs close	103
MOTS	Trip ETS	110
EOTS	Trip ETS	111.5

Maximum expected overspeed is ~115% of rated speed.

10.2 Hydraulic Control Oil

- **Draining oil (relieving pressure) allows springs to shut turbine valves**
- **Failure of piping between trip block and valve actuators trips turbines**
- **Drain headers**
  - Sized to handle maximum hydraulic control oil flow requirements, maintaining required valve stroke times
  - In series valves (e.g., ISVs and IVs) drain to separate stainless steel headers then to common drain line and reservoir
- **Hydraulic fluid in TGCS and ETS is separate from lube oil to minimize potential for contamination**
- **Non-return valves held open by instrument air but close as non-actuated swing check valve**

10.2 Overspeed Protection Design Principles

- **Diversity**
  - MOTS mechanical vs. EOTS & TGCS electrical
  - EOTS & TGCS use different technology speed inputs
- **Separation**
  - ETS valves in front standard
  - EOTS & TGCS trips in different cabinets with own UPS
  - Hydraulic control headers from series steam valves
- **Redundancy**
  - Series valves in each steam inlet supply line
  - 2 out of 3 sensors trip TGCS
  - 2 out of 3 sensors trip EOTS
  - 3 different automatic trips plus manual

10.2 Overspeed Protection Design Principles

- **Independence**
  - TGCS, MOTS, EOTS sensors different
  - Failure of one overspeed trip system will not affect others
  - Failure of one valve to close will not affect others
- **Single Failure Criterion**
  - No single failure will cause turbine overspeed
  - No single failure will prevent overspeed trip

10.2 Overspeed Protection Design Principles

- **Fail Safe**
  - Loss of power causes turbine trip
  - Failed speed sensor removed from logic but 2 failed sensors initiate trip
- **Testability during operation**
  - Provisions to test any MSV, CV, IV, or ISV
  - Overspeed sensors, controllers, and trips fully testable
  - MOTS not testable during operation to maintain simplicity

10.2 Turbine Missile Probability Analysis

- **Performed on selected design**
  - Use as-built material properties
  - Evaluate actual TGCS and ETS design
- **Orientation is favorable but applying a $1x10^{-5}$ per year criterion**
- **Establishes**
  - **Acceptability of overspeed protection**
  - **Inservice testing & inspections (what and how often)**

10.2 T/G COL Information

- **10.2(1) – Identify turbine vendor and model**
- **10.2(2) – Identify how functional requirements of DCD 10.2 are met and provide detailed schematics**
- **10.2(3) – Describe how turbine missile probability analysis conforms with DCD Section 10.2.3.6**
- **10.2(4) – Specify turbine rotor material properties**
  - Identify any deviation from extant SRP 10.2.3

(Open Item) 10.02-1 – Diversity/Redundancy/Independence

➢ **Open Item (RAI No. 8050, Question 10.02-02), Date issued (7/27/2015); KHNP responded (10/27/2015)**

- **Description of Issue**: Provide information on how overspeed trips are performed, and what components & subsystems are used in implementing these overspeed trip systems. In addition, describe how turbine steam inlet valves and associated hydraulic fluid systems and solenoid valves function in tripping the turbine.
- **Resolution:** As discussed in the preceding slides, in lieu of turbine design being specified, functional requirements for the T/G system and its overspeed protection are identified. The draft SER notes COL item 10.2(2) specifies that such details be provided once a T/G design is selected. To address the staff's concern for more detail without an actual TG design available, additional information is being included such as the generic schematic shown earlier and discussion of diversity, redundancy, independence, etc. Examples of the functional requirements are:

Redundant, in-series turbine steam valves are on each line admitting steam to high and low pressure turbines. Closure of turbine steam valves is accomplished by draining hydraulic control oil holding dump valves closed, allowing springs to shut each steam valve. Electrical Overspeed Trip signals are processed by both a primary and backup unit to determine trip validity based on 2 of 3 voting. Either unit opens contacts to de-energize both solenoids of the master trip valve, which repositions due to spring force, draining control oil, which also allows a spring to reposition the relay trip valve, which drains hydraulic control oil from the separate CV/IV header.

(Open Item) 10.02-2 – Fail Safe / Single Failure

- **Open Item (RAI No. 8050, Question 10.02-04), Date issued (7/27/2015); KHNP responded (10/27/2015)**
  - **Description of Issue**: Provide adequate details of the turbine trip-block and its configuration. If the design used a single trip block, provide information on single failure criteria for turbine overspeed, and justification on how it satisfied requirements for redundancy and diversity.
  - **Resolution:** To address the staff's concern for more detail without an actual TG design available, additional information is being included such as discussion of required diversity, redundancy, etc. An example is given below:

Independence – A failure of one of the overspeed protection systems will not propagate to the others because they are electrically isolated and physically separated. Failure of the hydraulic piping between the trip block and the valve actuator, or between the hydraulic fluid tank and the valve actuator will cause a loss of fluid pressure, which closes the turbine steam valves.

Redundancy – i. Each turbine steam inlet line has two valves (e.g., MSV and CV for high pressure turbine), closure of any one in each pair isolates that line. ii. Failure of any one component in overspeed protection systems will not prevent a turbine trip.

Single failure criterion – single failures are addressed through redundancy and independence, but additionally: i. No single failure will cause a turbine to overspeed.

(Open Item) 10.02-3 – Common Cause / Mode Failure

- **Open Item (RAI No. 8050, Question 10.02-05), issued (7/27/2015); KHNP responded (10/27/2015)**
  - **Description of Issue**: Address electrical and fluid flow paths, shared components, failure modes, and CCF vulnerabilities and also provide a description on reliable operation of hydraulic/air systems as associated with preventing turbine overspeed conditions. Clearly indicate what parts are shared. For clarity, the response should include schematic diagrams that show the control fluid flow paths, piping and valves being actuated (i.e., turbine stop, control, reheat stop, intercept, and extraction non-return valves).
  - **Resolution:** As noted in response to the last two Open Items, more detail is being added to the functional requirements to address requirements for diversity, redundancy, etc. Other examples are:

Diversity – i. In conjunction with normal control and electrical overspeed trips, the purely mechanical overspeed trip does not depend on electric power (power is required to keep the mechanical trip solenoid valve energized to prevent manual trip). ii. TGCS & EOTS use diverse speed inputs, determine trip validity using different technology, have different set points, and actuate to drain control oil, to eliminate common cause failures from rendering trip functions inoperable. MOTS senses speed via physical repositioning of a weight, rather than sensing rotation rate.

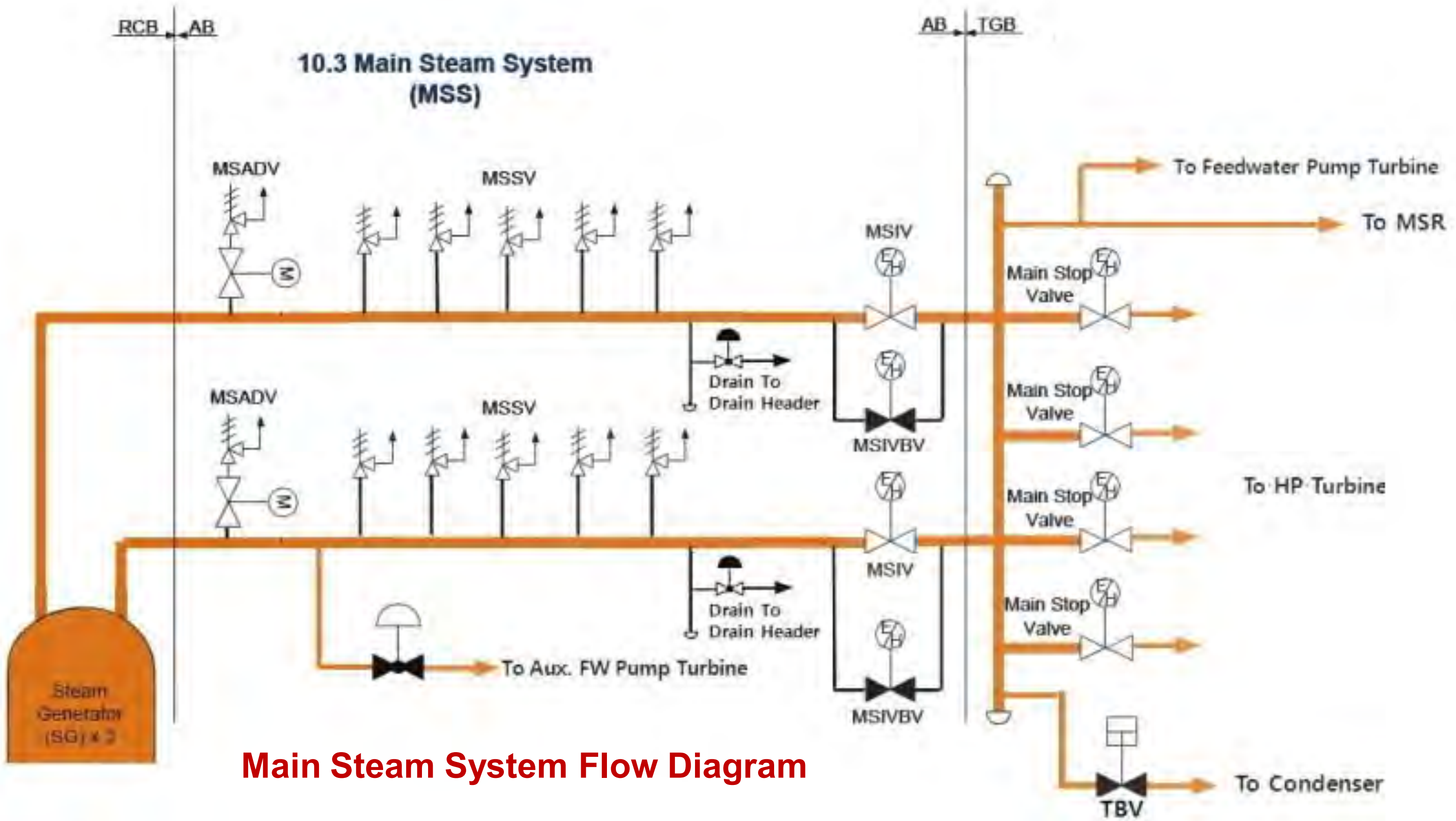
Separation – Hydraulic control oil drain headers for MSVs and CVs and for ISVs and IVs are separate and separated on opposite sides of the turbines.

(Open Item) 10.02-4 – Manual Turbine Trip

- **Open Item (RAI No. 8050, Question 10.02-03), Date issued (7/27/2015); KHNP responded (10/27/2015)**
  - **Description of Issue**: Provide detailed information regarding a manual control and/or manual turbine trip system for the APR1400 T/G system. Include any hard wiring from the main control room (MCR) to the T/G unit, including a push button at the turbine pedestal.
  - **Resolution:** Although the detailed wiring diagram will not be available until the COL applicant selects a T/G design, the DCD contains the following information:
    - ✓ Emergency manual trip activation at the turbine front standard and from the MCR by de-energizing a solenoid that moves the trip linkages.
    - ✓ The manual emergency trip shall be designed such that no single failure (e.g., push button) will prevent a manual trip and that failure of the ETS to initiate an automatic trip does not prevent a successful manual trip. The physical implementation (e.g., hard wiring) shall be included in the schematic required by COL item 10.2(2). Hydraulic control oil drain headers for MSVs and CVs and for ISVs and IVs are separate and separated on opposite sides of the turbines.

10.3 Main Steam System

- The MSS extends from the SG nozzles up to the turbine stop valves and consists of safety-related valves and branch piping.
- Major components of the MSS are as follows:



Main Steam System Flow Diagram

10.3 Main Steam System

- **The Main Steam System is designed to :**
  - Deliver steam from the SGs to the turbine-generator.
  - Dissipate heat when the main condenser is not available.
  - Provide steam to the feedwater pump turbines, auxiliary feedwater pump turbines, the second-stage reheater of the MSR, turbine steam seal system, and auxiliary steam system.
  - Provide adequate overpressure protection for the SGs and the MSS.
- **The Main Steam System is designed as following :**
  - The MSS piping in safety-related portion are designed in accordance with the requirements of ASME Section III, Class 2 and 3. The remaining steam piping is in accordance with ANSI/ASME-B31.1.
  - FAC-resistant materials are used for the FAC-susceptible piping.
  - The additional pipe thickness is applied for the carbon steel piping in consideration of the 40 years of design life.

10.3 Main Steam System

- **10.3 Main Steam System - Open Items (1/3)**
  - **Open Item 10.3-1 (RAI No. 8570, Question 10.03-5), Date issued (4/19/16); KHNP responded (6/23/16)**
    - **Description of Issue** : Provide a tabulation and descriptive text of all flowpaths that branch off the main steamlines between the MSIVs and turbine stop valves as specified by SRP 10.3, Section III.5.E.
    - **Resolution :** Provided the new table including information required in SRP 10.3, Section III.5.E.

10.3 Main Steam System

- **10.3 Main Steam System - Open Items (2/3)**
  - **Open Item 10.3-2 (RAI No. 8570, Question 10.03-4), Date issued (4/19/16); KHNP responded (6/29/16)**
    - **Description of Issue** : Provide how, with seismic category II classification, this section of piping can perform its safety-related function of discharging steam to the atmosphere during a seismic event.
    - **Resolution :** Described the validity of performing safety-related function of discharging steam to the atmosphere with seismic category II during a seismic event. Also, demonstrated the ability of the MSVH structures to adequately handle the discharged steam from MSADVs and MSSVs during the accident.

10.3 Main Steam System

- **10.3 Main Steam System - Open Items (3/3)**
  - **Open Item 10.3-3 (RAI No. 8575, Question 10.03-6), Date issued (4/19/16); KHNP responded (6/1/16)**
    - **Description of Issue** : List the items to be incorporated into operating and maintenance procedures consistent with NUREG-0927.
    - **Resolution :** Included the items to be incorporated into operating and maintenance procedures necessary to address water(steam) hammer specified in NUREG-0927 in DCD.

10.3 Key Review Item (FAC)

- **10.3.6 Steam and Feedwater System Materials – Open Items (1/5)**
  - **Open Item 10.3.6-1 (RAI No. 8649, Question 10.03.06-24, Date issued (05/24/16); KHNP responded (09/29/16)**
    - **Description of Issue** : The applicant references ASME Code, Section XI, but does not integrate the terms and conditions specified in 10 CFR 50.55a(b)(5) regarding RG 1.147 and conditions on the use of ASME Code Cases.
    - **Resolution :** The following sentence will be added to the end of COL item 10.3(3).

      "The program shall incorporate the conditions of 10 CFR 50.55a(b)(5) on ASME Code Case N-597-2".

10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (2/5)**
  - **Open Item 10.3.6-2 (RAI No. 8649, Question 10.03.06-25, Date issued (05/24/16); KHNP responded (09/29/16)**
    - **Description of Issue** : Item COL 10.3(3) describes the implementation a FAC monitoring program. As written the COL item reduces the scope of the FAC program to systems which are predicted to be susceptible to FAC. The EPRI NSAC-202L program requires that all systems are added into the FAC program and allows lines to be excluded from inspections based upon certain criteria; COL item 10.3(3) prescreens systems from the NASC-202L program.
    - **Resolution :** The COL item 10.3(3) will be revised.

      "The COL applicant is to provide a description of the FAC monitoring program. The description is to address consistency with GL 89-08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program".

10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (3/5)**
  - **Open Item 10.3.6-3 (RAI No. 8649, Question 10.03.06-26, Date issued (07/26/16); KHNP responded (09/29/16)**
    - **Description of Issue** : The staff noted a configuration of: chrome-molybdenum steel to carbon steel to chrome-molybdenum steel in the downcomer line. This configruation is more susceptible to FAC as discussed in NSAC-202L Revision 3.
    - **Resolution :**

a. In OPR1000 design, chrome-moly steel is utilized between MFCV and MSVH line which contains sharp bending portions susceptible to FAC as shown in Figure 1. In the APR1400 design, carbon steel is utilized between MFCV and MSVH line which does not have sharp bending portions as shown in Figure 2. The 3D piping layout is presented in Figure 3 in line of between MFCV and MSVH comparing OPR1000 and APR1400 design.

10.3 Key Review Item (Open Item)

Figure 1

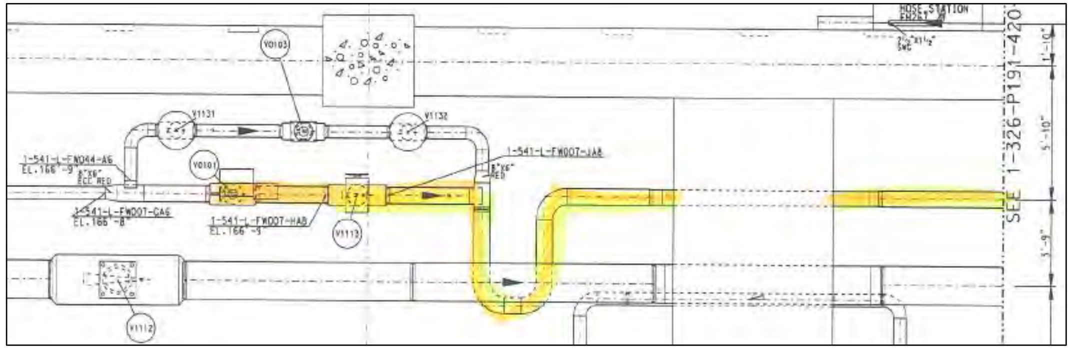


Figure 2

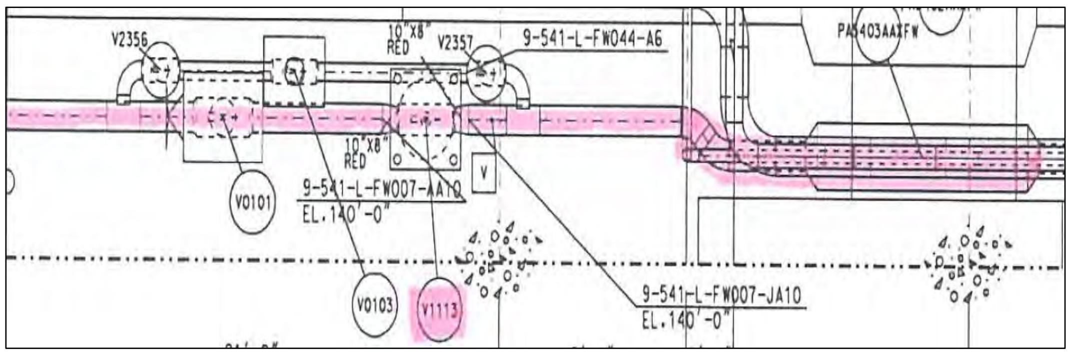
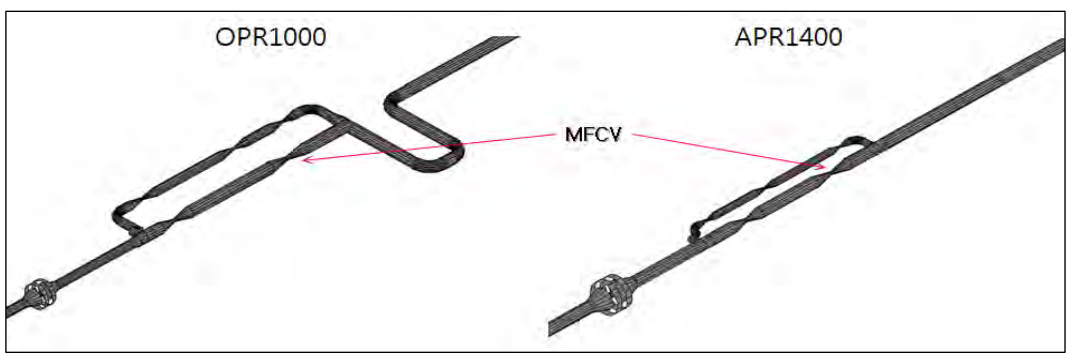
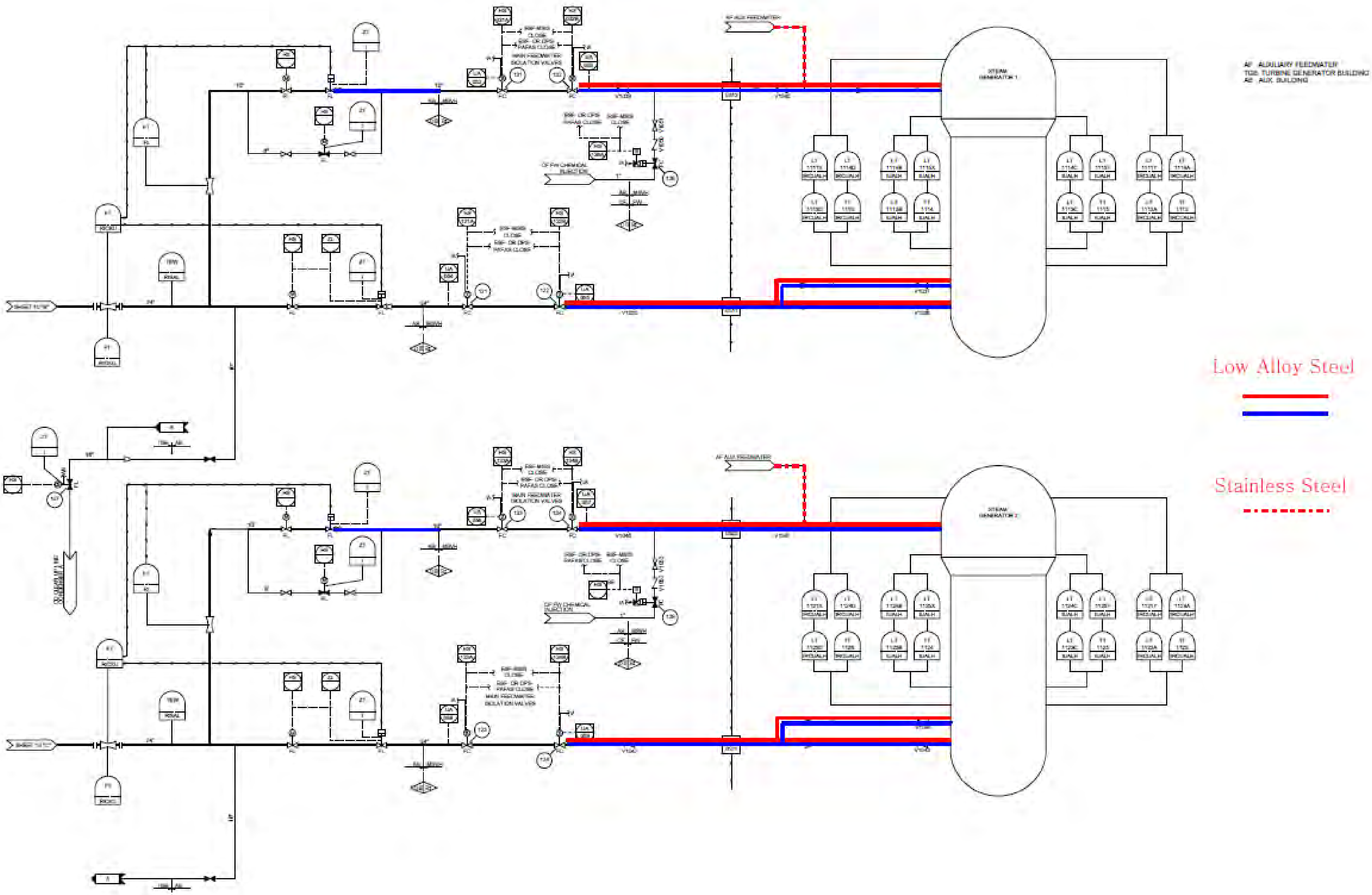


Figure 3



10.3 Key Review Item (Open Item)

Material comparison between OPR1000 & APR1400



10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (3/5)**

  - **Open Item 10,3,6-3 (RAI No. 8649, Question 10.03.06-26, Date issued (07/26/16); KHNP responded (09/29/16) - Continued**

    - **Resolution :**

      b. The carbon steel portions of the downcommer feedwater line between the chrome-moly steel portions are not subject to augmented in-service inspection (ISI). ISI is performed to evaluate weld degradation on the area of weld.

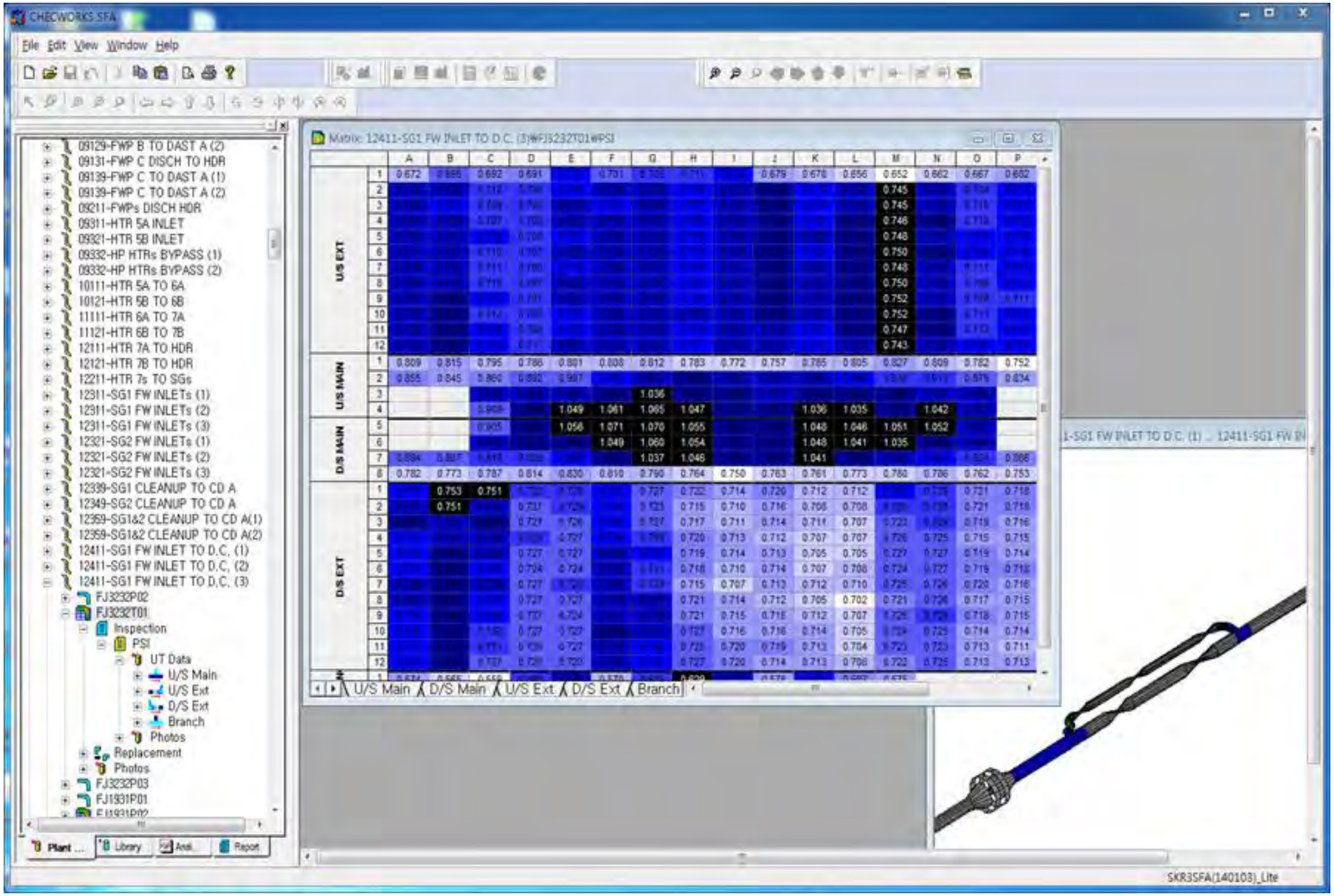
      UT thickness inspection is performed to evaluate component wear beyond the toe of the weld. Initial wall thickness is taken in components placed downstream of the MFCV and will be inspected periodically during plant operation. Figure 4 shows the UT inspection data implanted to CHECWORKS which has been taken prior to the pre-operation.

NON-PROPRIETARY

10.3 Key Review Item (Open Item)

Pre-service Measured Thickness for FAC Management

Figure 4



10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (4/5)**
  - **Open Item 10.3.6-4 (RAI No. 8649, Question 10.03.06-27, Date issued (07/26/16); KHNP responded (09/29/16)**
    - **Description of Issue** : Requests further information on why the economizer line did not require a FAC resistant material considering that the flow is similar to the downcomer line.
    - **Resolution :** The answer can be referred to the Question 10.03.06-26.

      Both the downcomer and economizer lines are installed with carbon steel. Accordingly, the FAC susceptibility comparison is not necessary between the two lines.

      In addition, the FAC susceptible portions are periodically inspected based on a long term inspection plan between the economizer and the downcomer feedwater line.

10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (5/5)**

  - **Open Item 10.3.6-5 (RAI No. 8671, Question 10.03.06-28, Date issued (08/12/16); KHNP responded (09/29/16)**

    - **Description of Issue**:

      1) If the removal of fittings, valves, and flanges from Tables 10.3.2-2, 10.3.2-3 and 10.3.2-4 is intended, provide a justification for the removal of these components from the tables and, as necessary, identify where the materials of construction for these components will be documented in the FSAR.

    - **Resolution**: FAC inspections are normally carried out using UT thickness measurements. For castings of valves and flanges it is often quite difficult to quantify wear as surfaces are non-parallel and thus UT thickness measurements are not used in this case.

      Visual inspections are more commonly used if wear is localized on valves and flanges. Therefore, material and size for valves and flanges have been excluded in Table 10.3.2-2, 10.3.2-3, and 10.3.2-4. The vendor design portions has been also excluded in Table 10.3.2-2, 10.3.2-3, and 10.3.2-4, which are irrelevant to FSAR 10.3.6.

10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (5/5)**
  - **Open Item 10.3.6-5 (RAI No. 8671, Question 10.03.06-28, Date issued (08/12/16); KHNP responded (09/29/16) - Continued**
    - **Description of Issue**:

      2) Provide an explanation for the proposed changes in pipe sizes documented in applicant's RAI 314-8378 response dated January 11, 2016.

      If the changes were intentional, identify other parts of the DCD, including P&IDs, transient analyses, and other impacted sections of the FSAR, which require corresponding changes and provide proposed corresponding changes. If the changes were not intentional, revise Tables 10.3.2-3 and 10.3.2-4 with the correct information (which may be to restore the information which was originally included in the tables).

10.3 Key Review Item (Open Item)

- **10.3.6 Steam and Feedwater System Materials – Open Items (5/5)**
  - **Open Item 10.3.6-5 (RAI No. 8671, Question 10.03.06-28, Date issued (08/12/16); KHNP responded (09/29/16) – Continued**

    - **Resolution**: Table 10.3.2-2, Table 10.3.2-3, and Table 10.3.2-4 have been reviewed with consideration to the changes. Indeed, there is no impact on to the other documents.
      - ✓ There was some confusion in the response to RAI 314-8378 dated January 11, 2016. Thus, Table 10.3.2.3 and Table 10.3.2.4 (1 of 2) have been revised.
      - ✓ Table 10.3.2-4 (1 of 2) will be revised. 26 inches and 30 inches will be added.

10.3 Key Review Item (Open Item)

RAI 514-8671 - Question 10.03.06-28

Attachment (3/3)

RAI 314-8378_Question 10.03.06-3

RAI 452-8545_Question 10.03.06-20

RAI 514-8671_Question 10.03.06-28

C

Table 10.3.2-4 (1 of 2)

Feedwater Piping Design Data

Segment	Material Specification	NPS	DN	Outside Diameter (in)	Remark	ASME Class
Feedwater pump to feedwater pump discharge header	A-106 Gr.B (seamless)	24	600	24.000	-	B31.1
Feedwater pump discharge header	A-672 Gr.B60 (welded)	30	750	30.000	-	B31.1
Feedwater pump discharge header to Feedwater heaters 5/6/7	A-672 Gr.B60 (welded)	26 32	650 800	26.000 32.000	-	B31.1
Feedwater heaters 7 to Feedwater heaters 7 outlet header	A-672 Gr.B60 (welded)	26	650	26.000	-	B31.1
Feedwater heaters 7 outlet header	A-672 Gr.B60 (welded)	32	800	32.000	-	B31.1
Fittings	A-234 WPB A-234 WPC	24 32	600 800	24.000 32.000	-	B31.1
Feedwater heaters 7 outlet header to **MSVH**	A-106 Gr.B (seamless, welded)	10 24	250 600	10.750 24.000	-	B31.1
Fittings	A-234 WPB	10 24	250 600	10.750 24.000		B31.1

Replace with "A"

"A"

24	600	24.000
26	650	26.000
30	750	30.000
34	800	32.000

ACRS Meeting (Oct. 4 . 2016)

10.4 Other Features

- **10.4.8 Steam Generator Blowdown System**
  - Performs no safety-related function except the containment isolation capability and steam generator shell side pressure boundary.
  - Assists in maintaining the chemical characteristics of the secondary side water within permissible limits during normal operation and Anticipated Operational Occurrences(AOOs) such as a main condenser tube leak or SG primary-to-secondary tube leakage.
  - Consists of two subsystems, the Blowdown Subsystem(BDS) and Wet Lay-up Subsystem(WLS).

10.4 Other Features

- **10.4.8 Steam Generator Blowdown System (cont.)**
  - The BDS removes impurities concentrated in SGs by Continuous Blowdown (CBD) and periodical High-Capacity Blowdown(HCBD).
  - In addition, an Emergency Blowdown(EBD) can be operated to reduce the SG water level during a Multiple Steam Generator Tube Rupture(MSGTR) event.
  - The WLS maintains the steam generator water chemistry within the specified ranges during shutdown operation.

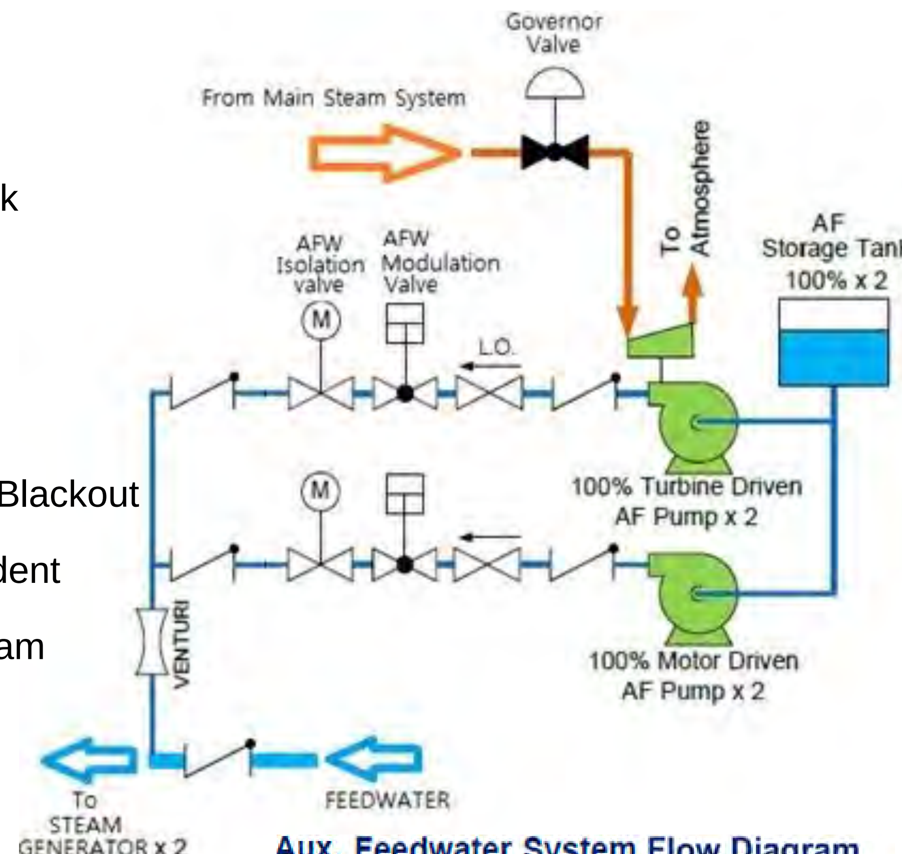
10.4 Other Features

- **10.4.8 Steam Generator Blowdown System – Open Item (1/1)**
  - **Open Item 10.4.8-1 (RAI No. 8596, Question 10.04.08-6), Date issued (5/4/16); KHNP responded (8/8/16)**
    - **Description of Issue** : Address the missing actuation signals (High Radiation Actuation Signal(HRAS) and Blowdown Flash Tank High-High Level Actuation Signal (BFTHHLAS) in DCD Figure 2.7.1.8-1 and to provide additional detail in DCD chapter 7 for consistency and clarity.
    - **Resolution :** Indicated the actuation signals (HRAS and BFTHHLAS) in DCD Figure 2.7.1.8-1 and provided the detailed description in DCD chapter 7 subsection 7.3.1.9.

10.4 Other Features

● 10.4.9 Auxiliary Feedwater System

- Provides the auxiliary feedwater to the intact SG(s) until the shutdown cooling system entry condition when the main feedwater system is inoperable for the following events:
  - Loss of normal feedwater
  - Main Steam / Feedwater Line Break
  - Steam Generator Tube Rupture
  - Transient conditions or postulated accidents such as reactor trip
  - Any incident that results in Station Blackout
  - Small-Break Loss-Of-Coolant Accident
  - Anticipated Transients Without Scram



Aux. Feedwater System Flow Diagram

10.4 Other Features

- **10.4.9 Auxiliary Feedwater System (cont.)**
  - The Auxiliary Feedwater System(AFWS) and supporting systems are designed to provide the required flow to the SG(s) with a Loss Of Offsite Power(LOOP) event, assuming a single active failure.
  - The AFWS components are located in the auxiliary building, which is designed as seismic Category I.
  - All mechanical components and piping up to the AFW isolation valves are safety Class 3 and designed to ASME Section III requirements.
  - All components and piping from and including the containment isolation valves to the SGs are safety Class 2 and designed to ASME Section III requirements.

10.4 Other Features

- **10.4.9 Auxiliary Feedwater System (cont.)**
  - The safety-related portions of the AFWS are appropriately protected against the possible effects of postulated high- or moderate-energy pipe failure including pipe whip or jet impingement.
  - A failure of a non-essential equipment or component does not affect the AFWS safety functions.

10.4 Other Features

- **10.4.9 Auxiliary Feedwater System – Open Item (1/1)**
  - **Open Item 10.4.9-1 (RAI No. 8664, Question 10.4.9-7, Date issued (No information);**

    KHNP responded (After receipt of RAI)

    - **Description of Issue** : Provide the description of the AFWS reliability analysis to be performed in accordance with TMI action item II.E.1.1 of NUREG-0737.
    - **Resolution :** The results of AFWS reliability analysis have already been provided in the response of RAI 86-8003. The description of the performed AFWS reliability analysis will be made available to the staff.

10.4 Other Features

- **10.4.10 Auxiliary Steam System – Open Items (1/2)**

  - **Open Item 10.4.10-1 (RAI No. 8556, Question 10.4.10-1, Date issued (04/28/16);**

    KHNP responded (06/16/16)

    - **Description of Issue** : State clearly which option they chose to meet 10 CFR 20.1406 regarding embedded and buried piping
    - **Resolution :** Piping embedment and buried piping in the yard shall be minimized to the extent practicable by using concrete tunnels. Where embedded and buried piping cannot be avoided, consideration shall be given to minimize embedded piping lengths and to utilize double-walled piping with leak detection capabilities on the outer piping.

    The response to RAI will be revised as shown above.

10.4 Other Features

- **10.4.10 Auxiliary Steam System – Open Items (2/2)**

  - **Open Item 10.4.10-2 (RAI No. 8556, Question 10.4.10-2, Date issued (04/28/16);**

    KHNP responded (06/16/16)

    - **Description of Issue** : Requests the applicant to clarify the actual seismic and quality group classifications of the auxiliary steam system components and piping within the reactor containment building. The applicant is requested to modify the DCD Figure 10.4.10-1 and Table 3.2-1 to clearly depict a consistent design

    - **Resolution :** Containment isolation valves and associated piping are seismic category I and quality group B. The piping and valves downstream of the containment isolation valve within the reactor containment building are non-safety related, seismic category II and quality group D.

10.4 Other Features

- **10.4.11 Combined License Information - Open Item (1/1)**
  - **Open Item 10.4-3 (RAI No. 246-8307, Question 09.02.08-3), Date issued (10/14/15); KHNP responded (06/29/16)**
    - **Description of Issue** : The staff noted inconsistencies among the Chapter 9 and Chapter 10 in providing operational procedures and maintenance programs to satisfy 10 CFR 20.1406. The staff for Chapter 11 and 12 has decided to take on this issue and asked the applicant to remove all COL items.
    - **Resolution :** KHNP had considered the removal of all COL items related to 10 CFR 20.1406 in Chapters 9 and 10. During a teleconference between KHNP and the NRC staff, it was agreed upon to keep the current COL items as is. The resolution to this issue was submitted in the revised response to RAI No. 246-8307, Question 09.02.08-3.

Summary

- Chapter 10 provides information concerning the plant steam and power conversion system.
- The turbine generator control system (TGCS), overspeed protection, turbine rotors, inspections, and supporting analyses specified in the DCD as functional requirements, principles and overarching architecture are compliant with the latest and extent regulatory guidance and industry experience.
- The steam and power conversion system removes energy from the RCS via the steam generators and converts it to electric power in the turbine-generator.
- It provides safety-related heat removal via the auxiliary feedwater system and the main steam atmospheric dump.

ACRONYMS

- CW – Circulating Water
- CDI – Conceptual Design Information
- CV – Control Valve
- EOTS – Electrical Overspeed Trip System
- ETS – Emergency Trip System
- FAC – Flow Accelerated Corrosion
- FATT – Fracture Appearance Transition Temperature
- ISV – Intermediate Stop Valve
- IV – Intercept Valve
- MOTS – Mechanical Overspeed Trip System
- MSADV – Main Steam Atmospheric Dump Valve
- MSIV – Main Steam Isolation Valve
- MSIVBV – Main Steam Isolation Valve Bypass Valve
- MSR – Moisture Separator Reheater
- MSSV – Main Steam Safety Valve
- MSV – Main Stop Valve
- MSVH – Main Steam Valve House
- POSRV – Pilot Operated Safety Relief Valve
- PTP – Point To Point
- RCS – Reactor Coolant System
- SSC – Structure, System or Component
- TGCS – Turbine Generator Control System
- WTM – Wall Thinning Management

U.S.NRC

United States Nuclear Regulatory Commission

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 Open Items: Chapter 10

STEAM AND POWER CONVERSION SYSTEM

OCTOBER 4, 2016

- **Technical Staff Presenters**
  - Angelo Stubbs – DCD Sections 10.2, 10.4.9 &10.4.10
  - Ryan Nolan – DCD Section 10.3
  - Andrew Yeshnik – DCD Section 10.3.6
  - Greg Makar – DCD Section 10.4.8
- **Project Managers**
  - Jeff Ciocco – Lead Project Manager
  - George Wunder – Chapter 10 Project Manager

Staff Review Team

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Angelo Stubbs**
  Plant Systems Branch
- **Ryan Nolan**
  Plant Systems Branch
- **Dennis Andrukat**
  Plant Systems Branch
- **Bob Vettori**
  Plant Systems Branch
- **Greg Makar**
  Materials and Chemical Engineering Branch
- **Andrew Yeshnik**
  Materials and Chemical Engineering Branch
- **John Honcharik**
  Materials and Chemical Engineering Branch
- **Eduardo Sastre-Fuente**
  Materials and Chemical Engineering Branch
- **Deanna Zhang**
  Instrumentation and Controls Branch
- **Kenneth Mott**
  Instrumentation and Controls Branch

United States Nuclear Regulatory Commission
Protecting People and the Environment

Technical Topics

- Turbine Generator Control and Overspeed Protection

  - Three Independent Systems Used
    - Turbine generator control system
    - Mechanical overspeed trip system
    - Electrical overspeed trip system

  - Proposed use of a combination of mechanical and electrical overspeed protection systems provide diverse and redundant turbine generator overspeed protection.

  - COL Item 10.2(2) states the COL applicant is to identify how the functional requirements of the overspeed protection system are met and provide a schematic of the turbine generator control system from sensors through valve actuators.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Items

- **RAI 8050, Question 10.02-2** – Requested that the applicant describe how the overspeed protection system conforms to SRP guidance with respect to satisfying the single-failure criteria and relevant redundancy and independency considerations. Information requested included electrical schematics and logic diagrams of the T/G control and overspeed protection system and detailed functional performance description of the control fluid systems in conjunction with schematics.
  - **Status :** In response to question 10.02-2, the applicant indicated that the requested information would be provided by the COL applicant when they address COL Item 10.2(2). The staff found the information in the DCD was insufficient to support statements in the DCD regarding functional design capabilities. The staff held public meetings with KHNP on turbine overspeed control. In response to the staff's concerns about information available on the turbine generator overspeed system design and operation, the applicant has made new information available in the electronic reading room (ERR). Such additional information includes a schematic drawing of the overspeed protection system architecture to be used and discussions on how diversity, redundancy, and independence, is to be included in the T/G control and overspeed protection system design. The staff is awaiting formal submittal of the information, after which the staff will complete its evaluation.

Technical Topics

Section 10.2 – Turbine Generator

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Items

- **RAI 8050, Question 10.02-3** – Requested that the applicant provide detailed information on a manual control and/or manual trip system for the APR1400 T/G system.
  - **Status:** In response to question 10.02-3, the applicant has provided additional information on the manual control and manual trip system. A revision to COL Item 10.2(2) will be made identifying specific functional design requirements and the inclusion of schematic in COL applications. The staff is awaiting formal submittal of the information, after which the staff will complete its evaluation.
- **RAI 8050, Question 10.02-4** – Requested that the applicant provide adequate information on turbine trip-block and its configuration.
  - **Status**: In response to question 10.02-4, the applicant has provided additional information on the functional requirements identified to address turbine trip-block. The staff is awaiting formal submittal of the information, after which the staff will complete its evaluation.
- **RAI 8050, Question 10.02-5** – Requested that the applicant address the details of the air/hydraulic systems as they relate to turbine overspeed systems.
  - **Status**: In response to question 10.02-5, the applicant has provided additional information on the functional requirements identified to address diversity and redundancy design. The staff is awaiting formal submittal of the information, after which the staff will complete its evaluation.

Technical Topics
Section 10.3 – Main Steam System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Items

- **RAI 8570, Question 10.03-4** – Requested the applicant to explain how the discharge piping of the MSADVs and MSSVs can perform their safety-related function of discharging steam to the atmosphere during a seismic event when its seismic classification is only seismic Category II.
  - **Status:** The response was received on 6/29/2016. The staff is still evaluating the response and whether seismic Category II is the appropriate classification for this section of piping because, by definition, seismic Category II is not safety-related.
- **RAI 8570, Question 10.03-5** – Requested the applicant for a description of all flowpaths that branch off the main steamline between the MSIVs and TSVs as specified in SRP 10.3, Section III.5.E.
  - **Status:** The response was received on 6/23/16. The response is still under staff evaluation.
- **RAI 8575, Question 10.03-6** – Requested the applicant to revise the DCD to include items to be incorporated into procedures necessary to address precautions associated with potential water/steam hammer consistent with NUREG-0927.
  - **Status:** The response was received on 6/1/2016. The response was found acceptable because the DCD will be revised to include elements to be incorporated into procedures to prevent water/steam hammer. This question is considered closed/resolved.

Technical Topics
Section 10.3.6 – Steam and Feedwater System Materials

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Item

- **RAI 8649 Question 10.03.06-24, DCD Supplement** - The FAC program for the APR1400 uses ASME Code Case N-597-2. Code Case N-597-2 is conditionally approved by the staff in RG 1.147 Rev 17. The staff requests that COL item COL 10.3(3) be revised to add a statement requiring compliance with the staff conditions.
  - **Status:** The applicant has submitted a RAI response which the staff finds acceptable. This item will be closed pending a DCD update.

- **RAI 8649 Question 10.03.06-25, DCD Revision:** COL Item COL 10.3(3) inappropriately narrows the scope of the FAC program by prescreening systems out of the FAC program.
  - **Status:** The applicant has submitted a RAI response that requires all feedwater and steam system lines will be included in the FAC program. This item will be closed pending a DCD update.

- **RAI 8649 Question 10.03.06-26** – The carbon steel main steam valve housing in the downcommer line may be more susceptible to FAC than other carbon steel portions of the feedwater system. The staff has requested a discussion on how the main steam valve housing is designed to accommodate the FAC conditions.
  - **Status:** The question is currently waiting a response

Technical Topics
Section 10.3.6 – Steam and Feedwater System Materials

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Item

- **RAI 8649 Question 10.03.06-27** – The staff has requested a discussion on why the downcommer line uses austenitic stainless steel for FAC prevention but the economizer line does not.
    - **Status:** The question is currently waiting a response
- **RAI 8671 Question 10.03.06-28** – The applicant's response to RAI 8545 Question 10.03.06-20 was incomplete. The applicant has not provided a rationale for changes to the piping diameters or removal of fittings, valves, and flanges. The staff requested an explanation on the changes and how the changes impact the design of the plant and impact the applicant's evaluations.
    - **Status:** The question is currently waiting a response

Technical Topics
Section 10.4.8 – Steam Generator Blowdown System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Open Item

RAI 475-8596, Question 10.04.08-6 – The staff requested information about control signals that activate the containment isolation valves (CIVs) in the SGBS. (Follow-up to Question 10.04.08-1). This information is needed to determine if the design of the SGBS meets GDC 13 as it relates to monitoring system variables and isolating containment.

- Revise Tier 1 Figure 2.7.1.8-1 to identify two additional control signals that activate CIVs in the SGBS. The applicant had proposed adding these control signals to the corresponding Tier 1 table but not to the figure. The two signals are:
  - High Radiation Activation Signal (HRAS)
  - Blowdown Flash Tank High-High Level Actuation Signal (BFTHHLAS)
- Provide a description in DCD Chapter 7 of the specific signals that activate the CIVs rather than a general description of instrumentation and control signals.

Status: The applicant provided a response on August 8, 2016 with the information requested. However, based on discussion with the staff on September 27, 2016, the applicant is revising the response to make editorial corrections.

Technical Topics

Section 10.4.9 – Auxiliary Feedwater System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Technical Topics

- System Design
  - Two 100 percent capacity motor-driven pumps
  - Two 100 percent capacity turbine-driven pumps
  - Two 100 percent capacity Auxiliary Feedwater Storage Tanks.
  - Total safety-related water inventory 800,000 gallons

Open Items

- **RAI 8664, Question 10.04.09-7** – Requested that the applicant provide detailed description of the AFWS reliability analysis that was performed to support DCD Tier 2, Section 10.4.9.1.2 (Item O), and clarify how the information demonstrates compliance with the AFWS unavailability target.
  - **Status:** Working internally and with the applicant to resolve the issue.

U.S.NRC United States Nuclear Regulatory Commission *Protecting People and the Environment*

Open Items

- **RAI 8556, Question 10.4.10-2** – Requested the applicant to clarify the actual seismic and quality group classifications of the auxiliary steam system components and piping within the reactor containment building.
  - **Status:** The response was received on 6/16/2016. The response stated that the nonsafety-related piping and components within the reactor containment building will be classified as seismic category II and quality group D. A DCD mark-up was provided. Staff has reviewed and finds the response acceptable. This question is now considered a confirmatory item.
- **RAI 8556, Question 10.4.10-1** – Requested the applicant clarify inconsistencies in the DCD regarding how they meet 10 CFR 20.1406. Specifically, whether there is no buried piping or buried piping will be minimized.
  - **Status:** The response was received on 6/16/16. The response stated that the auxiliary steam system will be designed with minimum embedded or buried piping and yard piping will be routed in an underground concrete tunnel that is designed with leakage collection and detection to minimize unintended contamination. DCD mark-up was provided. Staff has reviewed and finds the response acceptable. This question is now considered a confirmatory item.

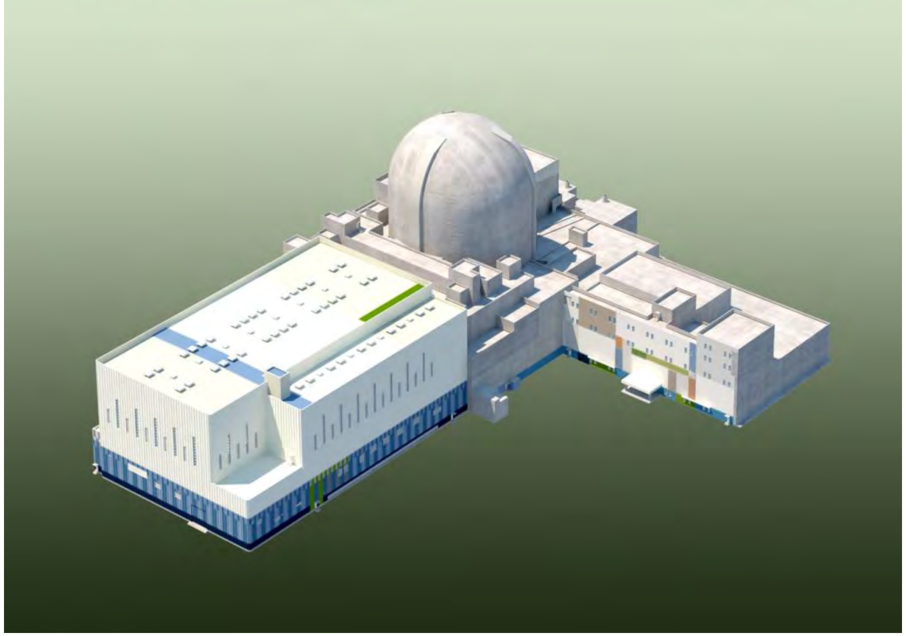
Technical Topics

Section 10.4.10 – Auxiliary Steam System

Open Items

- **OPEN ITEM 10.4-3** – Chapter 10 COL information items were inconsistent regarding operational procedures and maintenance programs with leak detection and contamination control requirements to satisfy 10 CFR 20.1406. In addition, the COL Information Item 10.4(1), as a standalone statement, does not identify which plant systems under DCD Tier 2, Section 10.4, are applicable.
    - **Status:** These COL Information Items address the programmatic aspects of 10 CFR 20.1406, which fall under the review scope of Chapters 11 and 12. NRC staff reviewers are working with Chapter 11 and 12 reviewers on this issue. Chapters 11 and 12 have been revised to ensure the proper programmatic aspects are covered for each affected plant system. However, the related COL Information Items in Chapter 10 were left unchanged. The staff is still evaluating what changes should be made to these Chapter 10 COL Information Items, if any. This question is considered open.

APR1400 DCA
Chapter 11: Radioactive Waste Management



KEPCO/KHNP
Oct. 4, 2016

Contents

Overview of Chapter 11

❑ List of Submitted Documents

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002 -P & NP	APR1400 Design Control Document Tier 2: Chapter 11 Radioactive Waste Management	0	DCD	ML15006A044
APR1400-K-X-IT-14001 -P & NP	APR1400 Design Control Document Tier 1	0	DCD	ML15006A039

❑ RAI Summary

No. of Questions	No. of Responses	Not Responded*	No. of OI
34	30	4	5

* The responses to RAIs for the Radiation Monitoring System will be submitted by the end of 2016

NON-PROPRIETARY

Overview of Chapter 11

❑ Section Overview

Section	Major contents	Presenters
11.1	**Source Terms**	Sangho Kang
11.2	**Liquid Waste Management System**	Sangho Kang
11.2.1	Design Bases	
11.2.2	System Description	
11.2.3	Radioactive Effluent Releases	
11.2.4	Testing and Inspection Requirements	
11.3	**Gaseous Waste Management System**	Sangho Kang
11.3.1	Design Bases	
11.3.2	System Description	
11.3.3	Radioactive Effluent Releases	
11.3.4	Testing and Inspection Requirements	
11.4	**Solid Waste Management System**	Sangho Kang
11.4.1	Design Bases	
11.4.2	System Description	
11.4.3	Radioactive Effluent Releases	
11.4.7	Testing and Inspection Requirements	
11.5	**Process and Effluent Radiation Monitoring and Sampling Systems**	James S. Jhun
11.5.1	Design Bases	
11.5.2	System Description	
11.5.3	Effluent Monitoring and Sampling	
11.5.4	Process Monitoring and Sampling	

1. Source Terms (11.1)

1.1 RCS and CVCS

1.2 BOP and Radwaste Systems

1.1 RCS and CVCS

❑ Design Basis Source Terms

- Design basis source term is used for the design of radioactive waste management system and for determining design lifetime integrated doses for the equipment qualification
- 1% fuel defect is assumed based on SRP 11.2 and 11.3
- Mass balanced differential equations described in DCD were used to calculate the activity of each nuclide
- RCS coolant maximum activity is calculated using DAMSAM code
- Activity for CVCS components are calculated using SHIELD-APR code based on maximum RCS specific activity

❑ Expected Source Terms

- Expected source term is used for estimation of the annual effluent releases to the environment
- Expected source terms are calculated based on ANSI/ANS-18.1-1999 and NUREG-0017
- RCS specific activities provided in ANSI/ANS-18.1 are adjusted using APR1400 design-specific parameters
- Activity for CVCS components are calculated using SHIELD-APR code based on expected RCS specific activity

1.2 BOP and Radwaste Systems

❑ Secondary System Activity

- Since the SGs are assumed to have tube leaks, the secondary system is considered to contain radioactive sources
- Design basis SG leak rate is 3,270 L/day (0.6 gal/min) for both SGs
- Radionuclides are removed from the secondary system by ion exchangers in the SGBDS and CPS, decay, and main steam leakage

❑ Source Terms for Radwaste Systems

- LWMS
  - LWMS collection tanks (EWT, FDT, CWT) process the input flows as follows:
    - EWT : Equipment drain sump and CCW drains
    - FDT : Floor drains from Containment, Auxiliary and Compound Buildings
    - CWT : TGB drain system and Chemical waste drain pump
  - DIJESTER code used to estimate the LWMS source terms

1.2 BOP and Radwaste Systems

❑ Source Terms for Radwaste Systems (cont'd)

- GRS
  - Input sources to the GRS are the vent gases from the RDT, VCT, EDT and gas stripper
  - Considering activity buildup, GRS source terms are calculated by differential equations
- SWMS
  - Source terms for SRLST are calculated by summing the source terms for the CVCS resins considering the decay for up to 10 years of storage
  - Source terms for LASRT are calculated by assuming that LASRT is filled with spent resins generated from LWMS, SFPCCS and SGBDS

2. Radwaste Management Systems

2.1 Design Requirements for Radwaste Systems

2.2 Liquid Waste Management System (11.2)

2.3 Gaseous Waste Management System (11.3)

2.4 Solid Waste Management System (11.4)

2.5 Key Review Items

2.1 Design Requirements for Radwaste Systems

- 10CFR50, App. A, GDC 60, "Control of Releases of Radioactive Materials to the Environment"
- 10CFR50, App. A, GDC 61, "Fuel Storage and Handling and Radioactivity Control"
- 10CFR20, App. B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides~"
- 10CFR50, App. I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion ALARA~"
- ANSI 55.1, "Solid Radioactive Waste Processing System for Light Water Reactor Plants", 1992 (Reaffirmed 2009)
- ANSI 55.4, "Gaseous Radioactive Waste Processing System for Light Water Reactor Plants", 1993
- ANSI 55.6, "Liquid Radioactive Waste Processing System for Light Water Reactor Plants", 1993 (Reaffirmed 2007)
- RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components~", Rev.2, 2001
- RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning", 2008

2.2 Liquid Radwaste Management System

❑ Objectives

- Collect, process, and hold-up radioactive or potentially radioactive liquid wastes generated during normal plant operation, including AOO
- Provide sufficient processing capacity, redundancy, and flexibility to treat the liquid radwaste in a manner to reduce the radionuclide concentrations to levels that do not exceed the ECLs

❑ System Classification

- Non-safety related system
- Seismic category is in accordance with RG 1.143
- Radwaste Safety Classification : RW-IIa or RW-IIc

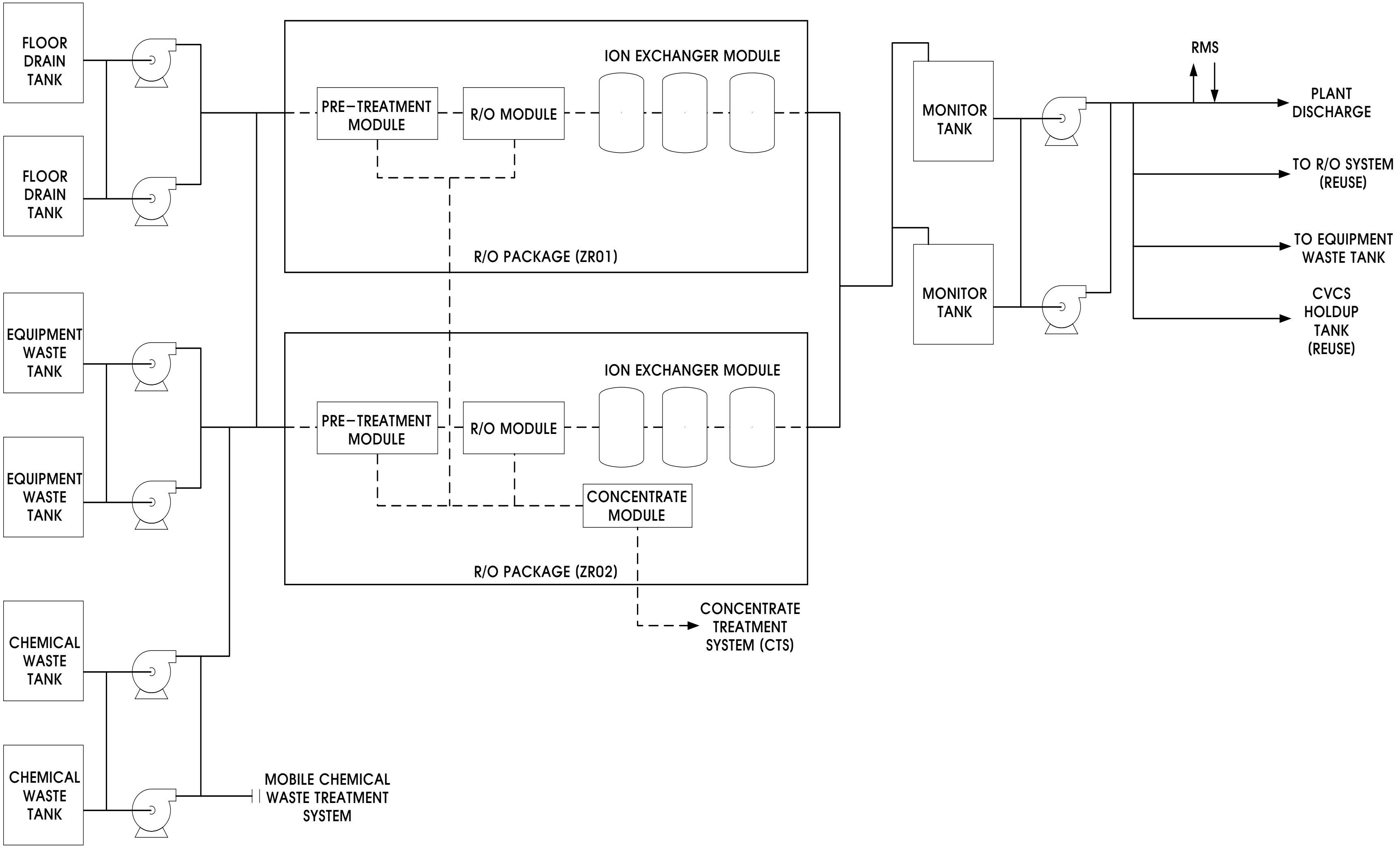
❑ Design Features

- Utilizes R/O technology to improve performance
- Provides pretreatment to remove the organic matters
- Provides ion exchangers to remove the specific ions such as Cs, Rb prior to discharge to Monitor Tank

NON-PROPRIETARY

2.2 LWMS (cont'd)

❑ Process Flow Diagram of LWMS



2.3 Gaseous Radwaste Management System

❑ Objectives

- To collect and process the radioactive waste gases during normal operation
- To meet the gaseous effluent release limits during normal operation and AOO

❑ System Classification

- Non-safety related system
- Seismic category is in accordance with RG 1.143
- Radioactive Safety Classification : RW-IIa

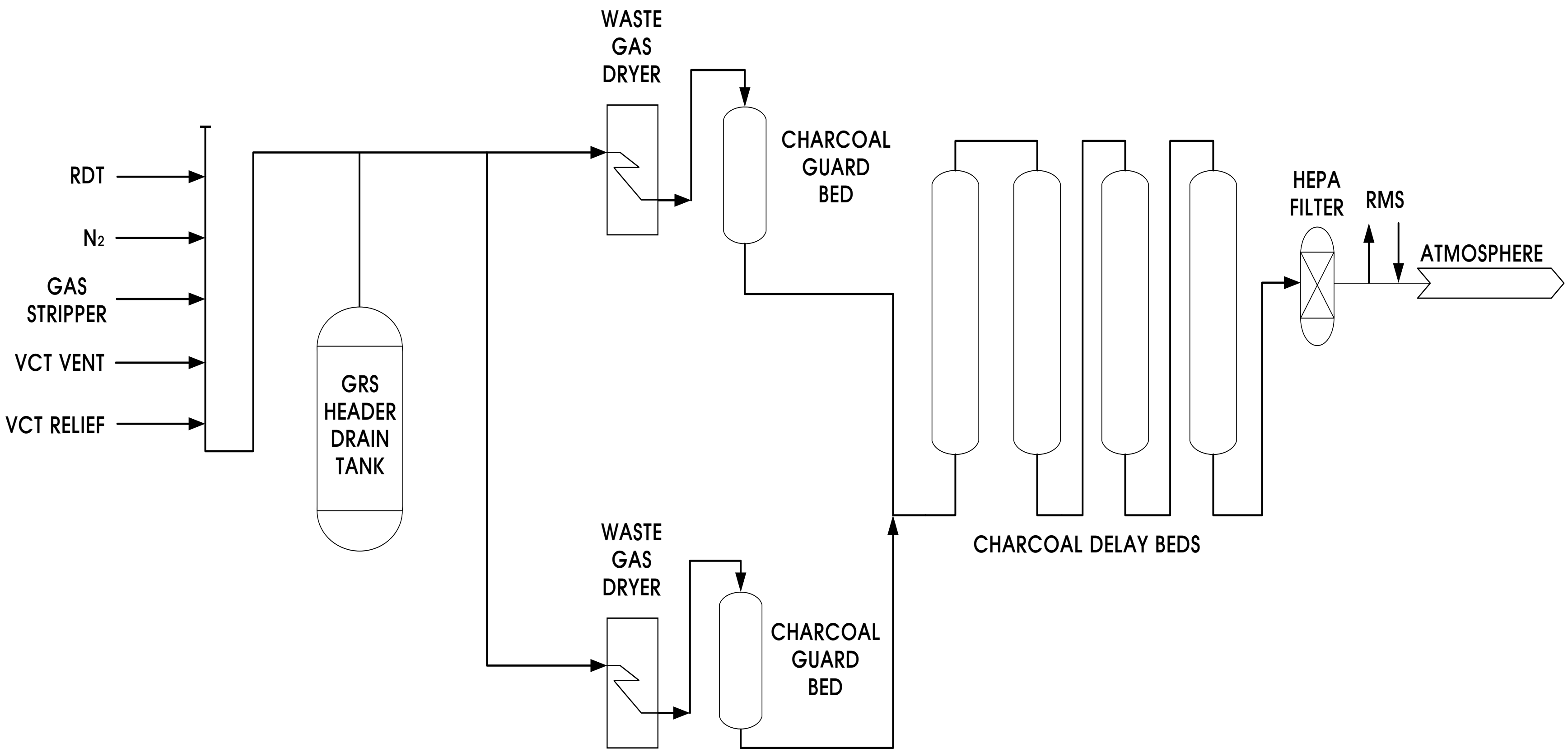
❑ Design Features

- Uses charcoal delay beds for delay and decay of radioactive nuclides
- Provides capability to delay Xe for not less than 45 days
- Prevents degradation of charcoal delay beds using chilled water control and moisture removal methods
- Provides gas concentration monitor and alarm to prevent hydrogen explosion
- Provides isolation valve in the Compound Building HVAC exhaust to close automatically on high radiation level indication

NON-PROPRIETARY

2.3 GWMS (cont'd)

❑ Process Flow Diagram of GRS



2.4 Solid Radwaste Management System

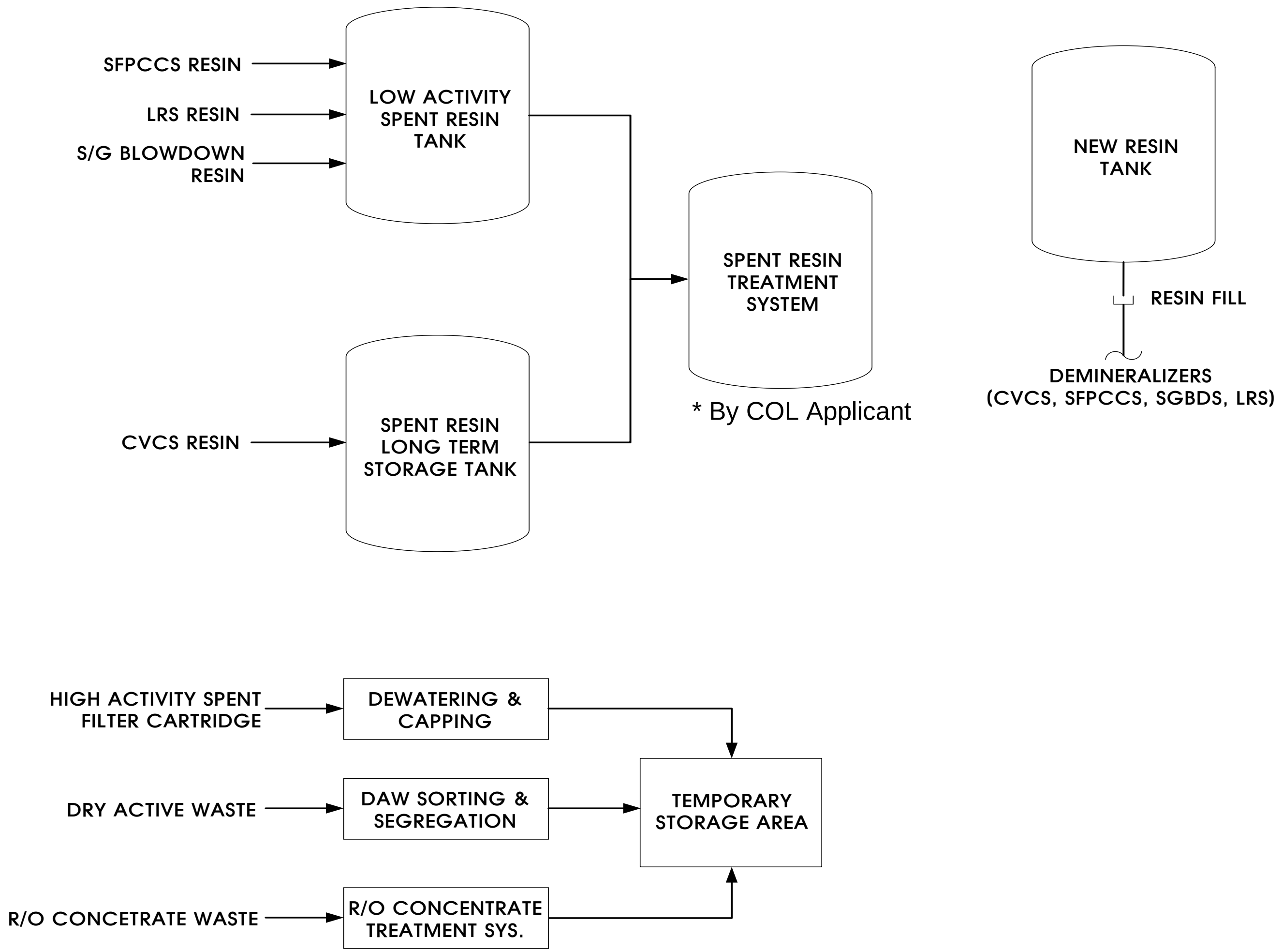
- **Objectives**
  - Provide storage capability for high and low activity spent resins
  - Provide handling and packaging capability for spent filters
  - Provide drying and packaging capability for R/O concentrate
  - Provide sorting and compacting capability for dry active waste (DAW)
  - Provide space and guidance for COL Applicant to facilitate dewatering and packaging of spent resins into disposable containers (COL item 11.4(3))

- **System classification**
  - Non-safety related system
  - Seismic Classification in accordance with RG 1.143
  - Radioactive Safety Classification : RW-IIa (for high and low activity spent resin tanks, and concentrate treatment subsystem)

- **Design Features**
  - Provide SRLST to store the high activity spent resin up to 10 years
  - Provide LASRT to temporarily store low activity spent resin for packaging for shipment and disposal
  - Provide filter handling subsystem to remove filters from filter housing, move to capping area, and package into disposable container
  - Provide R/O concentrate treatment subsystem to dry R/O concentrate in drums
  - Provide sorting table and compactor to reduce the volume of miscellaneous DAW
  - Provide space and guidance for COL Applicant to process spent resins in accordance with 10 CFR 61.56 requirement and ANSI 40.37(COL item 11.4(3))

2.4 SWMS (cont'd)

❑ Process Flow Diagram of SWMS



2.5 Key Review Items

- **Open Item : RAI 8201 Q11.02-6 Rev.1, Issued (9/28/15); Responded (9/8/16)**
  - Description of issue
    - Provide detergent liquid effluent process options including comparisons to the ECLs in 10 CFR Part 20, Appendix B, Table 2, Column 1; and liquid effluent doses using the LADTAP II code, for 10 CFR 50, Appendix I compliance.
  - Resolution
    - Effluent from the detergent waste tank is either discharged to the environment via the sole monitored discharge pipe or by the LWMS depending on the results of the sampling and analysis
    - The impact on the ECLs and doses to the public is already incorporated since the PWR-GALE code takes into account the additional releases from the detergent waste

2.5 Key Review Items (cont'd)

- **Open Item: RAI 8270 Q11.02-7 Rev.1, Issued (10/19/15); Responded (7/6/16)**
  - Description of issue
    - Request for consistent changes throughout sections 11.2, 11.3, 11.4 and 10.4.8, and the source terms for the components described in DCD section 10.4.8.
  - Resolution
    - The descriptions of system boundaries and their corresponding safety classifications in Sections 11.2, 11.3, 11.4 and 10.4.8 have been revised to be consistent.
    - The source terms for the components described in DCD section 10.4.8 and their safety classifications are specified in DCD table 10.4.8-4.

3. Process & Effluent Rad. Monitoring System (11.5)

3.1 Process & Effluent Rad. Monitoring System

3.2 Key Review Items

3.1 Process & Effluent Radiation Monitoring System

❑ Objectives

- Measures and records radioactivity levels of the liquid and gaseous process streams and effluents from LWMS, GWMS and other process systems during normal operation, AOO, and Postulated Accident.

❑ Function of PERMSS

- Provide early warning of malfunctioning or inappropriate operation of the radioactive systems or release of radioactive effluents.
- Provide monitoring of liquid and airborne activity in selected locations and effluent paths for postulated accidents - Iodine, particulates, and gases as well as grab samples.
- Generate alarms, indications, and controls the release of potential radioactive material.

❑ Classification

- Non-safety-related except for containment air monitors and MCR air intake monitors (SC-3)

3.1 PERMSS (cont'd)

Design Criteria

- NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," April 1991.
- RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," June 2009
- RG 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," Rev.1
- RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Rev.4
- RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," June 2008
- ANSI/HPS N13.1 "Sampling and Monitoring Releases of Airborne Radioactive Substance from the Stack and Ducts of Nuclear Facilities," January 1999
- IEEE Std. 603 "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," 1991

3.1 PERMSS (cont'd)

❑ Design Features (cont'd)

- PERMSS consists of gaseous PERMSS and liquid PERMSS.
- Depending upon the installation configuration, monitors could be Off-line, In-line, or On-line type detector.
- The detector types are designed to facilitate maintenance and calibration, while minimizing the effect of background radiation.
- Display of radiation level and alarms are basic functions provided by all monitors.
- The radiation detectors are located in easily accessible areas and have sufficient shielding.
- Safety-related PERMSS are environmentally and seismically qualified.

3.1 PERMSS (cont'd)

❑ Design Features (cont'd)

- Gaseous PERMSS monitors include the following:
  - ➢ High energy line break area HVAC effluent monitor (Off-line)
  - ➢ Auxiliary building controlled area HVAC exhaust monitor (Off-line)
  - ➢ Containment purge effluent monitor (Off-line)
  - ➢ Containment air monitor (Off-line)
  - ➢ Fueling handling area HVAC effluent monitor (Off-line)
  - ➢ Condenser vacuum pump vent effluent (Off-line)
  - ➢ MCR air intake monitor (In-line)
  - ➢ GWMS exhaust monitor (Off-line)
  - ➢ Compound building HVAC effluent monitor (Off-line)
  - ➢ Main steam line monitor (On-line)
  - ➢ Compound building exhaust monitor (Off-line)
- All the monitors are non-safety related except the containment air monitor and MCR air intake monitor.
- The MCR air intake monitor generates BOP ESFAS signal for actuation of MCR emergency ventilation system and the containment air monitor is used to detect RCS leakage in accordance with RG 1.45.
- Similarly the N-16 portion of the main steam line monitor detects primary to secondary leakage.

3.1 PERMSS (cont'd)

Design Features

- Liquid PERMSS monitors include the following:
  - CVCS letdown monitor (Off-line)
  - CVCS gas stripper effluent monitor (Off-line)
  - Condensate receiver tank outlet monitor (Off-line)
  - Steam Generator blowdown and downcomer monitor (Off-line)
  - CCW supply header monitor (Off-line)
  - Essential service water pump discharge header monitor (Off-line)
  - CPS area sump water monitor (Off-line)
  - LWMS effluent monitor (Off-line)
  - Fire pump and waste water treatment building drain monitor (Off-line)
  - Condenser pit sump water drain monitor (Off-line)
- All the monitors are non-safety related.
- The condensate receiver tank outlet monitor automatically diverts the condensate flow to the LWMS when high radioactivity is detected.
- The Steam Generator blowdown monitor, CCW supply header monitor, and Essential service water pump discharge monitor provide leak detection function while the CCW supply header monitor provides additional heat exchange isolation function.
- The CPS area sump water monitor, Fire pump and waste water treatment building drain monitor, and Condenser pit sump water drain line monitor stop sump pumps.

3.2 Key Review Items (cont'd)

- **Open Items: RAI 8087 Q.11.05-1 & RAI 8088 Q.11.05-2, Issued (8/7/15); Responded (5/8/16, Rev.1)**
  - Description of issue
    - Provide the monitor information in DCD texts: functions and safety related requirements; radiation detection ranges; process configuration; location; applicable regulatory guides; alarms and interlocks; sampling stations; purging of sample lines; safety classification; calibration and quality assurance; correlation to ODCM, REMP, and/or PCP
  - Resolution
    - The requested monitor information have been added and revised in the response with the exception of QA provisions of each monitor and the correlation to the operating programs, which will be supplemented in a revised response.

3.2 Key Review Items (cont'd)

- **Open Item: RAI 8203 Q.11.05-3, Issued (9/23/15); Responded (6/13/16, Rev.2)**
  - Description of issue
    - Address the sensitivity, response time, and alarm limit for the primary-to-secondary leakage detection instrumentation.
    - Provide additional information relating to the steam line effluent monitors.
  - Resolution
    - The information for the primary-to-secondary leakage detection instrumentation is not included in the ITAAC, as they are not used for the design-basis analysis.
    - A calculation to demonstrate the ability to monitor N-16 activity in the main steam line is provided.
    - Details in Appendix 11B shows compliance with monitoring SG tube leakage.

4. Design Evaluation (11.2 – 11.4, 11B)

4.1 Compliance to 10 CFR 50 App.I & 20 App.B

4.2 Radwaste System Failure Analysis

4.3 RW Classification & SG Leak Detection

4.1 Compliance to 10 CFR 50 App.I & 20 App.B

❑ Annual Gaseous/Liquid Effluents Calculation

- PWR-GALE was modified to incorporate ANSI/ANS-18.1(1999) per RG 1.112

❑ Offsite Public Doses due to Normal Operation

- Enveloping X/Q of 2.0E-05 s/m^3 and D/Q of 2.0E-07/m^2 were used to bound most US sites
- LWMS discharge is assumed to be diluted by a cooling water flow of 10,000 gpm
- GASPAR II and LADTAP II codes are used for offsite dose calculations based on RG 1.109
- APR1400 design complies with public dose limits of 10 CFR 50 App.I and ECL of 10 CFR 20 App.B
  - Estimated doses to max. organ due to gaseous and liquid effluents are 14.5 mrem/yr and 4.05 mrem/yr, respectively
  - Design basis effluent concentrations at EAB are within 18.0% of ECL for liquid and 16.2% for gaseous effluents

4.2 Radwaste System Failure Analysis

❑ Liquid Radwaste System Failure Analysis

- CVCS Boric acid storage tank (BAST) was determined to cause the worst consequence (i.e., contains the highest source in the yard area)
- Concentration in nearest potable water was estimated based on the guidance in BTP 11-6
- Minimum required dilution factor which can meet the concentration limits for potable water in 10 CFR 20 App.B was estimated to be 9,340

❑ Gaseous Radwaste System Failure Analysis

- Inadvertent bypass of charcoal delay beds in GRS is assumed
- Iodines and particulates are removed by the pre-filter and guard beds
- Activity released from a waste gas system failure is based on 1% fuel failure in accordance with BTP 11-5
- RADTRAD code is used for dose estimation with short term χ/Q of 1.0E-03 s/m^3
- Estimated doses at EAB and LPZ are 1.16 mrem, 0.255 mrem, respectively and meet the dose limit of 100 mrem

4.3 RW Classification and SG Leak Detection

❑ Classification of Radwaste Systems

- Evaluated for LWMS, GRS, SWMS and SGBDS per RG 1.143
- Based on 1% fuel defect source term
- Radwaste systems are classified as follows:
  - LWMS : RW-IIa or RW-IIc
  - GWMS, SWMS : RW-IIa
  - SGBDS : RW-IIc

❑ Primary-to-Secondary Leakage Detection Capability

- NEI 97-06 requires that the plant shall be able to detect a SG leak rate of 30 gal/day
- SG tube leakage is detected by main steam line N-16 monitors
- Estimated N-16 concentrations at detector location range from 3.68×10^{-4} to 1.68×10^{-1} Bq/cm^3 depending on the power level
- The SG leakage of 4.73 L/hr (30 gal/day) can be detected as N-16 monitor is capable of detecting 1.0×10^{-4} to 1.0×10^{2} Bq/cm^3

5. Open Items & Summary

❑ Open Items

- Responses for RAI Q11.2-6 and Q11.2-7 were already submitted on 9/8/16 and 7/6/16, respectively
- Responses for RAI Q11.05-1 and Q11.05-2 will be submitted by the end of Dec. 2016
- Response for RAI Q.11.05-3 has been submitted on 6/13/16

❑ Summary

- Radwaste management systems and PERMSS for APR1400 are designed to comply with the relevant NRC requirements
- Design evaluation shows that APR1400 complies with the public dose limits of 10CFR50 App.I and the ECL of 10CFR20 App.B
- LWMS and GRS failure analyses are performed based on BTP 11-6 and BTP 11-5 and satisfy the criteria

6. Acronyms

- AOO: Anticipated Operational Occurrences
- BAST : Boric Acid Storage Tank
- BTP : Branch Technical Position
- CCW: Component Cooling Water
- CPS : Condensate Polishing System
- CVCS: Chemical and Volume Control System
- CWT : Chemical Waste Tank
- DAW : Dry Active Waste
- DF: Decontamination Factor
- D/Q : Deposition factor
- EAB : Exclusion Area Boundary
- ECL : Effluent Concentration Limit
- EDT: Equipment Drain Tank
- EWT : Equipment Waste Tank
- FDT : Floor Drain Tank
- GWMS: Gaseous Waste Management System
- HUT : Holdup Tank
- LASRT: Low-Activity Spent Resin Tank
- LWMS: Liquid Waste Management System
- MCR: Main Control Room
- NEI: Nuclear Energy Institute
- ODCM: Offsite Dose Calculation Manual
- PA: Postulated Accident
- PCP : Process Control Program
- PERMSS: Process and Effluent Radiation Monitoring and Sampling System
- RCS: Reactor Coolant System
- RDT: Reactor Drain Tank
- REMP: Radiological and Environmental Monitoring Program
- R/O : Reverse Osmosis
- SFPCCS : Spent Fuel Pool Cooling and Cleanup System
- SG: Steam Generator
- SGBDS: Steam Generator Blowdown System
- SRLST: Spent Resin Long-term Storage Tank
- SWMS: Solid Waste Management System
- VCT: Volume Control Tank
- X/Q : Atmospheric dispersion factor

Presentation to the ACRS

Korea Electric Power Corporation
APR 1400 Design Certification Application Review

Safety Evaluation with Open Items: Chapter 11

RADIOACTIVE WASTE MANAGEMENT

October 4, 2016

Staff Review Team

- **Technical Staff**
  - **Stephen Williams** – DCD Section 11.1 to 11.5
    Radiation and Accident Consequences Branch
  - **Zachary Gran**– DCD Sections 11.1 to 11.5
    Radiation and Accident Consequences Branch
  - **Derek (Rick) Scully**– DCD Sections 11.2 to 11.4
    Plant Systems Branch
  - **Jing (Deanna) Zhang** – DCD Section 11.5
    Instrumentation, Controls & Electrical Engineering

- **Project Managers**
  - **Jeffrey Ciocco** – Lead Project Manager
  - **Tarun Roy**– Chapter Project Manager

Overview of DCD Review

		Number of Questions	Number of Open Items
11.1	Source Terms	4	0
11.2	Liquid Waste Management System	10	2
11.3	Gaseous Waste Management System	10	0
11.4	Solid Waste Management Systems	4	0
11.5	Process and Effluent Radiological Monitoring and Sampling Systems	6	3
Totals		34	5

Technical Topics of Interest:
DCD Section 11.1 – Source Terms

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.1 – No Open Items:

- Coolant source terms based on modified ANSI/ANS-18.1-1999 and an applicant modified GALE Code.

- Staff audited the KHNP modified GALE code.
  - Staff requested executable files and the source code files for review.
  - Staff determined that the only changes made to the GALE code were to update to the ANSI 18.1-1999 Standard.

- Applicant followed SRP Section 11.1 and Regulatory Guide (RG) 1.112 "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents From Light-Water-Cooled Nuclear Power Reactors"

- No COL Information Items

Technical Topics of Interest:
DCD Section 11.2 – Liquid Waste Management System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.2 with Open Items:

- LWMS design basis and features, system description, processing methods, and capacities; seismic and quality group classifications; performance characteristics; instrumentation and alarm systems; automatic termination of liquid effluent release; ALARA design features; and boundary definition
- Basis and development of liquid process waste streams, estimated inputs to LWMS, and treatment process performance (decontamination factors)
- KHNP proprietary version of the PWR-GALE code used to calculate liquid effluent releases (source term) during normal operations including AOOs described in KHNP RAI Technical Responses.

Technical Topics of Interest

DCD Section 11.2 – Liquid Waste Management System

SER Section 11.2 with Open Items (Cont'd):

- Staff confirmed the methodology, basis, and assumptions used to comply with Effluent Concentration Limits (ECLs) in 10 CFR Part 20, Appendix B, Table 2, Column 2; public dose limits in 10 CFR Part 20; and design objectives in 10 CFR Part 50, Appendix I

- Epoxy coating system used to line LWMS cells/cubicles and comply with 10 CFR 20.1406 and conform to RG 4.21 and RG 1.54 (recognizing more recent standards may be used)

- 10 CFR 20.1406, Tier 1 and ITAAC information, TS, and pre-operational testing

Technical Topics of Interest
DCD Section 11.2 – Liquid Waste Management System

SER Section 11.2 with Open Items (Cont'd):

- COL Information Items:
  - Mobile and temporary radwaste processing equipment and interconnection to plant systems
  - Release points, effluent temperature, shape of flow orifice, etc.
  - Hydrological data and groundwater or surface analysis comply with ECLs in 10 CFR Part 20, Appendix B, Table 2 for liquid tank failure
  - Offsite liquid effluent doses comply with 10 CFR Part 20; 40 CFR Part 190 under 10 CFR 20.1301(e); and 10 CFR Part 50, Appendix I
  - Cost Benefit Analysis (CBA)
  - Piping and Instrumentation Diagrams (P&IDs)

Technical Topics of Interest
DCD Section 11.2 – Liquid Waste Management System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.2 with Open Items (Cont'd):

- **Open Item 11.02-6 (RAI 8201, Question 11.02-6)**: Provide liquid effluent tracking process for detergent radwaste tank liquid effluent releases including comparisons to the ECLs in 10 CFR Part 20, Appendix B, Table 2, Column 1; and liquid effluent doses using the LADTAP II code, for 10 CFR 50, Appendix I compliance.

- **Open Item 11.02-7 (RAI 8270, Question 11.02-7)**: Request for consistent changes throughout sections 11.2, 11.3, 11.4 and 10.4.8. In addition, the staff requested the applicant include the system source terms for the components described in DCD section 10.4.8.

  - Applicant recently updated Response: Staff evaluation determines the response acceptable and therefore RAI is a confirmatory item.

Technical Topics of Interest

DCD Section 11.3 – Gaseous Waste Management System

SER Section 11.3 with Open Items:

- GWMS design basis and features, system description, processing methods, and capacities; seismic and quality group classifications; performance characteristics; instrumentation and alarm systems; automatic isolation of gaseous waste process flow and effluent release; hydrogen and oxygen monitoring; ALARA design features; and release point
- Basis and development of gaseous process waste streams, estimated inputs to GWMS, treatment process performance (removal efficiencies and holdup time), and building ventilation systems

Technical Topics of Interest
DCD Section 11.3 – Gaseous Waste Management System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.3 with Open Items (Cont'd):

- KHNP proprietary version of the PWR-GALE code used to calculate gaseous effluent releases (source term) during normal operations including AOOs described in KHNP RAI Technical Response.
- Staff confirmed the methodology, basis, and assumptions used to comply with ECLs in 10 CFR Part 20, Appendix B, Table 2, Column 1; public dose limits in: 10 CFR Part 20; and design objectives in 10 CFR Part 50, Appendix I
- Methodology, basis, and assumptions to assess radiological impacts due to postulated failure of a waste gas surge tank and charcoal bed leak
- No mobile or temporary equipment or connections to permanently installed equipment considered in GWMS design
- 10 CFR 20.1406, Tier 1 and ITAAC information, TS, and pre-operational testing

Technical Topics of Interest
DCD Section 11.3 – Gaseous Waste Management System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.3 with Open Items (Cont'd):

- COL Information Items:
  - Onsite vent stack design parameters and release point characteristics
  - Release points, effluent temperature, shape of flow orifice, etc.
  - Offsite gaseous effluent doses comply with 10 CFR Part 20; 40 CFR Part 190 under 10 CFR 20.1301(e); and 10 CFR Part 50, Appendix I
  - CBA
  - P&IDs

Technical Topics of Interest
DCD Section 11.4 – Solid Waste Management System

United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.4 – No Open Items:

- SWMS design basis and features, system description, processing methods, and capacities; seismic and quality group classifications; performance characteristics; instrumentation and alarm systems; annual estimated waste generation rates; ALARA design features; capability to move drums and HICs; provision for mobile or temporary equipment; and boundary definition

- No direct liquid and gaseous effluent releases from SWMS (associated releases and compliance with ECLs and dose limits are addressed in DCD Sections 11.2 and 11.3)

- Basis for design storage capacity of Class A, B, and C radioactive wastes

Technical Topics of Interest
DCD Section 11.4 – Solid Waste Management System

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

<u>SER Section 11.4 – No Open Items (Cont'd):</u>

- Process Control Program (PCP)
  - Description of operational program for processing of Class A, B, and C LLRW to comply with 10 CFR 61.55 and 10 CFR 61.56
  - DCD adopts NEI PCP template 07-10A until a plant-specific PCP is developed to support plant operation
  - Approach acceptable given staff endorsement of NEI PCP template

- 10 CFR 20.1406, Tier 1 and ITAAC information, TS, and pre-operational testing

- Epoxy coating system used to line SRST rooms and comply with 10 CFR 20.1406, and conform to RG 4.21 and RG 1.54 (recognizing more recent standards may be used)

Technical Topics of Interest
DCD Section 11.4 – Solid Waste Management System

SER Section 11.4 – No Open Items (Cont'd):

- COL Information Items:
  - Onsite radioactive waste storage
  - PCP and implementation milestones
  - Mobile/portable SWMS connections and other non-radioactive systems that may become contaminated and related operational procedures
  - Offsite laundry services or mobile compaction unit subsystem
  - CBA (addressed in DCD Sections 11.2 and 11.3)
  - Contract services or compaction equipment for solid waste
  - P&IDs
  - Mobile and temporary solid radioactive waste processing and interconnection to plant systems comply with 10 CFR 50.34a; 10 CFR 20.1406; and RG 1.143 "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants"

Technical Topics of Interest

DCD Section 11.5 – Process Effluent Radiation Monitoring and Sampling Systems

United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.5 with Open Items:

- Process Effluent Radiation Monitoring and Sampling System (PERMSS) design basis and features, system descriptions, types, number, and locations of PERMSS monitors and samplers; seismic and quality group classifications; operational ranges, sensitivities, and alarms; system calibrations and provisions for built-in check sources; provisions for automatic isolation and termination features; and ALARA design features

- Plant process systems and effluent flow paths monitored by radiation monitoring and sampling equipment

- 10 CFR 20.1406, Tier 1 and ITAAC information, TS, and pre-operational testing

Technical Topics of Interest

DCD Section 11.5 – Process Effluent Radiation Monitoring and Sampling Systems

United States Nuclear Regulatory Commission
Protecting People and the Environment

SER Section 11.5 with Open Items (Cont'd):

- Offsite Dose Calculation Manual (ODCM)
  - Description of the operational program for controlling and monitoring all effluent releases and assessing offsite doses in accordance with 10 CFR 20.1301; 10 CFR 20.1302; 40 CFR Part 190 as referenced in 10 CFR 20.1301(e); 10 CFR Part 20, Appendix B, Table 2 ECLs; and design objectives of 10 CFR Part 50, Appendix I
  - DCD adopts NEI ODCM template 07-09A until a plant and site-specific ODCM is developed to support plant operation
  - Approach acceptable given staff endorsement of NEI ODCM template

- RCS leakage detection conforms to RG 1.45 (Revision 1) and ANSI N42.18-2004, and primary-to-secondary leakage detection conforms to NEI 97-06 for TS basis

Technical Topics of Interest

DCD Section 11.5 – Process Effluent Radiation Monitoring and Sampling Systems

United States Nuclear Regulatory Commission
Protecting People and the Environment

<u>SER Section 11.5 with Open Items (Cont'd):</u>

- COL Information Items:
  - Aspects beyond PERMSS design in accordance with RG 1.12, RG 1.33, and RG 1.45; and comply with 10 CFR Part 50, Appendix I for offsite doses from liquid and gaseous effluent streams.
  - ODCM with description of methods and parameters for radiation monitor setpoints and follow NEI ODCM template 07-09A
  - Radiological Effluent Monitoring Program (REMP) and follow NUREG-1301, NUREG-0133, NEI ODCM template 07-09A
  - Analytical procedures and sensitivity radioanalytical methods and type of sampling media
  - Procedures related to radiation monitoring instruments
  - Analytical procedures and sensitivity radioanalytical methods and sampling media type

Technical Topics of Interest

DCD Section 11.5 – Process Effluent Radiation Monitoring and Sampling Systems

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

<u>SER Section 11.5 with Open Items (Cont'd):</u>

- **Open Item 11.05-1 and 11.05-2 (RAI 8087, Question 11.05-1 and RAI 8088 Question 11.05-2)**: Request for applicant to provide additional information in the descriptions of the LWMS and GWMS monitors.

- **Open Item 11.05-3 (RAI 8203, Question 11.05-3):** Request for clarification of the information on the Primary to Secondary Leak Detection calculation in DCD Appendix 11B.
  - Staff has reviewed the revised response to this question. Response was deemed to be acceptable. RAI is being tracked as a confirmatory item.

Conclusions
DCD Chapter 11

- Resolution of 5 open items expected in Phase 4 of DCD review

- Significant COL Information Items:
  - Offsite liquid and gaseous offsite doses
  - Liquid tank failure analysis
  - P&IDs
  - Epoxy coating system
  - Related operational, analytical, and radiation monitoring procedures
  - CBA
  - PCP
  - ODCM

Questions?

ACRONYMS

ALARA – as low as is reasonably achievable
ANSI – American National Standards Institute
AOOs – anticipated operational occurrences
ASTM – American Society for Testing and Materials
BTP- Branch Technical Position
CBA – cost-benefit analysis
CDI – conceptual design information
CFR – code of federal regulations
COL – combined license
DCD – design control document
ECLs – effluent concentration limits
EPA – Environmental Protection Agency
GL= Generic Letter
GDC – General Design Criterion
GSI – Generic Safety Issue
GWMS – gaseous waste management system
HEPA – high-efficiency particulate air
ITAAC – inspection, test, analysis, and acceptance criteria
LLRW – low-level radioactive waste
LWMS – liquid waste management system
NEI – Nuclear Energy Institute
NUREG – US Nuclear Regulatory Commission Regulation

ACRONYMS

ODCM – offsite dose calculation manual
PERMSS – process effluent radiation monitoring and sampling systems
P&IDs – piping and instrumentation diagrams
PCP – process control program
RAI – request for additional information
RCS – reactor coolant system
REMP – radiological environmental monitoring program
RG – regulatory guide
R/O – reverse osmosis
RTNSS – regulatory treatment of non safety sSE – Safety Evaluation
SER – safety evaluation report
SRP – standard review plan
SRST – spent resin storage tank
SWMS – solid waste management system
TMI – Three Mile Island
TS – technical specifications
USI – unresolved safety issue

U.S.NRC
United States Nuclear Regulatory Commission
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 Open Items: Chapter 2 (Section 2.3)

Chapter 2: SITE CHARACTERISTICS

October 04, 2016

Presentation Contents

- Staff Review Team
- Overview of Design Certification Application
- Technical Areas of Interest

  - 2.3 Meteorology

- **Technical Staff Presenters and Staff Review Team**
  - **Jason White- DCD Section 2.3 Meteorology and Oceanography Team**
  - **Jessica Voveris - DCD Section 2.3 Meteorology and Oceanography Team**

- **Project Managers**
  - **Jeff Ciocco – Lead PM**
  - **Tarun Roy– Chapter PM**

Section 2.3 - Meteorology

- The review involves the following sections of the APR1400 DCD:
  - 2.3.1 – Regional Climatology
  - 2.3.2 – Local Meteorology
  - 2.3.3 – Onsite Meteorological Measurements Program
  - 2.3.4 – Short-term Atmospheric Dispersion Estimates for Accident Releases
  - 2.3.5 – Long-term Atmospheric Dispersion Estimates for Routine Releases
  - 2.3.6 – Combined License Information
- The COL applicant is to provide this information as part of the COL application

Technical Topics of Interest

Section 2.3 - Meteorology

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Initial Clarification Questions – 12
- RAI Questions – 10
- SE Confirmatory Items – 8
- SE Open Items – 0

Meteorological Site Parameters

- The applicant identified meteorological site parameters related to:
  - Climatic Extremes and Regional Meteorological Phenomena, Including Severe Weather
  - Atmospheric Dispersion (Accident & Routine Releases)
- A COL applicant is required to compare its site characteristics to the APR1400 site parameters
- The staff performed its review of the APR1400 meteorological site parameter values, under SRP Section 2.0, to ensure they are representative of a reasonable number of sites that have been or may be considered for a COL application

Climatic Site Parameters

- Winter Precipitation (for Roof Load Design)
- Extreme Wind Speed (other than in Tornado/Hurricane)
  - Consistent with ASCE/SEI 7-05
- Tornado
  - Consistent with RG 1.76 Revision 1
- Hurricane
  - Consistent with RG 1.221
- Ambient Design Air Temperatures

Short-Term Atmospheric Dispersion Site Parameters for Accident Releases

- EAB and LPZ χ/Q Site Parameter Values
- MCR and TSC χ/Q Site Parameter Values

Long-Term Atmospheric Dispersion Site Parameters for Routine Releases

- Site Boundary and Food Production Area χ/Q and D/Q Values

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

FSAR Confirmatory Items:

- Confirmatory Item **2.3.1-1** and **2.3.1-2** (RAI 8012) both relate to corrections in FSAR Tier 1, Table 2.1-1, and Tier 2, Table 2.0-1.

- Confirmatory Item **2.3.1-3** (RAI 8012) related to revising FSAR Chapter 9.4 to include design ambient temperature exceedance values applied to HVAC systems.

- Confirmatory Item **2.3.1-4** (RAI 8012) related to identification of ambient temperature exceedance values in FSAR Tier 1, Table 2.1-1, and Tier 2, Table 2.0-1.

FSAR Confirmatory Items (continued):

- Confirmatory Item **2.3.4-1** (RAI 8211) related to updating FSAR Section 2.3.4 to include χ/Q values for the TSC.

- Confirmatory Item **2.3.4-2** (RAI 7912) related to updating FSAR Tables to include a definition of "effective χ/Q."

- Confirmatory Items **2.3.4-3** (ML15132A598) and **2.3.4-4** (ML15132A598) related to updating FSAR Tier 1, Table 2.1-1, and Tier 2, Table 2.0-1, to include a reference to DCD Tier 2, Tables 2.3-2 through 2.3-12, for MCR/TSC χ/Q values.

COL Information Items

- COL Information Item 2.0(1)
  - Demonstrate that the design meets the requirements imposed by the site-specific parameters and conforms to all design commitments and acceptance criteria
- COL Information Item 2.3(1)
  - Provide site-specific information on meteorology
- COL Information Item 2.3(2)
  - Perform the radiological consequences analysis and demonstrate that the related dose limits specified in 10 CFR 50.34 and GDC 19 are not exceeded, if the site-specific χ/Q values exceed the bounding values described in Table 2.3-1 to 2.3-12 of the FSAR

Conclusion
Section 2.3 - Meteorology

- All regulatory requirements for Section 2.3 have been satisfied
- No remaining Open Items
- 8 remaining Confirmatory Items

ACRONYMS

- ADAMS- Agencywide Documents Access & Management System
- CFR- Code of Federal Regulations
- COL- Combined License
- DC - Design Certification
- DBA- Design Basis Accident
- DBE- Design Basis Event
- DCD- Design Control Document
- D/Q- Relative Deposition Factor ($1/m^2$)
- EAB – Exclusion Area Boundary
- EPRI- Electric Power Research Institute
- ESP- Early Site Permits
- FSAR- Final Safety Analysis Report
- GDC-General Design Criterion

ACRONYMS

- ISG- Interim Staff Guidance
- ITAAC- Inspections, tests, analyses, and acceptance criteria
- KHNP- Korea Hydro & Nuclear Power
- OI- Open Item
- PMWP- Probable Maximum Winter Precipitation
- RAI- Request for Additional Information
- RG- Regulatory Guide
- SAR- Safety Analysis Report
- SE- Safety Evaluation
- SRP- Standard Review Plan
- SSC- Structures Systems and Components
- URD- Utility Requirements Documents
- χ/Q – Atmospheric Dispersion Factor (sec/m^3)