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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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APR1400 SUBCOMMITTEE

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THURSDAY

MAY 18, 2017

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 p.m., Ronald G Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman
CHARLES H. BROWN, JR., Member
JOSE MARCH-LEUBA, Member
DANA A. POWERS, Member
GORDON R. SKILLMAN, Member
JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

ALSO PRESENT:

TONY AHN, KHNP
DENNIS ANDRUKAT, NRO
MAITRI BANERJEE, ACRS*
ALEXANDRA BURJA, NRO
DANNY CHIEN, NRO
ANTONIO DIAS, NRO
THINH DINH, NRO
ADAKOU FOLI, NTO
CHEWUNG HA, KHNP
YOUNG TAE HAN, KHNP
GUN HEO, KHNP
RAUL HERNANDEZ, NRO
DIANE JACKSON, NRO
HYEOK JEONG, KEPCO E&C
BECKY KARAS, NRO
HANCHEOL KIM, KHNP

JUNGHO KIM, KHNP

MINGYU KIM, KHNP

YONG CHEOL KIM, KHNP

YOUGGUN KIM, KHNP

HIEN LE, NRO

CHANG LI, NRO

DAEHEON LIM, KEPCO E&C

DUNAM LIM, KHNP

SHANLAI LU, NRO

GREG MAKAR, NRO

RYAN NOLAN, NRO

JIYONG OH, KHNP

HONG SIK PARK, KEPCO E&C

CAYETANO SANTOS, JR., NRO

ROB SISK, Westinghouse

JAMES STECKEL, NRO

ANGELO STUBBS, NRO

ANDREA D. VEIL, Executive Director, ACRS

BOB VETTORI, NRO

BILL WARD, NRO

DAVE WAGNER, AECOM

GEORGE WUNDER, NRO

ANDREW YESHNIK, NRO

JINKYOO YOON, KHNP

DEANNA ZHANG, NRO

*Present via telephone

I-N-D-E-X

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

8:30 a.m.

OPENING REMARKS AND OBJECTIVES

CHAIRMAN BALLINGER: Good morning. The meeting will now come to order. This is a meeting of the APR1400 subcommittee of the Advisory Committee on Reactor Safeguards. I'm Ron Ballinger, Chairman of the APR1400 subcommittee.

ACRS members in attendance are Charlie Brown, Jose March-Leuba, John Stetkar, Matt Sunseri, Dana Powers, Dick Skillman, and we are also graced with the presence of our esteemed -- make that much-esteemed consultant, Steve Schultz. Chris Brown is the designated federal official for this meeting.

The purpose of today's meeting is for the subcommittee to receive briefings from Korea and Electric Power Corporation, KEPCO, and Korea Hydro and Nuclear Power Company Limited, KHNP, regarding their design certification application, and the NRC staff, regarding their safety evaluation report, with open items specific to Chapter 9 today, and tomorrow, Chapter 15.

Chapter 9 is auxiliary systems; Chapter 15 is transient accident analysis. The ACRS was established by statute and is governed by the Federal

Advisory Committee Act, FACA. That means that the committee can only speak through its published letter reports. We hold meetings to gather information to support our deliberations. Interested parties who wish to provide comments can contact our offices requesting time after the meeting announcement is published in the Federal Register, which it has been.

That said, we also set aside ten minutes for comments from members of the public attending or listening to our meetings. Written comments are also welcome. The ACRS section of the USNRC public website provides our chapter bylaws, letter reports and full transcripts of all full and subcommittee meetings, including slides presented at these meetings. Rules for participation in today's meeting were announced in the Federal Register on Tuesday, May 9, 2017.

The meeting was announced as an open to public meeting. No request for making statements to the subcommittee has been received by the public. A transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice. Therefore, I would request that participants in this meeting use the microphones, and when I say microphones, there's a little light on top, but that's not what you press. There's a little electrostatic thing below that, which you press to make the light come on green -- located throughout the meeting room when addressing the subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard. Also, if you're around, keep papers and pencils and stuff off of the microphone because that makes the person recording this unhappy.

We have a bridge line established for interested members of the public to listen in. Bridge number and password were published in the agenda posted on the NRC public website. To minimize disturbances, the public line will be kept in a listen-only mode. The public will have an opportunity to make a statement or provide comments at a designated time towards the end of this meeting.

I would request now that meeting attendees and participants silence cell phones and other devices that make sounds. I think -- yes, he's here -- invite Bill Ward, NRO project manager, to introduce the presenters and start the meeting. Bill.

STAFF OPENING REMARKS

MR. WARD: Good morning. Thank you. My name is Bill Ward. I'm now the lead PM for the APR1400 review. Today, I'm also the acting branch chief.

Mike McCoppin is out, so I'm covering two roles here. Thank you for meeting again. We're down to our last five chapters. We're doing one today, Chapter 9, and Chapter 15 tomorrow. We look forward to finishing the rest of them and finishing Phase 3. I wanted to point out that today's presentation does not include Section 9.1.2. We've discussed this previously. That section was not prepared.

There was some work still going on, and we could not conclude the review at this time, so that will be presented in Phase 5 for the first time, but the rest of Chapter 9 is being presented today and discussed by the staff in the SER presentation. If you have any further questions, I'll be here most of the day. Thank you.

KHNP OPENING REMARKS

MR. SISK: This is Rob Sisk, Westinghouse consultant to APR1400 DCA project. Again, good morning, and appreciate this opportunity to present both Chapter 9 today and Chapter 15 tomorrow. Without any undue delay, I will introduce Young Tae Han to get us started on Chapter 9, please.

DCD CHAPTER 9

MR. HAN: Thank you, Rob. Hi, I'm Young Tae Han from KEPCO E&C. Let me start the presentation of Chapter 9, Auxiliary Systems. This slide covers the contents of Chapter 9. This slide covers the section overview, the title, and presenters. This slide covers the list of submitted documents. This slide covers the subsections of 9.1, Fuel Storage and Handling. Subsection 9.1.1 is about criticality safety of new and spent fuel storage.

New and spent fuel storage facilities are located in the fuel handling area of the auxiliary building. New fuel is stored in standard stainless steel racks installed in a dry new fuel storage pit. Spent fuel is stored in high-density racks installed in a spent fuel pool filled with borated water. The high-density racks consist of structural material, stainless steel, and neutron absorbing material, METAMIC.

Criticality is precluded by adequate design and by administrative control procedures. The right picture shows the layout of the auxiliary building, the fuel handling area. The upper part shows spent fuel pool, with Region 1 and Region 2. The lower part shows the new fuel storage pit. Criticality analyses are performed in accordance with the following acceptance criteria. New fuel storage rack by 10 CFR 60.58 (b), Item (2) and (3). Keff must not exceed .95

with full density unborated water, and Keff must not exceed .98 with optimum moderation condition. Spent fuel storage rack by 10 CFR 50.68(b), Item (4), Keff must not exceed .95 with borated water, and Keff must remain under 1 with full density unborated water.

MEMBER MARCH-LEUBA: Can I ask a question to this? You do take credit for burnup credit?

MR. HAN: Yes.

MEMBER MARCH-LEUBA: For the spent fuel, taking credit for burnup credit, your criterion is exactly 1.0 with unborated water?

MR. HAN: Yes.

MEMBER MARCH-LEUBA: How about the optimum moderation condition, what's the difference? Why do you have a different criteria for fresh fuel?

MR. HAN: As you know, optimum moderation condition occurs in the condition of foam or mist -- mist condition or foam condition.

MEMBER MARCH-LEUBA: Say again. Can you explain it again?

MR. HAN: Optimum moderation condition can be made with mist, the water not reach density above 1.24, not 1.

MEMBER MARCH-LEUBA: So the density of .8 could be optimal? Is that what you're saying?

MR. HAN: It depends on the structure of the target model. It can be more than .95, or it can be lower than .95. It depends on the structure of the target system. We must analyze the optimum moderation condition, whether it is higher than the regulatory limit or lower than the regulatory limit.

MEMBER MARCH-LEUBA: My real question is why do you apply a different criteria for new fuel versus spent fuel?

MR. HAN: For the spent fuel, it considered burnup credit, and it should be lower than 1. Yes, spent fuel storage rack considered the credit of boron. The water is borated water. It's about 2,000 ppm. If there's a boron dilution accident, the Keff increases. If the boron does not exist in the extreme cases, in that cases, it must remain below 1. That's the criteria of the full density unborated water, under 1.

MEMBER MARCH-LEUBA: This assumes a 20-year equilibrium loading in the pool? How many fuel elements do you assume (Simultaneous speaking)?

MR. HAN: The capacity is containing 20 years of spent fuel operated in the plant. The capacity is 20 years.

MEMBER MARCH-LEUBA: It's at capacity?

MR. HAN: Yes.

MEMBER MARCH-LEUBA: Okay, thank you.

MEMBER BLEY: You've mentioned 2,000 ppm boron. I thought I read it was 4,000 ppm boron.

MR. HAN: Limited condition of operation is 2,150 ppm.

MEMBER BLEY: Okay, so the assumption is that there'll be dry storage somewhere?

MR. HAN: Yes.

MR. SCHULTZ: You mentioned the loading that you have for the spent fuel. It wasn't clear to me. The spent fuel loading assumes that you have a full core discharge, plus the other fuel assemblies that have been discharged in the past, is that correct? You assume a full core discharge into the pool, plus you have other irradiated assemblies that have been discharged from past cycles in the burned fuel area, in Region 2.

MR. HAN: Region 2.

MR. SCHULTZ: Do you also assume that you discharge a batch of fuel, then you go up to power and you find something has happened, so that you need to discharge the recently loaded core --

MR. HAN: It is for spent fuel Region 1.

MR. SCHULTZ: Just 1?

MR. HAN: Yes.

MR. SCHULTZ: What happens if you were in the circumstance where you go up to power and you find that something has happened and you need to discharge that core --

MR. HAN: (Simultaneous speaking) can contain 5 percent fresh fuel.

MR. SCHULTZ: You could shut down a reactor after two months of operation, put that fuel back in Region 1, and it would certainly satisfy --

MR. HAN: (Simultaneous speaking) fuel can be loaded in Region 1.

MR. SCHULTZ: Okay. But also, you can put irradiated fuel, if it happens to be necessary --

MR. HAN: Of course, yes.

MR. SCHULTZ: -- to unload the core --

MR. HAN: Of course.

MR. SCHULTZ: -- shortly after startup?

MR. HAN: Yes.

MR. SCHULTZ: Okay, thank you.

MEMBER SUNSERI: I wanted to follow up with that. I have similar questions. It's a common practice, as you approach the refuel, to be able to move the new fuel from the new fuel storage vault into the pool to facilitate the core load. Presuming you bring all the new fuel assemblies into the spent fuel pool, with the other core offloaded, getting ready to go back in, are you still meeting these criteria?

MR. HAN: I didn't understand your question (Simultaneous speaking).

MEMBER SUNSERI: The situation is all of the new batch of fuel, the new fuel is moved from the new fuel storage into the pool. The core is still offloaded, so you're getting ready to go back in with the next cycle, essentially.

MR. SISK: If I can, I guess, ask a clarifying question. Rob Sisk, Westinghouse. If I'm understanding your question, we've got new fuel in the pool --

MEMBER SUNSERI: Correct.

MR. SISK: -- ready to be staged into the core.

MEMBER SUNSERI: Correct.

MR. SISK: I'm assuming since you're talking about a refueling, you're only talking about one third of the core.

MEMBER SUNSERI: Correct.

MR. SISK: Then as you're staged with one third of the new core to go in, now you're saying I'm going to take the fuel out of the reactor vessel and put it into the pool, with the one-third core also in the pool, at the same time?

MEMBER SUNSERI: Correct.

MR. SISK: The question then becomes --

MEMBER SUNSERI: Are you still bounded by all your criticality analysis here.

MR. SISK: Understand. Do you understand the question?

MR. HAN: Still no.

MR. SISK: I'm sorry?

MR. HAN: I'm confused.

MEMBER MARCH-LEUBA: Are you asking if the fresh fuel storage rack, can it hold a full core, not just one third? Is that what you're asking?

(Simultaneous speaking.)

MEMBER SUNSERI: I'm talking about the reload.

MEMBER STETKAR: Move the fresh fuel into the spent fuel pool. Now, you've got spent fuel; you've got fresh fuel.

MEMBER MARCH-LEUBA: In the spent fuel?

MEMBER STETKAR: Yes, because that's where you pick it up to move it into the reactor.

MEMBER SUNSERI: As you're staging for the reload --

MR. SISK: One third of the core out of the new pool, into the spent pool, into the reactor.

MEMBER STETKAR: All of the new fuel into the spent fuel pool. It sits there with all the old spent fuel, and you do the fuel shuffle back and forth.

MEMBER SUNSERI: Right, but it's only one third of a core.

(Simultaneous speaking.)

MEMBER STETKAR: That's the configuration.

MEMBER SKILLMAN: I believe I read that in your Region 1, you were analyzed for 5 weight percent.

MR. HAN: Yes.

MEMBER SKILLMAN: If you have one third of a new core there, ready to be loaded, and you discharge, say, after two days of operation, your complete offload, you then have one and one-third core, with approximately three quarters of that at around 5 weight percent. You are analyzed for that, as I read your documentation. Is that accurate?

MR. HAN: The maximum enrichment is 5 weight percent. The new fuel is the most active fuel. If the fuel is loaded five seconds to ten seconds above zero second, the activity is lower than the new fuel, so the loaded fuels can be loaded Region 1, and it is under regulatory limit.

MEMBER SKILLMAN: Understand. That was clear in my mind. If you put a third of 5 weight percent and offload what is basically a brand new 5 weight percent, plus two-thirds that are twice burned, or heading to be twice burned and heading into thrice burned, we're below the limit for the regions. That's what I believe is in the document.

PARTICIPANT: Okay, thank you.

MR. HAN: Thank you. I may continue? The Keff value, including all biases and uncertainties, at a 95 percent probability, with 95 percent confidence level. Analysis conditions for new fuel storage rack. The surrounding concrete walls are adequately separated from the racks. The design maximum enrichment of 5 weight percent is applied.

No burnable poison rods or other supplemental neutron poisons are assumed. Biases and uncertainties from mechanical tolerances and variations in the design parameters are considered in the Keff. Analysis conditions for spent fuel storage rack. Region 1 storage rack area is designed to accommodate fuel assemblies with initial enrichment up to 5 weight percent. This structural material is stainless steel, and the neutron absorbing material is

METAMIC. Damaged fuel assemblies are separately evaluated. Biases and uncertainties from mechanical tolerances and variations in the design parameters are considered in the Keff.

Region 2 storage area is designed to accommodate spent fuel assemblies generated during plant operation. The structural material is stainless steel, and the neutron absorbing material is METAMIC. The most severe operating conditions are conservatively assumed in the fuel burnup calculation.

Biases and uncertainties from depletion calculation, along with those from mechanical tolerances and variations in the design parameters, are considered in the Keff. This is the end of Section 9.1.1. Next section will be proceeded by Mingyu Kim.

MR. M. KIM: Thank you, Mr. Han. Good morning, ladies and gentlemen. My name is Mingyu Kim in KEPCO E&C. I will continue my presentation with Section 9.1.3 regarding the spent fuel pool cooling and cleanup systems. This system -- I'm sorry; I missed a slide. This system removes the decay heat generated by the spent fuel assemblies stored in the spent fuel pool and purifies the water of spent fuel pool, IRWST, and many other pools. The spent fuel pool cooling system is safety related, and cleanup system is non-safety related and is composed of two 100 percent capacity. To preclude minimum spent fuel pool water level to provide proper shielding.

All the piping that penetrates the pool is located at approximately three meter above the top of the spent fuel assemblies, and all the piping extending down into the pool has siphon breaker holes above this level. The cooling system is designed to maintain the spent fuel pool temperature below 60 degrees Celsius in a single active failure.

CHAIRMAN BALLINGER: I have a question, which I couldn't find the answer in the reading. With the spent fuel pool level down to three meters above the top of the fuel, by some accident, if you will, what's the dose rate above that?

MR. M. KIM: Let me tell again your question to clarify your question. You want to know if the water level fell down about --

CHAIRMAN BALLINGER: I said three meters above the top of the fuel, because you can't get below that without boil off, what's the dose rate to people under those conditions?

MR. M. KIM: This condition, we have some regulation criteria.

CHAIRMAN BALLINGER: That's what I

thought, but I couldn't find the answer.

MR. M. KIM: (Simultaneous speaking) 2.5 millirem for hour is the regulation requirement for radiation exposure to the operator.

CHAIRMAN BALLINGER: That's with that three meters? Okay, thank you. I read the 2.5 millirems, but I didn't associate it with the three meters.

MR. M. KIM: Thank you for your comment. This slide shows a schematic diagram of the system. As you see, the spent fuel on the right side, and the other pool is shown. There is two pumps, so in case of a failure of one pump, the standby pump can start manually. This is just for the cooling system. Let me go to the next slide.

This section is for the light load handling system. Light load handling system is means the fuel handling system. The main function is to remove spent fuel from the reactor and replace it with new fuel and receive and store new fuel and store and ship spent fuel and remove and replace. For the safety operation, this system has the following design considerations. This system operates under adequately safety condition during natural phenomena, and the system is designed in accordance with ANSI/ANS 57.1. This system also designed to prevent unacceptable radioactivity release and unacceptable radiation exposure and criticality accidents.

The major system of this light load handling system are electrically interlocked with each other, and mechanical stops provide in both the refueling machine and spent fuel handling machine restrict withdrawal of the spent fuel assembly. When the fuel is carried, the grapple is mechanically interlocked against the inadvertent opening. Now I tell about the light load handling system very briefly.

Next section is 9.1.5 is for overhead heavy load handling system. This system performs non-safety related function. This system handles critically heavy loads in the fuel handling area of the auxiliary building and the reactor vessel area of the reactor containment building. The containment polar crane and fuel handling area overhead crane transfer the largest heavy load of the spent fuel shipping cask and to lift the integrated head assembly and reactor vessel internals during refueling, respectively. The containment polar crane shall be designed to provide single-failure-proof features, in accordance with the requirement of NUREG-0554 and 0612. The fuel handling area overhead crane handles critically heavy loads without single-failure-proof feature.

It restricts from moving heavy loads over the spent fuel pool by the permanent mechanical stop installed on the raise. It's limited to moving in such a manner as to avoid the possibility of falling into the pool, in accordance with the guideline of NUREG-0612. Thank you for your attention. I finished the section 9.1, so next --

MR. SCHULTZ: Excuse me. Before we move on to 9.2, water systems, I had a question about the METAMIC material. That material now has a fairly robust history, around ten years of operating experience. Is that true? How much operating experience does METAMIC have in spent fuel pool --

PARTICIPANT: METAMIC?

MR. SCHULTZ: Yes.

MR. HAN: Let me answer the question. It's the neutron absorbing material. I'm sorry, but expert about the METAMIC should be presented in 9.1.2, but it's delayed, so the expert is not here, so we cannot answer right now.

MR. SCHULTZ: But more information will be coming related to that? I'm sorry. Thank you.

MR. YESHNIK: METAMIC has about ten years' operating experience in nuclear power plant spent fuel pools.

MR. SCHULTZ: There's also a program for a coupon --

MR. YESHNIK: Correct.

MR. SCHULTZ: -- testing and so forth that goes with the material installation?

MR. YESHNIK: That's correct, and it is in the SR.

MEMBER BROWN: Give us your name, please.

MR. YESHNIK: This is Andrew Yeshnik. I'm in the Materials and Chemical Engineering Branch.

MR. SCHULTZ: Andrew, I understood there's a testing program and coupons will be inserted, but I didn't get information related to how that program then proceeds. Is there, then, a requirement for testing at certain time frame?

MR. YESHNIK: Yes, there is a table that describes when the coupons will be taken out. There's also the criteria that the coupons will be measured against, its neutron tenuation, looking at the thickness of the material, and any discoloration/blistering that may occur. The implementation is something that would be created, most likely, during the initial test phase or during construction.

MR. SCHULTZ: That's fine. Has that been implemented in the past with other licensees? METAMIC's been used for ten years, so the coupon testing has been ongoing, also?

MR. YESHNIK: Yes.

MR. SCHULTZ: Any deviations worthy of note?

MR. YESHNIK: We haven't seen anything yet. Everything's come back perfectly fine.

MR. SCHULTZ: Great, thank you.

CHAIRMAN BALLINGER: Just to clarify, this is METAMIC, not METAMIC HT?

MR. YESHNIK: Correct, not HT.

CHAIRMAN BALLINGER: Not HT.

MEMBER SKILLMAN: I would like to ask this question. Let me divert your attention back to Slide 6, please.

MR. SISK: This is Rob Sisk. One second, if I can. I just want to close out the METAMIC discussion.

PARTICIPANT: Excuse me, Rob, go ahead.

MR. SISK: Mr. Schultz is interested in 9124, on Page 9119. There is a discussion on the coupon surveillance program, the neutron absorbing material of METAMIC. There is some area there for you to get some background on how APR1400 is addressing the METAMIC issue.

MEMBER SKILLMAN: Thank you.

MR. M. KIM: Okay, thank you for your attention. Next --

MEMBER SKILLMAN: Let me ask this question. On this image on Slide 6, you show the spent fuel racks.

MR. M. KIM: Yes.

MEMBER SKILLMAN: On your Slide 14, at your second bullet, you communicate that you will -- let me see what I'm looking at. The intent is to make sure that the fuel assemblies are not injured, mechanically not injured. My question is what consideration have you given to a coal item for rack alignment?

MR. M. KIM: Rack alignment?

MEMBER SKILLMAN: Alignment of your fuel racks. Because the fuel racks are below your light load handling system. The ability to insert and withdraw, particularly an irradiated and bowed assembly, depends on the ability of the handling equipment to grasp plumb in the center of the cell.

If the racks are not aligned at original construction, you have the capability of raking your fuel assemblies and damaging them. My question is have you given consideration to the specificity of the alignment of your racks, as they relate to your light load handling system?

MR. M. KIM: Fuel handling each month considers many unexpected conditions. I try to, at this time, tell about only for our system. Many machine, for example, the refueling machine and spent fuel handling machine have some programmer over logic controller, with (unintelligible) coordinator.

The first time, maybe, the machine go into the designated locations, but if the rack accidentally misaligned and not placed in a correct position, when the machine load the fuel into the rack, maybe there's contact happen, yes. In that case, the motion catch the load tangent from the load cell, and also, operator watch the train level (phonetic) load transition. If the load is changed (unintelligible) level, the machine automatically stops loading. Another system is supported to safe operation is the camera system. Operator simultaneously watch the loading condition and the rack location with the camera. This is some safety function for the fuel handling light load handling system.

MR. OH: This is Andy Oh, KHNP Washington Office. In addition to Mr. Kim's comment about the fuel handling machine, we also have some call action items for periodic inspection program of spent fuel lack integrity to ensure that the design basis material and geometric assumption remain valid during the operating life of plant. That can also give you some credit to the right place for that spent fuel pool in a spent fuel pool lab.

MEMBER SKILLMAN: Thank you. I've made my point. What I wanted to really communicate is unless there is a precise alignment for bridge and trolley in the location of the cells, you have the great opportunity to rake the spacer grids and do damage. If you have a thrice-burned assembly that is bowed, and that assembly doesn't really want to go into that cell, you can end up destroying the fuel assembly in the cell. If you are very precise about your rack alignment at construction, you may save yourself great effort as the plant lives. Thank you.

MR. SCHULTZ: One more question on Section 1. Could you describe the spent fuel pool level monitoring system and the information that's available in the control room? I understand there's an enunciator for high level, low level, low low level, but what other information does the control room operator have regarding spent fuel pool level, and how is it obtained?

MR. OH: This is Andy Oh, KHNP Washington Office. In an MCR, regarding the spent fuel pool, there's temperature and level that's displayed in MCR display.

MR. SCHULTZ: That's a clear and constant display?

PARTICIPANT: Right.

MR. SCHULTZ: Thank you.

MS. BURJA: This is Alex Burja, from the staff. I just wanted to add, on the rack alignment question, there's an ITAAC to verify the layouts.

MEMBER SKILLMAN: Thank you, Alex.

CHAIRMAN BALLINGER: Along those lines, Dick was talking about going in. I'm talking about coming out. I think I read that a spent fuel assembly weighs about 1,700 pounds, round numbers, but that the light load handling machine is incapable of going over 1,900 pounds. Is there a physical limit on the machine, itself, that prevents you from applying an enormous amount of force that would destroy an assembly?

Is there a physical limit on the machine, itself, not just a load cell limit, but a physical limit on the ability of the machine to apply a force to pull something out of the rack which would destroy the assembly?

MR. M. KIM: Except design capability of hoisting is 2,000 pounds.

PARTICIPANT: 2,000? Okay.

PARTICIPANT: Thank you.

MR. M. KIM: Thank you very much. Youggun Kim will continue the --

MEMBER POWERS: Not going to get away that easy.

MR. M. KIM: Okay.

MEMBER POWERS: Nice try.

PARTICIPANT: You're in trouble.

MEMBER POWERS: Can I come back to your cleanup system, spent fuel cleanup system? What are you cleaning? What are you removing?

MR. Y. KIM: I'm Youggun Kim, KHNP. The spent fuel pool cleanup system cleans the water of the spent fuel pool and the fuel transport canal and the refueling pool, also IRWST.

MEMBER POWERS: What I'm interested in is what are you trying to remove?

MR. Y. KIM: Any suspended solid or the -- any crud maybe inside the pool will be --

MEMBER POWERS: But it's just particulate material? You're not trying to keep the solvent levels any particular concentration?

MR. Y. KIM: The material name you mean?

MEMBER POWERS: No.

MR. Y. KIM: Yes, also, the cleanup system has the filters and the demineralizer, so it can clean up the chemistry, the radioactivity, radioactive material in the pool.

MEMBER POWERS: So you're removing anions or cations or both?

MR. Y. KIM: Excuse me?

MEMBER POWERS: Are you just removing cations, or are you removing --

MR. Y. KIM: It's the mixed bed ion exchanger, so cation and anion, so two items can be controlled.

MEMBER POWERS: What do you anticipate your biggest contaminants to be? Where is your contamination coming from in the spent fuel pool?

MR. Y. KIM: Could you say again, please?

MR. SISK: This is Rob Sisk, Westinghouse. The individual that could best answer that question isn't available at this point. We'll take a note on that and (Simultaneous speaking).

MEMBER POWERS: It would seem to me that

the biggest contaminant is probably just dirt, so you get a lot of unknown kinds of materials. It's a lot of goethite and a lot of aluminum oxide, a little silica. Silica is really bad for your cleanup (Simultaneous speaking).

MR. SISK: Dissolved solids.

MEMBER POWERS: It then becomes interesting what the mean lifetime is on suspended solids and dissolved materials in the spent fuel pools.

MEMBER SKILLMAN: I need to follow up. I hadn't considered this in my review. At least my experience has been you will have some weepers. You'll have some leaking fuel assemblies. When those come into the spent fuel pool, the one to one anion/cation demineralizers are there to make sure that the dose rate at the top of the pool allows spent fuel operations to continue. I would question what the design limit is for failed fuel that has been transferred from the reactor vessel into the spent fuel pool. I presume it's something in the order of 1 percent.

MR. Y. KIM: The specific material to be cleaned by the cleanup system to be checked. So I cannot define any -- here, define the material here so I already check it.

MEMBER SKILLMAN: I'm checking on the DCD.

I did not check this question, but I've been at plants where there is 1 percent or so failed fuel. The cleanup system is the only remedy for that when the fuel comes over into the spent fuel pool. Those demineralizers are picking up predominantly cesium and strontium.

MR. Y. KIM: The cleanup system actually doesn't cause any accident in the spent fuel pool, like a failed fuel rod, but it can be -- the cleanup system has the demineralizer, so it can be controlled. It can control the radioactive material.

MEMBER SKILLMAN: This would be a good one to bring back. We can leave it there.

MR. SISK: At the break, we'll talk about this.

CHAIRMAN BALLINGER: Let's be clear on the question. The presumption is that in theory, the reactor can sustain 1 percent failed fuel. If you offload one third of the core that has 1 percent failed fuel, will the cleanup system be able to deal with that? Is that an accurate representation of what you're saying?

MEMBER SKILLMAN: Approximately, yes.

MR. Y. KIM: I need to check it. Good morning, everyone. My name is Youggun Kim from KEPCO E&C. I would like to introduce the water systems for

APR1400 listed on this slide. I will cover the systems from Subsection 9.2.1 to 9.2.5 and from 9.2.6 to 9.2.9 will be introduced by one of my colleagues at my right side. First is the essential service water system, short ESWS.

The function of the ESWS is to transfer heat from the component cooling water system to ultimate heat sink cooling tower during all modes of operation. The ESWS consists of two independent, redundant, and once-through safety-related divisions. Each division cools one of the two divisions of the component cooling water system, which cools 100 percent of the safety-related loads. The measures to prevent long-term corrosion and organic fouling will be provided by the COL applicant considering the ultimate heat sink design and the site conditions. The ultimate heat sink basin screen in the cooling tower design and the ESW filters are provided to prevent clogging the system. ESWS is designed to minimize the potential for the water hammer by following the guidance in the NUREG-0927.

MEMBER SUNSERI: I had a question about that. When I look at your detailed drawing -- I know you've got a simplified drawing on the next page -- in the text of the DCD, it describes the flow path for the discharge of ESW pump to be continuous from the discharge of the pump to the ultimate heat sink. I don't understand how that can physically happen because it takes suction off the ultimate heat sink, also.

It has to go up, and then come back down. I'm suspecting that the high point is going to be somewhere near the component water heat exchanger. So it's going to come up to the component heat exchanger. In fact, the drawing says that there's high point vents at the highest elevation, around there. That's the setup for my question. My question is you say your design for water hammer, you've taken the water hammer considerations from the NUREG-0927. I think this design appears to me to be vulnerable to column separation because in the event of a loss of offsite power, the pumps are going to stop. The water on the down leg side of the heat exchanger is going to start draining to the ultimate heat sink.

The discharge check valve is going to keep the other side full, so you're going to get column separation on the downstream side of the heat exchanger. In a minute or 45 seconds or whatever, the sequencer brings that essential service water back on, you're going to collapse that bubble and have water hammer. I've seen this happen, and it's severe.

I guess it appears that there's nothing in the design that accounts for that because NUREG-0927 talks about keep-full systems and backing breakers and such, but I see it looks like this application is passing all of that off to the COL applicant to design the water hammer system. Can you comment on this?

MR. Y. KIM: Like I just said, we are considering the column separation at the high point of the downstream of the system exchanger. As you said, there is the backing breaker in the system. The water hammer I mentioned in this slide is that the feature of operation of the one division pumps, as you see in this slide, there's two pumps in one division. In normal operation, only one pump is in operation, but they are switching each other periodically. In that operation, the water hammer can be happened in accordance with NUREG-0927. So we are considering the design of the check variable as the tilting disk time. The prevention of the -- minimizing the potential for water hammer in this slide is meaning that we are considering the check variable time as the tilting disk.

MEMBER STETKAR: Do you want me to try it, or do you want to try it again?

PARTICIPANT: You go ahead.

MEMBER STETKAR: Do not consider normal operation. Consider a loss of offsite power, all pumps stop. Got it?

MR. Y. KIM: Yes.

MEMBER STETKAR: On the downstream side of the CCW heat exchangers, so to the right of the CCW heat exchangers, drains, by gravity flow, back to the ultimate heat sink. The upstream side, between the heat exchanger and the pumps, remains full. Now, you start the pumps. What happens?

MR. Y. KIM: Actually, we are calculating that transit considering the configuration and the drain operation, the drain status. As I said, there is the vacuum breaker. If the whole pump is stopped and the high point is drained, then there will be a vacuum. Then the vacuum breaker will open, and the air will come to the system. It makes the opposite vacuum to be removed.

MEMBER SUNSERI: I hear you talking about a vacuum breaker. Can you tell me where this vacuum breaker is on this drawing?

MR. Y. KIM: This is just the schematic drawing, so I didn't put the details.

MEMBER SUNSERI: The detailed drawing is Figure 9.0.1-1 on --

MR. Y. KIM: (Simultaneous speaking.)

MEMBER SUNSERI: -- Page 278 of the DCD.

MR. Y. KIM: DCD Figure 9.2.1-1, there is the systems currently -- the flow diagram. There is a vacuum breaker in each division, downstream of the CCW exchanger.

MEMBER SUNSERI: Is that the component that's labeled TEWO-052? I don't see a vacuum breaker on this drawing.

MR. Y. KIM: The Figure 9.2.1-1.

(Simultaneous speaking.)

PARTICIPANT: What is this thing here?

PARTICIPANT: That's a vent.

PARTICIPANT: Is that a vent? I don't know what symbol stands for.

PARTICIPANT: That makes a funny looking symbol, too, but it says it's a vent for a chemistry addition, online chemistry addition is what the note says.

MEMBER STETKAR: I don't know whether those things that look like reliefs might be vacuum breakers (Simultaneous speaking). That's about the only thing that --

MEMBER SUNSERI: But the note associated with (Simultaneous speaking).

MEMBER STETKAR: No, the note's associated with the manual valve to the left of those.

MEMBER SUNSERI: Are you look at Note 2?

MEMBER STETKAR: Yes. If you look at Train 1, 1041 is the valve number up at the top of the drawing, 1041 is the thing that looks like a relief valve.

MEMBER SUNSERI: Oh, I see what you're saying. I thought that was (Simultaneous speaking).

MEMBER STETKAR: Note 2 is on the manual valve, 2033.

MEMBER SUNSERI: That looks to me like the ASME code required (Simultaneous speaking) thermal relief valve for the heat exchanger.

MEMBER STETKAR: It does, and it's a small line. It's a three-quarter-inch line.

MR. Y. KIM: Excuse me. In the reference plant for it, the APR1400, we used the sea level as the ultimate heat sink.

PARTICIPANT: I'm sorry; could you say that again?

MR. Y. KIM: In the reference plant for the APR1400, we used sea water as the ultimate heat sink. In that case, we made the vacuum breaker downstream of the CCW exchanger. But in the APR1400 design, we have not decided that the application of the vacuum breaker considering the ultimate heat sink.

Ultimate heat sink now is the conceptual design. The back pressure from the ultimate heat sink is not decided yet, so I think that the vacuum breaker application on the APR1400 ESWS has not been decided. The vacuum breaker application could be decided after the design of ultimate heat sink is determined.

MEMBER SUNSERI: The several statements -- there's the table on what is passed on to the COL applicant. There's several statements about water hammer and water hammer mitigation and procedures and such. Essentially -- because what I hear you saying is because you don't know what the site-specific elevations and how it's going to be laid out, you're passing this design aspect on to the COL applicant, is that accurate?

MR. SISK: Ultimately, the layout will dictate a little bit of where the high points, low points, vacuum breaker, yes --

MEMBER SUNSERI: You might want to look at that section of the DCD and just clarify it. Because it does say that the pump discharges from the discharge continuously upward to the ultimate heat sink, which can't be accurate. Thank you.

MR. SISK: Rob Sisk again. Thank you. We've noted that, and we'll take a look at that.

MR. Y. KIM: Thank you for your comments. I'll move to Section 9.2.2 for component cooling water system. The function of the component cooling water system, in short CCWS, is removing heat from the safety-related components required for plant emergency shutdown and mitigation of design basis accidents. CCWS provides an intermediate barrier between radioactive or potentially radioactive systems and essential service water system to reduce possibility of the radioactivity leakage to environment. CCWS consists of two safety-related divisions that are separate and independent, redundant. CCWS is designed as a closed loop. Each division is capable of supporting 100 percent of cooling requirements of safe shutdown following postulated accident coincident with LOOP. The CCWS designed to minimize the potential for water hammer, in accordance with the guidance in NUREG-0927.

The CCW supply to the RCP coolers is isolated on the low low surge tank level signal. This signal can be overriden by manual operation from the MCR to protect the RCP seal. This is the schematic diagram of the CCWS. The CCWS consists of two safety-related divisions, and each safety division includes three CCW exchangers, one CCW surge tank, two CCW pumps, and one chemical addition tank and the CCW radiation monitor. Piping and instruments are also included in the schematic diagram in the CCWS.

MEMBER STETKAR: Mr. Kim, a couple of questions about CCW. CCW supplies cooling to the reactor coolant pump, thermal barrier heat exchangers, the bearing oil coolers, and the motor coolers.

MR. Y. KIM: That's right.

MEMBER STETKAR: Do the reactor coolant pumps receive an automatic signal to trip if they do not have coolant?

MR. Y. KIM: You mean the RSP has the design to be around what we are noticed by the vendor CCWS is not supplied. Is that right?

MEMBER STETKAR: I'm asking are they -- some designs have an automatic trip signal for their reactor coolant pumps. I have seen these things. They are not common. I'm asking whether your design has an automatic trip signal for the reactor coolant pumps if you lose component cooling water flow?

MR. Y. KIM: The CCWS system does not provide any signal to RCP design.

MEMBER STETKAR: If I isolate component

cooling water to the reactor coolant pumps, if there's no component cooling water flow to the reactor coolant pumps, how long can a pump remain running before you have mechanical damage to the pump and mechanical damage to the seals due to loss of bearing cooling?

You may not have that information, but I'd like that information. If the pumps are not tripped automatically, it means the operators must trip the pump. That means there is some time during which the operators must recognize the loss of cooling and manually trip the pumps. If they have high vibration due to loss of bearing cooling, due to loss of oil cooling, you can have mechanical damage. Mechanical damage to the seals, not thermal damage.

MR. Y. KIM: I understand your comment. Actually, the question needs to be answered by the expert of the RCP. In this place, we don't have the engineer for --

MEMBER STETKAR: No. One of the things that we do on ACRS is to try to integrate the whole plant. Therefore, although this is not necessarily a question about component cooling water, it's a question about how loss of component cooling water affects something else. I recognize that you're not the (Simultaneous speaking).

MR. OH: This is Andy Oh, KHNP Washington Office. For the answer for the first question, there's no automatic trip signal for when the loss of CCW case for the RCP. Second is that can be taken care of based on normal operations procedure? There's two cases, loss of CCW only and loss of CCW and loss of injection water, so ceiling water. In the first case, when loss of CCW, we have ten minutes available time for operator to manually shut down RCP.

MEMBER STETKAR: Andy, I'm always skeptical of ten minutes because ten minutes is something that lawyers put in legal requirements. It is typically not from the pump manufacturer. I'm asking, from your pump manufacturer, how long is it? Maybe it's 37 minutes. I don't know. Ten minutes is just a requirement that people use for testing.

MR. OH: Based on it for the reference plan and normal procedure, that procedure that's described that the operator have to do some manual action within ten minutes when the loss of CCW. In case of loss of CCW and seal injection, most cases, operator have to manual trip for RCP within three minutes.

MEMBER STETKAR: Three?

MR. OH: Three minutes.

MEMBER STETKAR: Thirty, three zero?

MR. OH: No, three.

MEMBER STETKAR: Three?

MR. OH: Three.

MEMBER STETKAR: Three. That's a little closer to what I've heard from some plant manufacturers, but even there, there's uncertainty.

MR. OH: Because it's per the APR1400 and combustion engineering plants, even there's a loss of CCW, still, if the seal injection is available, some seal injection water can do the work of the cooling function.

MEMBER STETKAR: But again, I'm not concerned about the traditional cooling of the seals. I'm concerned about a large rotating pump, with no oil cooling and no bearing cooling. Having burned up a large rotating pump, or that's actually a main turbine, after loss of oil cooling for the main turbine, you get a lot of very high vibrations before things go really bad.

Depending on the clearance on your seals, you can get mechanical rubbing of those seals and damage to the seals, such that even after you trip the pump, that seal gap is open. That's the failure mode. It's not the traditional loss of cooling to a stationary reactor coolant pump. Anyway, take it back to your pump manufacturer. It's really a pump manufacturer question. I don't recall whether I asked it when we were talking about the reactor coolant pumps or not.

MR. SISK: That's what I was trying to (Simultaneous speaking).

MEMBER STETKAR: I can't remember. I have too many notes, Rob.

MR. SISK: I understand, but it does sound like it's more pointed to the reactor core, so we're going to write that down (Simultaneous speaking).

MEMBER STETKAR: Yes. No, it's the pump manufacturer, but the key is don't focus on cooling to the thermal barrier cooler for the seal. Focus on the pump is running with no cooling to anything, no component cooling. You might have seal injection. I'll ask a question in a few minutes about that.

MR. SISK: I think the question do you have no cooling or do you have no water flowing in? Because you can lose cooling, or you can lose the water actually flowing. In other words, the heat exchanger's not working, but the water's flowing.

MEMBER STETKAR: Isolate the flow. Because there are failure modes where you will have no flow. You'll have stagnant water.

MR. SISK: Understood, thank you.

MEMBER STETKAR: That's the worst condition, in terms of the time. I do have one question, though, that I hope I can get answered. In the DCD -- if you want the section numbers, I can give them to you, but let me just ask the general question. I know during normal operation, you have one component cooling water pump running in each division and one ESW pump running in each division. You need that. In the DCD, it says that, for example, in Section 9.2, four component cooling water pumps and six component cooling water heat exchangers in both divisions are required to accomplish a normal shutdown. That says that when I shut down the plant for refueling outage, you typically start all of the ESW pumps and all of the component cooling water pumps. First of all, is that necessary? Second of all, is it the normal practice at the reference plant?

MR. Y. KIM: Yes, that's correct.

MEMBER STETKAR: That's the normal practice?

MR. Y. KIM: That's right.

MEMBER STETKAR: The reason I ask this is it's not consistent -- the PRA models for shutdown are not consistent with that. The PRA models for shutdown assume that one pump -- one CCW pump and one ESW pump is running all the time during the outage.

MR. Y. KIM: During the outage.

MEMBER STETKAR: From power operation through the first part of the outage, through the normal outage, and into startup. This is, again -- I wanted to confirm that the information in the DCD is correct and consistent with actual practice. That's the important thing. If it is, then this is a PRA modeling question, it's not a system question. But the PRA model should be consistent with how the system is actually operated.

MR. Y. KIM: I think I need to check that (Simultaneous speaking).

MEMBER STETKAR: But the DCD is -- in both Section 9.2.1 and Section 9.2.2, the statements are made that for -- it says basically all four ESW pumps, all four CCW pumps, and all six component cooling water heat exchangers are required for a normal shutdown to achieve 60 degrees C within 24 hours. Typically, during refueling outage, you want to get as cold as you can, as fast as you can, so you can start moving fuel.

MR. Y. KIM: I don't know about, actually, the PRA assertion, but if they are concerning the safe shutdown mode --

MEMBER STETKAR: No, this is just --

MR. Y. KIM: (Simultaneous speaking) normal shutdown --

MEMBER STETKAR: The PRA should establish an operating configuration that is consistent with the actual plant configuration. If the actual plant has all of the pumps running, then the PRA initial conditions for that part of the outage should have that number of pumps running. It makes a difference in the PRA whether a pump is in standby or whether it's normally running, in terms of failure modes and failure rates and things. We try to make the PRA realistic, compared to how the plant is actually operating. Again, that's a PRA question. I just wanted to confirm that the information in the DCD is consistent with actual practice. Then the PRA has the problem of making the models correct.

PARTICIPANT: Thank you.

MR. Y. KIM: Thank you. Then I will move to Subsection 9.2.3. This is the reserved subsection. I will go to Subsection 9.2.4. This is the section for the domestic water and sanitary systems. Domestic water and sanitary system does not perform safety-related function. The function of the domestic water system is to supply potable water for domestic use in the plant site.

The function of the sanitary drainage system is to collect and transfer non-radioactive sanitary water to the sanitary water treatment facility for treatment and to discharge. These systems, they're designed as a conceptual design information with the following requirements. These systems are protected against radioactive contamination through all branches of the system supplying plumbing fixtures by installing backflow prevention devices. Also, there is no interconnection with the potential to contain radioactive material.

MEMBER SKILLMAN: Could I ask you to consider how the sanitary system will be handled if you have workers that have been subjected to nuclear medications?

MR. Y. KIM: Nuclear medications?

MEMBER SKILLMAN: Yes. I will leave it at that. I would just simply suggest that if your sanitary system ignores radioactive waste, you may be surprised. Because in the cultures in which we live, radioactive medications and radioactive procedures have become very common. You will have workers who will arrive who have either come out of a hospital or come out of some treatment, and your sanitary systems will all of a sudden be radioactive, when you didn't expect them to be. Unless you've designed capability into those systems, you're going to be surprised.

MR. SISK: Again, thank you for the comment. That's something we'll certainly document and go back and take a look at.

MR. Y. KIM: On the next page, the ultimate heat sink, in Subsection 9.2.5. The ultimate heat sink is a site-specific system. The COL applicant is to provide ultimate heat sink related design information based on the site-specific characteristics, including the meteorological conditions. The UHS cooling tower system is provided as a conceptual design for APR1400 design certificate. The ultimate heat sink cooling tower has a function to dissipate the heat transferred from the ESWS to air.

The UHS supplies cooling water for at least 30 days for safe shutdown without makeup water under the worst combination of adverse environmental conditions. The UHS system consists of two independent, redundant, safety-related divisions. Each division removes 100 percent of design heat load from ESWS. The UHS provides cooling capacity at 30 days without makeup water, assuming the worst meteorological data.

The UHS basin screen in the cooling tower design and the ESW filter are provided to prevent clogging. This is the schematic diagram for UHS provided as the conceptual design for APR1400. The UHS consists of two independent, redundant divisions. Each division consists of two 100 percent capacity UHS cooling towers and one common UHS cooling tower basin. Piping barriers considering INC provisions. UHS cooling tower is composed of three cooling tower fans, as shown in the schematic diagram. This is the end of my presentation for 9.2. From now on, Mr. Hancheol Kim, right next side of me, will introduce the remaining system in Section 9.2.

MR. H. KIM: This is Hancheol Kim from KEPCO E&C. This slide shows condensate storage facilities. This system consists of two systems, makeup demineralizer system and condensate storage and transfer system. The makeup demineralizer system does not perform any safety function, except for containment isolation portion.

Also, the condensate storage and transfer system has no safety function. The WM system provides the demineralized water to auxiliary feedwater storage tank, condensate storage tank, reactor makeup water tank, and so on. The CT system provides demineralized water from the WM system and provide condensate by means of gravity to the following equipment, condenser hotwell, auxiliary feedwater pump suction as alternate non-safety backup supply, and miscellaneous condensate makeup demands.

The WM system consists of 100 percent demineralized water storage tank, two 100 percent demineralized water transfer pumps, two 100 percent membrane oxygen removal subsystem, associated piping, and valves. The CT system consists of two 50 percent capacity condensate storage tanks, associated piping, and valves. Here is the simplified schematic diagram of condensate storage facilities. Next, chilled water system. APR1400 has two chilled water systems, essential chilled water system and plant chilled water system.

ECWS performs safety-related functions and provides chilled water to safety-related AHUs and cubicle coolers during normal operation and accidents. PCWS performs non-safety related functions and provides chilled water to non-safety related AHUs and cubicle coolers during normal operation and LOOP. The CIVs initiate automatically closure upon a receipt of CIAS.

Design features. ECWS consists of two independent and redundant divisions. Each division consists of two 100 percent capacity chillers, two 100 percent capacity pumps, a makeup pump, a compression tank, and a chemical additive tank. ECWS consists of central chilled water subsystem and compound building chilled water subsystem. The central chilled water subsystem within the building, reactor containment building, and the turbine generator building, and the compound building chilled water subsystem compound building. The central chilled water subsystem consists of four 33 percent capacity chillers, two 100 percent capacity pups, a compression tank, and chemical additive tank. The compound building chilled water subsystem consists of three 50 percent chillers, two 100 percent pumps, a compression tank, and a chemical additive tank.

MEMBER STETKAR: Mr. Kim, on the preceding slide -- just leave it -- said that the plant chilled water system performs non-safety related functions, except for containment isolation. Figure 9.2.7-2 and Table 9.4.3-1 in the DCD indicates that the normal plant chilled water system provides cooling for the turbine-driven auxiliary feedwater pumps.

Turbine-driven auxiliary feedwater pumps are safety related pumps. Why does the normal plant chilled water system provide cooling for the safety related turbine-driven auxiliary feedwater pump room?

MR. H. KIM: I'll explain about. This page explains to you safety related system, the cooled area where safety related equipment is located. Turbine driven, if pump is safety related and in usable condition, however no safety related equipment is installed in the room, it does not serve the cooling function at the actual condition. The reason why non-safety cooler is applied for the room is that room is high energy line breaker area that ECWS system could be damaged at the high energy line breaker area, a break accident. We put safety related equipment installed, for example, ECWS piping. ECWS is closed-loop system. In the case of accident occurring in the room, the ECWS piping will be broke. It will be broken if the accident damaged the ECWS. When we designed the ECWS, we considered this problem, and we determined concept chiller, but we have another alternative to issue of the operability, the turbine driven pump full, we conducted HEDOC (phonetic) calculation.

According to the result of HEDOC calculation, the operability turbine driven pump is qualified to guarantee the operating. The pump at room temperature is the maximum temperature is expected 116

Fahrenheit degrees for 24 hours (unintelligible) including related instruments, such as flow transmitter, pressure transmitter, this qualified at the maximum temperature 116 Fahrenheit degree and for 24 hours. The turbine driven auxiliary pump is operable at 24 hours.

MEMBER STETKAR: So you have room heatup analyses that show that the maximum temperature in that room, with no cooling, is less than 116 degrees Fahrenheit after 24 hours, is that -- did I understand you correctly? That's true?

(Simultaneous speaking.)

MEMBER STETKAR: I'd like to see those room heatup calculations.

PARTICIPANT: Can I have --

MEMBER STETKAR: What I hear is you're concerned because you have a high energy steam line in there, which is why you don't want a safety related chilled water system in there. That high energy steam line is really hot; 116 degrees Fahrenheit is not very warm. It's either a really well insulated steam line and a really well insulated turbine, or it's a really, really big room.

MR. OH: This is Andy Oh, KHNP Washington Office. A turbine driven pump center without any providing for cooling that room, we have some of the room cooling calculation, and also, we provided that material to the NRC. NRC audited that material and based on the recert the turbine-driven pump can be operated without any -- providing some room cooling.

MEMBER STETKAR: That's turbine driven pump, but there are other things in that room, like the auxiliary feedwater flow control valve, flow transmitters, as you mentioned, the auxiliary feedwater isolation valve. Those are all motor operated modulating valves. They're actually solenoid operated. All of that equipment needs to be able to survive, not just the turbine, itself.

MR. OH: For the motor operated isolation valve, it's not located in turbine (Simultaneous speaking).

MEMBER STETKAR: It is not? Where is it located?

MR. OH: It's next to the room or some other room, not the same room.

MEMBER STETKAR: Not the same room? Okay.

MEMBER SUNSERI: How about the governor controls for the pump, turbine governor?

MR. HEO: This is Heo Gun. I will give additional information, motor driven. There is --

(Simultaneous speaking).

MEMBER STETKAR: We're not talking about motor driven. We're talking only about turbine driven. Motor driven are cooled by the central chilled water system.

CHAIRMAN BALLINGER: Has the question been asked and answered satisfactorily?

MEMBER STETKAR: No, I said I'd like to see the room heatup calculations.

CHAIRMAN BALLINGER: I'm just trying to get the short form answer.

MEMBER STETKAR: Part of the problem is they said 24 hours. If temperature is going like this at 24 hours, and at 25 hours, it becomes really bad, then it's not clear that's success.

MR. H. KIM: Now, I present about turbine generator building closed cooling water system, short TGBCCWS. TGBCCWS system performs no safety function. This system provides continuous supply of cooling water for removing the heat from the turbine building and other non-safety related components.

The removed heat is rejected to the TGBOCWS system through TGBCCW heat exchange. TGBCCW system includes the independent closed loop cooling system that allows operation of air compressors when the TGBCCW system is not available. TGBCCW system consists of three 50 percent heat exchangers, two 100 percent pumps, one surge tank, one chemical addition tank, associated piping, valves and instruments.

Turbine generator building open cooling water system, short TGBOCW. TGBOCW does not perform safety-related function. The function of the system is to supply sufficient cooling water to the TGBCCW heat exchangers during all modes of plant operation with the circulating water system. This system consists of two strainers, valves, associated piping, and instrumentation. Cooling water for the system is supplied from the circulating water pumps. Operating pressure with the system is lower. TGBCCWS operating pressure to prevent TGBCCWS system contamination. This is the end of 9.2 presentation. Next.

MR. Y. KIM: Next is the process auxiliaries. I'm Youggun Kim. This section covers --

MEMBER STETKAR: I'm sorry; let me ask one question about the water systems. I forgot. The DCD Chapter 9 contains no information about the raw water system.

PARTICIPANT: Raw water system.

MEMBER STETKAR: Raw water system. I've asked this question a couple of times, but since we're talking about water systems, I want to pull together the information. The information I can find in the whole DCD is that the raw water storage tank is the makeup supply for the auxiliary feedwater system. Is that correct?

MR. H. KIM: My colleague will explain about it.

MR. LIM: This is Dunam Lim from KEPCO E&C. (Unintelligible) storage tank in emergency condition.

MEMBER STETKAR: I find different times to drain the auxiliary feedwater storage tanks, depending on assumptions of heat loads. Those times run anywhere from about 162 hours out to about 30 hours. If the 162 hours is correct under certain heat loads, it means that I must use the raw water tank to make up to the auxiliary feedwater storage tank within 24 hours. That's one function. I know that the raw water tank also is the suction supply for the emergency containment spray backup system.

MR. LIM: That's right.

MEMBER STETKAR: And it is the suction supply for the other FLEX type makeup pumps. Those makeup pumps and the ECSBS have requirements for a certain amount of water inventory, and they have requirements for a certain seismic design of the tank and the connected piping, so that they can survive the nominal conditions that FLEX is designed for.

I would think that the design certification document would at least specify the required volume of storage and basic structural design requirements for the raw water system, so that a combined license applicant knows, in one place, what they need to provide. I cannot find that information anywhere in the DCD. My question is why does the DCD not at least specify those basic design requirements, in terms of required storage capacity and, if nothing else, structural seismic design requirements for the tank, itself, and the connected piping?

MR. LIM: I am Dunam Lim from KEPCO E&C. Actually, our DCD does not state the load system goes the Reg Guide 1.2.06 does not require to cast (phonetic) system.

MEMBER STETKAR: Okay, let me interrupt you right there. If that is the case, then your DCD cannot take credit for the emergency containment spray backup system, the FLEX systems, or makeup to the auxiliary feedwater storage tank, which you do take credit for. You cannot have it both -- I don't care about regulatory guides. I care about design of the plant.

MR. LIM: Yes, I see. As I know the raw water system, such as raw water storage tank, considering site-specific condition, such as capacity of source or quality of source and so on. Raw water storage tank and associated piping from the tank to the proxy command (phonetic) or emergency connection designed as Seismic Activity 1. This statement is included in Section 19.3, as COL item.

MEMBER STETKAR: 19.3? It's not included in Section 3, where you have the seismic design for all of the other equipment and structures in the plant. What I'm looking for is if I am going to build this plant, I now am a COL applicant, I would like to understand how big this tank must be to satisfy the design requirements that are specified in the certified design. Those design requirements are those water supplies that I cited. Is it a ten-gallon tank? Is it a 10 billion-gallon tank? Is it a 100 million-gallon tank?

How big must it be, and where can I find -- I don't normally look in Chapter 19 for seismic design requirements. I usually look in Chapter 3. That's what I'm asking for. I'm not looking for a detailed design. I understand it's the COL applicant's decision about the detailed design of the tank and the connected piping, but it seems to me that the design certification should specify those minimum requirements.

What is the minimum volume that I need to provide, considering all of those functions that I mentioned, and a clear statement about the functional design for it. That may also extend into things like wind driven missile protection. Does it need to be protected against wind driven missiles? What is the seismic classification, and so forth?

MR. SISK: This is Rob Sisk. Just to build on that, I understand what you're indicating, but in 19.3, there are two COL items. One of the COL items, 19.3.6, is to confirm that the design is robust with respect to applicable hazards. It calls out things like the seismic events, floods, high winds, missiles. There is that COL item.

MEMBER STETKAR: It's 19.3, what is it, Rob?

MR. SISK: COL 19.3.6. It's on Page 1.8-40.

MEMBER STETKAR: 1.8-

MR. SISK: That's what it says here.

(Simultaneous speaking.)

MR. SISK: Table 1.8-2, Page 36 of 38.

MEMBER STETKAR: That's in DCD Section 1?

PARTICIPANT: Yes.

MEMBER STETKAR: Tier 1, okay. I didn't look at Tier 1.

MR. SISK: COL 19.3.

MR. OH: This is Andy Oh, KHNP Washington Office. Between the RAI and the NRC, that COL item is inserted to the DCD, so probably Rev. 1, there's no such COL item, but right now, we have some COL items regarding --

PARTICIPANT: Is that Rev 1.

MR. OH: Yes.

(Simultaneous speaking.)

MEMBER STETKAR: By the way, we only have Rev. 0.

MR. SISK: Rev. 1 is out. I defer.

MEMBER STETKAR: We don't need it. I'm just making statements of fact.

MR. OH: (Simultaneous speaking) there's a specific COL item regarding the raw water tank about seismic event, flood, and high wind, and also missiles. COL applicant have to design obviously --

MEMBER STETKAR: We have, somewhere in here, at least the structural requirements, but is there any specification for the volume --

PARTICIPANT: Yes.

MEMBER STETKAR: -- the size of the tank?

MR. OH: The raw water tank is mostly for providing inventory (phonetic) for the mitigation of beyond design basis event for the Fukushima or the ECSPS. When you see the Fukushima technical report, you can see that the volume is specified two raw water tank is provided for 2.6 million gallons. That is specified in technical report in Fukushima. Fukushima, the report is IBR. That means it's a kind of DCD. COL applicant have to consider that amount of the water, at least they have to prepare, in order to implement a FLEX strategy. Whether they can increase the amount of water or not, that's depending on the COL applicant's decision. However, we also have some COL applicant for the item about it. The COL applicant have to confirm the safety and fulfill the specific design functional requirement of the raw water tanks. Based on that COL action item, they have to confirm that the minimum amount of the raw water tank, that's based on a technical report in the IBR.

MEMBER STETKAR: Okay, thank you.

MR. Y. KIM: Now, we can go to Section 9.3, the process auxiliaries. This section covers the process auxiliaries, such as compressed air and gas systems, process sampling and post-accident sampling system, equipment and floor drainage system, and chemical and volume control system. The first is 9.3.1, the compressed air and gas system.

The compressed air and gas system performs non-safety related function, except for the containment isolation. The compressed air and gas system is divided into three subsystems, first the instrument air system, service air system, compressed gas system. The instrument air systems provides instrumentation and control air to safety related and non-safety related components and systems. Instrument air system consists of two 100 train and one air compressor and one air receiver, one set of air dryers, and one air filtering unit in the train. These components are figured in the next slide.

The safety related AOVs fail in safe position on loss of the instrument air, so it do not need the instrument air to perform safety related function. The service air system provides service air for pneumatic command (phonetic) and other services. Service air system consists of 100 percent train with an air compressor and an air receiver. In addition, service air system can provide a backup supply of air to instrument air, if it need.

Compressed gas system, such as high and low pressure nitrogen subsystem and hydrogen subsystem and carbon dioxide subsystem provide compressed gas to diverse usage point, such as purging, cooling, blanketing and pressurizing and etc. Each subsystem has pressure regulations and overpressure protection provisions.

MEMBER SUNSERI: Mr. Kim, what is the specification for dew point on the instrument air system?

MR. Y. KIM: The question will be answered by our expert.

MR. Y.C. KIM: Please say again, please.

MEMBER SUNSERI: What is the dew point specification requirements on your instrument air system.

MR. Y.C. KIM: This is Yong Cheol Kim from KEPCO E&C. Let me check my material, please. Give me just a second, please.

MEMBER SUNSERI: How many degrees? What?

MR. Y.C. KIM: Give me just a second, please. I need to check my --

MEMBER SUNSERI: Okay.

MEMBER STETKAR: While they do it, let me ask another question because they need to do some research.

PARTICIPANT: Sure.

MEMBER STETKAR: Can you tell me a little bit more about the cooling water for the instrument air compressors? I know that they are normally cooled by the turbine building closed cooling water system. Is that correct?

MR. H. KIM: This is Hancheol Kim. It's correct.

MEMBER STETKAR: But I also, in the DCD, see something that says an independent closed loop cooling system allows operation of one air compressor when the air compressor cooling water is not available. What is that, and how does it work?

MR. Y. KIM: This is --

MEMBER STETKAR: Again, I don't know whether this is air or cooling water, but --

MR. Y. KIM: It's instrument air system.

(Simultaneous speaking.)

MEMBER STETKAR: I'm sorry; if you have the dew point information (Simultaneous speaking).

MR. Y.C. KIM: I found the data. Dew point is -40 Fahrenheit degrees.

MEMBER SUNSERI: -40 Fahrenheit?

MR. Y.C. KIM: Yes.

MEMBER SUNSERI: Thank you.

MR. Y.C. KIM: Can I answer your question, please?

MEMBER STETKAR: I hope so.

MR. Y.C. KIM: TGBCCW system includes the independent closed loop cooling systems. TGBCCW system receives the cooling water from the TGBOCW system. TGBOCW system is connected to circulating water system. During the plant maintenance shutdown -- I mean shutdown -- we cannot use the circulating water system. At that time, we have to use the independent closed loop cooling water system (Simultaneous speaking) air compressors.

MEMBER STETKAR: But is that -- I'm interested in this, again, for how the plant works and how the PRA model evaluates the plant. Is that -- this slide that we see here says include an independent closed loop cooling system that allows operation of air compressors. In the DCD it says one air compressor. What I hear you saying is that this is -- is it only one of the two, or is it both?

MR. Y.C. KIM: No, three compressors, two instrument air compressors and one service air compressor.

MEMBER STETKAR: So the closed loop --

MR. Y.C. KIM: That's not correct (Simultaneous speaking).

MEMBER STETKAR: The closed loop is for all three?

MR. Y. KIM: Yes, right.

MEMBER STETKAR: Does that require manual operator action to put that into service? For example, I'm operating the plant at normal power operation. If I lose turbine building open cooling water or closed cooling water, to keep the air compressors operating, must the operators then locally align this independent closed loop system?

MR. Y.C. KIM: I remember, the system starts not automatically (Simultaneous speaking).

MEMBER STETKAR: Not automatically, so it's a local operation.

MR. Y.C. KIM: Right.

MEMBER STETKAR: Okay, thank you. It does supply all -- I don't care about service air, but it supplies all the compressors, once you align?

MR. Y.C. KIM: Exactly right.

MEMBER STETKAR: Okay, thank you. You should look at the DCD because the DCD seems to say it's only one instrument air compressor.

MR. Y.C. KIM: (Simultaneous speaking.)

MEMBER STETKAR: This says --

MR. Y.C. KIM: We changed the description

(Simultaneous speaking).

MEMBER STETKAR: Oh, you did?

MR. Y.C. KIM: -- Revision 1.

MEMBER STETKAR: Again, we only have Revision 0. Thank you. That explains it.

MR. Y. KIM: This slide shows the simplified schematic drawing diagrams for instrument air, service air system explained in the previous slide. Next is the process and post-accident sampling system. The process and post-accident sampling system is designed to collect and deliver representative samples of liquids and gases in various process systems to -- I've got a cough, so please understand.

Process and post-accident sampling system has a function to collect and deliver representative samples of liquids and gases in various process systems to various sampling station for chemical and radiological analysis. This system consists of the normal primary sampling system and the post-accident sampling system, and the secondary sampling system. The normal primary sampling system takes RCS samples and shutdown cooling system sample, CVCS samples, and primary off-gas samples for control if ICS chemistry and radiochemistry.

The post-accident sampling system takes

the reactor coolant and containment atmosphere samples during post-accident conditions. The secondary sampling system takes samples to control the steam generator secondary side water and the steam cycle quality and to detect a leak or failure of steam generator tubes or contaminated by corrosion products.

MEMBER SUNSERI: Mr. Kim, I may not have this accurate, so I'm just asking the question. I thought I read, in the DCD, where component cooling water is isolated to the post-accident sampling system coolers during an engineered safety feature's actuation, which, obviously, you wouldn't have an accident if you didn't have that happening. My question is you must have procedures or something to restore cooling to cool the samples down, or how does that work?

MR. Y. KIM: The sampling during the accident need to be followed by the (unintelligible). During the accident, the CSW system closes the valve for supplying water to non-safety related, so they should have -- the operator should follow the procedure to sample -- to cool the post-accident sampling.

MEMBER SUNSERI: Okay, thank you.

MEMBER STETKAR: But that means that the operator must then somehow reset a safety related isolation signal to re-open the cooling water supply. Is that true?

MR. Y. KIM: I do think so. Then the operator need to know the period and the operation methodology to open the non-safety isolation valve.

MR. OH: This is Andy Oh, KHNP Washington Office. There's two kinds of SPASS signals, SPASS 1 and SPASS 2. SPASS 1 is operator cannot be override, but the SPASS 2 signal, operator can override.

MR. Y. KIM: The next is the equipment and floor drainage system. The function of the equipment and floor drainage system, shortly the EFDS, is to collect and transport liquid containing wastes generated within the plant to the liquid waste management system or the wastewater treatment facility.

The EFDS performs non-safety related function, except for containment isolation valves and associated piping and the flood alarm loops of ESF pump rooms. The EFDS has components, such as the sumps and the sump pumps in the reactor containment building, in the auxiliary building, in the turbine generator building, and the compound building.

The system provisions, such as level monitoring instruments and the leak (unintelligible) for the detection of the leakage from the reactor coolant pressure boundary, as well as refueling pool, IFWST, auxiliary feedwater storage tank, spent fuel pool, refueling canal, and the cask loading pit. The sumps and the sump pumps are located at lower levels to facilitate transfer to the leakage waste management system. Drain and discharges from sumps in the turbine generator buildings are normally transferred to the wastewater treatment facility for processing, but it can be switched over to leakage waste management system upon detection of radiation. The next is the --

CHAIRMAN BALLINGER: This is a convenient break point. What I would like to do is to recess until -- well, call it quarter of.

(Whereupon, the above-entitled matter went off the record at 10:26 a.m. and resumed at 10:45 a.m.)

CHAIRMAN BALLINGER: Okay, we're back in session. Proceed.

MR. SISK: This is Rob Sisk, Westinghouse. Before we proceed on to the next section -- I think we're moving into chemical volume -- I do want to just get back briefly on the discussion of the spent fuel pool chemistry. I think the question was coming up what about the damaged fuel and what have you.

MEMBER SKILLMAN: The question was what is being removed? That was Dr. Powers' question. I kind of pushed that question because I've got experience with, actually, failed fuel in the spent fuel pool. I'd be curious how you take care of it at the design stage.

MR. SISK: The spent fuel pool is designed to have basically five fuel elements fail, fuel elements, in a -- it says canister, but I call it a sleeve. If you have failed fuel, you can sleeve it, basically isolate it from the pool water, so it doesn't continue to make contamination release into the spent fuel pool area.

One mitigating strategy is sleeving damaged fuel. That's one of the primary areas. I think John made a comment about there's always residual water from lifting it out of the reactor vessel or weeping -- I think I you used the word weeping fuel.

MEMBER SKILLMAN: I certainly did, and I used that word.

MR. SISK: Oh, is that yours?

MEMBER SKILLMAN: There are weepers and leakers. Here's the deal. What you're doing is you're defueling and you put the damaged fuel assembly or the degraded fuel assembly in your fuel transfer carriage. You transfer it across the spent fuel pool. You up-end it, and now you've got a tea bag that's breathing cesium and strontium and every other soluble isotope that is breathing out of that fuel assembly. You'd be surprised, in a matter of hours, you begin to get detectable counts in the spent fuel pool. If you get six or eight of them, then you now have, actually, a failed fuel challenge in your fuel handling building because it affects the water and affects the airborne.

MR. SISK: Hopefully, you're detecting it before it gets completely into the spent fuel racks because those are -- you want to detect them. You want to isolate them. You want to sleeve them and store them until more permanent -- either examinations are taking place or more permanent storage can take place. I just wanted to let you know that we do have those facilities. The APR1400 does have those facilities, limited number in the spent fuel pool.

With regard to some of the residual cleanup, the cleanup system has capacity, obviously, to clean up drippage and water and what little bit of, perhaps, weepage comes out. We haven't been able to get hold of the right person that can tell us the complete details on the water chemistry cleanup relative to radiochemistry activity or what have you. I just wanted to let you know that you do isolate the damaged fuel from the pool.

MEMBER SKILLMAN: Thank you. As long as

you've got anions and cations one to one in those resin beds, then it becomes an issue of managing the radiation zones that are established when the isotopes collect on those beds.

MR. SCHULTZ: Rob, just to repeat, you said that there was opportunity to cage/sleeve five assemblies?

MR. SISK: There's canisters for five damaged fuel assemblies.

MR. SCHULTZ: Available?

MR. SISK: That's correct.

MR. SCHULTZ: So the anticipation would be sipping would occur very soon after unload?

MR. SISK: Yes, depending on the refueling machines you'd have refueling machine sipping to make sure you know what the status of the fuel assembly is.

MR. SCHULTZ: Sure. Thank you.

MR. SISK: I assume that would address the question (Simultaneous speaking).

MEMBER SKILLMAN: That addresses the question, yes. Thank you.

MR. SISK: Thank you very much. We can continue on with 9.3.4.

MR. Y. KIM: I'll begin my presentation with 9.3.4, the chemical and volume control system, shortly CVCS. The CVCS is designed to perform the following functions. The next slide shows the chemical flow diagram of the CVCS, but I'm going to introduce the CVCS function at this slide. The CVCS maintains the chemistry and the purity of the reactor coolant during normal and shutdown operation.

It maintains the required water volume in the RCS, compensating for the reactor coolant contraction and expansion resulting from the changes in the reactor coolant temperature, and also compensating for other coolant losses or additions. This is the makeup and pressurizer level control function, using the charging and the letdown subsystem.

The CVCS receives and stores and separates nuclear waste for recycle or discharges to the nuclear waste management system. It also controls the boron concentration in the reactor coolant system to compensate for the reactivity changes due to the changes in the reactor coolant temperature, cooling or up, and the variations and to provide shutdown margin for maintenance and refueling operation. Also, the CVCS provides auxiliary pressurizer spray for pressurizer pressure control during the final stage of the shutdown operation. It provides injection water and the proper temperature, pressure, and purity for the reactor coolant pump seals and controls the bleed-off from the reactor coolant pump seals.

The CVCS provides the means for continuous removal of noble gases and other dissolved gases from the ICS. The reactor coolant makeup during the normal operation is provided by the CVCS, and the system is designed to meet the requirements of the GDC 33, Reactor Coolant Makeup. As I said, this is the schematic diagram for chemical and volume control system.

MEMBER STETKAR: A couple of questions, Mr. Kim. The centrifugal charging pumps have a minimum flow heat exchanger that's cooled by component cooling water. Is that cooling required when those pumps are running? In other words, if I lose that minimum flow heat exchanger cooling, will the pumps operate normally forever?

MR. Y. KIM: It's part of the CVCS.

MR. PARK: This is Hong Sik Park from KEPCO E&C. Let me answer your question. The operation of charging pump itself is not affected by CCW because its motor is air cooled. Charging pumps are not required to be tripped immediately by loss of CCW.

MEMBER STETKAR: I'm still not sure whether you answered my question. My question was if the charging pump is running, centrifugal charging pump, and I do not have cooling for the minimum flow heat exchanger, can the pump continue to run forever? Minimum flow heat exchanger. On this drawing -- is it shown on this drawing?

MEMBER SKILLMAN: Yes.

(Simultaneous speaking.)

MEMBER SKILLMAN: Dead center down, just below the CV tank, you can see the little heat exchanger. A little lower.

MR. PARK: If CCW is --

PARTICIPANT: Yes, it's --

MEMBER SKILLMAN: It's the little heat exchanger there.

MR. PARK: Entirety of CCW charging pump is also affected.

MEMBER STETKAR: I didn't quite understand. Is it affected, or is it not affected?

MR. PARK: Immediately not affected, but affected for long time without CCW.

MEMBER STETKAR: Okay, how long can it operate without CCW, is the question, to that heat exchanger?

MR. PARK: I don't have (Simultaneous speaking).

MEMBER STETKAR: Okay, that's just a

question we'll leave on the record.

MR. PARK: (Simultaneous speaking.)

MEMBER STETKAR: I'm obviously concerned about this because the small positive displacement -- the auxiliary charging pump does not require component cooling, either for the pump motor or the pump oil, and it does not circulate flow through that minimum flow heat exchanger. On loss of component cooling water, I certainly have the ability to use the auxiliary charging pump, but if that is the only pump that I can use, the PRA model, for example, does not say that.

I'm curious how long can the centrifugal pumps continue to run if I have no component cooling water to the seal water, the minimum flow heat exchanger, to be precise. Now, I will just put this on the record. It is way too complicated for anyone humanly possible to understand in real time. When I was studying the systems to learn how the plant works, I think that I discovered a very complicated dependence of the CVCS on instrument air. I want to confirm that I understand it correctly and, as I said, we cannot do that in real time, so I just want to get it on the record, so that you can go eventually answer it. I think that if I lose instrument air, normal letdown flow is isolated, and normal and reactor coolant pump seal water return flow is isolated.

That stops all of the flow out of the reactor coolant system. I think that charging flow increases to maximum because the charging flow control valve fails open, so I now have maximum charging flow into the system. I think that all normal makeup pump paths to the volume control tank will be isolated. I have a long list of valves here, but they're shown on this drawing as air operated valves. I believe that they fail closed.

Therefore, I am left in a configuration with the charging pumps running with suction from the volume control tank, which will be drained, and the charging pumps will lose suction and cavitate and fail, unless the operators do something to either align makeup to the volume control tank, which is what they need to do, or to the direct suction of the charging pumps. I have specific valve numbers here, but I'm not sure that I have all of the valve numbers correctly. Basically, I'm looking for confirmation that when I lose instrument air, must the operators manually open makeup valves -- and manually could be from the control room because there's some motor operated valves they could open -- to prevent the charging pumps from losing suction?

MR. PARK: If the loss of letdown may occur as a loss of instrument air, the volume control tank level goes down, then source for suction of charging pump is automatically changed from the volume control tank to the (unintelligible) tank.

MEMBER STETKAR: Which valves open on this drawing, if you want to start talking about valve numbers?

MR. PARK: In the figure, CV5034 and CV536 valves are open.

MEMBER STETKAR: Which valves, 534 and -- those motor operated valves open automatically?

MR. PARK: Yes, automatically. The low low level signal can open automatically these valves.

MEMBER STETKAR: That's not documented anywhere in the DCD, is it? That solves my problem, by the way, if one of those valves opens automatically. I could not find any documentation in the DCD that says that.

MR. PARK: This is included in DCD Section 9.3.4.5.2, 9.3.4.5.3, Item C. It does include that number.

MEMBER STETKAR: Yes, it doesn't include the valve numbers, so I assumed that it was somehow with the air operated valves that are in the other flow paths. If you're sure that those valves open, good. It's on the record, and I'm happy.

CHAIRMAN BALLINGER: What section number?

MEMBER STETKAR: The valves are not listed, as he said.

CHAIRMAN BALLINGER: Is it 9.3.4.5.3?

MEMBER STETKAR: It is.

MR. PARK: Yes, right.

MEMBER STETKAR: Item No. C.

Valves 534 and 536. They're at the bottom of this figure. Thank you.

MEMBER SKILLMAN: Let me add on to John's question. If loss of air stops letdown, but enables charging, and you feed from the boric acid storage tank through 536 and 534, what remedy is there for pressure control in the rack cooling system? Because if the letdown is stopped, what you're going to do is drive the pressurizer to your safety valve subpoint. Your charging pumps will do that.

MEMBER STETKAR: There are subparts to the question. The PRA model doesn't include any of this. It doesn't include those valves opening automatically or the dependencies, nor does it include any operator actions to take manual control of charging flow to control pressurizer level, basically. It doesn't include anything. Loss of instrument air is modeled as a benign event. I was just establishing how the system worked. I'm glad to hear that those valves open automatically. I know that they're included in the PRA.

MEMBER SKILLMAN: I would ask what is the action by the plant on loss of letdown, on loss of air? Because if you continue to charge, you are now driving your pressurizer level, and you'll continue to drive as long as you operate the charging pumps.

MR. PARK: If the letdown is isolated, then pressurizer level goes up, and actually the normal level range. The operator have to trip the charging pump.

PARTICIPANT: Yes, okay.

MEMBER STETKAR: Operator has to do something.

PARTICIPANT: He's got to do something.

MEMBER STETKAR: As I said, this is -- the problem is, here, as I had mentioned earlier, is that one of the things that we try to do is to understand how the whole plant works together. I'm obviously interested in the PRA, also, to understand that the PRA models the plant as it works. Anyway, we have this on the record. I'm glad to hear that those valves open automatically. The PRA doesn't include them, nor does it include operator actions.

MEMBER SKILLMAN: Would loss of instrument air also isolate component cooling water? Because if it does, you can end up with loss of seal injection, loss of component cooling water, in which case you're driven to stop your reactor coolant pumps.

(Simultaneous speaking.)

MR. OH: This is Andy Oh, KHNP Washington Office. In the component cooling water, there's no a or b, so even if the loss of air, the component cooling water function is properly working.

MEMBER SKILLMAN: Okay, thanks, Andy.

MR. Y. KIM: Okay, thank you. For the next slide, Mr. Heo will introduce.

MR. HEO: My name is Heo Gun from KEPCO E&C. Now, I am going to present Section 9.4, heating, ventilation, and air conditioning systems. Section 9.4 consists of eight subsections, as shown in this slide. From now on, I will explain each HVAC system. Control room HVAC system. This system performs following functions.

First, provide suitable environmental conditions within control room envelope. Second, provides adequate protection against airborne radioactivity and smoke from the outside. Third, limit the radiation exposure to the personnel in the CRE under accident conditions, to meet GDC 19. This system consists of AHUs, ACUs, fans, and PACUs. The HVAC equipment perform their functions as described in this slide. Fuel handling area HVAC system.

This system performs following functions. First, maintain suitable environmental conditions within the fuel handling area. Second, maintain the fuel handling area under slightly negative pressure with respect to the surrounding areas. Third, control the gaseous effluent release to the outside within design limits. This system consists of two subsystems, fuel handling area normal HVAC subsystem and emergency HVAC subsystem. Fuel handling area normal HVAC subsystem performs functions by AHU and ACU with HEPA filter during normal operation. Fuel handling area emergency HVAC subsystem performs functions by ACU with carbon adsorber and cubicle coolers during accidents. Auxiliary building clean area HVAC system. This system performs the following functions. First, maintain suitable environmental conditions within the auxiliary building clean area.

Second, provide ventilation for the

chiller rooms. Third, remove smoke from the area where the potential exists. This design consists of five subsystems. Auxiliary building Clean Area I and II HVAC subsystems perform functions by AHU, cubicle coolers, and fans during normal operation and maintain temperature within essential chiller rooms and motor driven auxiliary feedwater pump rooms by cubicle coolers during accidents.

Main steam valve room HVAC subsystems and main steam enclosure HVAC subsystem perform functions by AHU, cubicle coolers, and fans during normal operation. Auxiliary building smoke removal HVAC subsystem removes smoke by smoke removal fan after a fire has been suppressed. Turbine generator building HVAC system. This system performs following functions. First, maintain suitable environmental conditions within the turbine generator building. Second, minimize hot spot within the turbine generator building. Third, maintain the hydrogen gas concentration to less than 1 percent by volume within the battery rooms. This system consists of three subsystems. These subsystems perform functions by AHU, cubicle coolers, and fans during normal operation.

Engineered safety feature ventilation system. This system consists of four systems, emergency diesel generator area HVAC system, electrical and I&C equipment areas HVAC system, auxiliary building controlled area HVAC system, last, essential service water building and component cooling water heat exchanger building HVAC system. The design of this system will be provided by COL applicant, if required.

I will explain each ESF ventilation system in next slide. EDG area HVAC system. This system performs following functions. First, maintain suitable environmental conditions within the EDG area. Second, provide ventilation for the EDG area to prevent possible accumulation of oil fumes. This system consists of three subsystems, EDG ARA normal HVAC subsystem performs functions by AHUs, fans, and cubicle coolers during normal and EDG operation. EDG room emergency HVAC subsystem performs functions by cubicle coolers during EDG operation. Diesel fuel oil storage tank room HVAC subsystem performs functions by fans during normal and EDG operations. Electrical and I&C equipment area HVAC system. This system performs following functions.

First, maintain suitable environmental conditions within the electrical and I&C equipment areas of the auxiliary building. Second, maintain the hydrogen gas concentration to less than 1 percent by volume within the battery rooms. This system consists of six subsystems. Electrical and I&C equipment areas HVAC subsystem, Class 1E battery room HVAC subsystem, and remote shutdown room HVAC subsystem perform functions by fans and cubicle coolers during normal operation and accident.

Non-class 1E battery room HVAC subsystem, CEDM M/G set room HVAC subsystem and remote control console room HVAC subsystem perform functions by AHU and fans during normal operation. Auxiliary building controlled area HVAC system. This system performs the following functions. First, maintain suitable environmental conditions within the radiologically controlled area in the auxiliary building. Second, maintain the auxiliary building controlled area under a slightly negative pressure with respect to the surrounding areas. Third, control the gaseous effluent release to the outside within design limits. This system consists of three subsystems. Auxiliary building Controlled Area I and II HVAC subsystems perform functions by AHUs, ACUs, and cubicle coolers, during normal operation and accidents.

High energy line break are HVAC subsystem performs functions by AHU, ACU, and cubicle coolers during normal operation. Reactor Containment HVAC and purge system. First, I will explain reactor containment building HVAC system. This system performs following functions. First, maintain the containment atmosphere temperature. Second, maintain the temperature in the in-core instrumentation chase and reactor cavity.

Third, remove heat from the CEDM coils. This system consists of three subsystems. Reactor containment building cooling subsystem performs functions by RCFCs and fans during normal operation and LOOP. Reactor cavity cooling system perform functions by AHU during normal operation and LOOP. CEDM cooling subsystem performs functions by fans during normal operation and LOOP.

MEMBER STETKAR: In this plant, the RCFCs are not safety related, are they?

MR. HEO: Yes.

MEMBER STETKAR: Let me ask it differently. Are the RCFCs safety related?

MR. HEO: RCFCs are non-safety related.

MEMBER STETKAR: Not safety related? Okay. I know that they're normally cooled by the plant chilled water system. Is the cooling water supplied to the RCFCs isolated automatically if I have a safeguards actuation signal?

MR. HEO: Plant water system. Please. One more question.

MEMBER STETKAR: I know that the RCFCs are cooled by the -- I think -- let me try this -- that the RCFCs are cooled by the plant chilled water system. Is that correct?

MR. HEO: (Simultaneous speaking) correct.

MEMBER STETKAR: Is that cooling water supply and return isolated automatically when a safeguards actuation occurs?

MR. HEO: Upon the safety of CIAS, the CIVS of the plant chilled water system automatically close.

MEMBER STETKAR: Okay, thank you. So the RCFCs are not available for containment cooling during an event that results in containment isolation, is that correct?

MR. HEO: Correct.

MEMBER STETKAR: Okay, thank you. I understood that one. Thank you.

MR. HEO: Reactor containment building purge system. This system performs the following functions. First, provide the proper atmosphere and adequate ventilation for personnel before and during periods of personnel access. Second, control the containment atmosphere pressure. Third, control the gaseous effluent release to the outside within design limits.

Last, close CIVs upon receipt of CIAS or CPIAS. This system consists of two subsystems. Low volume purge subsystem performs functions by ACU and fan during normal operation, when required. High volume purge subsystem performs functions by AHU and ACU during cold shutdown and refueling conditions. The CIVs of low and high volume purge subsystems are automatically closed upon receipt of CIAS or CPIAS.

MEMBER STETKAR: Let me ask you about both of those systems. The slide here, and the DCD, say that the low volume purge subsystem can be operating during normal plant power operation when required. Let me try this. On average, what fraction of time during normal power operation would you expect that system to be operating? Is it operating most of the time? Is it operating half the time? Do you have any experience from the reference plants how much time that system is normally operating?

MR. HEO: The low volume purge system operates intermittently during normal operation. The low volume purge system operates when the containment pressure increases or for personnel access.

MEMBER STETKAR: I understand.

MR. HEO: When the pressure reaches, in domestic nuclear power plant, the containment pressure reaches 0.7 PSIG, we operate the low volume purge system.

MEMBER STETKAR: Okay. I'm asking for an estimate of the average fraction of the time that system is operating, based on experience or based on estimates. I'll tell you why in a second.

MR. HEO: I don't know.

MEMBER STETKAR: That's a question, if you have any experience. What is the size of the low volume purge supply and exhaust piping?

MR. HEO: Low volume purge system piping is eight inches.

MEMBER STETKAR: Eight inches, thank you. Here's why I'm interested in the low volume purge system. Again, I'm a PRA guy, so everything runs around the PRA. The PRA does not include isolation of that system. It assumes that it is normally always isolated. Why is that important? If I have an eight-inch hole in my containment that is not isolated, that can substantially affect containment heat removal and containment pressure response during an accident.

The good news is it can take containment heat away. The bad news is it can be a release path. The Level 2 models have absolutely no information in them about whether that line is ever open and what effect would be if it is open and not isolated. They simply have a containment isolation top event that includes several other lines, but not this big one.

Similarly, the shutdown PRA models do not account for the fact that the high volume purge is operating probably during the whole outage. My experience is you turn that system on, and it runs continuously. That also is a very large, probably much larger -- I don't care how much larger -- size of a penetration from the containment that, if it is not isolated, can affect the Level 2 response for the shutdown part of the PRA. It's the PRA's job to understand what fraction of the time during power operation the low volume purge system is actually operating. If there is not very good information, then the PRA will need to make an assumption, but it's clearly not zero. Then the PRA will then have to also account for the effects on the Level 2 models if that particular line is not isolated, if the isolation fails. Thank you. At least now, I know it's eight inches. I couldn't find the piping size in the DCD.

Thank you.

MR. HEO: Compound building HVAC system. This system performs following functions. First, maintain suitable environmental conditions within the compound building. Second, maintain the hydrogen gas concentration to less than 1 percent by volume within the battery rooms. Third, control the gaseous effluent release to the outside within design limits.

This system consists of two subsystems, compound building clean area HVAC system and controlled area HVAC subsystem. These subsystems perform functions by AHUs, ACUs, PACUs, cubicle coolers and fans during normal operation. Design features for minimization of contamination. The APR1400 HVAC systems that service areas that may contain radiologically contaminated materials are designed with features to meet the requirements of 10 CFR 20.1406 and NRC Reg Guide 4.21. The design features for minimization of contamination are described in Subsection 12.4.2. Thank you.

(Simultaneous speaking.)

MEMBER POWERS: I'd like to come back, actually, to your Slide 39, but it's more of a philosophical question than a specific design question. If we have fires in the control room and release smoke, after you suppress the fire, you exhaust the smoke, but how sensitive are the digital electronic systems to the contamination by smoke?

MR. HEO: The smoke -- I will answer. Smoke in the controlled area, the air in the controlled area, you could just sort of air clean units with HEPA filter or carbon adsorber after fire has been suppressed.

MEMBER POWERS: Prior to the suppression of a fire, you're putting a lot of smoke into the control room. Presumably, it deposits on digital electronic systems. The tables that you're burning and whatnot have a lot of chloride in them, so there's presumably a certain amount of HCL and other acidic things. How sensitive are those digital electronic systems to that corrosive smoke material?

MR. HEO: Please give me a second.

MEMBER POWERS: Sure. It's a philosophical question. It doesn't really have anything to do with this specific thing. If you know the answer, Stetkar, you're welcome to answer.

MEMBER STETKAR: It's not my job.

MEMBER POWERS: But out of the goodness of your heart, you might answer.

MR. SISK: We've noted the comment down,

and we don't have the right people or the right (Simultaneous speaking).

MEMBER POWERS: I wouldn't be surprised, but it's a question that keeps coming up into my mind, that we're going to much more miniaturized and smaller systems, where small amounts of corrosion can produce big effects.

MR. SISK: This is Rob Sisk, Westinghouse. I'll just speak from my perspective, as I look at the design --

MEMBER POWERS: (Simultaneous speaking.)

MR. SISK: -- philosophically. It's an interesting question, but I would defer to Dr. Brown, here, when we talk about redundancy and independence. As we have smoke in the main control room, if systems are not operating correctly because of contamination of smoke debris on electronic equipment, you certainly would use the remote shutdown room and can maintain controls. It's an interesting philosophical question, but I'm not sure we can generate a detailed answer on the impact on all the various electronic (Simultaneous speaking).

MEMBER POWERS: (Simultaneous speaking) consideration we put into reliability of control room systems? It seems like this affects your redundancy and diversity of your systems because it's all in the control room.

MR. SISK: I understand the philosophical aspect of it is something that we pay attention to, in general. It's one of the reasons, when we get to Chapter 7, you'll hear the pillars of design for I&C system. We talked about such things as redundancy and independence, and we have the remote -- we have separation, so that smoke will not contaminate all of the necessary safety-related equipment to maintain the plant safe.

MEMBER STETKAR: What he didn't tell you, which is important, is that the remote shutdown room has a different ventilation system, so that helps.

MR. SISK: It does, thank you.

MEMBER STETKAR: That doesn't completely satisfy the (Simultaneous speaking).

MEMBER POWERS: It's not a comprehensive answer.

MEMBER STETKAR: It is not a comprehensive answer. On the other hand, it's another piece of information that --

MEMBER POWERS: And useful, as usual.

MEMBER SKILLMAN: I didn't research the topic that Dana raises, but my experience is that CREVS normally takes care of the control room emergency ventilation system as a pre-filter and a hogging filter that will take out micron-size debris that is either the electrostatic or the chemical agent that Dana's talking about. I think that is probably in this application somewhere. I haven't gone digging for that.

MEMBER POWERS: The removal (Simultaneous speaking) suppression, it's all the deposition prior to the suppression that interests one here. I don't know the answer. It's not like I'm sitting here with my -- testing you and seeing if you pass or not. It's more of a philosophical question, as we move to more miniaturized and capable systems with smaller conductor pathways and contact areas and things like that, small amounts of corrosion that, in the past, were no never mind suddenly become, perhaps, pervasive in their effect. As we move to more and more sophisticated insulations in our cables, they're chemically more complex. Consequently, their pyrolysis is more complex, and it's harder to understand exactly what they'd be capable of doing to contactors.

MR. SISK: I would also offer just one more. I don't want to derail our big philosophical discussion today. I would also indicate that the equipment qualification programs involve I&C. They do things like dew points and temperatures and weights. As you look at these types of environments that the equipment has to operate in, you have to take into account (Simultaneous speaking).

MEMBER POWERS: Unfortunately, in looking at these ASGM standards and whatnot, I don't see them doing very much in this area. I'm just wondering if we should -- if it's something that we should be worried about, looking for your perspective. Thank you.

MR. HEO: Mr. Lim will present Section 9.5.

MR. LIM: My name is Dunam Lim from KEPCO E&C. I'm going to talk about other auxiliary systems.

MEMBER STETKAR: Microphone.

MR. LIM: Sorry. Again, my name is Dunam Lim from KEPCO E&C. I'm going to talk about other auxiliary systems described in DCD Subsection 9.5. The system lists are as shown in this slide. At first, I'm going to talk about Subsection 9.5.1, fire protection program.

The primary objective of the fire protection program is to minimize both the probability of occurrence and the consequences of a fire through defense-in-depth. Another objective is to minimize the radioactive releases to the environment in the event of a fire. The concept of defense-in-depth provides three purposes. First, to prevent fire from starting.

Second, to rapidly detect, control, and extinguish those fires that may occur. Third, to provide protection for structures, systems, and components important to safety for the safe shutdown of the plant. The fire protection program is designed to meet these requirements. The elements of fire protection program are such as comprehensive identification and analysis of fire and explosion hazards; organization and staff positions for fire protection program; administrative policy, procedures, and practices for training of general plant personnel; automatic fire detection and alarm systems; automatic and manual fire suppression systems; building design for fire protection; also post-fire safe shutdown analysis and procedures; and PRA.

For the integrated effort involved in components, procedure, analysis and personnel used in defining and carrying out all activity of fire protection, the COL applicant is to establish a fire protection program, including organization, training, and qualification of personnel, administrative controls of combustibles and ignition sources, firefighting procedures, and quality assurance.

MEMBER SUNSERI: This question doesn't directly impact this application, but I just have a curiosity. On your reference plant, does the organization maintain a standing fire brigade, or is that a delegated function to the operating crew?

MR. LIM: Actually, your question is the plant operation manner to train the personnel on how to training, so I think I'm not the right person to your question.

MR. SISK: This is Rob Sisk, Westinghouse, again. I think the question you're looking for is really to the COL applicants, as they put together their fire protection program.

MEMBER SUNSERI: No, that's why I said it's not -- my curiosity is for not this because clearly, you're delegating it to the COL to discuss. My question was for the reference plant, how do you do it?

MR. SISK: Oh, I'm sorry, for Shin Kori? The question is at Shin Kori, do you have a dedicated fire protection -- a fire brigade, or are your operators and maintenance people trained and respond to fire?

What do you have at Shin Kori?

MR. OH: This is Andy Oh, KHNP Washington Office. My understanding of your question is in Shin Kori site, there's some special firefighter -- department of firefighters located inside the site, yes. The KHNP personnel, there's some firefighters, engines, and firefighter dedicated person is 24 hours located in the site.

PARTICIPANT: Fire department.

MR. OH: Yes, fire department on site.

MEMBER SUNSERI: Great, that's what I was looking for. Thank you.

MR. LIM: DCD Subsection 9.5.1 provides the description on these design features. Minimize the potential for fire and explosions by controlling, separating, and limiting the quantities of combustibles and sources of ignition. Prevent the spread of fire by subdividing plant buildings into fire areas, separated by fire barriers and into fire zones. Also, separate redundant trains of safety-related equipment by three-hour fire-rated barriers for safe shutdown capabilities.

Provide safe shutdown capabilities using an MCR and RSR that are physically separated, electrically isolated. Fire protection systems, such as fire protection water supply system, including water storage tanks, pumps, and fire main (phonetic), and the distribution system is designed in accordance with Regulatory Guide 1.189 and NFPA codes.

Also, backup manual fire suppression systems, such as hose and portable extinguishers, are provided throughout the plant to limit the extent of fire damage. The system maintains 100 percent design capacity of fire pumps, assuming failure of one fire pump or the loss of offsite power with one electric and two diesel-driven fire pumps. Also, the seismic Category 1 fire protection water supply system serves as a seismic Category 1 fire hose and the stent (phonetic) pipe system in the containment building, auxiliary building, and the EDG building, where contained equipment required for safe shutdown in the event of safe shutdown earthquake. To provide the capability to rapidly detect, control, and promptly extinguish fires when fire is detected, the fire detection system produces a local area alarm that is audible and visually identifiable to any person in the area and the MCR. For your information, the description of fire hazard technology is included in the end of this presentation's material. Therefore, this is end of the fire protection program.

MR. SCHULTZ: Are you going to go over that piece, the fire protection program detail, later on today, or is that here for our reference?

MR. SISK: It is provided in the back. If you have specific questions or would like to go over any part of that, we welcome the --

MR. SCHULTZ: I have a general question I'll ask now. The fire protection program that you outlined focuses, as it should, first on prevention, and then on detection, and then into what happens when the fire, then, is detected, to suppress. I'm interested, in terms of the plant design, whether you could describe what types of detection systems you've designed into the plant? I wasn't sure if you have integrated that as part of the design, or you're expecting that the COL applicant is going to come up with innovative ways in which to detect fire?

MR. YOON: This is Jinkyoo Yoon. Let me answer your question. In our APR1400, we have types of fire detectors. One is smoke detect, second is heat detect, and photoelectric smoke detector, something like that. The other thing is there is choosable length-type (phonetic) detectors, line type detectors, something like that. We have been investigating detectors for these five areas or these five joints, and we have identified all of the information for detectors by protection reporter.

MR. SCHULTZ: Those are distributed based upon the likelihood of fire in particular areas? In other words, you purposefully select the types of detection systems in areas where you expect the fire might occur versus those areas where the hazard is low?

MR. YOON: Yes. Basically, the location of the fire detector is determined based on the analysis. We also considered a requirement to determine the types of fire detector based on SNP (phonetic) 9.5 and Reg Guide 1.1.8.9 et cetera.

MR. SCHULTZ: Thank you.

MEMBER STETKAR: Let me try to follow up on Steve's question. You say in some areas, you have a so-called early warning detection system. Is that what some people call an incipient fire detection system, something that's very, very sensitive, or is it just a normal smoke detector or infrared sensor?

MR. YOON: I understand your question is about the detector. Human friendly detector means clean agent fire detection systems.

MEMBER STETKAR: When you say clean agent fire detection, I'm not quite sure what that means. I understand what a clean agent suppression system is.

I'm talking about a detector. In new plants, people install so-called -- there's different names for them. They're typically called incipient fire detection. They're very, very, very sensitive detectors.

MR. YOON: You mean scatter systems?

MEMBER STETKAR: I don't know. The problem is they have different sort of names and because of translation problems -- let me try it this way. Do you have special types of detectors inside instrument control cabinets --

MR. YOON: Yes.

MEMBER STETKAR: -- or inside the main control panels?

MR. YOON: Yes.

MEMBER STETKAR: You do? Okay, what type of detectors are those?

MR. YOON: The detectors is located in raised floor beyond the MCR. And as you mentioned --

MEMBER STETKAR: Yes, but those are only -- I know about those. They have raised floors, and they have standard smoke detectors under the floor, where the cables are. I'm asking about in-cabinet detectors, above the floor, inside the cabinets (Simultaneous speaking)?

MR. YOON: Yes. The requirement is

addressed in the Reg Guide 1.1.8.9. We got cabinet in MCR and I&C equipment room. That cabinet has inside cabinet smoke detectors.

MEMBER STETKAR: They do?

MR. YOON: Yes.

MR. SCHULTZ: Just to describe, the incentive for my question is that fire is an event you would like to have not happen, obviously, in the plant environment. Like anything else that's accident related, if you can prevent it or detect it as early as possible and not have to suppress a fire that's done damage, then you have success. It looked like, from your design program, that this is how you were approaching it. Again, I'm hoping that given that this is a new plant design, you're thinking of innovate ways, as John says, of sensitive detection that is now available, not, perhaps, part of the regulation yet, but is available through work that's being performed by EPRI or other organizations or your organization, perhaps, to find ways to, in a very sensitive way, detect smoke, detect heat, detect the precursors to conflagration that you want to prevent. That was the intent of my question.

MEMBER STETKAR: I could not find any information like that in the DCD. I find things like

(Simultaneous speaking).

PARTICIPANT: I didn't see it earlier, but again --

MEMBER STETKAR: Systems are designed to provide early warning to the operators, is about as good --

(Simultaneous speaking.)

MR. SCHULTZ: But there seems to be the right philosophy with your qualitative description of prevention, in terms of materials distribution throughout the plant, protecting against the possibility of initiation of fire. But then the detection I thought was also at least stated that you wanted it to be robust, and I just (Simultaneous speaking).

MEMBER STETKAR: I will tell you that the PRA models for the fire -- and I quizzed them on this somewhat -- they take credit for the under-floor detectors for cable fires. They claim that there's no effective detection above the floor, which bothered me. But that's what they do.

Any fire in the PRA, cabinet fires, they just burn out the whole room. They take credit for the under-floor detectors for cable fires. I'm assuming -- they have, actually, pretty detailed fire models, not fire physics models, but I was pretty impressed, quite honestly, with what they did in the PRA for fire modeling for fire analysis.

When I quizzed them, they said in certain areas, they took credit for room smoke detectors to prompt the operators or to actuate automatic suppression systems, and they took credit for the under-floor ones in cabinet rooms, which doesn't sound to be the kind of things that we're probing for.

MR. YOON: Thank you for your comment. We have been trying to develop the innovative smoke detector system, but as you know, that system is very sensitive to, as you mentioned, fire, smoke, heat, something like dust.

MEMBER STETKAR: (Simultaneous speaking) a good positive aspiration and a lot of good filters (Simultaneous speaking).

MR. SCHULTZ: You want to prevent false alarms. You don't want to distract the operations crew with systems that are not warning of a real hazard, but at the same time, it's certainly worthwhile to pursue the technology.

MR. LIM: Now, here are the communication systems. Communication systems provide reliable and effective interplant communications and plant-to-offsite communications during all operating or emergency conditions. During a LOOP, communication systems are powered from a PNS bus. This PNS bus is backed up by the AAC source during a LOOP.

In case of either AAC source failure during a LOOP or station blackout condition, communication systems are powered from one of the two dedicated, 16-hours rated, non-safety related batteries. Communication systems are composed of plant, offsite, and security communication systems. In more details, plant communication systems are composed of evacuation order address, public address, some powered telephones, plant time synchronizing, local area network, and a bunch of private networks and wireless communication systems. Offsite communication systems are composed of commercial telephone, local law enforcement communication measures, and satellite telephone system. Lastly, security communication systems are composed of security telephones and security wireless communication systems.

Now, here are lighting systems. I am presenting the lighting systems, too. Lighting systems provide adequate lighting during normal and off-normal conditions, and are composed of normal, emergency, and security lighting systems. Normal lighting system provides an entire plant during normal plant operations and are powered from non-Class 1E 480 volts AC bus and PNS bus.

Emergency lighting system provides in areas required for safe shutdown of the plant, restoring the plant to normal operation, firefighting, and safe movement of people during plant off-normal condition and loss of normal power supply. In more details, emergency AC lighting system is powered from Class 1E 480 volts AC bus. This bus is backed up by the Class 1E emergency diesel generators during a LOOP and the AAC source during a station blackout. Emergency DC lighting system is powered from non-Class 1E 125 volt DC station battery or self-contained battery. Lastly, security lighting system provides in all areas which require security lighting and is powered from offsite for general security lighting and from the security power system for security alarm station.

I continue to talk about Subsection 9.5.4, emergency diesel engine fuel oil system. This system performs safety-related function. The function of this system is to provide for the required storage capacity and the continuous supply of fuel oil to each of four redundant Class 1E EDGs, following LOOP, in accordance with requirements. This system consists of four redundant train.

Also, each train of EDG supporting system, such as cooling water, lubrication, the combustion air intake and exhaust gas system are each one of the redundant EDG unit. All EDG support system is designed as safety Class 3 and seismic Category 1. Major component in each train consists of fuel oil storage tank, two transfer pumps, a day tank. The capacity of fuel oil storage tank and day tank are minimum seven days and one hour, respectively. Each train is provided with an emergency fill connection to allow fuel oil to be directly pumped from one outside fuel source into the day tank. Next is emergency diesel engine cooling water system. This system also performs safety-related function. The function of this system is to provide the cooling water to each EDG unit.

The safety-related function is the necessary cooling to dispel heat from the diesel engine coolant and the lubricating oil to maintain temperature within normal operating limits during operation condition. The non-safety related section is part of the preheating water circuit for engine standby. Cooling water system is the closed-cycle cooling system. This is subdivided into low temperature water subsystem and high temperature water subsystem.

Three-way thermostat is provided to maintain the proper water temperature. The water volume between the normal operating water level and the low level alarm is adequate for seven-day periods of diesel engine operation. Using this cooling water system, each EDG is capable of operating without component cooling water system for at least three minutes, and at no load following startup, and for one minute at full load during its normal operation. Next is emergency diesel engine starting air system. Also, this system performs safety related function. The function of this system is to provide fast-start capability for the diesel engine by using compressed air. This system consists of two redundant sets of equipment. It's completely independent of the other.

The set of equipment consists of a motor-driven compressor package, air receiver, and the device to crank the engine. Air driers with refrigerant type are provided in this system. The system is capable of storing sufficient air to crank a diesel engine five times without recharging the receivers.

MEMBER SUNSERI: Mr. Lim, I have a

question here. I was just looking in the DCD. I had asked a question earlier about instrument air dew point, which -40 degrees Fahrenheit was provided, and that seems very reasonable for instrument air. Your DCD for the starting air compressor indicates that the dew point is not more than 10 degrees C, which is 50 degrees Fahrenheit, in the normal condition, or 10 degrees Fahrenheit less than the ambient temperature. I understand why you're doing that, keep the air less than saturated, so you don't accumulate water in your tank. But my question is what are the controls for the engine, and do they use any pneumatics, and do those pneumatics come off the starting air receiver? Because if they do, then this would be wet, I would think, for pneumatic controls. It referred to Chapter 8.3 for the controls, but I couldn't find it. I couldn't find the details. I guess let's just start with the easy question. Is the engine controlled with pneumatics, or is there some other controls?

MR. Y.C. KIM: This is Yong Cheol Kim from KEPCO E&C. Actually, the system of the starting air system is designed by the diesel engine signal. I know there is some pneumatic systems in the engines, but I cannot explain exactly right now.

MEMBER SUNSERI: So the engine has

pneumatics. Maybe they came off the instrument air system. I don't know. I don't know where they get the air. Go ahead.

MR. SISK: Rob Sisk here. Just conferring with the APR1400 team, starting air is only for starting.

MEMBER SUNSERI: So the pneumatics will come from someplace else, then. Thank you.

MEMBER SKILLMAN: I would like to support my colleague's question. That's a question regarding the dew point for your starting air. If you were to check the operating experience for pneumatic starting in this country, you will find that there have been numerous failures to start of an emergency diesel engine 4160, based on ice forming in the starting solenoids. The reason is because the starting air has not been dehydrated.

It has not been taken down to maybe -50 Fahrenheit, which is a very different compressor. But the failure mode has been an ice puck forming in the solenoid. What happens is the moisture in the air freezes due to the adiabatic expansion heat. You might want to take a look at that specification for your drier air. I support my colleague that this seems awfully wet. It seems like you have specified a moisture content that you may regret. You may want to drop that down by 20 or 30 degrees Fahrenheit.

MR. SISK: Thank you for the comment. We've captured that and take a look.

MR. LIM: Next is emergency diesel engine lubrication system. This system also performs safety related function. The safety related function is to store and supply clean lubricating oil to the diesel engine to lubricate and cool various engine components during engine operation conditions. The non-safety related section is part of the keep-warm oil lubricating system to maintain engine lubricating oil in proper condition and to separate lubricating oil to the diesel engine during standby. This system consists of heat exchanger, a full-flow filter in engine enclosure, an engine-driven lube oil pump, a three-way thermostat valve, a prelube oil pump, and a lube oil makeup tank.

Three-way thermostat valve is provided to maintain the proper oil outlet temperature. Onsite lubricating oil storage capacity for each diesel engine is sufficient for seven days of operation. Next is emergency diesel engine combustion air intake and exhaust system. This system performs safety related function.

The function of this system is to supply adequate quantity of combustion air of reliable quality and exhaust combustion products to the atmosphere. This system consists of silencers, filter, expansion joints, air inlet duct, and air exhaust piping. This system is sized to permit continuous operation of the EDG at 110 percent rating output. The system criteria intake opening is located above about 6.1 meters from grade level. Exhaust stack is in a direction away from the air intake inlet with sufficient separation.

MEMBER SUNSERI: One question on combustion air. It wasn't in this section of the DCD, but somewhere in this series of DCD sections talking about the diesel, there was a reference to overspeed tripping of the machine and shutting off the fuel oil as the trip function. My experience is you shut off the combustion air as a faster way to shut it down. When you shut down this machine in a trip condition, is it removing the fuel oil, removing the combustion air, or both? You can get back with us on that if you need to.

MR. SISK: Let us do that.

MR. H. KIM: Let me explain by my experience. We have three points, three signals: the temperature lube oil, and also we can check out the power rating when the main control and local control. I think I remember we don't have any kind of trip signal from the air intake or the exhaust system because we cannot calculate the flow of rate. But we can find the system is okay or not by using the power rating.

MR. SISK: I understand the question. We'll talk over lunch and get back.

MEMBER SUNSERI: Yes, I would think it would be unusual not to have a damper in the air system. Thank you.

MEMBER SKILLMAN: I'd like to ask this question. I see that you have designed the exhaust, which is probably your muffler or your suppressor, against missile impact. What size missile did you choose for protection?

MR. YOON: You mean the size of external missile or internal?

MEMBER SKILLMAN: I didn't understand your comment.

MR. YOON: I think your question is the size of a missile --

MEMBER SKILLMAN: Yes. Is it a Buick sedan or is it a pickup truck, or either, or both?

MR. YOON: I think information on what you're saying is described in Section 3, Chapter 3.

MEMBER SKILLMAN: I'll take a look. I do see that you've made provision for that. I'm just curious.

MR. YOON: Let me take a note and check it again.

MEMBER SKILLMAN: I'll check it. Thank you.

MR. LIM: Finally, I continue to talk about Subsection 9.5.9, gas turbine generator facility. Gas turbine generator does not perform safety related function. The function of this system is to provide a standby power source for coping with station blackout.

The gas turbine generator is designed to be ready to accept load within two minutes, in the event of a station blackout. This system consists of a complete packaged of the unit with supporting auxiliary system. Starting system and AAC GTG building HVAC system are the COL item. This is end of our presentation.

MEMBER SUNSERI: My final question is on this topic right here. One of the COL items for this piece of equipment was deferring the method for starting the generator. You said there's a variety of methods that you can start these things and what have you. I understand that. My question may be -- it would seem to me that from a PRA perspective, there might be some reliability differences in which method you choose to start this thing. I don't know, John, but I would imagine the reliability of this might affect the PRA, ultimately, or have some influence on it.

MEMBER STETKAR: It does.

MEMBER SUNSERI: So then my question just is what did you choose or what did you use as an assumption for how it gets started to support its reliability?

MR. Y. KIM: This is Yong Cheol Kim from KEPCO E&C. I guess you mean the reliability of the GTG (Simultaneous speaking)?

MEMBER SUNSERI: The AAC.

MR. Y. KIM: (Simultaneous speaking) generator?

MEMBER SUNSERI: The AAC.

MR. Y. KIM: AAC? Yes, we designed the reliability for AAC gas turbine generator by using the Regulation Guide 1.155, 95 percent.

MEMBER SUNSERI: So it must be just some generic number, then? Okay, thank you.

MR. OH: This is Andy Oh, KHNP Washington Office. Our gas turbine generator, the reliability that is used in the PRA is we referenced by the NUREG-6928. There's some startup -- the running failure and the startup failure is divided, and there's some source about that reliability. Currently, we are using a generic source of the reliability.

MEMBER SUNSERI: Okay, thank you. I was just curious because you do such a good job of describing all the other features, and then there's this kind of oh, by the way, it's up to the COL applicant to decide how to start the thing. Okay, thank you.

MR. Y. KIM: Anyway, we designed the regulation by using the Reg Guide 1.155.

CHAIRMAN BALLINGER: Any other questions by members?

(No audible response.)

CHAIRMAN BALLINGER: Hearing none -- let me ask the question, then. Is it your plan to discuss the open items?

MR. SISK: We were not planning to go through each of the open items.

MEMBER STETKAR: Never mind.

CHAIRMAN BALLINGER: Never mind. Okay, we will recess until 1:15.

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

p.m.)

CHAIRMAN BALLINGER: Okay. We're back in session. The floor belongs to the staff.

MR. WUNDER: Okay. Thank you, Mr. Chairman, and good afternoon, gentlemen. I'm George Wunder, project manager assigned to Chapter 9. And we're here to present the results of the staff's phase 2 review of the auxiliary systems.

Because of the diversity of the systems covered in this chapter we had a large review team. At one point I believe I counted that I had inputs from some 18 reviewers, which is a lot to pull together into a final chapter.

Along the way some of the reviewers have moved on. But as far as our current team goes I'd like to introduce them.

From reactor systems we have Alexandra Burja and Matt Thonas. From the plant systems branch Raul Hernandez, Hien Le, Chang Li, Angelo Stubbs, Ryan Nolan, Bob Vettori, Dennis Andurkat, Thinh Dinh, and Andrea Meyer.

And from the materials and chemical engineering branch Greg Makar and Andrew Yeshnik. From the instrumentation control branch, Dawnmatthews Kalathivettil. I thought I could get that out. And from the electrical engineering branch NRR will be having Adakou Foli.

Not all the reviewers could be here today because of, you know, other business, other obligations. But we've got a couple of very capable pinch hitters. And we'll introduce them as they come up to present.

This is a roster of who we thought would be presenting the various systems today, and is largely correct. But there are going to be one or two last minute changes.

There are five sections to Chapter 9 on which we will be presenting. However, Subsection 9.1.2 on new and spent fuel storage, and the seismic evaluation thereof will not be presented today. But will be presented with no open items when we give you our phase 4 presentation.

Because of the large number of reviewers we've decided to bring them up in groups to present on the various sections. And we'll start with Section 9.1. And it is my pleasure to turn it over to Alexandra Burja. Alex.

MS. BURJA: Thank you, George. Good afternoon, everybody. Again, my name is Alex Burja. I'm from the reactor systems branch. And I'll present to you the staff's review of DCD Section 9.1.1, Criticality Safety of New and Spent Fuel Storage.

So, the staff reviewed many areas under this review topic. I'll go over some of the key highlights. I'll talk a little bit about the staff's confirmatory analyses, and then finally offer the staff's conclusions.

The staff reviewed the fuel assembly and storage rack design and modeling to ensure first that the parameters assumed in the criticality analysis are consistent with actual plus-7 fuel design information and the rack design information. And the staff also ensured that the modeling assumptions used in the analysis are appropriate.

For the fuel assemblies, one example is that the fuel enrichment bounds all fuel to be stored. And for the spent fuel storage racks the neutron absorber is a very key input, because any little difference could impact K-effective pretty significantly.

The staff notes that the applicant credited 75 percent of the boron-10 aerial density for safety margin. And also handled the tolerances in the material dimensions in a conservative manner.

MEMBER SKILLMAN: Alex, is that 75 percent a commonly used, if you will, margin, the 25 percent margin? Is it common to use 75 versus 85 or 90?

MS. BURJA: So, it has varied in my understanding. It has been used in some past instances. In other instances I believe 90 percent has been used. But there's, you know, extensive material qualification information that's presented for that case.

So, and it kind of, the handling of this varies from office to office. But I believe the 75 percent is conservative.

MEMBER SKILLMAN: Yes.

MS. BURJA: And if you have further questions I think Andrew Yeshnik would be better suited to answer those.

MEMBER SKILLMAN: That's fine.

MS. BURJA: Okay.

MEMBER SKILLMAN: Thank you. Thank you.

MS. BURJA: No problem. In addition, the staff noted that SRP Section 911 states that the design and layout of the fuel storage facilities should be such that fuel assemblies can only be inserted into design locations.

However, for both the new and spent fuel storage racks it's possible to stick an assembly outside the rack. But the applicant has provided justification through separate criticality analyses that this configuration is acceptable, and criticality is still precluded in those situations.

So, overall the staff found the approach for the design and modeling of the fuel assemblies and storage racks consistent with SRP, or otherwise justified, and therefore, acceptable.

In terms of storage rack materials the staff notes that applicant uses typical materials, type 3 or 4 stainless steel for both rack types, with the addition of the METAMIC neutron absorber for the spent fuel racks.

Material integrity on the front end is partially ensured through the racks being designed, fabricated, and inspected to ANSI requirements, as well as the neutron absorber being manufactured under the Holtec Quality Assurance Program.

The neutron absorber monitoring program consists of 14 coupons, plus two spares to be withdrawn over a period of 60 years. And this will allow the ability to monitor for material loss, blistering, changes in boron content, and corrosion.

The staff also notes that generic letter 16-01 on the monitoring of neutron absorbers in spent fuel pools had no impact on this review. Because the applicant is implementing a monitoring program consistent with that laid out in the Generic Aging Lessons Learned, or GALL Report.

So, overall, for the storage rack materials the staff found the approach consistent with the SRP and the GALL Report, and therefore, acceptable.

The staff also reviewed the computational methods and data that the applicant used, as well as the validation of the computational methods. The applicant used the SCALE 6.1.2 code with ENDF/B-VII 238 group cross section library. This is a current code. It has been used in recent licensing applications that the staff has approved. And it's appropriate for this application, therefore, acceptable.

The staff ensured that the code was validated consistent with NUREG/CR-6698. And notes that the benchmark experiments that were chosen for the validation are applicable to the APR 1400 design, and come from acceptable and widely known sources. Yes.

MEMBER MARCH-LEUBA: I'm confused. The SCALE 6.1.2 was used by the staff, or by KHNP?

MS. BURJA: By KHNP.

MEMBER MARCH-LEUBA: Okay.

MS. BURJA: In the staff's SCR there is

also an open item related to questions about how the experiments were grouped. You know, this is to stimulate conditions in the new fuel storage rack, and then each region of the spent fuel storage rack. However, the staff was able to finish its audit on this question. And it's no longer a concern.

The staff also notes that the area of applicability for the validation is clearly defined, and in agreement with the selected benchmark experiments.

And finally, the bias and bias uncertainty values were calculated consistent with the guidance provided in the NUREG, including the use of statistical analysis in trending parameters. So, overall the staff found the approach for the computational methods to be consistent with the SRP and the NUREG, and therefore, acceptable.

The staff also reviewed the entire bias and uncertainty analysis, because there are many biases and uncertainties that play into the final K-effective result, and you want to ensure conservatism.

So, the staff ensured that all relevant sources were considered. These include for all storage configurations the criticality code bias and bias uncertainty, statistical uncertainties due to the

Monte Carlo calculation, and uncertainties due to material and fabrication tolerances.

For the spent fuel pool in particular, there is also a bias due to the pool cooling water that was considered. And for Region II of the spent fuel storage racks there's the depletion code bias and bias uncertainty, for which the applicants didn't actually perform a formal validation. Rather, they cited the Kopp Memorandum, 1998 memo providing staff guidance and position on criticality analyses.

And basically that states that it's acceptable to assume that the uncertainty due to the depletion code is equal to five percent of the reactivity decrement, assuming the burn up of interest.

The applicant also considered a bias due to minor actinides in fission products, for which they cite NUREG/CR-7109, listed below. And a bias due to the axial power distribution, particularly taking into account the end effect, and burn up record uncertainty.

The staff also confirmed independently that all these presented values were combined correctly, and applied to the nominal K-effective values. So, this approach was consistent with the SRP, the Kopp memo, and the NUREG, and therefore, good to go here.

Staff also reviewed the reactor fuel depletion parameters. Because it's important to ensure that these parameters and assumptions are bounding and conservative when you are crediting burn up. So, these parameters include fuel temperature, fuel density, moderator temperature, soluble boron concentration, and power level.

The staff ensured that the values selected for each of these parameters were indeed conservative, and would serve to maximize the reactivity.

In addition, the staff noted that the APR 1400 may operate at some periods of time with rods in. And this can actually increase reactivity in a fuel assemble relative to un rodded operation, due to the preferential absorption of thermal neutrons, and hardening of the spectrum, which can enhance fissile plutonium production.

So, the staff posed this question to the applicant. And they provided a sensitivity analysis that showed that the effects of rodded operation are minimal, and don't need to be explicitly considered.

In addition, many of you are probably aware of the thermal conductivity degradation issues that the staff and applicant have been working out. The applicant has stated that this issue will not impact the fuel temperature assumed in the depletion analysis.

However, before the staff makes the final determination on that we're waiting for DCD markups, or the like, to be able to truly confirm that. So --

MR. SCHULTZ: So, Alex --

MS. BURJA: Yes.

MR. SCHULTZ: Then by that the applicant means that the assumption that was made is such that it would not be impacted by the technical evaluation incorporating the degradation and thermal conductivity?

MS. BURJA: That's correct. So, the applicant assumes a bounding fuel temperature for the --

MR. SCHULTZ: Yes, okay.

MS. BURJA: -- depletion. And as the applicant stated, that it's still bounded, even considering the effects of, you know --

MEMBER SKILLMAN: But they can demonstrate --

MS. BURJA: -- the new evaluation.

MR. SCHULTZ: -- that with a best estimate, plus the incorporation of the conductivity degradation?

MS. BURJA: That's correct.

MR. SCHULTZ: Okay. Thank you.

MEMBER MARCH-LEUBA: What's bounding, high temperature or low temperature? How do you know?

MS. BURJA: For this case it's high temperature.

MEMBER MARCH-LEUBA: Because really, I guess, in my mind what matters is how much plutonium you generate, right? So, if you shift you flexible, faster hadron spectrum you have more produce in the spent fuel.

MS. BURJA: I agree.

MEMBER MARCH-LEUBA: So, DCD will go in the wrong way. DCD will make it harder than you assume, and it will be in the wrong way. But you still think they're conservative?

MS. BURJA: Yes.

MEMBER MARCH-LEUBA: In bounding?

MS. BURJA: Yes. That's what I believe.

MEMBER MARCH-LEUBA: But --

MS. BURJA: Next slide, please.

MEMBER MARCH-LEUBA: Sorry. It has to be a second-order effect, right? And the temperature of the fuel has to be a low, compared to a rodded condition, where you greatly have in the fuel, a little hotter temperature.

MS. BURJA: I believe temperature is a fairly important affect.

MEMBER MARCH-LEUBA: Yes.

MS. BURJA: It's more, it's definitely more important than power. Because the applicant did a study to show that the temperature was more dominant.

MEMBER MARCH-LEUBA: Okay.

MS. BURJA: Okay. So, overall the approach for the reactor field depletion parameters was consistent with the SRP, and interim staff guidance, and therefore, acceptable.

The staff also reviewed the normal conditions for the fuel storage facilities, including the models for the normal conditions, and the assumption, and the analysis results.

The staff ensured that the criticality models bound the full range of normal conditions for the fuel racks, and conservatively simulate normal operating conditions.

So, for instance, in the spent fuel pool the assumed water temperature is 4 degrees Celsius, which corresponds to the most dense water possible. In addition, the spent fuel pool models simulate infinite arrays of assemblies.

The applicant also considered damaged fuel as the normal condition in a separate spent fuel pool, Region I model. And finally, the applicants provided an RAI response that actually had some criticality analyses for normal conditions of fuel handling, which showed no criticality issues there.

The applicant also did not credit soluble boron for spent fuel pool normal conditions. So, they must remain at a K-effective of below one. And indeed, the analysis results show that they comply with 10 CFR 50.68. So, this approach was again, you know, it agreed with the SRP and 50.68. And it was therefore, acceptable.

The staff also reviewed the abnormal conditions. First to ensure that a comprehensive set of them was analyzed. For new fuel storage this included flooding of the racks with water of full density, and a density that optimizes moderation, as well as placement of an assembly outside of design locations.

For the spent fuel pool the analyzed abnormal conditions for a fresh fuel assembly being dropped outside of the Region I rack, a fresh fuel assembly being misloaded into Region II where burn up is credited, as well as boron dilution accidents.

And again, the applicants showed through an RAI response conditions of abnormal fuel handling. And showed that criticality was precluded, even in those situations.

However, the staff notes that the structural and seismic evaluations of the fuel racks must be completed to ensure that there's no mechanical accident that affects criticality, even by rack deformation.

The staff also ensured that the abnormal conditions model --

MEMBER POWERS: How substantial?

MS. BURJA: Substantial?

MEMBER POWERS: How substantial would either the distortion of the racks or their relocation have to be to lead to a criticality event?

MS. BURJA: I can't really speak to that. What would be important for my review is if the neutron absorber is affected. So, if there's anything that would cause deformation of the neutron absorber would be the primary concern.

The applicant also did analyze what would happen with different rack spacing. So, they've kind of already, you know, considered relocation for seismic events. So, what I'm mainly concerned about is whether there would be any damage to the neutron absorber.

MEMBER POWERS: Well, okay. How extensive would the damage to the neutron absorber have to be before we had any cause for alarm?

MS. BURJA: That's a good question that I --

MEMBER POWERS: Have to disappear completely?

MS. BURJA: I don't think it, personally I would have to run an analysis to figure that out. But I think the hope is that the evaluation would show that there's no permanent damage to --

MEMBER POWERS: Well, I'm sure that's what --

MS. BURJA: -- the racks.

MEMBER POWERS: -- the evaluation was going to come out. I just wondered how bad things had to be.

MS. BURJA: I can't answer that question right now.

MR. LU: This is Shanlai Lu --

MS. BURJA: I would have to run an analysis.

MR. LU: -- from the staff. And I think the, let me try to answer that question. I think the spent fuel pool rack, including the neutron absorber, has been defined according to the certain seismic catheterization to satisfy that one.

My understanding is we need to confirm with the structure branch. And that we do not expect that between the design-basis seismic event the spent fuel pool rack, especially the neutron absorber, would lose its, you know, integrity to the point that it would lose the absorbing capability.

MEMBER POWERS: Well, my question remains. I mean, you take a design-basis earthquake. Okay, how much worse does the earthquake have to be before I get into any trouble?

If the design, if it's ten percent more than the design basis earthquake, then that's kind of interesting. If it's bigger than any earthquake that's been ever known in the solar system, then that too is kind of interesting.

MS. BURJA: Agreed.

MS. KARAS: This is Becky Karas. We would typically as part of our review run I guess extensive, you know, I don't know what you want to call them, like parametric studies, you know, to see I guess how bad things would typically get.

They would, you know, they'd follow their SRP review and check, you know, what the applicant's given, and confirm that. So, that type of look at things would typically be beyond, you know, what we would normally look for.

MEMBER POWERS: How unfortunate.

MS. BURJA: Okay. Moving on. The staff also ensured that the abnormal conditions models are correct and appropriate. For instance, the selection of correct boundary conditions, as well as crediting an appropriate boron concentration.

KHNP credited the tech spec minimum boron concentration for each spent fuel pool accident. But then also, because that was more than what was needed for each accident they also calculated the minimum boron concentration needed to mitigate each accident, and keep K-effective at the regulatory limit.

Overall the analysis results for the abnormal conditions also comply with 10 CFR 50.68. And there was an earlier question about where the applicant got its acceptance criteria. And those are all just from 10 CFR 50-68. There are different numbers for the different storage configurations. But that's from our regulations.

Overall the approach for the abnormal conditions was consistent with the SRP, and in compliance with 10 CFR 50.68, and therefore, acceptable.

The staff also conducted confirmatory analyses to have confidence that the analysis, or the applicant's results were, you know, in the right ballpark that the staff would expect.

The staff also used the SCALE 6.1.2 code, but used the SCAS6 sequence and KENO-6 module, rather than SCAS5 and KENO-5a. The only difference there being is that KENO-6 is capable of more complex geometry input.

The staff also used the end of B-7 continuous energy cross sections as opposed to the multi-group cross sections. The key difference there being that continuous energy cross sections typically produce more accurate results, because there is not a need for cross section or resonance processing.

However, it does result in longer run times and, you know, greater computational power needed. However, the use of a multi-group library can replicate the use of a continuous energy library if judicious cross section processing is done

And there will be some, there are some differences between the staff and applicant results, as I will discuss later on, due to what I believe is just the cross section library difference.

The staff built its models independently using design information from the application itself. And below you see a top cut through view of the new fuel storage rack model that the staff used.

It includes two seven by eight arrays of fuel assemblies, surrounded by, in yellow, that would be an area filled with water of density that the staff buried. And then the green around that is the concrete pit. Next slide, please.

And as I, I had hoped to show you the staff, a comparison of the staff results to the applicant results. But since the applicant results are proprietary, I'll just tell you what you would have seen.

These are results without bias and uncertainty, besides the Monte Carlo uncertainty. So, you see a water density of like 13, .13, .14, .15. These are all densities around the optimum moderation region that we talked about earlier.

And what the staff saw in this area was that the applicant's results were actually higher, and therefore more conservative than the staff's. The differences were kind of substantial. About, you know, 100 to 200 PCM, which is considerably greater than the Monte Carlo uncertainty.

But I believe this is due to using continuous energy, versus multi-group cross sections. And there's a lot of neutron reflection going on with all the water, and the concrete in the model.

MEMBER MARCH-LEUBA: But since this is under pressure and temperature, only 15 grams per, say it's only 15 percent of the volume is occupied by water. What's the other 70, 85 percent? Air? Nothing? Vacuum?

MS. BURJA: It's air. What I did was, the composition actually has, you know, a density that you can input. So, I believe it's just air, or even void.

MEMBER MARCH-LEUBA: And that arbitrary number density for your cross sections, which physically is very difficult to realize. I mean, unless you put some droplets in there and hold them by air. And it's surprising that it's higher.

MS. BURJA: Yes. For the --

MEMBER MARCH-LEUBA: I know how, yes. It has --

MS. BURJA: Yes.

MEMBER MARCH-LEUBA: -- cross section.

MS. BURJA: It totally depends on the physics of the problem and the layout of the racks, where that region of optimum moderation occurs. But for this one it appeared in this range. And it agreed with what the applicant presented as well.

Now, for full density water the staff results were actually higher than the applicant's. But the staff doesn't consider that to be a concern. Because the applicant had considerable margin to the regulatory limit for this case.

Even with their bias and uncertainty added in they still had thousands of PCM. So, lots of margin.

MEMBER MARCH-LEUBA: So, this is a single assembly with reflective boundary conditions?

MS. BURJA: This one, if you, could you go back to the previous slide? Thank you. It's actually this model. It's a full pool model to really incorporate the effects of the concrete and the water.

MEMBER MARCH-LEUBA: But this is the fresh fuel.

MS. BURJA: Yes.

MEMBER MARCH-LEUBA: So, you assume that they use the whole pool for refueling, which is I'm sure --

MS. BURJA: Yes. I mean --

MEMBER MARCH-LEUBA: I'm sure they have more space than they need.

MS. BURJA: Right. So, the assumption is

that the racks are filled to capacity for this analysis.

MEMBER MARCH-LEUBA: For the fresh fuel?

MS. BURJA: Mm hmm.

MEMBER MARCH-LEUBA: And do you do that with MCMP?

MS. BURJA: This is with SCALE.

MEMBER MARCH-LEUBA: Oh, with SCALE.

MS. BURJA: Yes.

MEMBER MARCH-LEUBA: Because with Monte Carlo it would take a few months of CPU to do that.

MS. BURJA: It did take awhile, yes.

MEMBER SUNSERI: Alex, while you have that slide up, I had a question.

MS. BURJA: Sure.

MEMBER SUNSERI: I didn't ask it earlier. So, your analysis is that the new fuel storage area fills up with water somehow, right?

MS. BURJA: Mm hmm.

MEMBER SUNSERI: Now, I presume there's drains in there to prevent that from happening. So, did you do a, I mean, does it make a difference if it's half full? Is it more reactive at a quarter full? Or is it fully full? Fully full?

(Laughter)

PARTICIPANT: All for emphasis.

MEMBER SUNSERI: Does it make a difference?

PARTICIPANT: It's awful, right?

MS. BURJA: The assumption that the staff made was that it was fully filled, however you want to say it. Because ultimately the regulation states that when fully flooded with water of, you know, the full density, or of density that optimizes moderation, it needs to meet K-effective of, you know, .95 or .98. So, we assumed fully flooded.

MEMBER SUNSERI: Thank you.

MS. BURJA: You're welcome. So, I think we've covered this slide, if we can move on? The staff also looked at the spent fuel pool models. On the left we have the Region I model, which is a single fuel assembly.

And you can see it's surrounded by the stainless steel racks, all with neutron absorber panels on all sides, and a water gap equal to half the distance to the next fuel assembly. And around this are all reflective boundary conditions to simulate the infinite array.

Region II is a little bit different. Because there are only storage tubes in diagonal locations. So, the staff had to do a two by two model here to accurately replicate the accurate layout. And there are periodic boundary conditions on the sides of the Region II model.

MEMBER MARCH-LEUBA: Yes. Looking at that Region II, now back to the seismic. You shake that all you want. The green lines is stainless steel, correct?

MS. BURJA: That's correct.

MEMBER MARCH-LEUBA: And the orange or yellow lines are absorbers?

MS. BURJA: Yes.

MEMBER MARCH-LEUBA: You can shake it all you want. It sort of has nowhere to fall off there? I mean, it's going to stay there? I mean, you can move a centimeter to the left or to the right, but it's not going to fall? So, you're going to have boron in there after a terrible seismic event.

MR. YESHNIK: Okay. I'm Andrew Yeshnick. I'm the materials reviewer for this. And what the model does not show is that there's a sheath on the outside of the neutron absorber that's welded into place.

So, no matter how much it shakes that's going to stay on. It's going to protect the neutron absorber from being damaged.

MEMBER MARCH-LEUBA: Yes. Thanks.

MS. BURJA: So, we can move on to the next slide. And this slide shows the staff's results. For Region I of the spent fuel pool the calculated K-effective was within 50 to 60 PCM of the applicant's results. Staff's were a little bit higher. But again it's, you know, pretty good agreement, considering that the uncertainty due to the calculation is, you know, about half to a third of that.

For Region II of the spent fuel storage rack the staff analyzed just one point that the applicant did, the case of five percent initial enrichment with no burn up. And yes, K-effective is greater than one here, because this is only a data point used to generate the burn up loading curve.

This is not a realistic storage condition. So, the staff's results here were also within about 50 PCM of the applicant's results, which is pretty good agreement.

So, overall there were some differences in the new fuel storage rack K-effectives. But there was no regulatory or safety concern. And there was good agreement overall for the spent fuel storage racks.

MEMBER MARCH-LEUBA: I'm sure you, go back here.

MS. BURJA: Sure.

MEMBER MARCH-LEUBA: Once you put two or three bundles you're essentially infinite. I mean, a bundle doesn't see five bundles further away, except for leakage a little bit. So, this tells me that if you put fresh fuel in Region II, your K-effective of 1.2?

PARTICIPANT: Can be.

MEMBER MARCH-LEUBA: And that's what you're saying, right?

MS. BURJA: Right. That --

MEMBER MARCH-LEUBA: With all the absorbers, and the water at 1 gram per center, I mean, all too much.

MS. BURJA: Right. With absorbers, and with full density water.

MEMBER MARCH-LEUBA: What's different on the fresh fuel that makes it go to .9?

MS. BURJA: The spacing is a little bit larger.

MEMBER MARCH-LEUBA: They have a larger water gap?

MS. BURJA: Yes. There's greater spacing. And then there are neutron absorber panels on all sides of the tubes. So, if you remember the models --

MEMBER MARCH-LEUBA: Yes.

MS. BURJA: -- for Region --

MEMBER MARCH-LEUBA: I'm looking at it.

MS. BURJA: Okay. Yes, there you go. So, yes. In Region I there are neutron absorber panels on all sides. And then there's the additional spacing to kind of decouple. And in Region II there are only, you know, diagonal locations for the neutron absorbers.

MEMBER MARCH-LEUBA: But the K-effective is not that large in the core, which is optimized to produce power. I mean --

MS. BURJA: This is --

MEMBER MARCH-LEUBA: Something to think about.

MS. BURJA: This is true.

MEMBER MARCH-LEUBA: It's, 1.2 is an awfully large, that's an awful lot of dollars.

MS. BURJA: That's a good consideration.

MEMBER MARCH-LEUBA: Okay.

MS. BURJA: But ultimately that's the number that the code gave. The staff also reviewed the Tier I information ITAAC for the new and spent fuel storage. The staff ensured that the Tier 1 information is complete and clear, and consistent with what was presented in Tier 2.

And the staff also ensured the clarity of the ITAAC, and its consistency with the guidance in the risks on ITAAC submittal. And overall the approach for the Tier 1 information, as modified by RAI responses was consistent with the RSP and the risks, and therefore, acceptable.

So, in conclusion, the staff determined that the applicant's criticality calculation methodology is acceptable and appropriately benchmarked, that the criticality models the applicant used correctly incorporate design information, and use appropriate assumptions. And that the applicant's analyses presented in the associated technical report comply with 10 CFR 50.68 and GDC 62.

In addition, the staff's confirmatory analyses generally support the conclusions from the applicant's analyses.

The staff also ensured that the Tier 1 information ITAAC for new and spent fuel storage is sufficient and necessary to ensure that the Commission's regulations are met..

However, before the staff can make its ultimate safety finding with regard 10 CFR 5068 and GDC 62 the applicant must docket information confirming that thermal conductivity degradation doesn't affect the field depletion temperature. And the staff's structural and seismic evaluation must show that mechanical and seismic events will not affect criticality.

And finally, the staff must close several confirmatory items in its safety evaluation. Are there any questions?

MEMBER POWERS: No. But I'll make a closing remark.

MS. BURJA: Sure.

MEMBER POWERS: I really, really appreciate these independent analyses.

PARTICIPANT: Microphone. Mic.

MEMBER POWERS: Independent analyses that you did and presented for confirmation. I think that adds confidence in your review. And very much appreciate it. Thank you a lot.

MS. BURJA: You're very welcome. Thank you. All right. If there are no further questions, I'll turn it over to Raul Hernandez.

MR. HERNANDEZ: Good afternoon. My name's Raul Hernandez, the reviewer for the nuclear plant. And I'll be presenting the staff evaluation of the spent pool cooling and cleanup system. The applicant already provided you guys with a description of the spent fuel pool system. So, I'm not going to repeat all of that.

The staff reviewed the spent fuel pool cooling system, in particular the safety related cooling portion of it to ensure that it's capable of -- maintain the spent fuel pool assemblies cool and covered with, during all accident conditions.

The staff reviewed the spent fuel cooling and cleanup systems in accordance with the guidance on SRP 9.1.3. We reviewed the systems to ensure that the configuration of all the connections and piping ensured that there's adequate inventory of water in the spent fuel pool to provide cooling, and so that the spent fuel pool -- the safety related cooling portion can operate and maintain the fuel protected.

With -- the staff evaluated the key assumptions on the turbine analysis, in particular with an audit of the applicant's calculations. We've submitted several RAIs related to additional details on these assumptions.

And the system description provided on the DCD, all the RAI responses have been found except for the one that your, the SE that you guys received has many open items. But all of them have been closed with exception of one.

We still are, we are waiting for the applicant's to reevaluate the thermal analysis to confirm that the system can perform its intended function at the bounding conditions, which in this case is a low water level. Any question on the spent fuel pool?

MEMBER SKILLMAN: Yes.

MR. HERNANDEZ: Yes.

MEMBER SKILLMAN: Raul, you said all of the open items except one in the SE --

MR. HERNANDEZ: Yes.

MEMBER SKILLMAN: -- have been closed, satisfactorily closed?

MR. HERNANDEZ: Yes.

MEMBER SKILLMAN: Yes, sir. Okay. Got it Thank you.

MR. HERNANDEZ: Yes. All of them have been closed. We created a new RAI to encompass the concerns about the, that one item of one of the RAIs still remains open.

MEMBER SKILLMAN: Okay.

MR. HERNANDEZ: It's a tracking issue. But it has a different number.

MEMBER SKILLMAN: Okay. Thank you.

MR. HERNANDEZ: No other questions? Okay So, I'll allow Hien Le to continue with fuel handling and heavy load systems.

MR. LE: Good afternoon. My name's Hien Le. I am with the planned system branch, covering load handling system. The objective of this area of review is to ensure that the design and operation of the load handling system can prevent or minimize the likelihood of an event that could cause a release of radioactivity, a critical accident on the ability to cool the fuel within the reactor vessel, or spent fuel pool of -- could prevent the safe shutdown of the reactor.

As you can see from the preceding staff presentation, the review of the load handling system is only a part of the overall review of the fuel handling, of the fuel storage and handling system to address GDC 61 regarding control of release of radioactive material to the environment, shielding for personal radiation protection, or prevention of significant reduction of the fuel storage coolant inventory, GDC 62 regarding prevention of great critical event, and GDC 4 regarding the effect of a load drop event.

Example is then from the use of high load handling equipment include misplacement of the fuel assembly in the core, or in the spent fuel pool, or fuel handling accident either in the containment building or in the fuel handling area auxiliary building.

Example of the use of the heavy load handling equipment include dropping of a shipping cast fully loaded with the spent fuel assembly, failure of the handling equipment to maintain the structural integrity and/or functionality during a seismic event.

For these event the protected targets are the open vessels, open reactor vessel --

PARTICIPANT: Microphone.

MR. LE: -- which still contain the spent fuel assembly, or spent fuel pool. And the residue heat removal equipment that are in service to support refueling operation.

For the review of the load handling equipment I would like to bring to your attention three item of particular interest. First, the difference between SRP 9.1.4 and SRP 9.1.5 in term of respond of load handling equipment to a safe shutdown earthquake.

SRP 9.1.4 require light load handling equipment only to be classified as seismic category 1, category 2. While SRP 9.1.5 require heavy load handling equipment to be capable of handling the load, in addition to being seismic category 2. What this mean is to include a design picture to stop any ongoing motion, and the capability to hold the load during an SSC event.

Second, the staff position on the application of design criteria for single proof to various components in the heavy load handing system with respect to a load drop event.

In essence, redundant audio component are required in the load carrying path, or the component is designed to carry that load with a ready capacity. Because with single failure proof equipment the likelihood of a drop load event be minimized. And analysis of the impact of the heavy load drop is not required.

Per programmatics control for the design, and construction of heavy load handling equipment. And in particular key element of a program for safe handling, safe load handling operation. That is deferred to be addressed by a COA applicant.

As presented in the SER, all issue RAIs have to seek clarification on various description of space fit design feature of the load handling equipment, and identify open items. And not for clarification respond to previous issue RAI.

The latest respond are found acceptable.

And all open items can now be closed. With that I conclude my portion of the presentation.

MEMBER SKILLMAN: I would like to ask this question, please. From the design control document, I'm on Page 9.1, Item 54. And this is the text, "The containment polar crane is used to handle the IHA and RV internals. The containment polar crane, which has a 450 ton rated capacity for normal operation, is used with various lifting rigs to move equipment. A 60 ton load block is used for routine maintenance, and for in service inspection."

Here's my question. During construction the polar crane is equipped with a special trolley arrangement that increases the load block rated capacity to 900 tons. That doubles the rating. Can you explain how that is done?

MR. LE: The staff review of interim heavy load handling is only from a perspective of nuclear safety. The handling during construction do not have any safety significance. It more of a, to meet all of the OSHA requirement.

Because from a staff review of heavy load handing system, the target was a spent, prevention of damage to the spent fuel, to the area, to the spent fuel. And safety equipment to ensure a safe shutdown.

So, construction activity was an OSHA thing. However, from a perspective of, I would say more or less, was more a investment protection when you have it under construction.

MR. DIAS: Let me say something. This is Antonio Dias, the plant branch system, plant systems branch. I'm sorry, I'm confusing you. Anyway, Mr. Skillman, we will get back to you on this. It is something that we did not review.

But we can look at, probably contact someone in Region II that could tell us exactly what exactly this means, and what it's done. And if I have any information I'll get back to you on this.

MEMBER SKILLMAN: Thanks, Antonio. That's good. Thanks.

MEMBER MARCH-LEUBA: My brain works in delay mode. And I also know this, Raul was disappointed I would not ask him any questions. So, this is about the thermal.

Any consideration was given on flow blockage? I'm thinking somebody drove in front of this general shoe covers, and it goes into an assembly or, you know, Murphy's Law, you'll carry six Tivek shoes and they fall down. Is any consideration given to that on the thermal?

MR. HERNANDEZ: That, you're talking about blocking the flow of water through the fuel assemblies?

MEMBER MARCH-LEUBA: You drop something on the spent fuel pool, which hopefully will fall on top, which is the wrong, the right way, or there -- But any consideration was given to that?

MR. HERNANDEZ: Not in this part of the evaluation. This part of the evaluation is looking at the bulk thermal analysis of the spent fuel pool, not the flow through the racks. That's evaluated, flow through the racks is 9.1.2, when we look at the --

I'll explain. In Section 9.1.2 when we're looking at the actual rack design, we do look at the maximum temperature flow through the racks. I will have to get back to you as to if we do look at the block flow or not. But t's not part of this section. This section is looking at the bulk thermal analysis of the spent fuel pool. And the --

MEMBER MARCH-LEUBA: You're looking at the heat exchangers --

MR. HERNANDEZ: Yes.

MEMBER MARCH-LEUBA: -- if they can handle that much load? But you don't care about what the fuel limits are doing?

MR. HERNANDEZ: No, no. We don't particularly look at that here. In Section 9.1.2 we do have a thermal analysis that looks at the maximum temperature of water flowing through the racks, assuming worse conditions it's, they need to demonstrate that you don't have nucleic boil. And even if you shut down the safety related cooling system. So, that one does look through the actual fuel element. It's more in detail. But I will have to get back to you as to what amount of block gets evaluated.

PARTICIPANT: Five second rule.

PARTICIPANT: Okay. Your turn.

MR. HERNANDEZ: There's not a lot of space for something to block the flow from the bottom. Typically you have a few inches of separation, depending on the rack design, maybe six to eight inches. So, it's not a lot of --

MEMBER MARCH-LEUBA: You know, it's, what if it's low?

MR. HERNANDEZ: Yes.

MEMBER MARCH-LEUBA: If you have a lot of room you can put a mattress in there. It has more room, you can block in with a small thing. So, we can think bad.

MEMBER POWERS: It's the plastic sandwich wraps that get you here. They're invisible once they're here in the pool.

MR. WUNDER: Okay. If there are no more questions then I'd like to bring up our next group of reviewers to go over Sections 9.2.X.

(Off microphone comments)

MR. WUNDER: Okay. I'm now joined by Chang Li, Angelo Stubbs, and Ryan Nolan to continue on with the water systems. And I'll first turn it over Chang Li. Thank you.

(Off microphone comments)

MR. LI: My name's Chang Li from plant systems branch. The staff review of the systems from the service water pump to the points of cooling water discharge, including piping, valves, instrumentation, and the controls.

The function of the central service water system is to remove heat from the component cooling water systems, and transfer the heat to ultimate heat sink. DCD Revision 0 did not specify this heat load adequately in response to a staff RAI. The applicant clarified the heat load information in the DCD markup.

The staff review was in accordance with the SRP, which includes the system's design conformance with the applicable regulatory requirements, initial testing, ITAAC, technical specification, and the COL information items.

The COL information items includes procedures for maintaining water hammers, site specific information associated with ESWS pump design measures to prevent long term erosion and corrosion, erosion and organic flowering, the location and design of the ESW building and makeup water sources.

The staff asked the applicant clarify some design information to understand the systems better, and the basis for the compliance with applicable regulations.

For example, to response to RAIs the applicants incorporated two new COL information items to specify piping materials, and to develop operational procedure relating to leak detection, and the contamination controls in the ESWS.

In response to RAI the applicant also revised the PNIDs to identify the radiation monitor in the diagram. The staff found the design acceptable, and will verify the confirmatory items in the next revision of the DCD. Do you have any questions? If not, I'm going to turn the presentation to Angelo for the next topics.

MR. STUBBS: Okay. Thank you, Chang.

Good afternoon. My name's Angelo Stubbs. And I want to go on to the next subject, which is the component cooling water system, which the applicant describes in Section 9.2.2 of the DCD

The system is a closed loop cooling system that provides cooling to the safety related and non safety related plant components for normal operation and shutdown, and to safety related components during accidents and emergencies.

The system also serves as an intermediate barrier between radioactive, or potentially radioactive components, or heat sources, and the central service water system.

In conducting our review we used the guidance in SRP 9.2.2 to determine what, that the design was in compliance with the applicable GDCs. Based on the review the staff found that the design, the system to be adequately protected against natural phenomena, such as earthquakes, and also external environmental hazards such as wind, floods, hurricanes, tornados, et cetera. And it was also protected from the internal hazards in the plant.

So, based on that we felt that it was in, it complied with GDCs 2 and 4. And we also found that, the system to be capable of providing the necessary heat cool, the necessary cooling and heat removal capability to support the safety related functions, even assuming a single failure and the loss of site power.

And therefore, we, that made it in compliance with GDCs 44, 45, and 46. So in our, we found that system were in compliance with the applicable GDCs. And there's no open items associated with this, based on our review. Any questions on that system? Okay. If there's no questions I'll ask --

MEMBER SKILLMAN: Angelo, I do have a question.

MR. STUBBS: Yes, sir.

MEMBER SKILLMAN: And it's on your safety evaluation.

MR. STUBBS: Okay.

MEMBER SKILLMAN: And the page number of my question is on Page 9-95 of your SE.

MR. STUBBS: Okay.

MEMBER SKILLMAN: And you make, the staff makes this statement. "The staff reviewed the applicant response and found it acceptable." This about the performance of CCW. "Because the CCWS is designed with margin", with margin, "to allow it to continue to perform its safety function, taking into account normal system degradation over time."

MR. STUBBS: Okay.

MEMBER SKILLMAN: Would you explain that, please? What is normal system degradation over time? I'm thinking of plants down on the Tennessee River, where you open up the CCW heat exchanger, and three-quarters of the heat exchanger is filled with red mud, with one inch of worms and things that crawl.

MR. STUBBS: Okay.

MEMBER SKILLMAN: So, what is normal system degradation over time?

MR. STUBBS: Okay. That's a good question. I don't have the safety evaluation in front of me. I know, I think we asked the question because of we wanted to know down the road that this system would still be able to perform this function. So, we wanted there to be adequate margin.

I believe their response indicated different margins in things that they were having. Also, they indicated that with the plate type heat exchangers they'll be able to --

MEMBER SKILLMAN: Get rid of the worms?

MR. STUBBS: -- get additional heat transfer in the future if necessary, by adding plates. But I guess your question is normal. I guess normal, I guess normal is a term that I can't really define.

Typical, or what people have experienced would vary from location to location. So, maybe that's something we need to revisit and, in terms of the way it's discussed. And either give some indication of the extent to degradation.

Basically what we're looking at is, historically, you know, what type of margin have we seen and not have problems with? So, when we were talking about 10, 15, 20 percent margin, we thought that was an acceptable amount of margin to keep from being in trouble as far as when we get later down the road, and everything isn't new, and you've had the issues with plugging of tubes, and the degradation.

And that, we thought that was a sufficient margin built into the design. But that's something I'll go back and revisit. And see if there's a better way to discuss that, and try to give a, something so that people can know what we were looking for, and why we found it acceptable.

MEMBER SKILLMAN: I would find that useful I would also observe that I have every confidence that if this plant is ever built there will be a heat exchanger monitoring program.

MR. STUBBS: Right.

MEMBER SKILLMAN: And there will be

actions under the heat exchanger monitoring program, plus maintenance role activities that will ensure that this system remains fit for duty.

MR. STUBBS: Right.

MEMBER SKILLMAN: So, I have every confidence that that will occur.

MR. STUBBS: Right.

MEMBER SKILLMAN: I just find it a little difficult to say, okay, everything's dandy because they say, they're taking into consideration --

MR. STUBBS: Right, right.

MEMBER SKILLMAN: -- normal degradation over time.

MR. STUBBS: Right.

MEMBER SKILLMAN: That's pretty vague

MR. STUBBS: Right. That is vague. And we were, I was looking more at the whole picture. I was thinking also in terms of not just the heat exchangers, but also the pumps, and everything else that goes into the system. But I understand your point, yes..

MEMBER SKILLMAN: Thank you, Angelo. Thank you.

MR. STUBBS: Okay. If there's no other questions on that we'll move on to the next system, which is domestic water and sanitary drain system. This is really two systems I guess. And what they do is provide potable water for domestic use and human consumption, and a collection transfer site sanitary waste for treatment, and a discharge during normal operation.

This is generally a site specific system. So, what the applicant has done is to provide a representative conceptual design of these two systems in the DCD.

So, for us, the staff review, we focused on basically the stuff that's not included in the conceptual design. And we looked to see how they address the portions of the systems that deal with protecting the system against contamination, and having it conform to the GDC 60.

And based on our review of what was provided, we found that they included the things in the design to, they included provisions in the design to prevent inadvertent contamination of the system.

Again, the interface is what we were, is also the other thing that we looked at. But basically the bulk of this system is reveiwed at the COL level, when they actually have the particular location, the municipal water system, wherever they're connecting to.

But we did look at interfaces and requirements. We did look at what was there to prevent contamination from other systems, cross contamination with other systems. And we found that they complied with the GDC 60. And there were, they addressed the items that were identified as SRP 9.2.4. Is there any questions with that?

MEMBER SKILLMAN: I've got to ask this. And this is --

MR. STUBBS: Okay.

MEMBER SKILLMAN: -- kind of a snarky question. But it's not intended to be. I'm wondering if the SRP is weak in pointing to the need to make sure that particularly on the sanitary system they're can be streams of radioactive waste from individuals that have had procedures.

MR. STUBBS: Okay.

MEMBER SKILLMAN: Those of us who have been in a plant have experienced this. And it's been a, the first time it happens is a real surprise. Then we walk away saying, that should not have been a surprise, because the culture in which we live --

MR. STUBBS: Right.

MEMBER SKILLMAN: -- brings workers who

are going through medical procedures. So, I'm wondering if there needs to be a, at least some change to the SRP to point people to the need to make sure there is --

MR. STUBBS: Right.

MEMBER SKILLMAN: -- there's a provision for this.

MR. STUBBS: Okay. The SRP, that's one area I think you accurately pointed out. The SRP is really interested in introducing radioactive activity through connections within a plant.

It doesn't really address how you, other ways you could get radioactivity into the system. Whether it's somebody taking something imported into a drain, or by medical ways.

So, it, you know, that's a area that we don't, haven't provided guidance on. And I don't, I'm not sure on this system, because we're looking to keep things out, what we have in a way of being able to have detection, and either diverting flows or isolating parts of the system. So, you're correct.

MEMBER SKILLMAN: And I'm fast to agree that this is not, if you will, an overall safety issue, particularly for the plant. But to the extent that the plant and we as an industry are seen as allowing radioactivity to get loose into the environment, this becomes an issue.

MR. STUBBS: Yes.

MEMBER SKILLMAN: And hence, I raise the question.

MR. STUBBS: And this is a good question. And again, you start thinking forward, okay, so how would you approach the, address, how would you try to address this? And I'm not quite sure. It may be based on where you're at in the system how you got to address it.

But we don't have any guidance on making an assumption that introduce things into the system that way. And that may be one of the weaknesses. Because we're assuming we're just preventing things from getting in. And we're not looking at other factors of getting things into the sanitary system.

Okay. If there's no further questions I'm going to turn this back over to Chang Li. And he's going to go over the ultimate heat sink.

MR. LI: Ultimate heat sink system. The staff reviewed the systems in accordance with SRP, which includes system function and design, ultimate heat sink cooling towers, initial test program, ITAAC, technical specifications, and the COL information items.

The function of ultimate heat sink is to dissipate the heat rejected from the ESWS. The DCD states that the ultimate heat sink is safety related, and meets the requirements of Reg Guide 1.27 to supply cooling capacity for at least 30 days without makeup water.

Portions of this section, such as ultimate heat sink, cooling towers, are specified as CDI, which is a representative conceptual design not subject to the review for the design certifications.

The staff will verify the compliance with applicable GDCs during the review of future site specific COL application. The interface requirements for COL applicants are described in DCD 201

q These interface items are used for develop the COL information items, such as heat load requirements, Reg Guide 1.27 guidance, temperature requirements, net pumps, suction head, applicable ASME code requirements, seismic category 1 requirements, and for applicable structures, instrumentations, and the controls, et cetera.

In response to a staff RAI the applicant added a COL information item in the DCD markups for COL applicants to provide the design provisions to permit operation and in service testing and inspection, based on the type of UHS design.

This is a confirmatory item. The staff found the applicant's approach acceptable, and will verify the DCD confirmatory item during review of next DCD revision. Any questions? If you don't, I turn back to Angelo.

MR. STUBBS: Okay. We're going to move on to the next system for the water system. This is the condensate storage facilities. For APR1400, a condensate storage facility not a safety related system. And it doesn't directly support any safety related system.

Unlike many of the operating reactors where the condensate storage system provides a safety related water supply source for the auxiliary feedwater system, in this plant the auxiliary feedwater system has auxiliary feedwater source tanks that provide that safety related water source.

Also, in this plant, the condensate storage tank or condensate storage facility isn't used to support station blackout. So there's no safety related functions associated with this. And in Rev C of the application, the applicant came to us and said that the system -- that our SRP wasn't applicable.

Well, we still -- looking at the system and looking at what's going on, we felt that portions were still applicable because the failure of the system could impact safety related or reporting the safety SSCs.

Because not being safety related, the condensate storage tank was not seismic, or tanks, I guess, and it was subject to failure in earthquake conditions. And we also had, like, portions of the system that connected to the aux feedwater system, because it provided a non-safety related backup water supply to the aux feedwater system, I think, on the supply side of the aux feedwater pump.

So in our review, we determined that GDCs related to the cooling, GDCs 44, 45, and 46, weren't applicable. So we focused on the GDCs 260 and the 10 CFR 20.1406.

Based on our review, the GDC 2, we looked at the areas of the system that went to the aux building and connected it to the aux feedwater system. And we found that it was designed appropriately, seismic and safety-wise, for where it was running. So that this really will not impact safety related or important safety SSCs there.

And we also looked at -- and I think we

asked some questions about what would happen if there's flooding resulting from the failure of the tank or the failure of the system. And they provided information on the removal of the flood water in such a way that it would not affect the safety related SSCs or the buildings.

And they did this by saying that there will be -- the site grading and drainage will ensure that SSCs will -- the water we've taken away from the SSCs. And this is something, again, we'll be looking -- if there is a COL outcome, then it will be looked at to make sure that the actual site-specific design satisfies that condition.

As far as GDC 60, we initially asked about that. Because we thought that there would be interaction between the condenser hot well, and the condensate storage tank, and that water would be exchanged back and forth.

The Applicant indicated that though the condensate storage tank will be providing makeup to the condenser hot well, but there was no path for water to go back to the condensate storage tank. So that pretty much took care of the GDC 60 concern that we had. Because we didn't have the exchange of water back into the system, so anything that left the condenser would be handled by the drain system.

And they also had information about 20.1406 about minimization of contamination. We reviewed it, and we found that they took appropriate measures to ensure that 10 CFR 20.1406 was being met. And we found the system design acceptable, and we have no open items for the system. Is there any questions?

(No audible response)

MR. STUBBS: Okay. If not, then I'm going to turn it over to Ryan Nolan. And he's going to go over the --

MR. NOLAN: Hello, my name's Ryan Nolan. And I performed the review of the chilled water system. And as the Applicant presented earlier, they described how the chilled water system is basically two sub-systems. There's the safety related, essential chilled water system, and then there's the non-safety related plant chilled water system.

The staff performed its review in accordance with SRP 9.2.7. And we looked to ensure that the chilled water system, that it's protected from natural phenomena, we looked at its performance, the capability to inspect and test it.

We also looked to ensure whether there was the failure of non-safety-related portions that could adversely interact with safety related portions. An example of this would be the portions of the plant chilled water system. The non-safety plant chilled water systems that are in the aux building are designed to Seismic Category 2 criteria.

We also looked at the ITAAC, pre-operational testing, as well as the tech specs for this system. We issued multiple RAIs. All of them are resolved. There are five remaining confirmatory items that will be addressed when we look at the Rev 1 of the DCD.

The staff concludes that the chilled water system has the heat removal capability to transfer the design basis heat loads from safety related, import into safety systems, to the chillers, and therefore it complies with GDCs 245, 44, 45, 46. We also did review for the minimization of contamination 20.1406, and we find that it complies with that as well.

MEMBER STETKAR: Okay. Are you the room heat up guy or not?

MR. NOLAN: I think that we do more of the systems review.

MEMBER STETKAR: Okay.

MR. NOLAN: The heat up would be more of a ventilation review.

MEMBER STETKAR: I'll wait.

MR. NOLAN: Okay. I think that concludes the water systems section.

MR. WUNDER: If there are no more questions, it does. And if we'd like to continue now, we'll bring up our next panel.

I am now joined by Raul Hernandez, Greg Makar, and Shanlai Lu to go through the staff's review of the process auxiliaries. Raul?

MR. HERNANDEZ: Good afternoon again. I'll be presenting the compressed gas system. As the Applicant already explained this morning, the compressed gas systems -- compressed air and gas systems is a non-safety related system. However, the instrument here does go into an interact with safety related valve. Therefore, we looked in detail into the quality of the air to make sure that it has no adverse impact on safety related valves.

The staff used the guidance from SOP 931 to review the systems. Sorry, already read that. We looked at the compressed air to -- we looked at the instrument air to ensure that the quality would not have an adverse impact, that it is high quality and it follows the guidance, the NRC endorsed guidance. There are several guidelines for compressed air, but endorsed a particular one.

The compressed gas, service air, and the breathing air subsystem, they have no safety function. And we looked at the system to make sure that they don't adversely impact safety related systems.

The staff issued several RAIs. And at the moment, all the RAIS have been resolved and resulted in several confirmatory items. Therefore, the staff finds and concludes that the compressed air and gas systems conform to the applicable guidance, I mean, the applicable regulations. Any particular questions on the system?

(No audible response)

MR. HERNANDEZ: If no more questions, Greg Makar will continue with the process and post-accident sampling system.

MR. MAKAR: This sampling system is comprised of three subsystems, normal, primary, secondary, and post-accident. And with respect to functionality, the focus is on what is measured, where it's measured, and how it's measured, really.

The samples have to be taken from the proper locations, there has to be enough information gathered. And it has to be done in a way that provides representative samples and samples that are safe and don't harm people or the environment.

There's also a safety related function for this system. And that is the containment isolation that aligns with the containment.

So with these samples -- please stay on that slide, please.

MALE PARTICIPANT: Oh, I'm sorry.

MR. MAKAR: The sampling locations and capabilities are related to several things. There's the reactor coolant, pressure boundary, so measuring things like pH, ionic conductivity in the water, solid oxygen content are important. There's, of course, boron for reactivity control.

There in the post-accident phase there'll be chemical additives that are both for ion retention, protection of the materials from degradation. And then there's also the monitoring of radioactivity.

MEMBER SKILLMAN: Greg, let me ask this. In your review or in the staff's review of this system, what consideration was given to PASS, post-accident sampling system, after an accident where you had significant fuel degradation? I'm talking 100, 200, 300 microcuries per cc of basically cesium and strontium.

MR. MAKAR: I don't know. It's not clear

to me from the safety evaluation that was done. The reviewer is one of those people that has moved on. And I would have to go back and look at our -- I think I would look at our guidance, what guidance we used to come to our findings and see how that particularly was addressed. But I'm sorry, I don't know any --

MEMBER SKILLMAN: Well, let me just set a background for my questions so you can understand the context. Very often, the sample lines come into a sample sink. You have, perhaps, a couple for a steam generator at various locations and for feedwater at various locations.

Then there might be one or two for the reactor cooling system in that same sample sink. And that's in a hooded environment, probably off the radiation protection area, off the RadCon area.

But if you really have an accident, if you pull water out of the reactor coolant system sample, you may have to evacuate the entire area. Because if you've truly had some amount of fuel failure, the almost instant background radiation will go to R per hour, in some cases 100 R per hour.

And so, to me, the issue is, when you talk about a post-accident sampling system, one must anticipate that you've had an accident of sufficient seriousness that you can, in fact, get that sample somehow.

I will tell you at TMI 2, during the accident, we couldn't go near the PASS. I mean, we were just overwhelmed. It just literally knocked our socks off. We couldn't go near it.

And that was one of the reasons we went for such a long time without an ability to describe what happened other than to say we know we lost a lot of fuel. We don't know how much.

So as I look at a design cert, and what this might, unfortunately, ultimately be used for, for it to be useful, it needs to be in a place where people can actually use it. So it's going to be -- it should be something different than just a spigot in your sample sink. Because if you've truly had a fuel failure accident, and you try to go to that spigot, you'll never go back. You've lost the system. You see my point?

If you really, really need it, then it needs to be somewhere else where you could really confine what might come out of the PASS, both gas and water.

MR. MAKAR: Okay. And it's been awhile since we incorporated the Three Mile Island action plan. And so --

MEMBER SKILLMAN: Well, it may be part of that. I don't --

MR. MAKAR: Okay. I was going to ask that. Are you thinking it's not addressed by that, or I just don't know that it's addressed by that?

MEMBER SKILLMAN: I don't know, sir. I honestly don't know. And I wasn't trying to trick you here. I'm just saying if the PASS is going to be used at all, it's got to be in a place where it's usable after the condition for which that system was intended.

MR. MAKAR: Well, I think, you know, considering we have a conclusion that it meets that guidance.

MEMBER SKILLMAN: And I think --

MR. MAKAR: But I need to go back and --

MEMBER SKILLMAN: Take a look at it.

MR. MAKAR: -- make sure that it addresses that.

MEMBER SKILLMAN: Thank you.

MR. MAKAR: Understand.

MEMBER SKILLMAN: Thanks.

MR. MAKAR: Okay. So in addition to taking samples, this system, since it's connected to other systems, it has to have the seismic and quality design requirements that meet those systems so there's no vulnerability to them. And we have to be able to detect and control leakage outside containment. And as I mentioned, there has to be that containment isolation function.

Next slide, please, George. We have regulatory guides, we have Three Mile Island action plan in our regulations and guidance that address all of these items.

And so with respect to the sampling lines and containment isolation, those valves are designed to close on containment isolation actuation signals, and they are designed to fail in the closed position which meets our requirements.

They are also capable of collecting liquid and gaseous samples from many sources, not only those addressed in the guidance documents and the water chemistry guidelines but some additional locations as well.

And those procedures include things to make the samples -- ensure the samples are representative, like heating the lines or extending the lines to allow decay of N16, and the shielding, and hoods in the collection areas.

Based on the drawings and the table in the DCD, tables in the DCD, we concluded that the system is designed to seismic and quality requirements of the systems to which it's connected. And there are some COL items to address, the programs for leak detection, contamination control, as well as to maintain the records of the as-built condition of the system.

MR. SCHULTZ: Yes. The current SCR that we have, version that we have, does suggest that there's some guidance provided related to NUREG-0737 but that the COL's responsible for implementation. So it would be good for you to review the details of what has been provided by the design applicant and determine whether or not you feel the COL can implement appropriately to address what --

MR. MAKAR: Okay, thank you.

MR. SCHULTZ: -- Mr. Skillman has indicated here.

MR. MAKAR: Thank you. And I want to add we have no open or confirmatory items here. We did have -- the safety evaluation does say that we didn't reach a conclusion at the time that it was written about the seismic and quality requirements. But we have done that since then.

MEMBER SKILLMAN: Dr. Schultz's comment is accurate. That is on Page 9-148 of your safety evaluation, okay. Thank you.

MR. MAKAR: If nothing else, I'll turn it back to Raul.

MR. HERNANDEZ: Yes. I'll be talking about the equipment and for drain system. The staff focused its review on the equipment for drain systems to ensure that the system cannot adversely impact safety related SSEs. Portions of the system where it could impact safety related components were classified as safety related.

The staff followed the guidance of SRP 9.3.3. And issues -- at the time of issuing the SE, there was one open item. But as of now, all RAIS have been closed out. The open item has been resolved.

Any questions in this section?

No? And Shanlai Lu will continue with the CVCS system.

MR. LU: Right, Shanlai Lu from reactor system. And another reviewer on this section, but the reviewer is Matt Thomas, and he's not available to give the presentation. So I am going to have to give the presentation to the committee.

So in terms of the chemical and the volume control system, the staff did review that on a design basis, the safety related design basis of the CVCS in terms of the functionality. We reviewed the functional design basis and the system of design operational modes for different, you know, reactor in modes there too. The system response is for different accidents, component details, including instrumentation and the controls, materials, and then chemical aspects.

In terms of the protections the system provided, and then we reviewed the protections used for boric acid precipitation, a flow into the cavitation protection for the charging pumps, seismic certification, and purifying pewter components, control of venting and draining, and contamination minimization.

And we also reviewed the protection about the vacuum condition in the tanks, the water control tanks, and the material and chemistry compatibility.

In addition, I think that we also reviewed testing, taking certification, and the surveillance requirements of the CVCS. So that's the review scope of this section. So next page.

We did issue RAIs. The total number of RAIs we had about nine RAIs. If you check the SER you can see that one. At this point, all of the RAIs have been responded by KHNP, very detailed responses. We were happy.

And the first three actually were related to the isolation schemes of the different injection lines, charging lines, seal injection line, IRWST makeup line, the reactor cooling pump, during accidents.

And we also particularly reviewed that volume control tank and the inward buckling protection, because there is a possibility of vacuum.

And then I would review the use of EPRI guideline for controlling water chemistry, how they are going to operate in the CVCS. That part we also reviewed, the treatment of dissolved oxygen, a whole bunch of chemicals, hydrogen, sulfate. So that's the RAIs we asked, the Number 4, the PH control procedures and the standard chemical specifications.

So at this point of the version you saw, that you guys have, there is no open items. We closed. Everything was fine.

But we answered a question in Chapter 15, which is related to the boron dilution. And that part was declared as part of Phase 2. It was an open item. The resolution of that open item could, could, 50/50 percent chance of impact as part of SER.

Because that resolution right now is still ongoing. We are planning write direction to close that particular RAI in Chapter 15. But the outcome of the closure might have, you know, trigger the additional justification of the fresh water source pump and the valve.

So that part, as part of our presentation, we just wanted to identify there was still a link here. The reason is because when we give you guys the SER, Phase 2 SER, at that time, the resolution of the particular RAI in Chapter 15 was still ongoing. So we did not know what might be the change.

So right now, there was a potential change. We may come back to say, okay, the fresh water source valve, isolation valve, needs to be either safety graded or not safety graded. And how the, you know, what relevant technical certification might need to be changed. So that's one right now. I just want to -- as a reminder, at this point.

MEMBER SKILLMAN: What is the status of that valve right now? Is it locked closed --

MR. LU: Okay, it's --

MEMBER SKILLMAN: -- fully lock closed.

MR. LU: No, no. It's a valve can be controlled from the control room. So that during the operation and the mode four, mode five, that can be used to supply the fresh water. And what we found that I can't give you -- well, tomorrow we are going to be here to talk about Chapter 15 which is one of the items we can -- I can give you a nutshell of another issue.

It is that, once you have fresh water comes in, and then you have dilution, in the Mode 4 and Mode 5. So the question becomes the dilution will trigger the leak critically, okay. And then currently we did have the questions about the, you know, boron dilution analysis. We found that it may not be conserving enough. So there is a possibility we are going to mandate the isolation of fresh water source during Mode 4 and the Mode 5 operation.

So if we do that, I think the specification change and there might be also the detection of whether the control room can see that valve or not, all right.

If they can see the valve, or the signal, and then whether that should be safety graded or not safety graded, so that's the determination. We have not reached closure with the KHNP yet. I don't think it's going to be a, you know, show stopper of design issue. It's just that the documentation, we never cleared it out.

MEMBER SKILLMAN: Thank you.

MR. LU: So that's just a reminder here.

Next page. So overall, based on the

current review, I think the staff has reached some whole new findings.

In terms of design basis, CVCS has probably the safety related design basis. Functionality-wise, the system functional design has included all the components necessary for that cooling the system, chemical and volume control. The CVCS charging pumps adequate for coping with station blackout event. Components, instrumentation, controls are appropriate, adequate chemistry and purity control.

Protection, it does provide the intended protection. It has the protection against boric acid precipitation, cavitation, and the minimum flow protection for the charging pumps.

Appropriate seismic classification has been completed for the CVCS, purifying equipment appropriate protected, CVCS leakage control adequate to minimize the contamination. And the volume control tank did have the adequate protection of the structure against a possible vacuum condition.

And then the Applicant has already provided adequate testing, technical specifications, and the surveillance requirements, okay.

So the conclusion here, at this point, besides as a reminder, and I think as part of Phase 2 review, established conclusion that the CVCS has been designed appropriately for chemical and volume control. APR1400 application includes a proper ITAAC and technical specifications, and no open items, except that reminder.

We may take actions after we -- depends on the outcome of that resolution of that open item. So that's the conclusion of the chemical and the volume control system review. Any questions?

(No audible response)

MR. LU: Okay.

MR. WUNDER: If there are no questions, we're ready for our next panel, a very small panel. I'm joined now by Diane Jackson. She is the heating, ventilation, and air conditioning branch who comes with her own hand-made name tag.

CHAIRMAN BALLINGER: Are you the heat-up person?

MS. JACKSON: I think I am. But I hopefully won't disappoint you too much. I am Diane Jackson. I recently took over as the first line supervisor for containment and ventilation systems.

Unfortunately, the reviewer of this section, Danny Chien, was not able to be here today. On Tuesday, he called me and said I'm in the hospital.

And he's doing okay but clearly not making it in this week. So I quickly reviewed his slides in his --

MEMBER POWERS: He's still alive. It's no excuse.

MS. JACKSON: He is.

(Laughter)

MS. JACKSON: I didn't drag him in. It wasn't drug testing or anything, you know. So I just wanted to give you that preface. If there are questions, I'd be happy -- that I can't answer, I'd be happy to take them back. And we'll get you a more thorough answer.

So we're going to talk about ventilation systems this afternoon. I'm going to talk about control room ventilation, fuel handling, compound building, and emergency safety features ventilation system.

So the first one up is the control room HVAC system. We reviewed it to determine if it is capable of maintaining suitable environmental conditions for personnel and equipment, a little typo there, under normal and accident conditions.

We looked for the normal compliance for, you know, seismic, missiles -- obviously shared systems don't apply to APR1400 -- control room habitability, and control of radio release.

We also, you know, there's a non-safety related part of this, safety related part. The non-safety related isolates on an ESF actuation system. The non-safety part looks to keep a positive pressure. Oops, wait, no. For the emergency part, it's a positive pressure.

For normal stuff they are looking to make sure, and in emergency, that there is conditioned air. So it's proper temperature, and humidity, and all that kind of good stuff, so the operators can do their jobs.

For our safety findings, we found that they met all of the regulations. We did note, in the ITAAC, that it had just said the control room will maintain a positive pressure and kind of just left it at that.

Danny didn't think that was quite sufficient, so he pushed them a little bit in the ITAAC and in the FSAR. It now says it will be maintained at a minimum of 0.125 inch water gauge positive pressure with respect to the surrounding area. So, you know, it pushes the envelope to make sure that we have a little bit of margin there.

We're waiting just for the next rev of the FSAR to make sure that it's in there, as we had agreed, and they had supplied a markup for it. So our conclusion is it complies with all the design criteria, and it's capable of performing its intended function.

MR. SCHULTZ: Is that value to be a technical specification, do you know?

MS. JACKSON: I don't think so. I think it's an ITAAC.

MR. SCHULTZ: Okay. Thank you.

MS. JACKSON: I don't think, I know. And it will be an ITAAC but not a tech spec, okay.

Next one if the fuel handling area which is SRP Section 942. We're looking to see that the system is capable of preventing the spread of airborne contamination and maintaining the fuel handling area if there are airborne concentration below the regulatory limits for normal and accident conditions.

Of course, we look at all the normal GDCs, seismic, control of radiological release, 61 airborne radiological reactivity, release of it, lack of release of it.

So again, for the non-safety related in normal ops, we want to maintain a suitable environment for both the operators as they're moving around the spent fuel area, as well as the equipment, that it doesn't get too warm there.

For the fuel handling area, it is

maintained at a slightly negative pressure to make sure everything is kept in. For the safety related functions, they have to isolate everything. They have cooling to the spent fuel pool heat exchanger rooms. And it starts to maintain its negative pressure, of course, and it looks to remove the iodine and any particulates.

Let's see, for the staff findings, a pretty minor one, but I guess it's a general one. He found this through a number of different areas in the ITAAC. There was nothing to say that they would verify the capability of the heating coils, so that was put in as an ITAAC issue.

And it will be in accordance with ASME AG1, Section CA. With that, Danny was satisfied and felt like it could meet and perform its intended functions during normal and accident conditions.

Okay, compound building HVAC system. It's pretty much a non-safety related system except for the safety related cubicle coolers for the motor-driven aux feedwater or pump room. And there's one other room, an auxiliary room or something.

MEMBER STETKAR: Back up.

MS. JACKSON: Yes?

MEMBER STETKAR: How does the compound

building HVAC system affect the motor-driven auxiliary feedwater pumps which are out in the aux building?

MS. JACKSON: You know, I was trying to -- I didn't get a chance to look at the layout of it to see how it is. But that is one of its functions.

MEMBER STETKAR: Really.

MS. JACKSON: Is it --

MEMBER STETKAR: Okay.

MS. JACKSON: -- in the HAVC system, so they are safety-related. And they're in two of these rooms.

Okay. In our staff findings, they found they didn't provide a carbon absorber, air cleaning unit, or HEPA filter maximum air flow ratings. They had come up with this 45,000 cubic feet per minute design. And what's in REG Guide 1.140 says you should have a max flow rate of 30,000 cubic feet per minute, unless you use multiple units.

So go to the next slide. This kind of continues on. They changed the layout of their filters to be three by ten, so there's now 30 of these. And it is higher than what the Reg Guide recommends.

But from what I could tell, because of particularly the in-place testing, to say is it working and functioning properly, and they can continuously monitor this, they said, okay, it is -- it's acceptable.

They also -- that was their number one thing. And they changed those configurations. I don't know what the original configuration was, but it looks like they added additional filters to make sure that it was a nice wide area and perhaps less differential pressure going through it.

With that change, he was satisfied that the HVAC system for the compound building complied and would meet its intended function.

MEMBER STETKAR: Ma'am, just to clarify the record --

MS. JACKSON: Yes?

MEMBER STETKAR: -- and indulge me, just so we get it on there, can you confirm how and where the compound building HVAC system interfaces at all with the -- you said auxiliary feed -- motor driven auxiliary feed waterwater pumps, I believe.

MS. JACKSON: It's the chillers for the room is what it says.

MEMBER STETKAR: Yes. I'm not finding that anywhere.

MS. JACKSON: Are you in the -- I don't have the --

MEMBER STETKAR: I'm in the DCD.

MS. JACKSON: Okay. I don't have the DCD in front of me. I have the SE in front of me.

MEMBER STETKAR: Well, that's why I'm asking you to confirm it. Because the SE might have an error it.

MS. JACKSON: Okay. Hang on. Okay.

MEMBER STETKAR: I'll just leave it at that.

MS. JACKSON: It is -- well, this section is labeled aux building clean area HVAC system, and compound building HVAC system.

MEMBER STETKAR: Okay. Well, aux building clean area HVAC system, I guarantee you, has something to do with the auxiliary feedwater pumps.

MS. JACKSON: Yes.

MEMBER STETKAR: Compound building, not so much.

MS. JACKSON: Okay. You got me on this one. We put them together because there's normally --

MEMBER STETKAR: Yes, yes.

MS. JACKSON: -- a lot of compound --

MEMBER STETKAR: Okay, fine.

MS. JACKSON: -- buildings out --

MEMBER STETKAR: I just wanted to make sure that the transcript is --

MS. JACKSON: Is accurate. I appreciate that. Thank you. Okay, so I don't have a question, so I can stop, right?

Engineered safety feature ventilation system, we reviewed this to make sure it was capable of maintaining a suitable and controlled environment for the ESF components following anticipated transients and design basis accidents. We evaluated them for the normal regulations.

It is -- the ESF ventilation system has really three sub-systems. It's the emergency diesel generator rooms, the electrical and INC rooms, aux building controlled area emergency exhaust system. And it also lists the essential service water and component cooling. But that is a COL item, so it's really only three.

So what he found is -- the only thing he found that was outside of what he expected was that, again, the heating coils' capacity was not in the ITAAC, so that has been added, or will be added, and is waiting as a confirmatory item. And just as before, it will meet ASME AG1, Section CA 5400 so that it falls along into the appropriate criteria.

With that, he was satisfied and the staff is satisfied that it is capable of performing its intended function under normal and accident operations. Okay.

MEMBER MARCH-LEUBA: Going back to the positive pressure, you said the requirement is 0.15 PSI?

MS. JACKSON: Excuse me?

MEMBER MARCH-LEUBA: The positive pressure in the control room, early in your presentation, you first said a requirement of how much?

MS. JACKSON: It was 0.125.

MEMBER MARCH-LEUBA: 0.125 PSI?

MS. JACKSON: Inches, water gauge.

MEMBER MARCH-LEUBA: Oh, inches of water.

MS. JACKSON: And water gauge.

MEMBER MARCH-LEUBA: Okay. All right.

MS. JACKSON: I --

MEMBER MARCH-LEUBA: I can't really put the force across the door. I just want recognition on the force across the door and you can't open it.

MEMBER STETKAR: Well, you can't open it, I can.

(Laughter.)

MS. JACKSON: All right. Thank you very much.

MR. WUNDER: Thank you so much. And if

you're ready, we can bring up our last group which is as large as the last one was small.

CHAIRMAN BALLINGER: I think we probably are. We're way ahead of schedule, but we're scheduled for a break at 3:15, but it looks like we'll have a recess close to 3:15.

Okay. And for Section 9.5, I am joined by Bob Vettori, Deanna Zhang, who is pinch-hitting for Dawn Matthews, and Adakou Foli, and Thinh Dinh. And Bob will start off, please.

MR. VETTORI: Thank you. Bob Vettori, Plant Systems Branch.

CHAIRMAN BALLINGER: Thank you.

MR. VETTORI: The review of the fire protection program consisted of the review of Sections 9.5.1 of the DCD and also Appendix 9.5A which is titled Fire Hazard Analysis.

The APR1400 fire protection program uses the concept of defense-in-depth to achieve the required degree of safety. First, as they said, this is to prevent or minimize potential for fire to occur, second, if a fire should occur, rapidly detect, control, and hopefully extinguish, and lastly to protect the structure, systems, and components important to safety so that a fire will not prevent the safe shutdown of the plant.

During this review, the staff asked 43 RAIs. To date, all have been adequately answered. With incorporation of the confirmatory items in the next revision of the DCD, we will be able to conclude that the sections of the DCD related to fire protection include sufficient information to find that the design conforms to the reg guidance in Reg Guide 1.189.

This concludes my presentation on the fire protection program. Are there any questions?

(No audible response)

MR. VETTORI: If not, I'll turn the presentation to Deanna who will discuss the communications system.

MS. ZHANG: Mine's not quite so short. So again, my name is Deanna Zhang. I'm the lead INC reviewer for the APR1400. And as George had mentioned, I'm here on behalf of Dawn Matthews to discuss the staff's review of Section 9.52 which is on communication systems.

She's actually off getting married. So I don't know who drew the short end of the stick here. So the communication system first mentioned is non-safety related. It's a non-safety related structure, system, and component.

And for the onsite communication systems, they consist of the paging phone system, the evacuation alarm address system, the public address system, the sound-powered telephone system, the telecom system, the plant time-synchronization system, the local area networks, and the VPN, and the wireless communication system.

All site communication systems consist of the commercial telephone system, the local law enforcement communication system, the emergency telephone system, and the satellite telephone system.

So the staff's review focused on verifying that these systems provide reliable and effective communications, both within plant buildings, between different plant buildings, and as well as with external locations during all plant conditions.

The review also verified that reliable backup, alternating current, and battery power are available in case of loss of off-site power or station blackout conditions.

Next slide. So the staff, in general, found the communication systems conformed to the applicable NRC regulations except for two cases in which the staff wrote subsequent RAIs to resolve these open items. And I will go into it in more detail in the next two slides.

Next slide, please. So for the first open item, the Applicant stated that because the communication systems are classified as non-safety, these systems are not required to meet 10 CFR Part 50, GDCs 1 through 4.

However, based on the APR1400 probabilistic risk assessment results, it appears that the communication system availability is an implicit assumption. So as such, the staff requested the Applicant to justify why the communication systems are not classified as risk-significant and do not need to comply with the aforementioned GDCs.

So in the Applicant's response, KHNP stated that a reliability assurance program expert panel will be established to determine whether the communication systems are risk significant or not. And the results will inform whether the communication systems need to meet these aforementioned GDCs.

However, to date the staff has not received an update on that response providing information as far as whether this panel has been established and the results of the assessment there. So the staff is issuing a follow-up RAI to get that information.

Next slide. The second open item has to

do with one consistency issue in the DCD, particular in Tier 1, as well as another issue with the initial test program.

So in DCD Revision 0, Tier 1, the Applicant used the term functional arrangement of communication systems. And it was not clear to the staff what the functional arrangement of the communication systems, what that meant. Because it was not described in Tier 1. So the staff asked the Applicant to either describe it, add a definition in Tier 1, or provide supplemental information to support use of that term.

However, the Applicant's response did not add any clarity. And I think they used another term that the staff also found there was no definition for in Tier 1. So as such, the staff identified this as an open item in the SER.

In addition, the Applicant also claimed that the COL Applicant will address any initial test requirements for the communication systems and provide a corresponding COL item. However, based on the staff understanding, the plant communication system is not site-specific. Therefore, the communication system should be included in the initial test program of the DC Application.

Further, an initial test was proposed for the security communication system. Therefore, it is not clear why there is an inconsistency for security communication systems versus communication systems in general. Therefore, the staff issued a subsequent RAI to track this issue.

So that concludes my presentation. And if there are no questions --

MEMBER SKILLMAN: I do have a question.

MS. ZHANG: Okay.

MEMBER SKILLMAN: And I would start with this observation. Twenty-five or 30 years ago, most of the communication in the plant was through the sound powered phones, through the intercom systems or those types of systems.

And leap ahead about ten years, the operators were wearing equipment very much like what the law enforcement men and women are using today, which is a walkie talkie with a microphone on the chest or close to the mouth.

In the last number of years, a lot of communication is with personal phones, iPads, personal communication devices. So there has been this change in technology that's available to everyone in the world, in fact.

But that change in technology has worked its way into the plants. And you now have an aux operator who's out in the yard calling the shift manager on a cell phone, a personal phone.

How is that type of communication considered in your evaluation?

MS. ZHANG: Well, the design certification did not include personal cell phones as a communication system that's credited in the design. Therefore, if any operator chooses to use that, that had not been described in the application itself.

MEMBER SKILLMAN: Fair enough. Thank you. Okay.

MS. FOLI: Okay. My name is Adakou Foli. I will talk about the lighting system. The lighting systems are designed to provide illumination during normal and off-normal plant conditions. The systems include the normal lighting and emergency lighting systems.

The normal lighting system provides general illumination for the plant during normal plant operation. The emergency lighting system, consisting of the AC and DC systems, provide illumination in areas including for safe shutdown of the plant, fire fighting, and access valves.

The staff reviewed the normal and

emergency lighting systems to ensure that the systems would perform the designed function during all plant operating conditions. Specifically, the staff reviewed the capability of the normal and emergency lighting system to provide adequate illumination and to operate without adversely impacting the operation, control, and maintenance of security systems.

Based on the staff review of the illumination, and the seismic category of the lighting system, and the isolation between known Class 1, and Class 1 is circuit, the staff concluded that the normal and emergency lighting systems are capable of performing the design function without negatively impacting security systems during all plant operating conditions. Any questions?

MEMBER SKILLMAN: I do. On your safety evaluation, you basically communicate the security lighting is powered from offsite by the 480 VAC buses and backed up by the AAC source upon route.

MS. FOLI: Yes.

MEMBER SKILLMAN: When I go up to your description of the emergency AC lighting system, it is provided to the main control room, the Rad waste control room, the tech support center, operation support center, the shutdown panel, the EDG room, Class 1A battery room, Class 1A switch gear room, and our access aisles. No word about powering the lighting around the gas turbine generator.

MS. FOLI: It is. We asked that question. Actually, if you follow --

MEMBER SKILLMAN: Oh, really?

MS. FOLI: Yes.

MEMBER SKILLMAN: I didn't --

MS. FOLI: Yes. And they say that we have, I think, the DC lighting.

MEMBER SKILLMAN: In there?

MS. FOLI: In the AC building.

MEMBER SKILLMAN: Well done. I didn't see that.

MS. FOLI: Yes.

MEMBER SKILLMAN: Okay.

MS. FOLI: It's in the --

MEMBER SKILLMAN: Thank you.

MS. FOLI: Yes.

MEMBER SKILLMAN: Thank you. No further questions.

MR. DINH: Okay. My name is Thinh Dinh from the Plant System Branch. I'm the technical reviewer for the emergency diesel engine support system. The emergency diesel engine support system consists of five sub-systems.

The fuel oil system provides storage and continued supply of fuel for the four Class 1 EDGs following the loss of offsite power event.

Cooling water system provides cooling water to maintain the temperature of the EDG within optimum range during standby and through an operation condition, starting a system, provide compressed air to facilitate EDG fast-start capability, the engine lubricating system, store and deliver clean lubricating oil to the EDG moving parts during standby and full operation condition.

And, lastly, the engine combustion air intake and exhaust system would provide reliable, quality combustion air and removal of exhaust combustion products for EDG operations.

The key design features of the engine support system are each train has a separate and independent emergency diesel engine support system for each of the four EDGs.

Emergency diesel engine support systems are designed to function during and after a safe shutdown earthquake event and protected from natural phenomena, internal flood, missile, pipe break, and interaction with non-seismic systems in the vicinity.

Their seven-day fuel oil capacity, instrumentation, and alarms are provided to monitor the operation of the emergency diesel engine support system, the capability to isolate the system, or piping components including isolation portions of the system for excessive leakage of component malfunction to maintain the system's safety function.

Provisions are made to allow for functional testing, periodic inspection, and maintenance of the emergency diesel engine support system.

Staff review will conclude that the diesel support system in -- the staff review, the diesel support system in accordance with SRP 9.5.4 through 9.5.8, the systems are designed, fabricated, and tested to qualify standards in accordance with applicable NRC guidance, providing adequate assurance that the Class 1 EDG can perform the intended functions during a loss of outside power event.

They are independent and separate. And components are not shared between the EDG. Any single active failure will not prevent the other redundant EDG from performing their safety function.

The EDG and their associate support system are physically separated and designed to function during and after a safe shutdown earthquake event protected from natural phenomena, internal floods, missiles, pipe break, and interaction with other non-seismic system in the vicinity.

Therefore, they are reasonable to expect above accident conditions will not lead to loss of more than one EDG at a time. Their provision for functional testing, periodic inspection, and maintenance of the emergency diesel engine support system ensure reliability as a system.

There is one last standing open item at the time of the SER, however we have received additional information from the Applicant to close this out in the next -- the review of the next revision. May I answer any questions that you may have?

MEMBER SKILLMAN: Yes. What is the item that was just addressed? Was it the consumption rate?

MR. DINH: Yes, the consumption rate was missing from the ITAAC. And we asked for that, and we just received that.

MEMBER SKILLMAN: Okay, thank you.

MR. DINH: Sure. Okay, there's nothing else?

MS. ZHANG: No.

MR. DINH: We move to -- I don't know what the next section is.

MEMBER STETKAR: Did you look at -- I know that the design has the fuel oil supply for the, I'll call it the flex gas turbine generator, for lack of a better term, coming from the day tank from the emergency diesel generator, right?

MR. DINH: I think they have a separate --

MEMBER STETKAR: Shake your -- no, shake your head yes.

(Laughter.)

MR. DINH: Well, I'm not a reviewer of those so --

MEMBER STETKAR: Well, but no. But you're a reviewer on the diesels, right?

MR. DINH: Right.

MEMBER STETKAR: Okay. Fuel system is part of the diesel?

MR. DINH: Yes.

MEMBER STETKAR: Okay. So I'm looking at a drawing here. And unfortunately, the diesel fuel oil system drawing in the DCD shows Train A and says all the others are the same.

So if I look at the Fukushima technical report, it says that I can supply the flex gas turbine generator from any of the four emergency diesel generator day tanks. And if I look at the building layout, I can kind of see how I do that from the two diesel generators that are in the diesel generator building, not so clear from the ones that are in the aux building, unless they got really long pipes.

So can somebody tell me how I can connect the gas turbine generator to the diesel generators that are in the aux building?

MR. DINH: I have to get back on that.

MEMBER STETKAR: Because this fuel -- see, this fuel oil drawing just shows a little pipe going out. And it says emergency diesel generator building. And there's a little dash line that says yard. And I get that for the emergency diesel generator building. Yes?

MR. KIM: This is Yong Cheol Kim from KEPCO E&C. We have a providence to connect the line from the day tank to flex in emergency diesel building, not aux building.

MEMBER STETKAR: Not the aux? Well, but, okay. Now I'm a bit confused. Because in the technical report which I have been told I am to assume is part of the design certification, the technical report gives me a table that lists four valve numbers, one from each emergency diesel.

And I know two of those emergency diesels are in the aux building. So can I connect the flex gas turbine to the diesels in the aux building or not?

MR. LIM: This is Dunam Lim. The technical report, the table in the technical report is revised to original one.

MEMBER STETKAR: Okey dokey.

Didn't see that one. Thank you. I was trying to see if the staff -- again, we try to connect a lot of the dots and all that sort of thing. So thank you. Okay.

MR. VETTORI: Gas turbine generator facility, again, I'm Bob Vettori, Plant Systems Branch. I'll be giving the presentation for the staff's review of Section 9, 5.9, gas turbine generator facility. The individual who performed the review is not available at this time.

The gas turbine generator provides power to the set of required shutdown load to bring the plant to safe shutdown during a station blackout.

The objectives of the review were to determine if the gas turbine generator support systems have the capability to support gas turbine generator operation, independent of the emergency diesel generators, and to determine if the systems support operation of the gas turbine generator for 16 hours of station blackout coping time.

The staff's review was based on the requirements of 10 CFR 50.63 and the guidance in Reg Guide 1.155. The staff finds that the support systems are diverse and independent of the emergency diesel generators and that the gas turbine generator has sufficient fuel oil to support the 16 hour station blackout coping time.

There were two open items in the safety evaluation. Staff has received supplemental information from the Applicant. And with the incorporation of this information in the next revision of the DCD, we will be able to close out these two open items. This concludes my presentation. Are there any questions?

(No audible response)

MR. WUNDER: That concludes the staff's presentation on Chapter 9, Auxiliary Systems.

CHAIRMAN BALLINGER: Well, thank you very much.

(Off the record comments)

MR. SCHULTZ: Tell him I've got a question for George, just perhaps to help the committee.

The Applicant has provided their four page attachment which lists, I presume, their current understanding of open items, many of which are, you know, we've submitted a response to the staff. And I'm not sure if they've received a response from the staff on each of those or not, or they're all addressed in or to be addressed in Rev 1.

Does the staff have a similar list of where things stand? Because today, we've gotten a number of items that have been --

MR. WUNDER: We do. And we've recently met with the Applicant on this so that we have a common understanding of what's left to be done --

MR. SCHULTZ: Good.

MR. WUNDER: -- in Phase 4 to resolve all open items and get you a clean SER, with no open items and only confirmatory items, sometime in the fall.

MR. SCHULTZ: Okay. Thank you.

CHAIRMAN BALLINGER: Okay. Now, we're finished with today's presentations with the exception of asking if there are comments from people in the room. Are there any comments? I have to speak into this without looking in the back of my head. Is there anybody in the room that would like to make a comment? Okay, five second rule? Is there anybody on the phone line that would like to make a comment?

MALE PARTICIPANT: It's open.

CHAIRMAN BALLINGER: It's open.

MS. BANERJEE: This is Maitri. And did we do KHNP's 9.5A?

MEMBER STETKAR: Maitri, give your full name since nobody else knows who you are.

MS. BANERJEE: Of course. Yes, this is Maitri Banerjee, ACRS staff. I have a question which is did we allow KHNP to present 9.5A, the fire hazards analysis, the remaining slides, before we broke for lunch?

CHAIRMAN BALLINGER: We would have allowed to, but they didn't want to.

MS. BANERJEE: Oh, I'm sorry. I didn't follow that.

MEMBER STETKAR: And in fairness, on the record, we didn't ask them to.

CHAIRMAN BALLINGER: And we didn't ask them to.

MS. BANERJEE: Okay.

CHAIRMAN BALLINGER: Other comments from the people on the phone line?

(No audible response)

CHAIRMAN BALLINGER: Hearing none, I think I'm probably going to make a mistake by going around the room. Not making a mistake? Can we go around the table and ask for any final comments for today? None from you?

MEMBER BROWN: I have no additional comments.

CHAIRMAN BALLINGER: Jose?

MEMBER MARCH-LEUBA: Yes. I'd like to agree with Dr. Powers when he said earlier that the staff has done a very -- an excellent job doing this review, especially on the criticality safety on the spent fuel pool. I was very impressed.

MEMBER STETKAR: Nothing more?

CHAIRMAN BALLINGER: Mr. Stetkar? Matt?

MEMBER SUNSERI: I appreciate all the presentations from the staff, and the Applicant, and attention to my questions that I asked. Thank you.

MEMBER POWERS: No additional comments?

CHAIRMAN BALLINGER: Okay.

MEMBER SKILLMAN: Thank you, George, and to the staff, and to each one who has participated. Thank you also to the KHNP team, very well done. Thank you.

I would like to raise one point regarding the air start tank dew point. We raised this with KHNP, would like to raise it with the staff.

The safety evaluation communicates that

the dew point is not more than ten degrees centigrade, 50 Fahrenheit, when installed in a normally controlled 21C 70 degree Fahrenheit environment. And the dew point is controlled to at least 5.5C less, 10 degrees Fahrenheit less than the lowest expected ambient temperature.

I would like to suggest that that number probably needs to be challenged. My view is that that number is too moist. And as the air compressors compress the air for the diesel start, that number, I believe, will ensure water in those storage tanks. If that number is dropped to minus 20, minus 30 Fahrenheit, you'll have a nice dry tank.

The operating experience has been that when the moist air expands, takes on this latent heat expansion, and it will freeze in the solonoid orifice. It's happened at several plants.

What they've done is gone in after the event, why didn't the diesel start, and they found the piping absolutely pristine clean. Unless they catch it in the first several minutes, then they find that there's water in the solonoid, starting solonoid, which meant that there was an ice puck in there.

So it's not something that's immediately intuitive, but when you think of the gas expanding, it's chilling. And it will freeze on the second start or the third start attempt.

So you might want to consider standard review plan for the NUREG and determine whether or not you want to require that that temperature be dropped, 10, 15, 20 degrees Fahrenheit. Thank you.

CHAIRMAN BALLINGER: Steve?

MR. SCHULTZ: Thank you, Ron. I wanted to thank KHNP and also the staff for the presentations today.

My general comment is that, based on what we've heard today and what's been presented in materials in preparation for this meeting, is that both the Applicant and the staff are working very diligently to address quite a large number of different issues that have been raised by the staff.

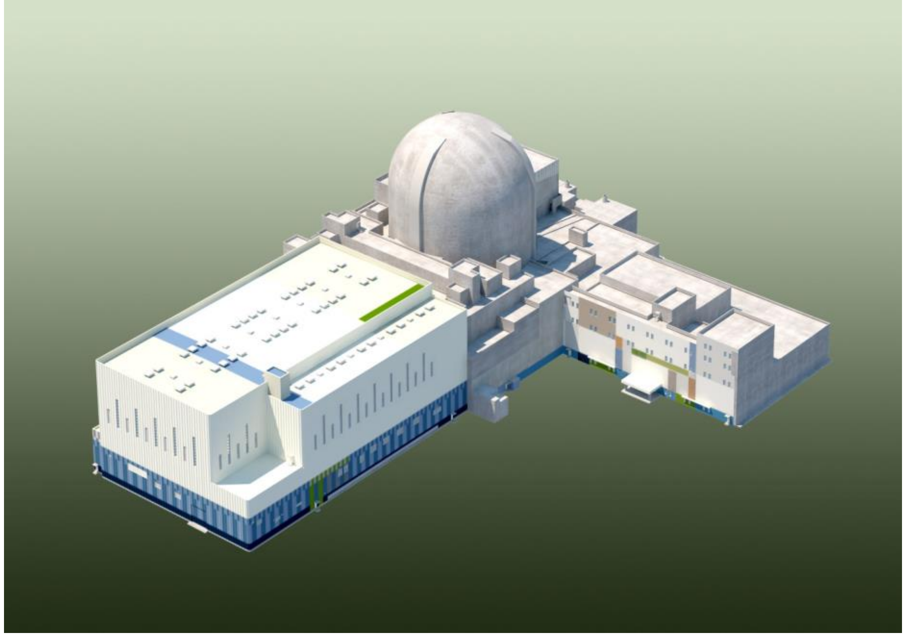
The staff has demonstrated enthusiasm under which they're proceeding to challenge both themselves as well as the Applicant to assure a good product in the end. And, George, as you just responded, that by this fall a number of other items are going to be addressed.

I would just encourage both the Applicant as well as the staff to continue with that enthusiasm, and don't hold back on challenging each other and responding appropriately to assure that these design improvements, if they're needed, are in fact made before the final approval.

CHAIRMAN BALLINGER: Thank you very much. If there are no further comments, we are adjourned until 0800, 0830 tomorrow morning.

(Whereupon, the above-entitled matter went off the record at 3:32 p.m.)

APR1400 DCA
Chapter 9: Auxiliary Systems



KEPCO/KHNP

May 18, 2017

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☐ Section Overview

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9.1	Fuel Storage and Handling	Young Tae Han Min Gyu Kim
9.2	Water Systems	Yong Gun Kim Han Cheol Kim
9.3	Process Auxiliaries	Yong Gun Kim
9.4	Heating, Ventilation and Air Conditioning Systems	Gun Heo
9.5	Other Auxiliary Systems	Du Nam Lim
9.5A	Fire Hazard Analysis	Jin Kyoo Yoon

Overview of Chapter 9

❑ 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 9 Auxiliary Systems	1	DCD	N/A
APR1400-K-X-IT-14001-P/NP	APR1400 Design Control Document Tier 1	1	DCD	N/A
APR1400-Z-A-NR-14011	Criticality Analysis of New and Spent Fuel Storage Racks	1	Technical Report	ML17094A138

9.1 Fuel Storage and Handling

9.1.1 Criticality Safety of New and Spent Fuel Storage

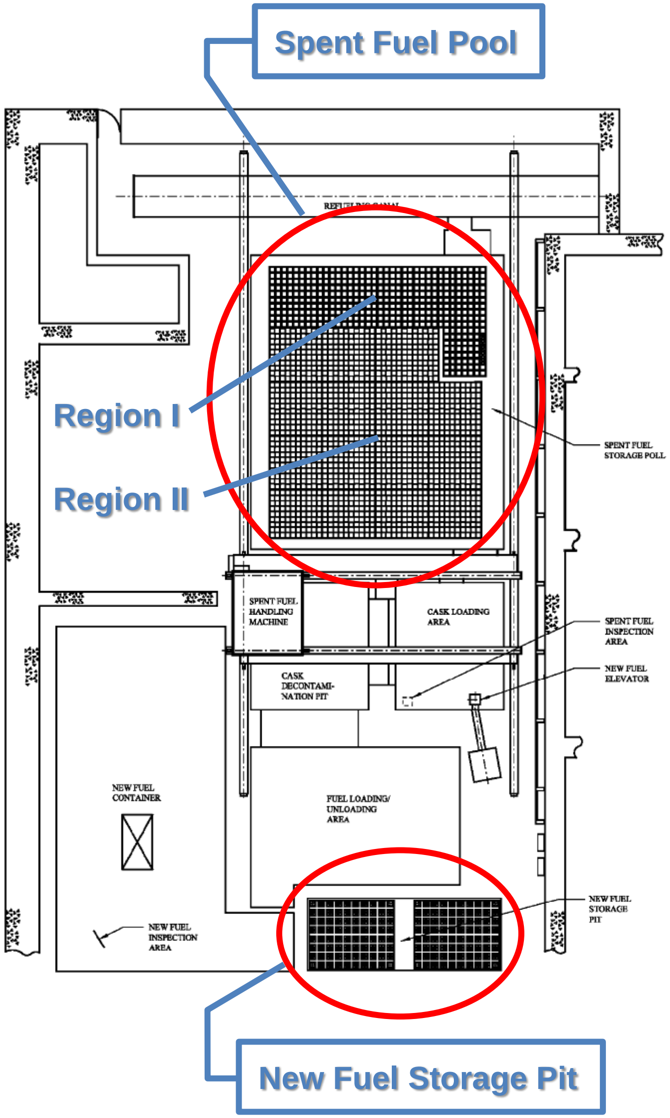
9.1.3 Spent Fuel Pool Cooling and Cleanup System

9.1.4 Light Load Handling System

9.1.5 Overhead Heavy Load Handling System

9.1.1 Criticality Safety of New and Spent Fuel Storage

- ❑ **New and spent fuel storage facilities are located in the fuel handling area of the auxiliary building**
- ❑ **New Fuel is stored in standard stainless steel racks installed in a dry new fuel storage pit**
- ❑ **Spent Fuel is stored in high-density racks installed in a spent fuel pool filled with borated water**
  - The high-density racks consist of structural material (stainless steel) and neutron absorbing material (METAMIC^{TM})
- ❑ **Criticality is precluded by adequate design and by administrative control procedures**



Spent Fuel Pool

Region I

Region II

New Fuel Storage Pit

9.1.1 Criticality Safety of New and Spent Fuel Storage

❑ **Criticality analyses are performed in accordance with the following acceptance criteria**

- New Fuel Storage Rack by 10CFR50.68 (b) item (2), (3)
  - Keff* ≤ 0.95 with full density unborated water
  - Keff* ≤ 0.98 with optimum moderation condition
- Spent Fuel Storage Rack by 10CFR50.68 (b) item (4)
  - Keff* ≤ 0.95 with borated water
  - Keff* < 1.0 with full density unborated water

* Keff value, including all biases and uncertainties, at a 95 percent probability with 95 percent confidence level (95/95)

9.1.1 Criticality Safety of New and Spent Fuel Storage

❑ Analysis Conditions for New Fuel Storage Rack

- The surrounding concrete walls are adequately separated from the racks
- The design maximum enrichment of 5.0 wt% is applied
- No burnable poison rods or other supplemental neutron poisons
- Biases and uncertainties from mechanical tolerances and variations in the design parameters are considered in the Keff

9.1.1 Criticality Safety of New and Spent Fuel Storage

❑ Analysis Conditions for Spent Fuel Storage Rack

- Region I storage area is designed to accommodate fuel assemblies with initial enrichment up to 5.0 wt%
  - The structural material is stainless steel and the neutron absorbing material is METAMIC^{TM}
  - Damaged fuel assemblies are separately evaluated
  - Biases and Uncertainties from mechanical tolerances and variations in the design parameters are considered in the Keff
- Region II storage area is designed to accommodate spent fuel assemblies generated during plant operation
  - The structural material is stainless steel and the neutron absorbing material is METAMIC^{TM}
  - The most severe operating conditions are conservatively assumed in the fuel burnup calculation
  - Biases and Uncertainties from depletion calculation along with those from mechanical tolerances and variations in the design parameters are considered in the Keff

9.1.3 SFP Cooling and Cleanup System

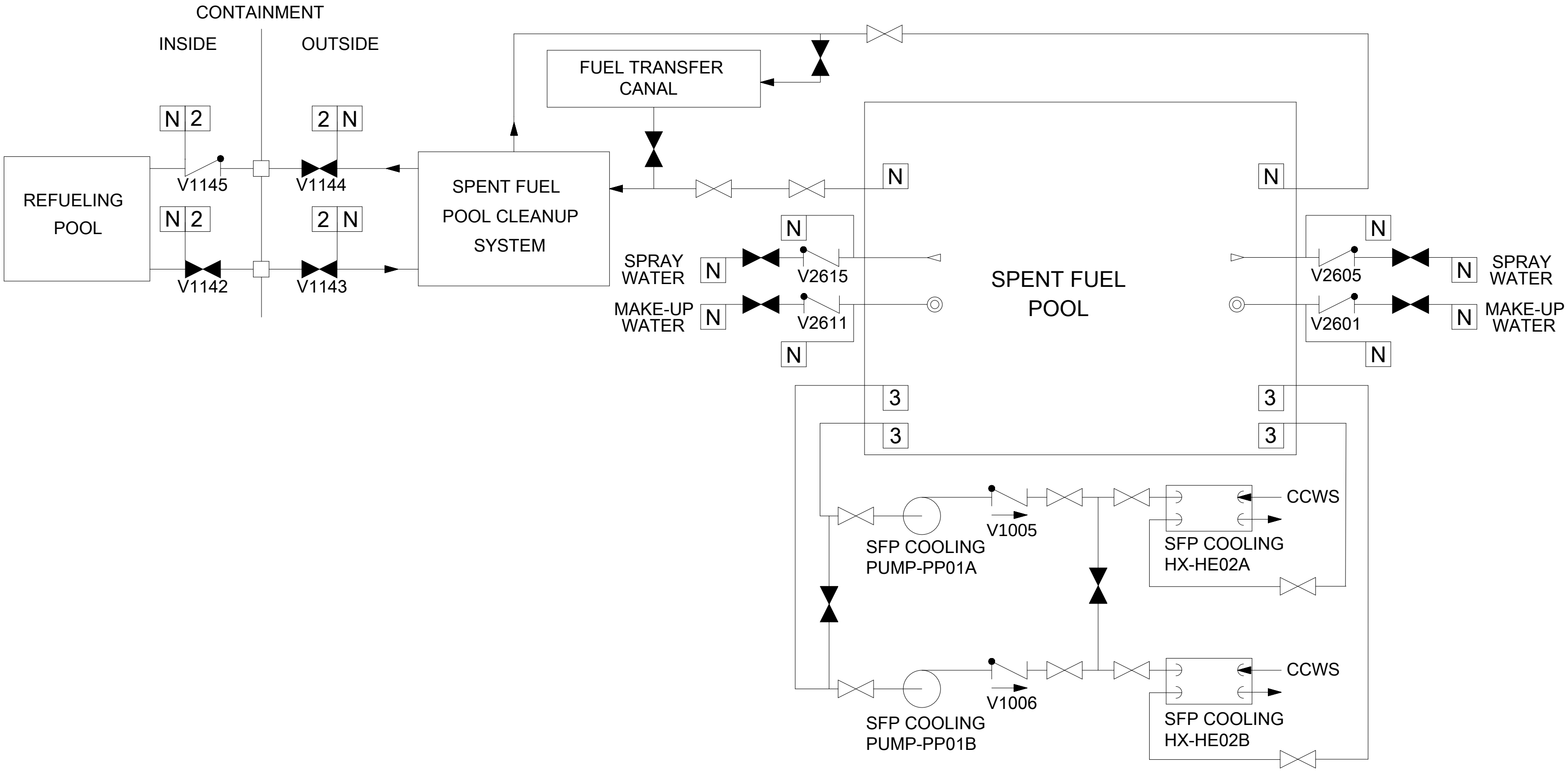
❑ Function

- The SFPCCS removes the decay heat generated by the spent fuel assemblies stored in the SFP, and purifies the water of SFP, IRWST, CLP, fuel transfer canal and refueling pool.

❑ Design Features

- The SFP cooling system (safety-related) is composed of two redundant 100% capacity cooling divisions.
- The SFP cleanup system (non-safety-related) is composed of two 100% capacity combined cleanup divisions.
- All piping that penetrates the pool is located at approximately 3 m (10 ft) above the top of the spent fuel assemblies, and all piping extending down into the pool has siphon breaker holes above this level.
- The SFP cooling system is designed to maintain the SFP temperature below 60°C (140°F) in a single active failure.

9.1.3 SFP Cooling and Cleanup System



ACRS Meeting (May.18 , 2017)

9.1.4 Light Load Handling System

❑ **Function :**

- Remove spent fuel from the reactor and replace it with new fuel
- Receive and store new fuel, store and ship spent fuel, and remove and replace CEA
- Provide for safe and rapid handling and storage of the fuel

NON-PROPRIETARY

9.1.4 Light Load Handling System

❑ Design Features

- The Light Load Handling System(LLHS) is evaluated to provide reasonable assurance that the LLHS operates under adequately safety condition during natural phenomena.
- LLHS is designed in accordance with ANSI/ANS 57.1-1992.
- To prevent mechanical damage to fuel assemblies and withstand natural phenomena
- To prevent unacceptable radioactivity release, unacceptable radiation exposure, and criticality accidents

9.1.4 Light Load Handling System

❑ Design Features (cont.)

- The major system of the LLHS are electrically interlocked with each other to assist the operator in properly conducting the fuel handling operation.

- Mechanical stop in both the refueling machine and the spent fuel handling machine restrict withdrawal of the spent fuel assemblies to assure the adequate water shielding.

- Mechanically interlocked grapple against the inadvertent opening.

9.1.5 Overhead Heavy Load Handling System (OHLHS)

❑ **Perform no safety-related function**

❑ **Function**

- Handle critical heavy loads in the fuel handling area and the reactor vessel area
- Containment Polar Crane : the integrated head assembly (IHA) and reactor vessel (RV) internals
- Fuel Handling Area Overhead Crane : the largest heavy load of a spent fuel shipping cask

❑ **Design Features**

- Containment Polar Crane : provide single-failure-proof features in accordance with NUREG-0554 and NUREG-0612
- Fuel Handling Area Overhead Crane : mechanical stops and electrical interlocks without single-failure-proof features in accordance with NUREG-0612

9.2 Water Systems

- 9.2.1 Essential Service Water System
- 9.2.2 Component Cooling Water System
- 9.2.3 Reserved
- 9.2.4 Domestic Water and Sanitary Systems
- 9.2.5 Ultimate Heat Sink
- 9.2.6 Condensate Storage Facilities
- 9.2.7 Chilled Water System
- 9.2.8 Turbine Generator Building Closed Cooling Water System
- 9.2.9 Turbine Generator Building Open Cooling Water System

9.2.1 Essential Service Water System (ESWS)

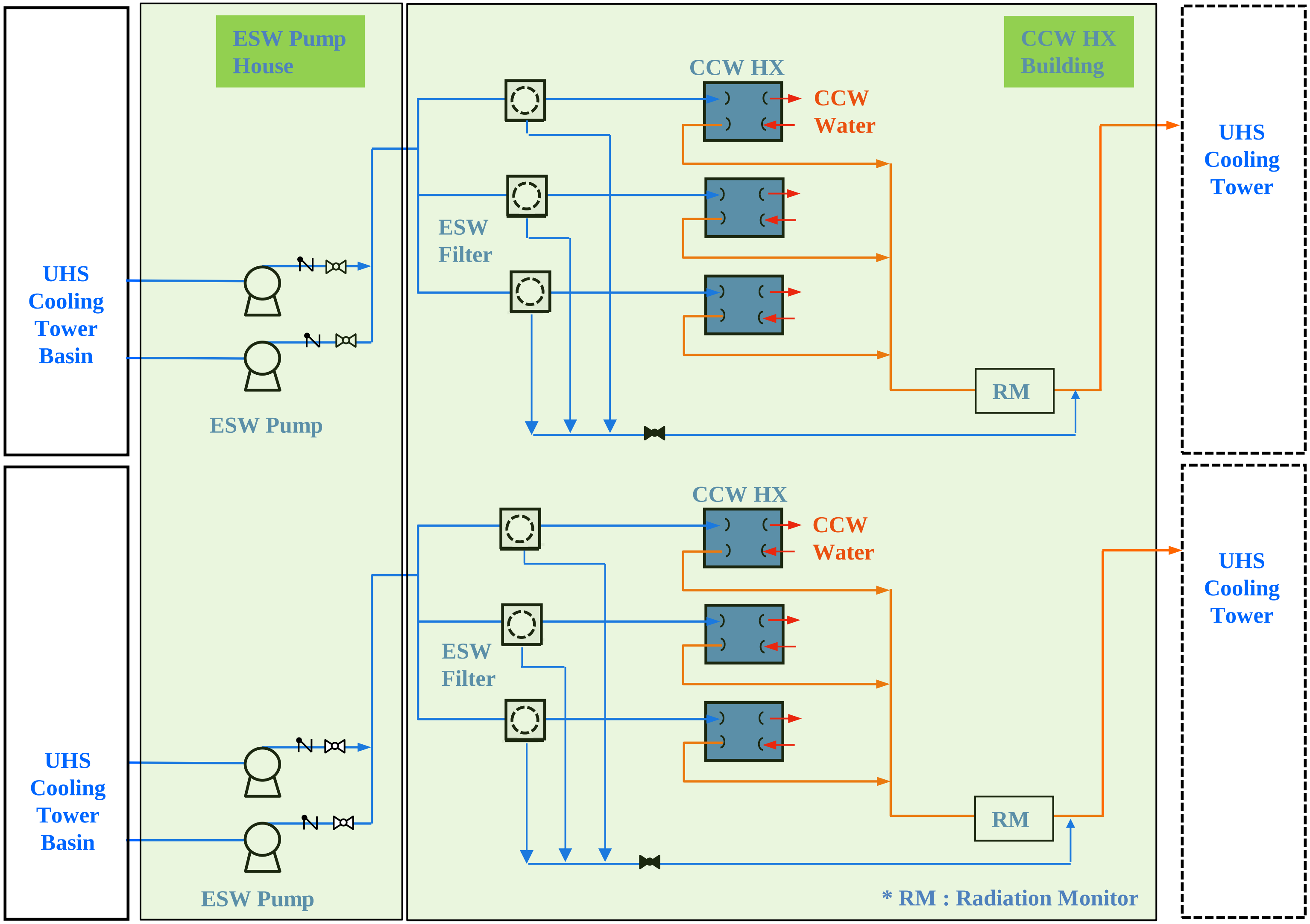
❑ Function

- ESWS transfers heat from Component Cooling Water System (CCWS) to Ultimate Heat Sink(UHS) cooling tower during all operation modes.

❑ Design Features

- ESWS consists of two independent, redundant, once-through, safety-related divisions.
- Each division cools one of two divisions of the CCWS, which cools 100 percent of the safety-related loads.
- Measures to prevent long-term corrosion and organic fouling will be provided by COL applicant.
- UHS basin screen and ESW filters are provided to prevent clogging.
- ESWS is designed to minimize the potential for water hammer by following the guidance in NUREG-0927.

9.2.1 Essential Service Water System (ESWS)



* RM : Radiation Monitor

9.2.2 Component Cooling Water System (CCWS)

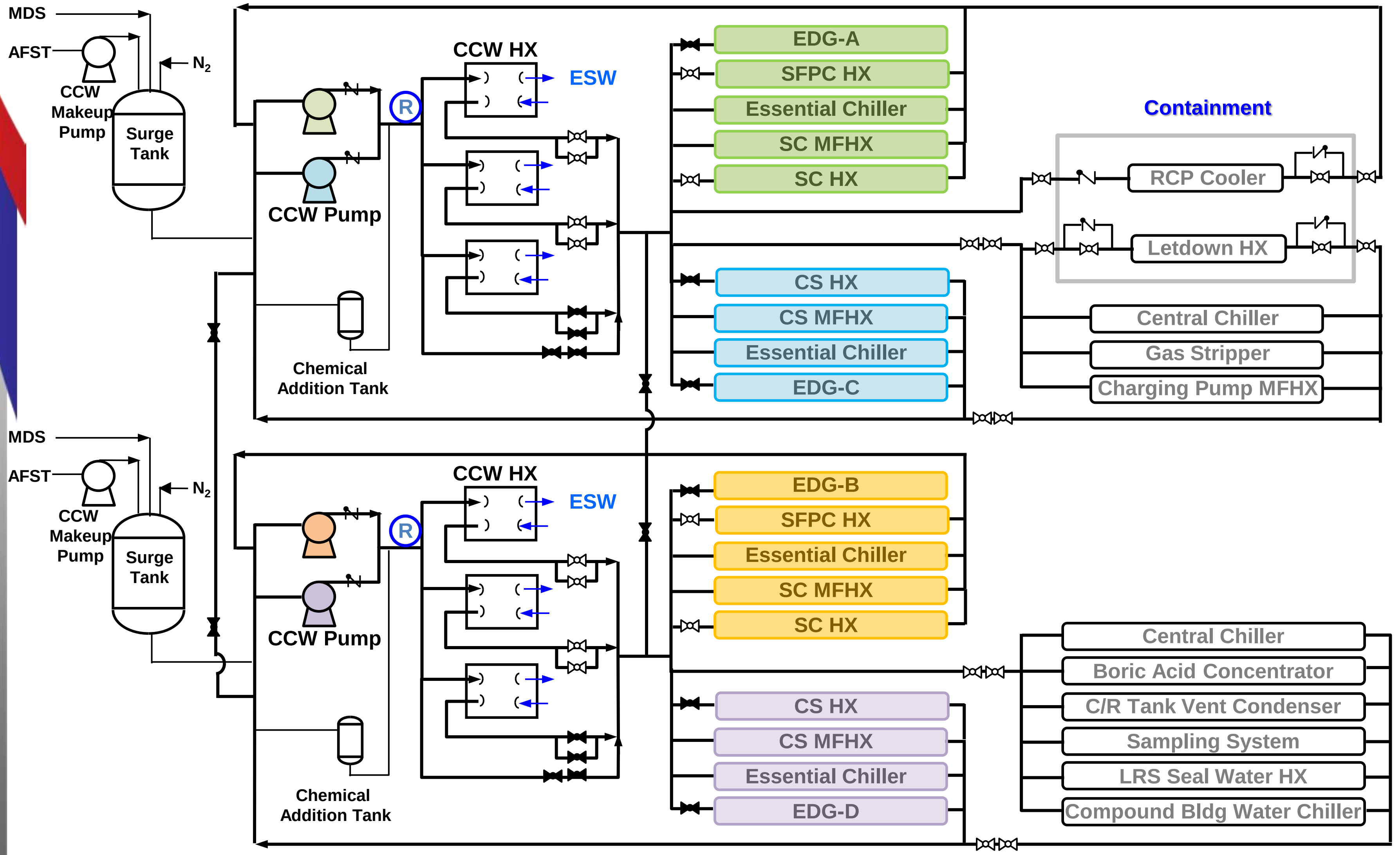
❑ Function

- CCWS removes heat from safety-related components required for plant emergency shutdown and mitigation of design basis accidents.
- CCWS provides an intermediate barrier between radioactive or potentially radioactive systems and ESWS to reduce possibility of radioactivity leakage to environment.

❑ Design Features

- CCWS consists of two safety-related divisions that are separate, independent, redundant, and closed-loop.
- Each division is capable of supporting 100% of the cooling requirements of a safe shutdown following a postulated accident coincident with LOOP.
- CCWS is designed to minimize the potential for water hammer in accordance with the guidance in NUREG-0927.
- CCW supply to the RCP coolers is isolated on a low-low surge tank level signal. This signal can be overridden by manual operation from the MCR to protect the RCP seal.

9.2.2 Component Cooling Water System (CCWS)



Ⓡ : Radiation Monitor MDS : Makeup Demineralizer System AFST : Auxiliary Feedwater Storage Tank

9.2.3 Reserved

- ❑ Reserved Subsection in accordance with NRC RG 1.206

9.2.4 Domestic Water and Sanitary Systems

❑ **Perform no safety-related function**

❑ **Function**

- Domestic Water System (WD)
  - Supply potable water for domestic use in the plant site
- Sanitary Water Drainage System (ST)
  - Collect and transfer non-radioactive sanitary water for treatment and to discharge

❑ **Design Features**

- Designed as conceptual design information
  - Protected against radioactive contamination through all branches of the system supplying plumbing fixtures by installing backflow prevention devices
  - No interconnections with the potential to contain radioactive material

9.2.5 Ultimate Heat Sink (UHS)

❑ UHS Design Concept

- UHS is a site-specific system.
- COL applicant is to provide UHS-related design information based on specific site characteristics, including meteorological conditions.
- UHS cooling tower system is provided as conceptual design for APR1400 design certificate.

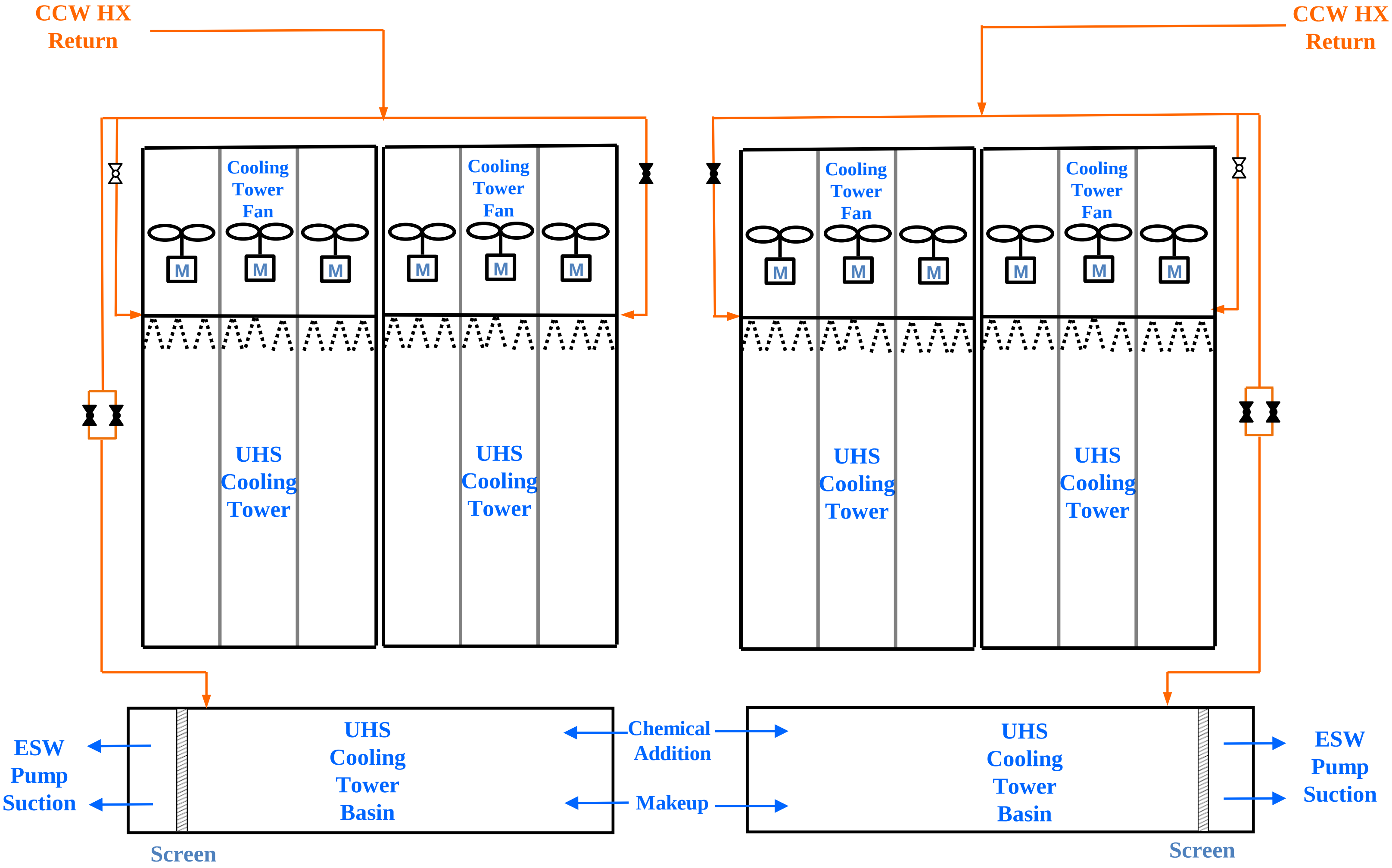
❑ Function of UHS cooling tower system

- UHS cooling tower dissipates heat transferred from ESWS to air.
- UHS supplies cooling water for at least 30 days for safe shutdown without makeup water under the worst combination of adverse environmental conditions.

❑ Design Features

- UHS system consists of two independent, redundant, safety-related divisions.
- Each division removes 100% of design heat load transferred from ESWS.
- UHS provides cooling capacity for at least 30 days without makeup water assuming the worst meteorological data. Each UHS basin provides a minimum 30-day capacity.
- UHS basin screen and ESW filters are provided to prevent clogging.

9.2.5 Ultimate Heat Sink (UHS)



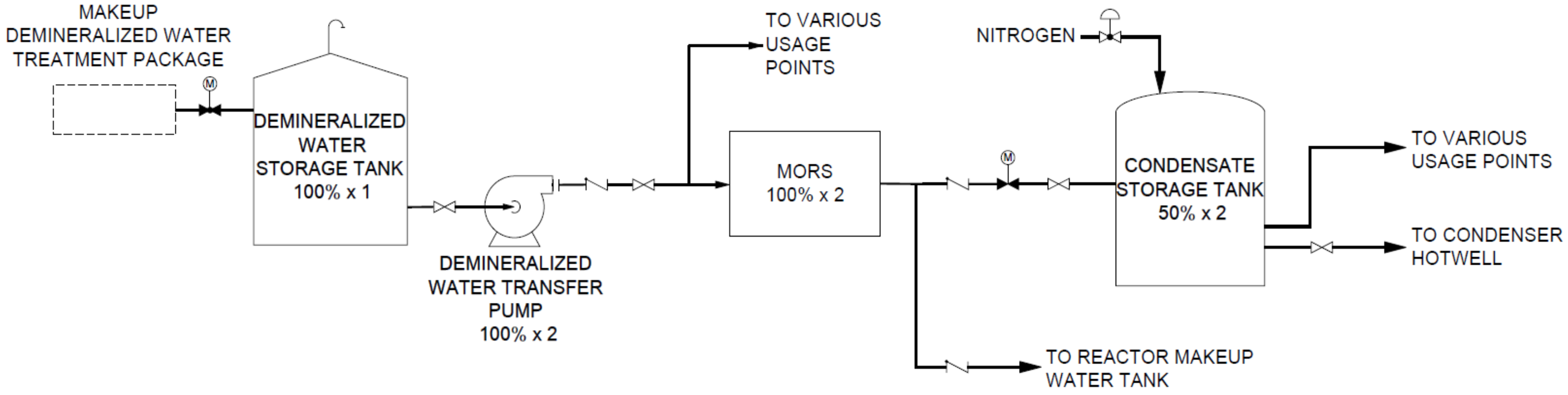
9.2.6 Condensate Storage Facilities (CSFs)

- ❑ **Perform no safety-related function except for containment isolation portion**
- ❑ **Function**
  - Makeup demineralizer system (WM) and Condensate storage & transfer system (CT)
  - WM system
    - Provide the demi. water to aux. feedwater storage tank, condensate storage tank, reactor makeup water tank, and so on
  - CT system
    - Provide condensate by means of gravity to the following equipment:
      - Condenser hotwell
      - Auxiliary feedwater pump suction as alternate non-safety backup supply
      - Miscellaneous condensate makeup demands

9.2.6 Condensate Storage Facilities (CSFs)

❑ Design Features

- WM system
  - One 100% demi. Water storage tank, two 100% demi. Water transfer pumps, two 100% membrane oxygen removal subsystem(MORS), associated piping, and valves
- CT system
  - Two 50% capacity condensate storage tanks (CSTs), associated piping, and valves



Condensate Storage Facilities(CSFs) Flow Diagram

9.2.7 Chilled Water System

- ☐ **Two systems : Essential chilled water system (ECWS) and plant chilled water system (PCWS).**
- ☐ **Function**
  - ECWS
    - Perform safety-related functions
    - Provide chilled water to safety-related AHUs and cubicle coolers during normal operation and accidents
  - PCWS
    - Perform non-safety related functions except for containment isolation portions
    - Provide chilled water to non-safety related AHUs and cubicle coolers during normal operation and LOOP
    - Close CIVs upon a receipt of CIAS

9.2.7 Chilled Water System

❑ Design Features

- ECWS
  - Consist of two independent and redundant divisions
  - Each division consists of two 100% capacity chillers, two 100% capacity pump, a makeup pump, a compression tank, and a chemical additive tank.
- PCWS
  - Consist of central chilled water subsystem and compound building chilled water subsystem
  - The central chilled water subsystem consists of four 33% capacity chillers, two 100% capacity pumps, a compression tank, and chemical additive tank.
  - The compound building chilled water subsystem consists of three 50% capacity chillers, two 100% capacity pumps, a compression tank, and a chemical additive tank.

9.2.8 Turbine Generator Building Closed Cooling Water System(TGBCCWS)

❑ Perform no safety-related function

❑ Function

- Provide cooling water for the removal of heat from turbine generator building equipment.
- Reject heat from the equipment to the TGBOCWS through TGBCCW heat exchangers
- Include the independent closed loop cooling system that allows operation of air compressors when the TGBCCW system is not available

❑ Design Features

- Three 50% heat exchangers, two 100% pumps, one surge tank, one chemical addition tank, piping, valves & instruments

9.2.9 Turbine Generator Building Open Cooling Water System(TGBOCWS)

❑ **Perform no safety-related function**

❑ **Function**

- Supply sufficient cooling water to the TGBCCW heat exchangers during all modes of plant operation with the CW system

❑ **Design Features**

- Two 100% strainers, valves, associated piping, and instruments
- Cooling water is supplied from the CW pumps
- Lower design operating pressure than TGBCCW's to prevent TGBCCW system contamination

9.3 Process Auxiliaries

9.3.1 Compressed Air and Gas Systems

9.3.2 Process and Post-Accident Sampling System

9.3.3 Equipment and Floor Drainage Systems

9.3.4 Chemical and Volume Control System

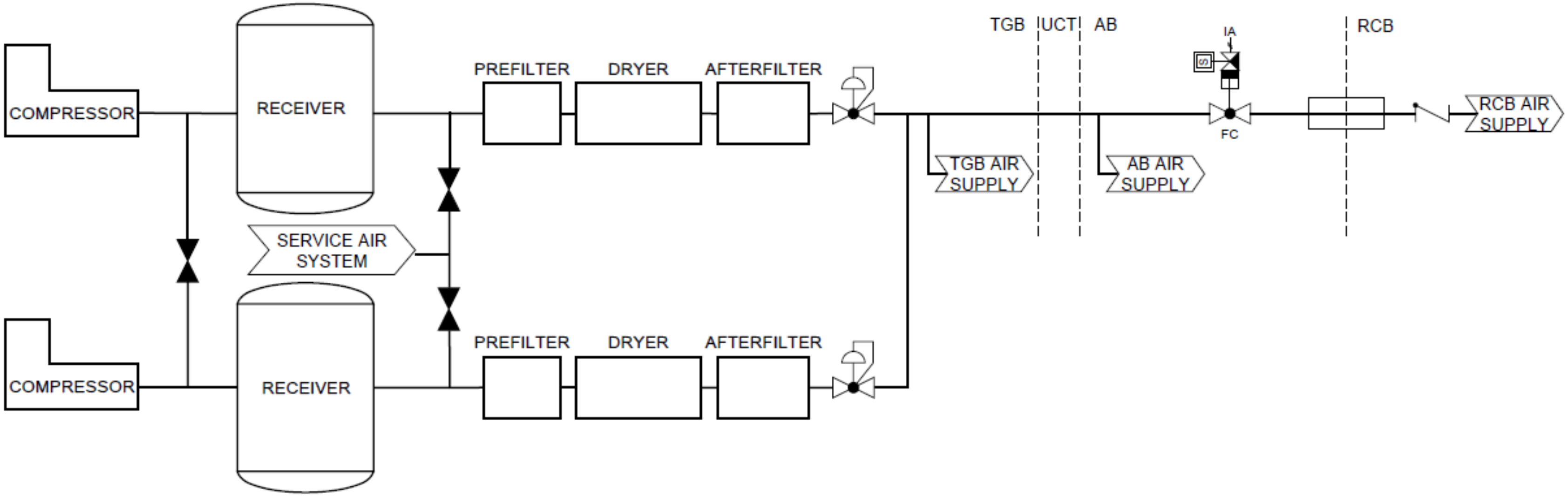
9.3.1 Compressed Air and Gas Systems

- **Perform no safety-related function, except for containment isolation**
- **Design Features**
  - Instrument Air System (IA)
    - Two 100% trains with an air compressor, an air receiver, one set of air dryers, and an air filtering unit in each train
    - The safety-related AOVs fail in safe position on loss of IA and do not need IA to perform a safety function
  - Service Air System (SA)
    - One 100% train with an air compressor, and an air receiver
    - Provide a backup supply of air to IA system
  - Compressed Gas System
    - High and low pressure nitrogen subsystem, hydrogen subsystem, Carbon dioxide subsystem
    - To various usage point (purging, cooling, blanketing, pressurizing)
    - Each subsystem has pressure regulations and overpressure protection provisions

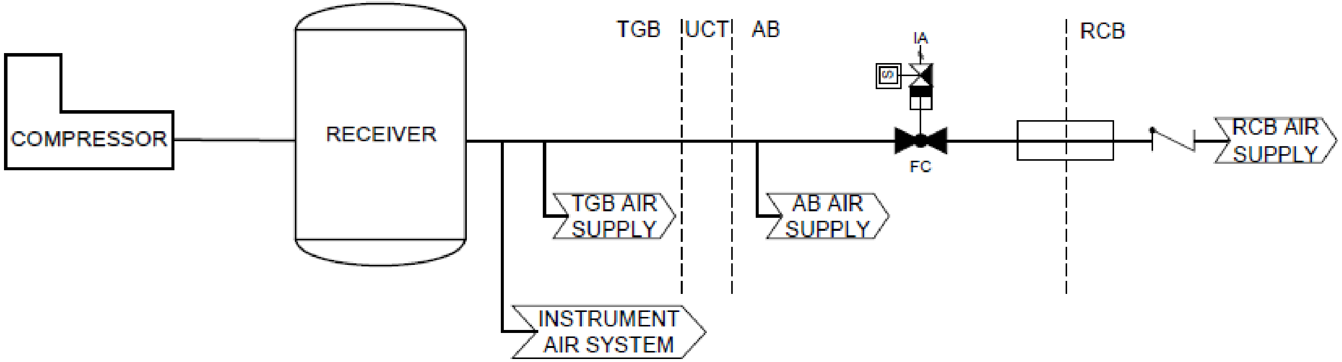
NON-PROPRIETARY

9.3.1 Compressed Air and Gas Systems

❑ IA System



❑ SA System



9.3.2 Process and Post-Accident Sampling System

❑ Function

- The process and post-accident sampling system is designed to collect and deliver representative samples of liquids and gases in various process systems to various sample stations for chemical and radiological analysis.

❑ Design Features

- The system consists of the NPSS, the PASS, and the SSS.
- The NPSS takes RCS samples, shutdown cooling system samples, CVCS samples, and primary off-gas samples.
- The PASS takes reactor coolant and containment atmosphere samples during post-accident conditions.
- The SSS takes samples to control the SGs secondary side water and steam cycle quality and to detect a leak or failure of SG tubes or contaminated by corrosion products.

9.3.3 Equipment and Floor Drainage System

❑ Function

- The equipment and floor drainage system (EFDS) collects and transports liquids containing wastes generated within the plant to the liquid waste management system (LWMS) or wastewater treatment facility (WWTF).
- The EFDS performs no safety-related function except for containment isolation valves and associated piping, and flood alarm loops of ESF pump rooms.

❑ Design Features

- The EFDS has components in the reactor containment building, the auxiliary building, the turbine generator building, and the compound building.
- The EFDS has provisions for the detection of leakage from the reactor coolant pressure boundary as well as refueling pool, in-containment refueling water storage tank, auxiliary feedwater storage tank, spent fuel pool, refueling canal, and cask loading pit.
- Sumps and sump pumps are located at lower levels to facilitate transfer to the LWMS.
- Drains and discharges from sumps in the turbine generator building are normally transferred to the WWTF for processing, but can be switched over to LWMS upon detection of radiation.

9.3.4 Chemical and Volume Control System (CVCS)

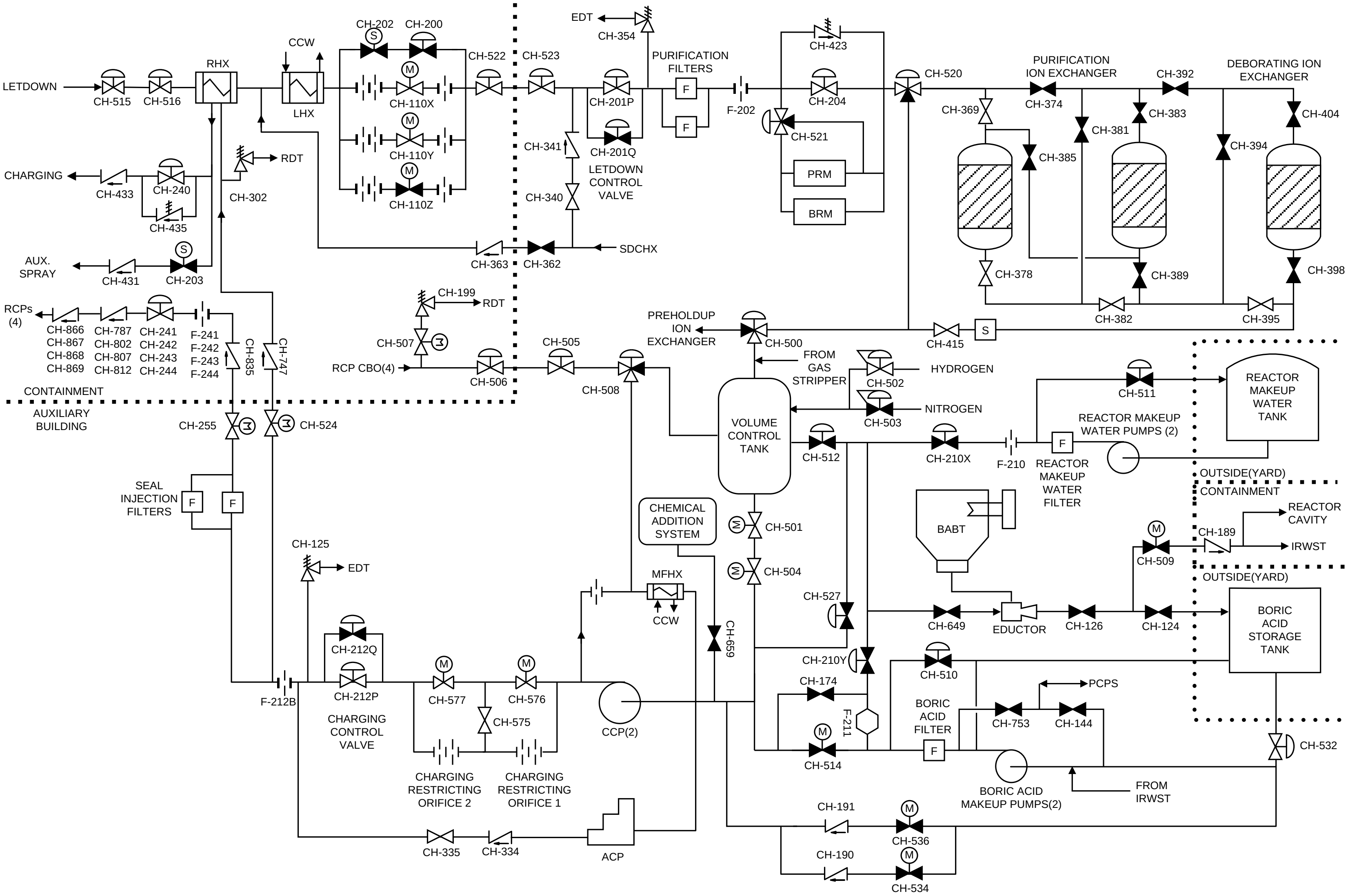
❑ CVCS Functions:

- Reactor coolant chemistry and purity control
- RCS inventory control: makeup and pressurizer level control
- Boron recovery
- Reactor coolant boron concentration control
- RCS pressure control: auxiliary pressurizer spray
- RCP seal injection
- Reactor coolant noble gases and other dissolved gases removal

❑ Compliance with Regulatory Requirements:

- General Design Criteria 33 “Reactor Coolant Makeup”

9.3.4 Chemical and Volume Control System (CVCS)



9.4 Heating, Ventilation and Air Conditioning Systems

9.4.1 Control Room HVAC System

9.4.2 Fuel Handling Area HVAC System

9.4.3 Auxiliary Building Clean Area HVAC System

9.4.4 Turbine Generator Building HVAC System

9.4.5 Engineered Safety Feature Ventilation System

9.4.6 Reactor Containment Building HVAC System and Purge System

9.4.7 Compound Building HVAC System

9.4.8 Design Features for Minimization of Contamination

9.4.1 Control Room HVAC System

☐ Function

- Provide suitable environmental conditions within control room envelope
- Provide adequate protection against airborne radioactivity and smoke from the outside
- Limit the radiation exposure to the personnel in the CRE under accident conditions to meet GDC 19

☐ Design Features

- Consist of AHUs, ACUs, fans, and PACUs
  - Perform functions by AHU and ACU during normal operation and accidents
  - Exhaust air by exhaust fan during normal operation
  - Maintain temperature within computer room by PACU during normal operation and LOOP
  - Remove smoke by smoke removal fan after a fire has been suppressed

9.4.2 Fuel Handling Area HVAC System

❑ Function

- Maintain suitable environmental conditions within the fuel handling area
- Maintain the fuel handling area under a slightly negative pressure with respect to the surrounding areas
- Control the gaseous effluent release to the outside within design limits

❑ Design Features

- Fuel Handling Area Normal HVAC Subsystem
  - Perform functions by AHU and ACU with HEPA filter during normal operation
- Fuel Handling Area Emergency HVAC Subsystem
  - Perform functions by ACU with carbon adsorber and cubicle coolers during accidents

9.4.3 Auxiliary Building Clean Area HVAC System

❑ Function

- Maintain suitable environmental conditions within the auxiliary building clean area
- Provide ventilation for the chiller rooms
- Remove smoke from the area where the potential exists

❑ Design Features

- Auxiliary building clean area I and II HVAC subsystems
  - Perform functions by AHU, cubicle coolers, and fans during normal operation
  - Maintain temperature within essential chiller rooms and motor-driven auxiliary feedwater pump rooms by cubicle coolers during accidents
- Main steam valve room HVAC subsystem, Main steam enclosure HVAC subsystem
  - Perform functions by AHU, cubicle coolers, and fans during normal operation
- Auxiliary building smoke removal HVAC subsystem
  - Remove smoke by smoke removal fan after a fire has been suppressed

9.4.4 Turbine Generator Building HVAC System

❑ Function

- Maintain suitable environmental conditions within the turbine generator building
- Minimize hot spot within the turbine generator building
- Maintain the hydrogen gas concentration to less than one (1) percent by volume within the battery rooms

❑ Design Features

- Main building HVAC subsystem, Enclosed room HVAC subsystem, Repair shop and office area HVAC Subsystem
  - Perform functions by AHU, cubicle coolers, and fans during normal operation

9.4.5 Engineered Safety Feature Ventilation System

❑ **Consist of following systems.**

- Emergency diesel generator (EDG) area HVAC system
- Electrical and I&C equipment areas HVAC system
- Auxiliary building controlled area HVAC system
- Essential service water (ESW) building and component cooling water (CCW) heat exchanger building HVAC system (COL 9.4(3)).

9.4.5 Engineered Safety Feature Ventilation System

◆ EDG area HVAC system

❑ Function

- Maintain suitable environmental conditions within the EDG area
- Provide ventilation for the EDG area to prevent possible accumulation of oil fumes

❑ Design Features

- EDG room normal HVAC subsystem
  - Perform functions by AHUs, fans, and cubicle coolers during normal and EDG operations
- EDG room emergency HVAC subsystem
  - Perform functions by cubicle coolers during EDG operation
- Diesel fuel oil storage tank room HVAC subsystem
  - Perform functions by fans during normal and EDG operations

9.4.5 Engineered Safety Feature Ventilation System

◆ Electrical and I&C Equipment Areas HVAC System

❑ Function

- Maintain suitable environmental conditions within the electrical and I&C equipment areas of the auxiliary building
- Maintain the hydrogen gas concentration to less than one (1) percent by volume within the battery rooms

❑ Design Features

- Electrical and I&C equipment areas HVAC subsystem, Class 1E battery room HVAC subsystem, Remote shutdown room HVAC subsystem
  - Perform functions by fans and cubicle coolers during normal operation and accidents
- Non-class 1E battery room HVAC subsystem, CEDM M/G set room HVAC subsystem, Remote control console room HVAC subsystem
  - Perform functions by AHU and fans during normal operation

9.4.5 Engineered Safety Feature Ventilation System

◆ Auxiliary building controlled area HVAC system

❑ Function

- Maintain suitable environmental conditions within the radiologically controlled area in the auxiliary building
- Maintain the auxiliary building controlled area under a slightly negative pressure with respect to the surrounding areas
- Control the gaseous effluent release to the outside within design limits

❑ Design Features

- Auxiliary building controlled area I and II HVAC subsystems
  - Perform functions by AHUs, ACUs, and cubicle coolers during normal operation and accidents
- High energy line break (HELB) area HVAC subsystem
  - Perform functions by AHU, ACU, and cubicle coolers during normal operation

9.4.6 Reactor Containment Building HVAC and Purge System

◆ Reactor Containment Building HVAC System

❑ Function

- Maintain the containment atmosphere temperature
- Maintain the temperature in the in-core instrumentation chase and reactor cavity
- Remove heat from the CEDM coils

❑ Design Features

- Reactor containment building cooling subsystem
  - Perform functions by RCFCs and fans during normal operation and LOOP
- Reactor cavity cooling subsystem
  - Perform functions by AHU during normal operation and LOOP
- CEDM cooling subsystem
  - Perform functions by fans during normal operation and LOOP

9.4.6 Reactor Containment Building HVAC and Purge System

◆ Reactor Containment Building Purge System

❑ Function

- Provide the proper atmosphere and adequate ventilation for personnel before and during periods of personnel access
- Control the containment atmosphere pressure
- Control the gaseous effluent release to the outside within design limits
- Close CIVs upon a receipt of CIAS or CPIAS

❑ Design Features

- Low volume purge subsystem
  - Perform functions by ACU, and fan during normal operation, when required
  - Close CIVs upon a receipt of CIAS or CPIAS
- High volume purge subsystem
  - Perform functions by AHU and ACUs during cold shutdown and refueling conditions
  - Close CIVs upon a receipt of CIAS or CPIAS

9.4.7 Compound Building HVAC System

❑ Function

- Maintain suitable environmental conditions within the compound building
- Maintain the hydrogen gas concentration to less than one (1) percent by volume within the battery rooms
- Control the gaseous effluent release to the outside within design limits

❑ Design Features

- Compound building clean area HVAC subsystem, Compound building controlled area HVAC subsystem
  - Perform functions by AHUs, ACUs, PACUs, cubicle coolers and fans during normal operation

9.4.8 Design Features for Minimization of Contamination

- ❑ The APR1400 HVAC systems that service areas that may contain radiologically contaminated materials are designed with features to meet the requirements of 10 CFR 20.1406 and NRC RG 4.21.
- ❑ The design features for minimization of contamination are described in Subsection 12.4.2.

9.5. Other Auxiliary Systems

9.5.1 Fire Protection Program

9.5.2 Communication System

9.5.3 Lighting System

9.5.4 Emergency Diesel Engine Fuel Oil System

9.5.5 Emergency Diesel Engine Cooling Water System

9.5.6 Emergency Diesel Engine Starting Air System

9.5.7 Emergency Diesel Engine Lubrication System

9.5.8 Emergency Diesel Engine Combustion Air Intake and Exhaust System

9.5.9 Gas Turbine Generator Facility

9.5.1 Fire Protection Program

☐ Objectives

- To minimize the probability of occurrence and the consequences of a fire through defense-in-depth.
- To minimize the radioactive releases to the environment in the event of a fire.
- Concept of defense-in-depth
  - To prevent fires from starting
  - To rapidly detect, control, and extinguish those fires that may occur
  - To provide protection for structures, systems, and components(SSCs) important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant

☐ Requirements

- 10 CFR 50.48
- Section 9.5.1.1 of the Standard Review Plan(SRP) (NUREG-0800)
- The guidance of NRC RG 1.189
- NFPA 804

9.5.1 Fire Protection Program

☐ Elements of FPP(Fire Protection Program)

- Comprehensive identification and analysis of fire and explosion hazards
- Organization & staff positions for FPP
- Administrative policy, procedures, and practices for training of general plant personnel
- Automatic fire detection and alarm systems
- Automatic and manual fire suppression systems
- Building design for fire protection
- Post-fire safe shutdown analysis and procedures
- Probabilistic risk assessment (PRA)

For the integrated effort, the COL applicant is to establish a fire protection program, including organization, training, and qualification of personnel, administrative controls of combustibles and ignition sources, firefighting procedures, and quality assurance.

9.5.1 Fire Protection Program

❑ Design Features

- Minimize the potential for fire and explosions by controlling, separating, and limiting the quantities of combustibles and sources of ignition
- Prevent the spread of fire by subdividing plant buildings into fire areas separated by fire barriers and into fire zones
- Separate redundant trains of safety-related equipment by 3-hour fire-rated barriers for safe shutdown capabilities
- Provide the safe shutdown capabilities using an MCR and RSR that are physically separated, electrically isolated
- Provide Fire protection system designed in accordance with RG 1.189 and NFPA codes
- Maintain 100% design capacity of fire pumps, assuming failure of one fire pump or the loss of offsite power (LOOP) with one electric and two diesel-driven fire pumps
- Provide the seismic Category I fire protection water supply system in areas containing equipment required for safe shutdown following a safe shutdown earthquake (SSE)
- When fire is detected, the fire detection system produces a local area alarm that is audibly and visually identifiable to any personnel in the area and MCR.

9.5.2 Communication Systems

❑ Design Features

- Provide reliable and effective interplant communications and plant-to-offsite communications during all operating or emergency conditions
- Powered from a permanent non-safety (PNS) bus backed up by the alternate alternating current (AAC) source during a loss of offsite power (LOOP), and from one of the two dedicated 16 hours rated non-safety-related batteries in case of either AAC source failure during a LOOP or station blackout (SBO) condition
- Composition of Communication Systems
  - Plant communication systems
  - Offsite communication systems
  - Security communication systems

9.5.3 Lighting Systems

❑ Design Features

- Provide adequate lighting during normal and off-normal conditions
- Details of each lighting subsystem
  - Normal lighting system
    - Provide in entire plant during normal plant operation
    - Powered from non-Class 1E 480 Vac bus and PNS bus
  - Emergency lighting system
    - Provide in areas required for safe shutdown of the plant, restoring the plant to normal operation, firefighting, and safe movement of people during plant off-normal condition and loss of normal power supply
    - Emergency ac lighting system: Powered from Class 1E 480 Vac bus backed-up by the Class 1E emergency diesel generators during a LOOP and the non-Class 1E AAC source during an SBO
    - Emergency dc lighting system: Powered from non-Class 1E 125 Vdc station battery or self-contained battery
  - Security lighting system

9.5.4 Emergency Diesel Engine Fuel Oil System (EDEFOS)

- ❑ **Perform safety-related function**
- ❑ **Function**
  - Provide for the required storage capacity and continuous supply of fuel oil to each of four redundant Class 1E EDGs following LOOP (RG 1.137 and ANSI/ANS 59.51)
- ❑ **Design Features**
  - Consist of a fuel oil storage tank (7 days), a day tank (60 min.), two transfer pumps in each train
  - Provide separate and independent EDEFOS per each EDG unit
  - Emergency fill connection to allow fuel oil into day tank in each train

9.5.5 Emergency Diesel Engine Cooling Water System (EDECWS)

- ❑ **Perform safety-related function**
- ❑ **Function**
  - Provide the necessary cooling water for the diesel engine coolant and lubricating oil during engine operation conditions
  - Provide the preheating water for engine standby
- ❑ **Design Features**
  - Closed-cycle cooling system(LT/HT water subsystem)
  - Three-way thermostat valve (NUREG/CR-0660)
  - Water volume between operating range : 7 days
  - Operate without CCW for at least 3 minutes at no load and for 1 minute at full load

9.5.6 Emergency Diesel Engine Starting Air System (EDESAS)

- ❑ **Perform safety-related function**
- ❑ **Function**
  - Provide fast-start capability for the diesel engine by using compressed air in accordance with the requirements of SRP 9.5.6
- ❑ **Design Features**
  - Two redundant sets of equipment in EDESAS per each train
  - Consist of a motor-driven air compressor package, an air receiver and a devices to crank the engine in each set of equipment
  - Air driers with refrigerant type (NUREG/CR-0660)
  - Storing air to start engine five times without recharging the receivers

9.5.7 Emergency Diesel Engine Lubrication System (EDELS)

❑ Perform safety-related function

❑ Function

- Store and supply clean lubricating oil to the diesel engine to lubricate and cool various engine components during engine operation conditions in accordance with the requirements of SRP 9.5.7 and ANSI/ANS-59.52
- Keep-warm oil lubricating system during standby

❑ Design Features

- Consist of a lube oil/LT water heat exchanger, a lube oil / preheating water heat exchanger, a full-flow filter, an engine-driven lube oil pump, a three-way thermostat valve, a prelube oil pump, and a lube oil makeup tank
- Three-way thermostat valve (NUREG/CR-0660)
- Lubricating oil storage capacity for each diesel engine : 7 days

9.5.8 Emergency Diesel Engine Combustion Air Intake and Exhaust System (EDECAIES)

☐ **Perform safety-related function**

☐ **Function**

- Supply an adequate quantity of combustion air of reliable quality and exhaust combustion products to the atmosphere in accordance with the requirements of SRP 9.5.8

☐ **Design Features**

- Consist of silencers, filter, expansion joints, air inlet duct, exhaust piping
- Continuous operation of the EDG at 110% rating output
- Intake opening above about 6.10 meters from grade level (NUREG/CR-0660)
- Exhaust stack in a direction away from the air intake inlet with sufficient separation (NUREG/CR-0660)

9.5.9 Gas Turbine Generator Facility

- ☐ **Perform no safety-related function**
- ☐ **Design Features**
  - Provide the standby power source for coping with SBO in accordance with the requirements of 10 CFR 50.63 and RG 1.155
  - Ready to accept load within 2 minute after receipt of a start signal in the event of SBO
  - Two 100% fuel oil transfer pump, One fuel oil storage tank (for 24hours), one fuel oil day tank (for min. 1 hour)
  - Completely packaged GTG including the lubrication system, ventilation system
  - Combustion air and exhaust system with piping, duct and silencer
  - Starting system and AAC GTG building HVAC system are the COL item

Summary

- ❑ **DCD Tier 2, Chapter 9 provides information concerning the auxiliary systems.**
- ❑ **APR1400 Auxiliary systems are designed to meet the US regulatory requirements.**

Appendix 9.5A Fire Hazard Analysis

App. 9.5A.1 Introduction

App. 9.5A.2 Analysis Methodology

App. 9.5A.3 Fire Hazard Analysis Result

App. 9.5A.1 Introduction

❑ The purpose of the FHA

- The potential in-situ and transient fire hazards.
- The capability to safely shutdown the reactor and minimize and control the release of radioactivity to the environment
- The appropriate measures for fire prevention, fire detection, fire suppression, and fire confinement

❑ Regulatory Basis

- R.G 1.189, Rev.2
- NFPA Codes
- ANSI/IEEE Std. 383
- NEI 00-01, Rev.2

App. 9.5A.1 Introduction

❑ The Flow Chart of the FHA Methodology

Identification of the Fire Area and Fire Zone

⇩

Review on Combustibles and Load Quantity

⇩

Estimation of the Design basis fire

⇩

Review on the Detection and Suppression System

⇩

Evaluation of the Inadvertent actuation of Suppression System

⇩

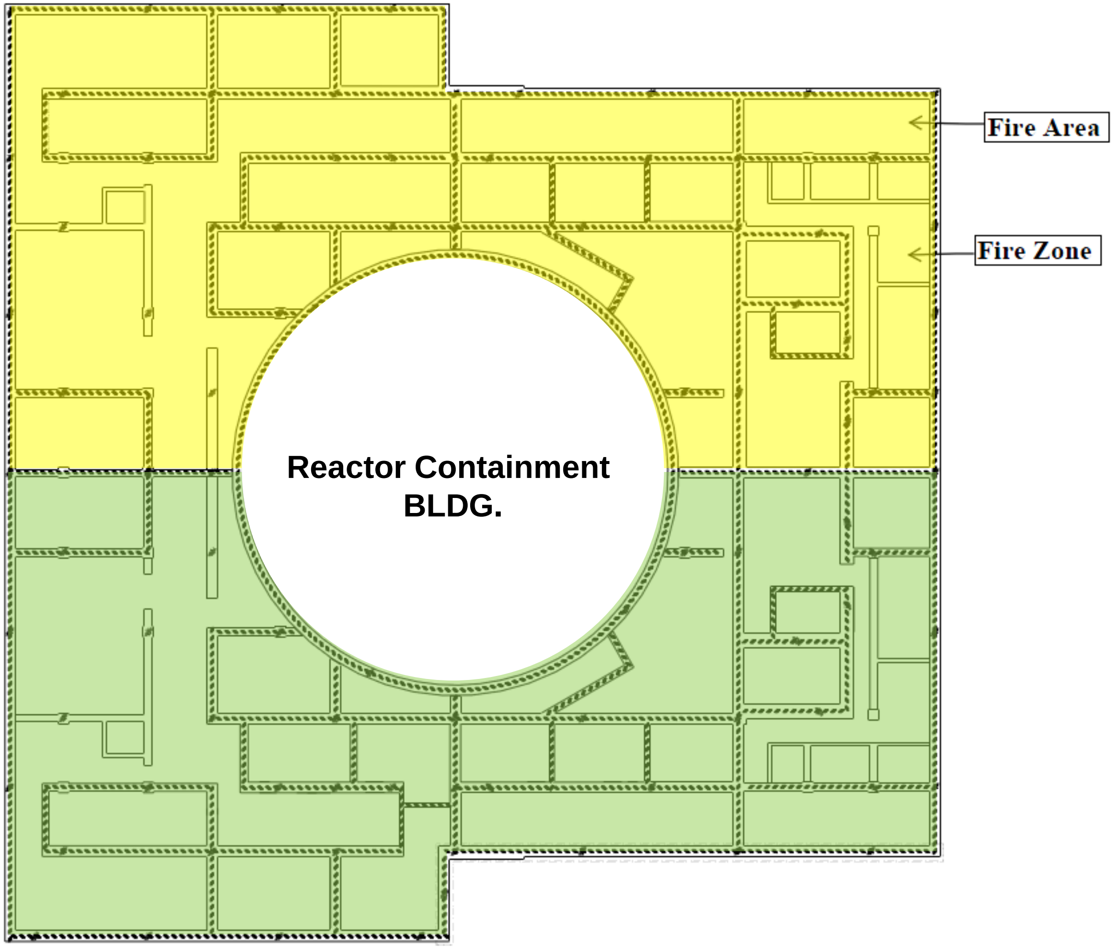
Conduct of the Fire Safe Shutdown Analysis

⇩

Result of the FHA

App. 9.5A.2 Analysis Methodology

❑ Example of Fire Area and Fire Zone



Division I

Division II

Fire Area : 256 EA

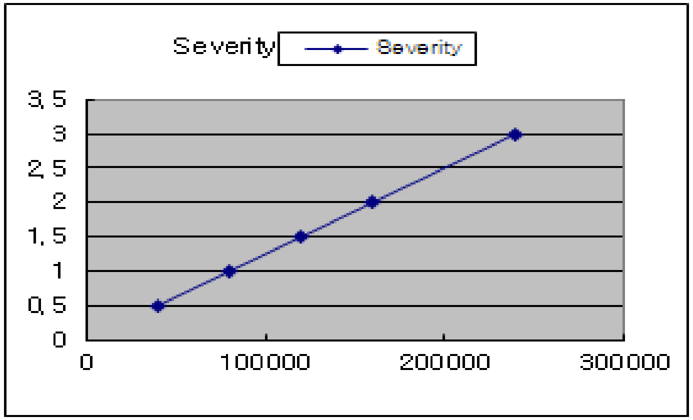
Example of Reactor Containment / Auxiliary Building

App. 9.5A.2 Analysis Methodology

❑ Combustibles and Load Quantity

- Heat Load [kJ (Btu)]
  - In-situ combustible load
  - Transient combustible load
- Floor Surface Area of the Fire Area [$m^2(ft^2)$]
- Fire Load [kJ/m^2 (Btu/ft^2)]
- Equivalent Fire Severity [Hr]

Heat Load (Btu)	Severity (Hr)
40,000	0.5
80,000	1.0
120,000	1.5
160,000	2.0
240,000	3.0



Source: Fire Protection Handbook, 19th Edition, NFPA, Section 12, Chapter 5, Table 12.5.1.

App. 9.5A.2 Analysis Methodology

❑ Fire Protection Adequacy

- Evaluation on Fire Protection Feature
  - Conformance with regulatory guidance or requirements
  - Review of how the fire is detected and suppressed
  - Verification of a fire barrier to confine a fire and limit fire damage
  - Verification that the HVAC system in the fire area properly limits the spread of fire and removes or controls smoke
  - Verification that a fire in a non-safety-related area does not threaten safety-related areas
- Fire Protection Measure
  - Detection System
  - Suppression System
  - Provisions for access and egress

App. 9.5A.2 Analysis Methodology

❑ Fire Protection System Integrity

- The Potential for a credible inadvertent actuation of automatic fire-suppression systems in fire area

- The design of firefighting systems is evaluated to verify that their rupture or inadvertent operation does not significantly impair the safety capability of SSCs

App. 9.5A.2 Analysis Methodology

❑ Fire Safe Shutdown Analysis

- Performance goal of the FSSA
    - RCS pressure boundary integrity

    - Reactivity control function

    - Reactor coolant makeup and coolant level control function

    - Decay heat removal function

App. 9.5A.2 Analysis Methodology

❑ Fire Safe Shutdown Analysis (cont.)

- Assumptions
  - All equipment in fire area is rendered inoperable
  - Re-entry into the fire area for Manual actions is impossible
  - A design basis fire is the most severe fire that would cause the most damage in fire area and dictates the design of protective measures
  - Fire-caused damage is assumed to be capable of resulting in the unintended any one spurious operation of circuit faults

App. 9.5A.2 Analysis Methodology

❑ Fire Safe Shutdown Analysis(cont.)

- Methodology for FSSA
  - Identification of systems and components that could be used to meet safe shutdown conditions
  - Identification of the control, instrument, and power cables necessary for operation of safe shutdown systems and components
  - Identification of the routing of cables by the fire area/zone they pass through
  - Determination of the location by fire area/zone of all safe shutdown equipment and instruments
  - Review on equipment and cable location to ensure compliance that one train be free of fire damage
  - Identification of all fire areas where one train of safe shutdown equipment is not free of fire damage

App. 9.5A.3 Fire Hazard Analysis Result

❑ The Result of Fire Hazard Analysis

- The FHA has conducted for the plant structures and 256 associated fire areas
  - The type and quantity of combustible materials in each fire area is identified and the adequacy of fire protection is evaluated
  - The safety-related fire areas are completely separated from the adjacent areas with 3-hour rated fire barriers
  - In the event of a fire in APR 1400, at least one train of equipment is available for safe shutdown

Summary

- ☐ The FHA of APR 1400 has confirmed the appropriate measures for fire prevention, detection, suppression, and confinement for each area containing SSCs important to safety in accordance with NRC guidelines and regulations

- ☐ The results of FHA show reasonable assurance that APR 1400 has the capability to safely shutdown the reactor and minimize and control the release of radioactivity to the environment

Open Items (1/4)

RAI No	Question No	Staff Position	Status
469-8578	09.01.01-39	• Unacceptable because the previous staff acceptance of METAMIC™ exposed to elevated temperatures was predicated on the coupon monitoring program using coupons that were exposed to the same conditions as the fabricated material • With regard to storage rack materials, the SER is not yet complete	Response submitted through RAI No. 8725 (09.01.01-43)
484-8598	09.01.01-42	• This item is being tracked as a confirmatory item pending the DCD Tier 2 revisions and submittal of WCAP-17889-P on the docket. Because the report has yet to be docketed, the evaluation is based on the staff's audit of WCAP-17889-P, Rev.0.	Response submitted : The criticality validation report (WCAP-17889-P) will be submitted on the docket and incorporated as a reference into DCD Tier 2.
167-8191	09.01.01-13	• Acceptable response, but unable to confirm the applicant's statement that the mechanical accidents do not cause rack deformation that would affect criticality.	Newly Issued in SER : The mechanical accidents are addressed in the technical report APR1400-H-N-NR-14012-P (DooSan DOR) provided in section 3.8.4 of SER and the report is currently under staff review.
473-8582	09.01.03-4	• To identify the minimum safety water needed to ensure the safe operation of the safety-related SFPCS	Response submitted
497-8622	09.01.03-6	• To correct this inconsistency between the DCD and the SFP thermal analysis report.	Response submitted

Open Items (2/4)

RAI No	Question No	Staff Position	Status
497-8622	09.01.03-7	• To remove COL 9.1(1) and ensure that the concerns expressed by COL 9.1(1) are addressed in Chapter 11 and 12 of the DCD.	Response submitted
497-8622	09.01.03-8	• To remove the COL item, or to provide the basis for the COL item and to discuss why post licensing aspects such field changes and operations are included.	Response submitted
480-8608	09.01.02-55	• To provide additional information clearly identifying how the SFHM design prevents it from falling into the SFP following an SSE (assuming failure of the seismic Category III rails), and to update the DCD accordingly	Revised response submitted
161-7992	09.01.04-1	• To design the refueling pool seal as a seismic Category II component does not preclude seal leakage as stated in the applicant's response	Revised response submitted
474-8588	09.01.04-6	• To identify all non-Seismic Category I SSCs that connect to the refueling pool (including their associated elevations), and to evaluate the drain-down scenario caused by failure of these non-Seismic Category I SSCs	Revised response submitted
474-8588	09.01.04-5	• To justify the basis for the assumed initial assumptions, or to re-evaluate the drain-down scenario with more limiting initial conditions	Revised response submitted
477-8589	09.03.01-6	• To update the DCD to reflect how the compressed air system design conforms with the staff's approved air quality standard.	Response submitted

Open Items (3/4)

RAI No	Question No	Staff Position	Status
244-8326	09.03.03-3	• COL items unacceptable because the turbine generator building is within the scope of the DCD certification • The staff asked the applicant to provide the turbine generator building EFDS reference schematic provided in the RAI response and the appropriate SSC classifications into the DCD as this is about the level of detail the staff requires	Revised response Submitted
244-8326	09.03.03-4	• Acceptable response, but the applicant proposes the same challenging COL items as provided in response to Question 09.03.03-3	Revised response Submitted
212-8246	09.05.01-35	• To include a fire hazards analysis for the AAC gas turbine generator building and the two ESW/CCW HX buildings.	Response submitted
456-8566	09.05.01-40	• To remove the sentence that indicates equipment that is not beneficial to safe shutdown will continue to operate.	Response submitted
212-8246	09.05.01-39	• To state whether the final fire hazards analysis will evaluate/consider the effects of spurious actuations caused by heat from a fire on cabinets that contained digital signal processing equipment and fiber optic cable.	Response submitted

Open Items (4/4)

RAI No	Question No	Staff Position	Status
500-8634	09.05.01-42	• To provide a markup for these two DCD sections correcting the information as stated in the February 17, 2016, phone call.	Response submitted
491-8613	09.05.02-5	• To provide the COL Items which are applicable to communication systems, to provide a detailed description of all ITAAC items along with their acceptance criteria and to provide the ITP for the communication systems in Section 14.2	Response submitted
491-8613	09.05.02-4	• To justify why the communication systems are not considered as risk significant SSCs in order to demonstrate the requirements of 10 CFR Part 50, Appendix A, GDC1, GDC 2, GDC 3, and GDC 4 are not applicable to the communication systems	Response submitted
491-8613	09.05.02-5	• To clarify what the applicant means by functional arrangement of communication systems and also to provide the COL Items which are applicable to communication system ITAACs	Revised response will be submitted after clarification.
459-8573	09.05.04-14	• To provide the proper acceptance criteria in Table 2.6.2-3 (ITAAC) to confirm that the as-built conditions meet the design commitments	Response submitted
501-8635	09.05.04-15	• To describe the specific inspections or tests in DCD Tier 1, Table 2.6.6-1 • To verify that the “as-built” AAC GTG meets the design and performance commitments following the completion of its installation at its final location at the plant site	Response submitted

Acronyms

AAC	Alternate Alternating Current
AB	Auxiliary Building
ACU	Air Cleaning Unit
AFST	Auxiliary Feedwater Storage Tank
AHU	Air Handling Unit
ANS	American Nuclear Society
ANSI	American National Standard Institute
AOV	Air Operated Valve
BAST	Boric Acid Storage Tank
C/R	Condensate Receiver
CCW	Component Cooling Water
CCWS	Component Cooling Water System
CEDM	Control Element Drive Mechanism
CIAS	Containment Isolation Actuation Signal
CIV	Containment Isolation Valve
CLP	Cask Loading Pit

COL	Combined License
CPIAS	Containment Purge Isolation Actuation Signal
CRE	Control Room Envelope
CS	Containment Spray
CSFs	Condensate Storage Facilities
CST	Condensate Storage Tank
CT	Condensate Storage And Transfer System
CVCS	Chemical and Volume Control System
CW	Circulating Water Pump
DWST	Demineralized Water Storage Tank
ECWS	Essential Chilled Water System
EDECAIES	Emergency Diesel Engine Combustion Air Intake And Exhaust System
EDECWS	Emergency Diesel Engine Cooling Water System

Acronyms

EDEFOS	Emergency Diesel Engine Fuel Oil System
EDELS	Emergency Diesel Engine Lubrication System
EDESAS	Emergency Diesel Engine Starting Air System
EDG	Emergency Diesel Generator
EFDS	Equipment and Floor Drainage System
EPRI	Electric Power Research Institue
ESF	Engineered Safety Features
ESW	Essential Service Water
ESWS	Essential Service Water System
FHA	Fire Hazard Analysis
FPP	Fire Protection Program
FSSA	Fire Safe Shutdown Analysis
GTG	Gas Turbine Generator
HELB	High Energy Line Break

HEPA	High Efficiency Particulate Air
HT	High Temperature
I&C	Instrumentation and Control
IA	Instrument Air System
IEEE	Institute of Electrical and Electronics Engineers
IHA	Integrated Head Assembly
IRWST	In-containment Refueling Water Storage Tank
LLHS	Light Load Handling System
LOOP	loss of offsite power
LRS	Liquid Radwaste System
LT	Low Temperature
LWMS	Liquid Waste Management System
MCR	Main Control Room
MDS	Makeup Demineralizer System

Acronyms

MFHX	Mini-Flow Heat Exchagner
M/G set	Motor Generator set
MORS	Membrane Oxygen Removal Subsystem
NFPA	National Fire Protection Association
NPSH	Net Positive Suction Head
NPSS	Normal Primary Sampling System
OHLHS	Overhead Heavy Load Handling System
PACU	Packaged Air Conditioning Unit
PASS	Post-Accident Sampling System
PCWS	Plant Chilled Water System
PNS	permanent non-safety
PRA	Probabilistic Risk Assessment
PWR	Pressurized Water Reactor
RCFC	Reactor Containment Fan Cooler
RCB	Reactor Containment Building
RCP	Reactor Coolant Pump

RCS	Reactor Coolant System
RSR	Remote Shutdown Room
RG	Regulatory Guilde
RV	Reactor Vessel
SA	Service Air System
SBO	station blackout
SC	Shutdown Cooling
SFP	Spent Fuel Pool
SFPC	Spent Fuel Pool Cooling
SFPCCS	Spent Fuel Pool Cooling and Cleanup System
SG	Steam Generator
SRP	Standard Review Plan
SSCs	Structure, System, Components
SSE	Safe Shutdown Earthquake

Acronyms

SSS	Secondary Sampling System
ST	Sanitary Drainage System
TGB	Turbine Generator Building
TGBCCW	Turbine Generator Building Component Cooling Water
TGBOCW	Turbine Generator Building Open Cooling Water
TGBOCWS	Turbine Generator Building Open Cooling Water System
UHS	Ultimate Heat Sink
UCT	Underground Common Tunnel
TGBCCW	Turbine Generator Building Component Cooling Water
TGBOCW	Turbine Generator Building Open Cooling Water
WD	Domestic Water System
WM	Makeup Demineralizer System
WWTF	Waste Water Treatment Facility

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Korea Hydro & Nuclear Power Company, Ltd (KHNP), and
Korea Electric Power Company (KEPCO)

APR1400 Design Certification Application Review

Safety Evaluation with Open Items: Chapter 9

AUXILIARY SYSTEMS

May 18, 2017

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Chapter 9: Auxiliary Systems

U.S.NRC
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Water Systems	Chang Li, SPSB Ryan Nolan, SPSB Angelo Stubbs, SPSB Robert Vettori, SPSB
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Other Auxiliary Systems	Thinh Dinh, SPSB Robert Vettori, SPSB Deanna Zhang, ICE Adakou Foli NRR/EEB

Project Managers:	Bill Ward – Lead Project Manager
	George Wunder – Chapter 9 Project Manager

Section 9.1: Fuel Storage and Handling

Subsections:

- Criticality Safety of New and Spent Fuel Storage
- New and Spent Fuel Storage (to be presented at a later date)
- Spent Fuel Pool Cooling and Cleanup System
- Light Load Handling System
- Overhead Heavy Load Handling System

Criticality Safety of New and Spent Fuel Storage

- Fuel Assembly and Storage Rack Design and Modeling
    - Parameters are consistent with PLUS7 fuel and rack design information
    - Modeling assumptions are appropriate
        - Assumed fuel enrichment bounds all fuel to be stored
        - Neutron absorber: 75% B-10 credit; tolerances handled conservatively
    - Justification (analysis) provided for storage configurations, which, contrary to SRP Section 9.1.1, allow placement of fuel assemblies outside of design locations

The staff found the approach consistent with SRP Section 9.1.1 or otherwise justified and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

- Storage Rack Materials
  - Applicant uses typical materials for fuel storage racks
    - New fuel racks: Type 304 stainless steel
    - Spent fuel racks: Type 304 stainless steel, Metamic™ neutron absorber
  - Fuel racks are designed, fabricated, and inspected to ASME Code Section III-NF requirements
  - The Metamic™ neutron absorber will be manufactured under the Holtec 10 CFR Part 50, Appendix B Quality Assurance program
  - Neutron absorber monitoring:
    - 14 coupons (plus 2 spares) to be withdrawn over 60 years
    - Monitor for material loss, blistering, changes in boron content, corrosion
  - GL 16-01 had no impact on this review. The applicant is implementing a monitoring program that is consistent with staff expectations provided in the Generic Aging Lessons Learned (GALL) Report (NUREG-1801).
- The staff found the approach consistent with SRP Section 9.1.1 and GALL and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

- Computational Methods and Data
  - SCALE 6.1.2 code with ENDF/B-VII 238-group cross-section library are appropriate for the application and acceptable

- Computational Method Validation
  - Ensured code validated consistent with NUREG/CR-6698, “Guide for Validation of Nuclear Criticality Safety Calculational Methodology”
  - Benchmark experiments are applicable and from acceptable sources
  - Questions regarding experiment groupings resolved through audit
  - Area of applicability clearly defined in agreement with the selected benchmark experiments
  - Bias and bias uncertainty values calculated consistent with NUREG/CR-6698, including statistical analysis and trending

The staff found the approach consistent with SRP Section 9.1.1 and NUREG/CR-6698 and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

- Bias and Uncertainty Analysis
  - Ensured all relevant sources of bias and uncertainty considered
    - Criticality code bias and bias uncertainty
    - Statistical uncertainties
    - Material and fabrication tolerance uncertainties
    - Pool cooling water temperature bias
    - Depletion code bias and bias uncertainty (Kopp memo, 1998)
    - Minor actinides and fission products bias
    - Axial power distribution (end effect) bias
    - Burnup record uncertainty
  - Confirmed values combined correctly and applied to nominal k_{eff} values

- The staff found the approach consistent with SRP Section 9.1.1, the Kopp memo, and NUREG/CR-7109, “An Approach for Validating Actinide and Fission Product Burnup Credit Criticality Safety Analyses – Criticality (k_{eff}) Predictions,” and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

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- Reactor Fuel Depletion Parameters
  - Ensured the fuel depletion parameters and assumptions are bounding and conservative and would maximize reactivity
    - Fuel temperature, fuel density, moderator temperature, soluble boron concentration, power level
    - Applicant provided justification that effects of rodded operation are minimal and need not be explicitly considered
  - Applicant stated that the thermal conductivity degradation issue will not impact the fuel temperature assumed for the depletion analysis
    - Staff is waiting for DCD/technical report markups before making a determination

- The staff found the approach consistent with SRP Section 9.1.1 and DSS-ISG-2010-01, “Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools,” and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

- Normal Conditions
  - Ensured criticality models bound the full range of normal conditions for the fuel racks and conservatively simulate normal operating conditions
    - Assumed SFP water temperature is 4ºC (density = 1 g/cm^3)
    - SFP models simulate infinite arrays of fuel assemblies
    - Separate SFP region I model for damaged fuel
    - RAI response considered fuel handling in the fuel storage facilities
  - No soluble boron credit for SFP normal conditions
  - Analysis results comply with 10 CFR 50.68

- The staff found the approach consistent with SRP Section 9.1.1 and the analysis results in compliance with 10 CFR 50.68 and therefore acceptable.

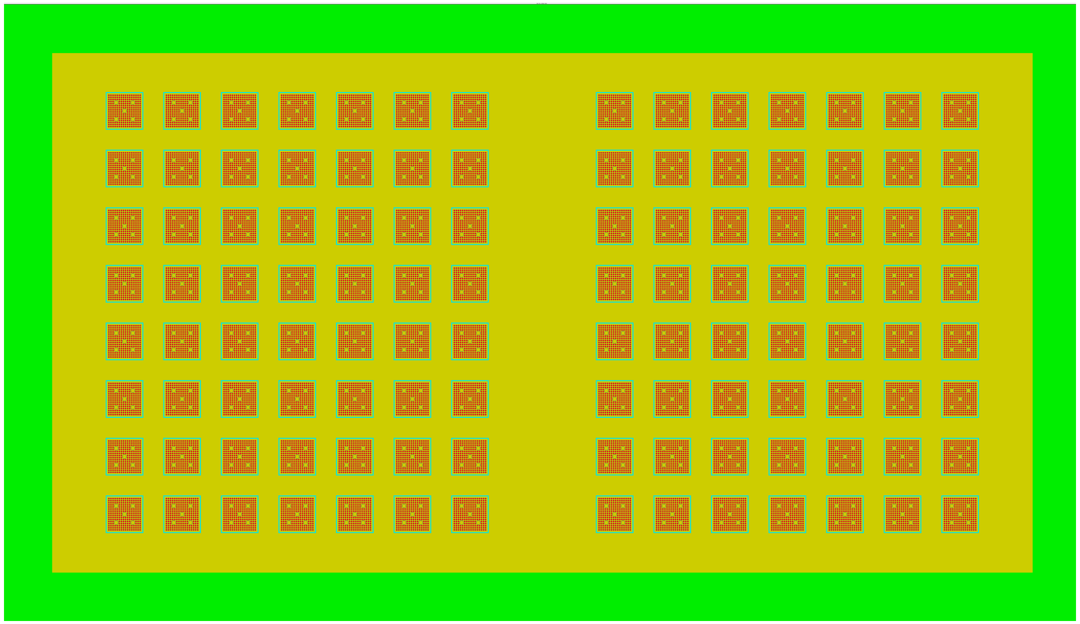
Criticality Safety of New and Spent Fuel Storage

- Abnormal Conditions
  - Ensured a comprehensive set of abnormal conditions was analyzed
    - New fuel storage: flooding with water of full and optimum moderation density; placement of assembly outside design locations
    - SFP: fresh fuel assembly dropped outside region I rack; fresh fuel assembly misload in region II; boron dilution accident
    - RAI response considered fuel handling in the fuel storage facilities
    - Structural and seismic evaluation of fuel racks must be completed to confirm that no mechanical accident affects criticality
  - Ensured abnormal-conditions models are correct and appropriate
    - Boundary conditions selected appropriately
    - Technical specifications minimum boron concentration credited for SFP and minimum necessary concentration for each accident identified
  - Analysis results comply with 10 CFR 50.68

- The staff found the approach consistent with SRP Section 9.1.1 and the analysis results in compliance with 10 CFR 50.68 and therefore acceptable.

Section 9.1.1, Criticality Safety of New and Spent Fuel Storage

- Staff Confirmatory Analyses
  - Methodology: SCALE 6.1.2 with CSAS6 and ENDF/B-VII continuous energy cross sections
  - Staff built models independently using design information
  - New Fuel Storage Rack Model



Criticality Safety of New and Spent Fuel Storage

- Staff Confirmatory Analyses
  - New Fuel Storage Rack Calculated k_{eff} (without bias and uncertainty)

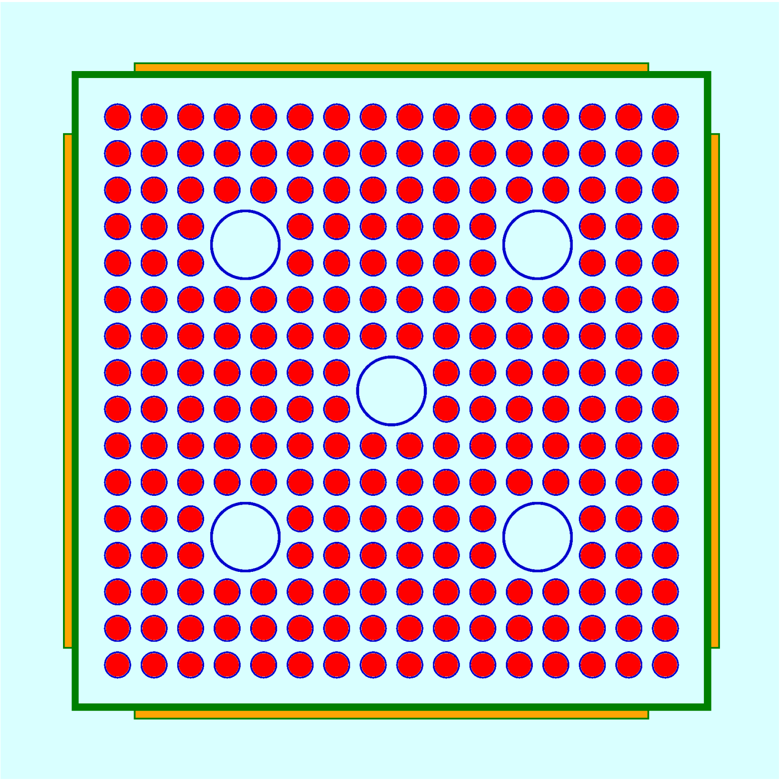
Water Density	Staff Results	
0.13 g/cm^3	0.91313 ± 0.00013	
0.14 g/cm^3	0.91424 ± 0.00015	
0.15 g/cm^3	0.91407 ± 0.00017	
1.00 g/cm^3	0.89904 ± 0.00015	

    - Differences likely due to continuous energy vs. multigroup cross-sections
    - Applicant’s results more conservative than staff’s for density around optimum moderation
    - Staff’s higher result for full density not a concern because of applicant’s margin to regulatory limit

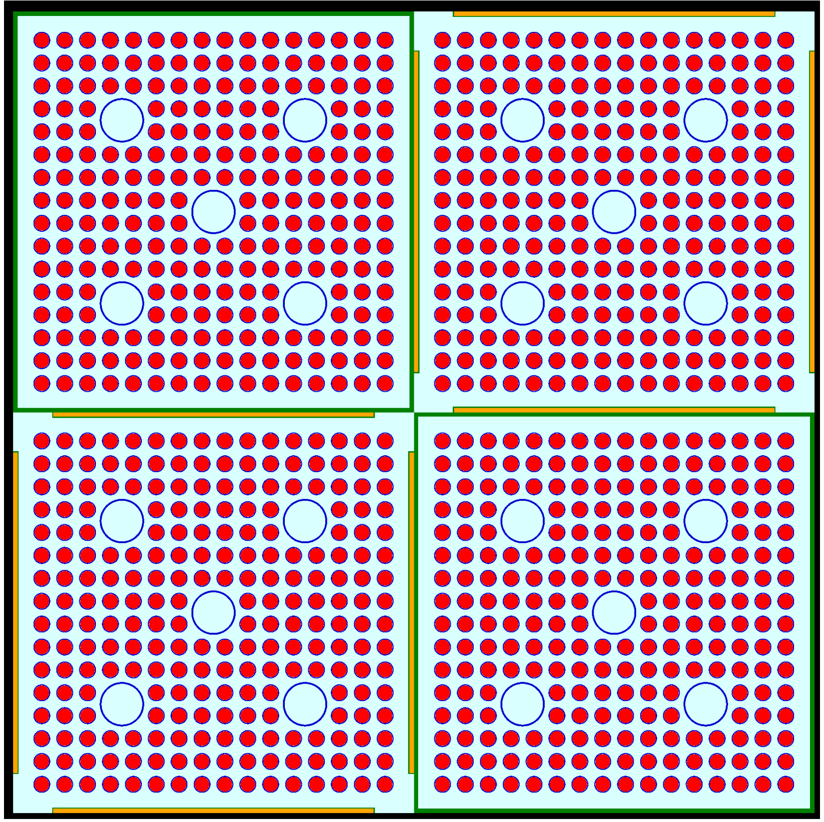
Criticality Safety of New and Spent Fuel Storage

- Staff Confirmatory Analyses
  - Spent Fuel Storage Rack – Region I and Region II Models

Region I



Region II



Criticality Safety of New and Spent Fuel Storage

- Staff Confirmatory Analyses
  - Spent Fuel Storage Rack – Region I Calculated k_{eff}
    - Staff: 0.90762 ± 0.00018
  - Spent Fuel Storage Rack – Region II Calculated k_{eff}
    - Staff analyzed the case of 5% initial enrichment with no burnup
    - $k_{eff} > 1.0$ because this data point is used to generate burnup loading curve; storage of fresh 5 wt% fuel in region II is not allowed
    - Staff: 1.20152 ± 0.00015
  - Confirmatory Analysis Conclusions
    - Some differences in new fuel storage rack k_{eff} but no safety concern
    - Good agreement overall for spent fuel storage racks

Criticality Safety of New and Spent Fuel Storage

- Tier 1 information and ITAAC for New and Spent Fuel Storage
    - Ensured Tier 1 information complete and consistent with Tier 2 information
    - Ensured clarity of ITAAC and consistency with guidance in RIS 2008-05, Revision 1, “Lessons Learned to Improve Inspections, Tests, Analyses, and Acceptance Criteria Submittal”

The staff found the approach, as modified by RAI responses, consistent with SRP Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” and RIS 2008-05, Revision 1 and therefore acceptable.

Criticality Safety of New and Spent Fuel Storage

- Conclusions
  - Criticality calculation methodology is acceptable and appropriately benchmarked
  - Criticality models correctly incorporate design information and use appropriate assumptions
  - Applicant's analyses presented in the associated technical report comply with 10 CFR 50.68 and GDC 62
  - Staff's confirmatory analyses support the applicant's analyses
  - Tier 1 information and ITAAC for new and spent fuel storage sufficient and necessary to ensure regulations are met
  - Before staff can make overall finding with regard to 10 CFR 50.68 and GDC 62, the following must occur:
    - Applicant must docket information confirming that thermal conductivity degradation doesn't affect depletion temperature
    - Staff's structural and seismic evaluation must show that mechanical and seismic events do not affect criticality
    - Staff must close several confirmatory items

Cooling and Cleanup System

Review Objective

- Ensure the safety-related Spent Fuel Pool Cooling System is capable of maintaining the spent fuel assemblies cooled and covered with water during all storage conditions.

Items of major interest

- Staff reviewed SFPCCS in accordance with the guidance in SRP 9.1.3
- Ensure system configuration ensures adequate water inventory in the SFP
- Evaluate all key assumptions of the thermal analyses
- RAI responses found acceptable and proposed changes to DCD are been track as Confirmatory Items

- 1 Open Item remains
  - Staff awaits the revision of the bounding thermal analysis to confirm adequate design of the SFPCS

Light and Heavy Load Handling

Review Objective

To ensure the design and operation of the load handling systems can prevent or minimize the likelihood of an event that could cause a release of radioactivity, a criticality accident, or an inability to cool fuel within the reactor vessel or spent fuel pool; or could prevent the safe shutdown of the reactor.

Items of major interest

- Responses of load handling equipment to a safe shutdown earthquake (SSE) event consistent with guidance in SRPs 9.1.4 and 9.1.5.
- Design criteria for single-failure-proof load handling components consistent with guidelines of NUREG-0554
- Procedures for safe load handling operations consistent with guidelines of NUREG-0612

Identified open items are for clarification of responses to previously issued RAIs. The latest responses are found acceptable and all open items can now be closed.

Water Systems

Subsections:

- Essential Service Water System
- Component Cooling Water System
- Domestic Water and Sanitary Systems
- Ultimate Heat Sink
- Condensate Storage Facilities
- Chiller Water System

Essential Service Water System

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Review Objectives

- Reviewed from the service water pump intake to the points of cooling water discharge including piping, valves, instrumentation, and controls.
- Review Guidance: SRP Section 9.2.1, "Station Service Water System," Revision 5
- Review Areas: system design considerations, conformance with applicable regulatory requirements (GDCs 2, 4, 44, 45, 46, and 10 CFR 20.1406), initial test program, ITAAC, Technical Specifications, COL Information Items

Staff Review and Conclusion:

- Nine RAIs, all being resolved
- Eight confirmatory items, 15 COL information items
- NRC staff finds the applicant's approach acceptable and will verify the DCD confirmatory items during review of next DCD revision.

Component Cooling Water System

Key Design Features and Considerations

- CCWS is designed to support safe shutdown and cooling of the reactor following a postulated accident coincident with a loss of offsite power (LOOP).
- CCWS consists of two separate, independent, redundant closed-loop safety-related divisions each capable of supporting 100% of required cooling functions for safe reactor shutdown following accident with LOOP.
- CCWS nonessential cooling loops are automatically isolated and CCW flow to nonessential equipment terminated in event of an accident.

Staff's Review and Evaluation Results

- Staff reviewed CCWS in accordance with SRP 9.2.2.
- The system was found to be capable of providing the necessary cooling to essential SSCs and the system was found to have sufficient redundancy to perform its safety function assuming a single active failure and a LOOP.
- The staff found the system to be in compliance with GDCs 2, 4, 5, 44, 45, and 46.

- There are no Open Items

Domestic Water and Sanitary Systems

Key Design Features and Considerations

- Systems provide potable water for domestic use and human consumption and collects and transfers site sanitary waste for treatment and discharge.
- Systems are site specific therefore only conceptual design information, interface requirements and design features to prevent radioactive contamination of the system is included in the DCD.

Staff's Review and Evaluation Results

- Staff reviewed the systems in accordance with SRP 9.2.4
- The staff found the conceptual design information and the interface requirements in the DCD to be in accordance with 10 CFR 52.47(a)
- Design provision made to prevent inadvertent contamination of the domestic water and sanitary systems with radioactive material was found to be acceptable and the design is in compliance with GDC 60.

- There are no Open Items

Ultimate Heat Sink

Key Design Features and Considerations

- Review Guidance: SRP Section 9.2.5, “Ultimate Heat Sink,” Revision 4
- Review Areas: system functional design, UHS cooling towers, initial test program, ITAAC, Technical Specifications, COL Information Items
- Large portions of this section are CDI, which is a representative conceptual design not subject to the review for design certification
- The staff will verify the compliance with GDCs 2, 4, 5, 44, 45, 46 during review of future site-specific COL application

Staff’s Review and Evaluation Results

- One confirmatory item, 16 COL information items
- NRC staff finds the applicant’s approach acceptable and will verify the DCD confirmatory item during review of next DCD revision

Condensate Storage Facilities

Key Design Features and Considerations

- The CSF provides condensate to the condenser hotwell and is a nonsafety-related backup water supply for the AFWS
- The CSF is a nonsafety-related system with non-seismic storage tanks
- In the event of failure of non-seismic CSF storage tanks, site grading and drainage will ensure SSCs important to safety will not be adversely affected

Staff's Review and Evaluation Results

- Staff reviewed CSF in accordance with SRP 9.2.6.
- The system was found to be in compliance with GDCs 2 and 60 and 10 CFR 20.1406.
- GDCs 5, 44, 45, and 46 were found not applicable because system is not safety-related and not credited for supporting safety-related systems.

- There are no Open Items

Chilled Water System

Areas of Review

- Staff reviewed the CWS design for performance, inspection, and testing capabilities to ensure the system can perform its safety-related functions
- Staff reviewed whether the failure of the nonsafety-related portions of the CWS can adversely impact any safety-related systems or components
- Staff also reviewed ITAAC, pre-operational testing, and technical specifications to ensure the system is operated in accordance with the design bases.

Staff Findings

- Staff reviewed CWS in accordance with SRP 9.2.7.
- The CWS has the heat removal capacity to transfer the DBA heat loads from SSCs important to safety to the safety-related chillers and complies with GDCs 2, 4, 5, 44, 45, 46, and 10 CFR 20.1406

Section 9.3 : Process Auxiliaries

Subsections:

- Compressed Air and Gas Systems
- Process and Post-Accident Sampling System
- Equipment and Floor Drainage Systems
- Chemical and Volume Control System

Compressed Air and Gas Systems

Review Objective

- Ensure the quality of air does not prevent the safety-related air operated valves from performing their safety function

Items of major interest

- Staff reviewed compressed air and gas systems in accordance with the guidance in SRP 9.3.1.
- Instrument Air system has no safety function, but provides air to safety-related valves, therefore, high quality air is required
- Compress gas, Service Air, and the breathing air subsystems have no safety function
- All RAIs are resolved and resulted in several Confirmatory Items

- Staff finds that the compress air and gas systems conforms with the guidance of SRP 9.3.1

Process / Post-Accident Sampling Systems

System Description

The system consists of the following:

- Normal primary sampling system (NPSS)
- Post-accident sampling system (PASS)
- Secondary sampling system (SSS)

Scope of Review

- Sampling locations and capabilities related to …
  - reactor coolant pressure boundary integrity
  - boron concentration for reactivity control
  - chemical additives for materials compatibility and iodine removal
  - detecting and monitoring radioactivity
- Quality and seismic design requirements
- Detection and control of leakage outside containment
- Containment isolation

Process / Post-Accident Sampling Systems

Conclusions

- Sampling lines penetrating containment have containment isolation valves that close on a containment isolation actuation signal
- Capable of collecting and analyzing liquid and gaseous samples from the primary coolant, secondary coolant, containment air, spent fuel pool, and other sources
- Includes the sampling locations in the SRP acceptance criteria, and other locations
- Meets the requirements for a leakage control program for minimizing leakage of radioactive material
- Quality and seismic classifications match those of the systems to which the sampling lines and components are connected (determined after Phase 2 completion)
- COL applicant will ….
  - Develop operational procedures and maintenance program for leak detection and contamination control
  - Maintain documentation of system design modifications, construction, and operations
- Staff review has no open or confirmatory items

Equipment and Floor Drainage Systems

Area of Review

- Staff reviewed the EFDS design for performance, inspection, and testing capabilities to ensure the system cannot adversely impact safety-related SSCs
- Staff reviewed safety-related portions of the EFDS that can adversely impact any safety-related systems or components

Staff Findings

- The EFDS conforms with the guidance of SRP 9.3.3
- Staff had asked for a simplified flow diagram of the turbine generator building EFDS be included in DCD.
  - The staff has closed this open item based on a diagram included in RAI responses, a COL item has been generated, this is a nonsafety-related system

Review Topics

- **Design Basis**
    - Safety-related design basis of the CVCS
- **Functionality**
    - Functional design basis of the CVCS; System design; Operational modes
    - System responses for different accidents
    - Component details including instrumentation and controls
    - Materials and chemistry aspects
- **Protection**
    - Protection against boric acid precipitation
    - Minimum flow and cavitation protection for charging pumps
    - Seismic classification; Purifying/filter components
    - Control of venting/draining and contamination minimization
    - Vacuum conditions in tanks; Materials and chemistry compatibility
- **Testing, Tech Specs, and Surveillance Requirements**

Chemical and Volume Control System

RAIs and Status

RAIs Issued And Resolved:

1. Isolation scheme for the charging line, seal injection line, IRWST make-up line and Reactor Coolant Pump CBO line during accidents
2. Volume Control Tank wall inward buckling protection
3. Use of EPRI guideline for controlling water chemistry
4. Treatment of dissolved oxygen, ammonia, lithium, hydrogen, fluoride and sulfate
5. pH control procedures and standards
6. Chemical specifications

Open Item in Chapter 15 regarding Boron dilution during Mode 4&5 may impact the staff conclusions about CVCS design

Chemical and Volume Control System

Findings

- **Design Basis**
  CVCS has appropriate safety-related design basis

- **Functionality**
  - System functional design to include all components necessary for RCS chemical and volume control
  - CVCS ACP adequate for coping with SBO
  - Components, instrumentation and controls appropriate
  - Adequate chemistry/purity control

- **Protection**
  - Protection against boric acid precipitation adequate
  - Cavitation and minimum flow protection for charging pumps appropriate
  - Appropriate seismic classification completed for CVCS
  - Purifying equipment appropriately protected
  - CVCS leakage control adequate to minimize contamination
  - VCT adequately protected against vacuum conditions

- **Testing, Tech Specs, and Surveillance Requirements Adequate**

Conclusions

- **The CVCS has been designed appropriately for chemical and volume control of APR1400**
- **Application includes appropriate ITAAC and Technical Specifications**
- **No open items**

Section 9.4: Heating, Ventilation and Air Conditioning Systems

Subsections:

- Control Room HVAC System
- Fuel Handling Area HVAC System
- Compound Building HVAC System
- Engineered Safety Feature Ventilation System

Control Room HVAC System

Area of Review

- Staff reviewed the CRHS design to determine whether it is capable of maintaining suitable environmental conditions for personnel and conditions under normal and accident conditions.
- The staff evaluated the CRHS for compliance with GDC 2, 4, 5, 19, and 60 as well as with 10 CFR 50.63 and 10 CFR 52.47(b)(1)

Staff Findings

- Staff noted ITAAC acceptance criteria regarding positive pressure in the CR were not specific enough.
- This issue has been resolved and is now confirmatory

Staff Conclusion

Staff concluded that the CRHS complies with all applicable design criteria and is capable of performing its intended function under normal and accident conditions.

Fuel Handling Area HVAC System

Area of Review

- Staff reviewed the system design to determine whether it is capable of preventing spread of airborne contamination and maintaining fuel handling area airborne concentration below 10 CFR Part 20 limits under normal and accident conditions.
- The staff evaluated the CRHS for compliance with GDC 2, 5, 60, and 61 as well as 10 CFR 52.47(b)(1)

Staff Findings

- Staff noted that inspection and testing requirements did not address inspection and testing of ACU heating coils.
- This issue has been resolved and is now confirmatory

Staff Conclusion

Staff concluded that the fuel handling area HVAC system complies with all applicable design criteria and is capable of performing its intended function under normal and accident conditions.

Compound Building HVAC System

Area of Review

- Staff reviewed the compound building HVAC system design to determine whether it is capable of maintaining a suitable environment for personnel and equipment in both clean and potentially radioactive areas of the compound building.
- The staff evaluated the CRHS for compliance with GDC 2, 5, and 60, as well as 10 CFR 52.47(b)(1).

Staff Findings

- Staff noted that the applicant did not provide carbon absorber ACU or HEPA ACU maximum air flow ratings.
- Staff found that applicant's 2000 cfm HEPA and 45,000 CFM ACU design is acceptable.

Staff Conclusion

Staff concluded that the fuel handling area HVAC system complies with all applicable design criteria and is capable of performing its intended function under normal and accident conditions.

Compound Building HVAC System

Area of Review

- In the APR1400 standard design, the compound building HVAC system uses 1,500~2,000 cfm HEPA filters and the compound building HVAC system ACUs can allow at least a 45,000 cfm airflow rate without increasing the physical size and changing the filter layout of 3 HEPA filters high and 10 HEPA filters wide. In-place test equipment, such as aerosol generators, has been developed that provides the capability to perform reliable in-place testing for ACUs up to 65,000 cfm.

Staff Conclusion

Staff concluded that the compound building HVAC system complies with all applicable design criteria and is capable of performing its intended function under normal and accident conditions.

Engineered Safety Feature Ventilation System

Area of Review

- Staff reviewed the engineered safety feature ventilation system design to determine whether it is capable of maintaining a suitable and controlled environment for engineered safety feature components following anticipated transients and DBAs.
- The staff evaluated the CRHS for compliance with GDC 2, 4, 5, 17, and 60, as well as 10 CFR 50.63 and 10 CFR 52.47(b)(1).

Staff Findings

- Staff noted that the applicant did not address the inspection and testing requirements for heating coils. .
- Applicant responded that DCD will be modified to address these requirements and this is now a confirmatory item.

Staff Conclusion

Staff concluded that the engineered safety feature ventilation system complies with all applicable design criteria and is capable of performing its intended function under normal and accident conditions.

Section 9.5: Other Auxiliary Systems

Subsections:

- Fire Protection Program
- Communication Systems
- Lighting Systems
- Emergency Diesel Engine Fuel Oil System
- Emergency Diesel Engine Cooling Water System
- Emergency Diesel Engine Starting Air System
- Emergency Diesel Engine Lubrication System
- Emergency Diesel Engine Combustion Air Intake / Exhaust System
- Gas Turbine Generator Facility

Fire Protection Program

Review Objectives

- Review of Fire Protection Program and Fire Hazard Analysis
- Minimization of potential for fires and explosions to occur. Ability to rapidly detect, control, and extinguish fires that do occur. Ensure that fire will not prevent the performance of necessary safe shutdown functions and will not significantly increase the risk of radioactive releases to the environment.

Items of major interest

- With incorporation of the confirmatory items in the next revision of the DCD staff will be able to conclude that the Fire Protection DCD sections include the necessary information to find that the design conforms to the guidance in Regulatory Guide 1.189.

Communication Systems

N**on-safety-related** structures, systems and components (SSCs)

Intended to provide reliable and effective communications inside buildings, between buildings and with external locations during normal operation, maintenance, transient, fire, accident conditions including LOOP and security-related events

Communications Systems Conformance to Regulations

Staff finds that the communication systems conform to applicable NRC regulations, except for 2 cases:

- 10 CFR Part 50, Appendix A, GDC1, GDC 2, GDC 3, and GDC 4
- 10 CFR 52.47(b)(1), which requires that a design certification application contain the necessary and sufficient ITAAC

Communications Systems - Findings

- Applicant has classified all communication systems as non-safety related (not requiring compliance with 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 3, and GDC 4)

- Communication systems availability is an implicit assumption in the APR1400 PRA.

- Staff requested the applicant to clarify whether the communication systems are risk-significant SSCs

Communications Systems - Findings

- To assure compliance with the requirements of 10 CFR 52.47(b)(1), Staff requested additional detail on which particular procedures would be followed
- Ensure that each communication subsystem is capable of performing its intended function within ITAAC and Acceptance Criteria provided in APR1400 FSAR Tier 1, Table 2.6.9-1

Lighting Systems

Lighting systems include the normal and emergency lighting systems.

- Normal lighting system provides general illumination throughout the plant during normal plant operation
- Emergency lighting system provides illumination in required areas during plant off-normal conditions and loss of the normal lighting system

Staff reviewed the capability of the normal and emergency lighting systems to provide adequate illumination in all plant areas during all plant operating conditions and to operate without adversely impacting safety-related systems.

Based on the illumination, the isolation, and the seismic category of the lighting equipment, the staff concluded that the normal and emergency lighting systems are capable of performing their design function.

Emergency Diesel Engine Support Systems

Functional Description:

- Consist of emergency diesel engine fuel oil system (EDEFOS), emergency diesel engine cooling water system (EDECWS), emergency diesel engine starting air system (EDESS), emergency diesel engine lubrication system (EDELS), and emergency diesel engine combustion air intake and exhaust system (EDECAIES)
- EDEFOS provides storage capacity and continuous supply of fuel oil for the four Class 1E EDGs following a lost of offsite power event.
- EDECWS provides cooling water to maintain the temperature of the EDGs within optimum range during standby and full operation conditions.
- EDESS provides compressed air to facilitate EDGs fast-start capability.
- EDELS stores and delivers clean lubricating oil to the EDGs moving parts during standby and full operation conditions.
- EDECAIES supplies reliable quality combustion air and removal of exhaust combustion products for EDGs operation.

Emergency Diesel Engine Support Systems

Key Design Features:

- Four separate and independent trains of EDGs, each train has a separate and independent emergency diesel engine support systems.
- Emergency diesel engine support systems are designed to function during and after a SSE and protected from natural phenomena, internal floods and missiles, pipe breaks, and interaction with non-seismic systems in the vicinity.
- 7-day fuel oil capacity
- Instrumentation and alarms are provided to monitor the operation of the emergency diesel engine support systems.
- The capability to isolate system or piping components, including isolation of portions of the system for excessive leakage or component malfunction, to maintain the system safety function.
- Provisions are made to allow for periodic inspection, functional testing, and maintenance of the emergency diesel engine support systems.

Emergency Diesel Engine Support Systems

Staff's Review and Conclusion:

- Staff reviewed the diesel support systems in accordance with SRP 9.5.4-9.5.8.
- Designed, fabricated, and tested to quality standards in accordance with applicable NRC guidance; providing adequate assurance that the Class 1E EDGs can perform their intended functions during a LOOP event.
- Independent, separate, and components are not shared between the EDGs. Any single active failure will not prevent the other redundant EDGs from performing their safety function.
- The EDGs and their associated support systems are physically separated and designed to function during and after an SSE. Protected from natural phenomena, internal floods and missiles, pipe breaks, and interaction with non-seismic systems in the vicinity. Reasonable to expect the above accident conditions will not lead to a loss of more than one EDG.
- Provisions for functional testing, periodic inspection, and maintenance of the emergency diesel engine support systems ensures reliability of systems.

- One outstanding Open Item; however, staff has received additional information from the applicant to close it out in the review of the APR1400 DCD, Revision 1.

Gas Turbine Generator Facility

Review Objectives

- Determine if GTG support systems have the capability of support GTG operation independent of plants EDGs with minimum potential for common mode failure
- Capability to support operation of the GTG for 16 hour SBO coping period.
- Staff's review of the GTG support systems was based on the requirements of 10 CFR 50.63 and guidance provide in Reg. Guide 1.115

Staff's Findings

- GTG support systems are diverse and independent of the plant EDGs (air cooling vs. water cooling, separate fuel oil supply, intake and exhaust, etc.)
- GTG has sufficient fuel oil to support SBO coping time

- Two Open Items; however, staff received additional information from the licensee to close them out in the review of the APR1400 DCD, Revision 1

ACRONYMS

ACP – auxiliary charging pump
AFWS – auxiliary feed water system
CCWS – component cooling water system
CDI – conceptual design information
CE – Combustion Engineering
COL – combined license
CRHS – control room HVAC system
CSF – condensate storage facility
CST – condensate storage tank
CVCS – chemical and volume control system
CWS – chilled water system
DBA – design basis accident
DCD – design control document
EDECAIES – emergency diesel engine (EDE) combustion air intake and exhaust system
EDECWS – EDE cooling water system
EDEFOS – emergency diesel engine fuel oil system
EDELS – EDE lubrication system
EDESS – EDE starting air system
EDG – emergency diesel generator
EFDS – equipment and floor drainage systems
GALL – generic aging lessons learned
GL – generic letter
GDC – general design criterion
HVAC – heating, ventilation and air conditioning
LOOP – loss of offsite power
MCR – main control room
RAI – request for additional information
RCS – reactor coolant system
RIS – regulatory issue summary
SBO – station blackout
SFP – spent fuel pool
SFPCS – spent fuel pool cooling system
SFPCCS – spent fuel pool cooling and cleanup system
SRP – standard review plan
SSC – structure, system and component
SSE – safe shutdown earthquake
ITAAC – inspections, tests, analyses, and acceptance criteria
UHS – ultimate heat sink
VCT – volume control tank