



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

June 29, 2017

MEMORANDUM TO: ACRS Members

FROM: Maitri Banerjee, Senior Staff Engineer **/RA/**
 Technical Support Branch
 Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS APR1400
 SUBCOMMITTEE ON MAY 18, 2017, ROCKVILLE, MARYLAND

The minutes for the subject meeting were certified on June 27, 2017. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc with Attachment: A. Veil
 M. Banks
 C. Brown



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

MEMORANDUM TO: Maitri Banerjee, Senior Staff Engineer
Technical Support Branch
Advisory Committee on Reactor Safeguards

FROM: Ronald Ballinger, Chairman
APR1400 Subcommittee
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFIED MINUTES OF THE ACRS APR1400 SUBCOMMITTEE
MEETING ON MAY 18, 2017

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on May 18, 2017, are an accurate record of the proceedings for that meeting.

/RA/

June 27, 2017

Ronald Ballinger, Chairman
APR1400 Subcommittee

Dated

**ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE APR1400 SUBCOMMITTEE MEETING ON
MAY 18, 2017, ROCKVILLE, MD**

The ACRS APR1400 Subcommittee held a meeting on May 18, 2017 in T2B1, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 8:30 a.m. and adjourned at 3:32 p.m.

ATTENDEES

ACRS Members/Consultant/Staff:

R. Ballinger, Chairman	J. Stetkar, Member
G. Skillman, Member	J. March-Leuba, Member
D. Powers, Member	C. Brown, Member
M. Sunseri, Co-Chairman	Andrea Veil, Executive Director
Stephen Schultz, ACRS Consultant	C. Brown, ACRS Staff (DFO)
M. Banerjee, ACRS Staff *	

NRC Staff, Consultants & Other Attendees:

DIANE JACKSON, NRO	WILLIAM WARD, NRO
DENNIS ANDRUKAT, NRO	ALEXANDRA BURJA, NRO
DANNY CHIEN, NRO	ANTONIO DIAS, NRO
ADAKOU FOLI, NRO	THINH DINH, NRO
RAUL HERNANDEZ, NRO	BECKY KARAS, NRO
HIEN LE, NRO	CHANG LI, NRO
SHANLAI LU, NRO	GREG MAKAR, NRO
RYAN NOLAN, NRO	CAYETANO SANTOS, JR., NRO
ANGELO STUBBS, NRO	JAMES STECKEL, NRO
BOB VETTORI, NRO	GEORGE WUNDER, NRO
ANDREW YESHNIK, NRO	DEANNA ZHANG, NRO

KHNP and Other Attendees:

TONY AHN, KHNP	YOUGGUN KIM, KHNP
CHEWUNG HA, KHNP	JUNGHO KIM, KHNP
YONG CHEOL KIM, KHNP	MINGYU KIM, KEPSCO E&C
HYEOK JEONG, KEPSCO E&C	DAEHEON LIM, KEPSCO E&C
DAEHEON LIM, KEPSCO E&C	HANCHEOL KIM, KHNP
DUNAM LIM, KHNP	JIYONG OH, KHNP
YOUNG TAE HAN, KEPSCO E&C	GUN HEO, KHNP
HONG SIK PARK, KEPSCO E&C	ROB SISK, Westinghouse
JINKYOO YOON, KHNP	D. WAGNER, AECOM

*Attending via telephone

SUMMARY

The purpose of the meeting was for the ACRS members to receive briefings on the Korea Electric Power Corporation (KEPCO) and Korea Hydro and Nuclear Power Company (KHNP) design certification application (DCA) and NRC staff's review specific to Chapter 9, "Auxiliary Systems." The meeting transcripts are attached, and contain a description of matters discussed at the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

The following list describes significant issues discussed during the meeting with the corresponding pages of the transcript referenced. Unless specifically noted, the chapter and section references belong to the Design Certification Document (DCD) Tier 2 submittal or the NRC staff's safety evaluation report (SER).

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Chairman Ballinger convened the meeting by introducing the ACRS members present. He noted the purpose of the day's meeting was to review the APR1400 Design Certification Application and the staff SER with open items specific to DCD Chapter 9, "Auxiliary Systems."	6-8
Mr. Bill Ward, NRO PM, and Rob Sisk, Westinghouse, consultant to the applicant, provided short introductions. Mr. Ward noted that presentations would not include Section 9.1.2 (New and Spent Fuel Storage). Mr. Young Tae Han, KEPCO E&C, started the applicant's presentation with Section 9.1.1 on criticality safety of new and spent fuel storage. He mentioned use of neutron absorbing material for high density spent fuel racks and the criticality limits. Upon member March-Leuba's question on why a different criterion was applied for new fuel versus spent fuel, Mr. Han mentioned burnup credit and went into a discussion of optimum moderation condition. Discussion on spent fuel rack loading situations including 1/3 core fresh fuel ready to be loaded and various spent fuel offload conditions in spent fuel pool took place. Mr. Han discussed how Keff values were analyzed for new and spent fuel storage.	8-19 Slides 2-9
Mr. Mingyu Kim, KEPCO E&C, presented Section 9.1.3, SFP Cooling and Cleanup System. Upon Chairman Ballinger's question, Mr. Kim noted that the dose rate of 2.5 mRem/hour is expected if the water level is three meters above the top of the fuel.	19-21 Slides 10-11

Mr. Kim presented Sections 9.1.4, Light Load (fuel) Handling System, and 9.1.5, Overhead Heavy Load Handling System.	21-23 Slides 12-15
ACRS Consultant Schultz asked about operating experience of METAMIC neutron absorbing material used in spent fuel pool. Mr. Yeshnik, NRO, answered the question and a discussion on the coupon surveillance program took place. Member Skillman pointed out the need for fuel rack alignment considerations related to fuel handling. A discussion followed and an ITAAC to verify the layouts was noted. Mr. Schultz asked about spent fuel pool level monitoring in the main control room.	23-30
Upon member Powers' question on spent fuel pool cleanup system capability, a discussion ensued regarding the types of contaminants, suspended solids and dissolved materials, and from leaking fuel assemblies. Chairman Ballinger asked if the cleanup system be able to deal with 1 percent failed fuel in offloaded one third of the core. This was taken for later follow-up. At a later point in the meeting Mr. Sisk addressed members' question on how failed/leaky fuel was designed to be handled in the spent fuel pool.	30-33 75-77
Mr. Youggun Kim, KEPCO E&C, presented the water systems in DCD Section 9.2.1 to 9.2.5. Member Sunseri initiated a discussion on susceptibility of the essential service water system to water hammer, and pointed out a possible mistake or need for clarification in the DCD. The detailed design of the vacuum breaker/ water hammer prevention is a COL item.	33-41 Slides 16-24
Mr. Kim presented Section 9.2.2, Component Cooling Water System (CCW). Member Stetkar asked if the design has an automatic trip of the reactor coolant pumps upon loss of CCW, time available for operator action, scenarios with no component cooling water. He also asked about the CCW and ESW system configuration for normal operation and shutdown conditions and if PRA models for shutdown was consistent.	41-49 Slides 19-20
Mr. Kim presented Section 9.2.4, Domestic Water and Sanitary System, noting Section 9.2.3 had been reserved by RG 1.206. Member Skillman's question on how the sanitary system would handle workers that have been subjected to nuclear medications was taken for later follow-up.	49-51 Slide 21-22
Mr. Kim presented Section 9.2.5, Ultimate Heat Sink.	51-52 Slides 23-24
Mr. Hancheol Kim, KEPCO E&C, presented Section 9.2.6, Condensate Storage Facilities. This system consists of two sub-systems, makeup demineralizer system and condensate storage and transfer system.	52-53 Slides 25-26

Mr. Hancheol Kim, KEPCO E&C, presented Section 9.2.7, Chilled Water System. This system consists of two sub-systems, essential chilled water system (ECWS) and plant chilled water system (PCWS). Member Stetkar asked about the basis for the non-safety related plant chilled water system to provide cooling for the safety related turbine-driven auxiliary feedwater pump room. A discussion followed. Member Stetkar requested to see the room heat-up calculations.	53-58 Slides 27-28
Mr. Kim presented Section 9.2.8, Turbine Generator Building Cooling Water Systems. Member Stetkar asked about the raw water system design requirements. A discussion followed. A COL item addresses the raw water system for the COL applicant to design.	58-65 Slides 29-30
Mr. Kim presented Section 9.3, Process Auxiliaries, starting with Section 9.3.1, Compressed Air and Gas Systems. Member Sunseri's question on dew point of the instrument air system was followed by member Stetkar asking about the cooling water for the instrument air compressors. Both questions were answered.	65-71 Slides 31-33
Mr. Kim presented Section 9.3.2, Process and Post-Accident Sampling System (PASS). Discussion on resetting cooling water to PASS post-accident followed. Then Mr. Kim presented Section 9.3.3, Equipment and Floor Drainage System.	71-74 Slides 34-35
Mr. Kim presented Section 9.3.4, Chemical and Volume Control System (CVCS). Member Stetkar asked about cooling to the centrifugal charging pumps, and how long the pump can operate without CCW to the minimum flow heat exchanger. Then a discussion on the effects of loss of instrument air to CVCS, and modeling of the event in PRA ensued.	77-86 Slides 36-37
Mr. Heo Gun, KEPCO E&C, presented Section 9.4, Heating, Ventilation, and Air Conditioning Systems. He briefly described the functions of the Control Room, Fuel handling area, Auxiliary Building Clean Area, and Turbine Generator Building HVAC Systems, and then the Engineered Safety Feature Ventilation System. Member Stetkar wanted to know if the containment fan coolers are safety related and availability of chilled water upon containment isolation.	86-92 Slides 38-46
Mr. Gun presented Section 9.4.6, Reactor Containment Building HVAC and Purge System. Member Stetkar asked about the average time period during which the low volume purge system would be operating and size of the line. He also explained the link of these information to the PRA. The first information was not available.	92-96 Slides 47-48
Mr. Gun presented Section 9.4.7, Compound Building HVAC System. He noted the design features for minimization of contamination (Section 9.4.8) are described in Subsection 12.4.2.	96 Slide 49

Member Powers' question regarding the effect of smoke to the digital electronic components in the main control room (MCR) upon a fire was taken for later follow-up.	96-101
Mr. Dunam Lim, KEPCO E&C presented Section 9.5, Other Auxiliary Systems, starting with 9.5.1, Fire Protection Program. Upon member Sunseri's question it was noted that the Shin Kori site has a fire department on site. A discussion on fire detectors in the plant and inside MCR instrument cabinets took place.	101-111 Slides 51-54
Mr. Lim presented Sections 9.5.2, Communication Systems, and 9.5.3, Lighting Systems.	111-113 Slides 55-56
Mr. Lim presented Emergency Diesel Engine (EDE) support systems (Fuel Oil, Cooling Water, Starting Air, Lubrication, Combustion Air Intake and Exhaust Systems). Upon member Sunseri's question, a discussion on instrument air dew point, its impact on diesel engine controls, and if the set point should be lowered took place. His question on the method of EDE shut down in a trip condition, by removing fuel oil, combustion air, or both, was taken for future follow up.	113-121 Slides 57-61
Mr. Lim presented Section 9.5.9, Gas Turbine Generator Facility. Questions regarding its start method and reliability were discussed.	121-123 Slide 62
Mr. George Wunder, NRO, introduced the NRC staff members at the meeting, and scope of their presentation. Ms. Alex Burja presented staff's review of DCD Section 9.1.1, Criticality Safety of New and Spent Fuel Storage, including the design, neutron absorber monitoring program, computational methods, its bias and uncertainties, depletion parameters, rodded operation, thermal conductivity degradation issues, normal and abnormal conditions, and staff's confirmatory analyses. Member Powers' question on how much worse does the earthquake have to be to cause unacceptable damage to the neutron absorber was noted by the staff as beyond their review scope. Members also discussed staff's confirmatory analyses assumptions and results.	124-152 Slides 2-17
Mr. Raul Hernandez, NRO, presented staff's review of DCD Section 9.1.3, Spent Fuel Pool Cooling and Cleanup System. Member March-Leuba's question if consideration was given on flow blockage was responded as a Section 9.1.2 issue and a staff follow-up item.	152-155 159-162 Slide 18
Mr. Hien Le, NRO, presented staff's review of DCD Sections 9.1.4 and 9.1.5, Light and Heavy Load handling System.	155-159 Slide 19
Mr. Chang Li, NRO, presented staff's review of DCD Sections 9.2.1, Essential Service Water System.	162-163 Slide 21
Mr. Angelo Stubbs, NRO, presented staff's review of DCD Sections 9.2.2,	164-169 Slide 22

Component Cooling Water System. Member Skillman asked for a clarification of staff's use of "normal system degradation over time" in their safety evaluation. Staff will revisit for a more improved explanation.	
Mr. Stubbs presented staff's review of DCD Sections 9.2.4, Domestic Water and Sanitary Systems, bulk of which is to be reviewed at the COL stage. Member Skillman reiterated his question if handling of radioactive waste from individuals after medical procedures needed to be addressed in the SRP.	169-172 Slide 23
Mr. Li presented staff's review of DCD Sections 9.2.5, Ultimate Heat Sink.	172-174 Slide 24
Mr. Stubbs presented staff's review of DCD Sections 9.2.6, Condensate Storage Facilities.	174-177 Slide 25
Mr. Ryan Nolan, NRO, presented staff's review of DCD Sections 9.2.7, Chiller Water System.	177-179 Slide 26
Mr. Hernandez presented staff's review of DCD Section 9.3.1, Compressed Air and Gas System.	179-180 Slide 28
Mr. Greg Makar, NRO, presented staff's review of DCD Section 9.3.2, Process and Post-accident Sampling System (PASS). Member Skillman stated his concern regarding design of PASS to allow sampling of highly radioactive reactor coolant post-accident. It was suggested that staff re-review the DCA and COLA responsibility to address TMI action plan items.	180-186 Slides 29-30
Mr. Hernandez presented staff's review of DCD Section 9.3.3, Equipment and Floor Drainage Systems.	187 Slide 31
Mr. Shanlai Lu, NRO, presented staff's review of DCD Section 9.3.4, Chemical and Volume Control System. He discussed a Chapter 15 SER open item related to the fresh water isolation valve and its potential impact to accident analysis related to boron dilution.	187-193 Slides 32-35
Ms. Diane Jackson started staff presentation on ventilation systems with review of DCD Section 9.4.1, Control Room HVAC System. Then she presented staff's review of DCD Section 9.4.2, Fuel Handling Area HVAC System and Section 9.4.7, Compound Building HVAC System; and how staff RAs were resolved. Upon member Stetkar's question it became clear that she was also addressing DCD Section 9.4.3, Auxiliary Building Clean Area HVAC System.	194-200 Slides 37-40
Ms. Jackson presented staff's review of DCD Section 9.4.5, Engineered Safety Feature Ventilation System. Upon member March-Leuba's question, she clarified that the positive pressure inside the MCR was 0.125 inch WG.	201-202 Slide 41

Mr. Bob Vettori, NRO, presented a very brief summary of staff review of DCD Section 9.5.1, Fire Protection Program, and Appendix 9.5A, Fire Hazard Analysis.	203-204 Slide 43
Ms. Deanna Zhang presented staff review of DCD Section 9.5.2, Communication Systems. She discussed open items from staff review.	204-209 Slides 44-47
Ms. Adakou Foli, NRO, presented staff review of DCD Section 9.5.3, Lighting System.	209-211 Slide 48
Mr. Thinh Dinh, NRO, presented staff review of DCD Sections 9.5.4-9.5.8 on five EDE support systems. Member Stetkar wanted to know how one can connect the gas turbine generator fuel oil supply to the day tanks of emergency diesels that are in the Auxiliary Building. It was explained that the technical report that included the information was being revised to show the supply would come from diesel generators in the Emergency Diesel Building and not the ones in the Auxiliary Building.	211-217 Slides 49-51
Mr. Vettori, NRO, presented a summary of staff review of DCD Section 9.5.9, Gas Turbine Generator Facility.	217-218 Slide 52
Chairman Ballinger asked for comments from the members of the public attending the meeting. There was a question on the status of presentations on Appendix 9.5A, the fire hazards analysis.	219-220
Chairman Ballinger asked for comments from the members. Member Skillman raised his concern on dew point of the diesel start air and asked the staff to review adequacy of the SRP guidance. Members felt that both KHNP and the staff had done a good job.	220-224
Chairman Ballinger adjourned the meeting at 3:32 p.m.	224

Following is a list of questions and comments the members raised for which a response was not available at the meeting:

MEMBER REQUESTS AND QUESTIONS	
Items	Reference Pages in Transcript
Member Skillman's question on how the sanitary system would handle workers that have been subjected to nuclear medications was taken for later KHNP follow-up. Staff to follow up, if the SRP should address it.	50, 172
KHNP to provide room heat-up calculations for turbine-driven auxiliary feedwater pump room for member Stetkar's review.	58

KHNP to address member Stetkar's question on how long the centrifugal charging pump can operate without CCW to the minimum flow heat exchanger.	80
KHNP to address member Stetkar's question on time period during which the low volume purge system would be operating.	94
KHNP to address member Powers' question on the effect of smoke to the digital electronic system during an MCR fire.	99
KHNP will review the dew point setpoint for the instrument air system.	118
KHNP to address member Sunseri's question if EDE shut down in a trip condition is by removing the fuel oil, combustion air, or both,	119
Staff to get back on how the containment polar crane load block rated capacity is increased to 900 tons during construction.	159
Staff to responds regarding flow blockage consideration during Section 9.1.2 presentation.	161
The staff will confirm that PASS was designed to allow sampling reactor coolant with high radioactivity post-accident.	184
The staff to review adequacy of SRP guidance on diesel start air dew point.	222-223

REFERENCE:

1. Korea Electric Power Corporation and Korea Hydro & Nuclear Power Company, Ltd., "Korea Electric Power Corporation and Korea Hydro & Nuclear Power Co., Ltd Application for Design Certification of the APR1400 Standard Design," December 23, 2014 (ML15006A098).
2. U.S. Nuclear Regulatory Commission, "Advanced Power Reactor 1400 Design Certification Application – Safety Evaluation with Open Items for Chapter 9 (ML17110A028)
3. CD containing RAI responses.

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
APR1400 Subcommittee

Docket Number: N/A

Location: Rockville, Maryland

Date: May 18, 2017

Work Order No.: NRC-3079

Pages 1-226

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4 DISCLAIMER
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8 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
9

10
11 The contents of this transcript of the
12 proceeding of the United States Nuclear Regulatory
13 Commission Advisory Committee on Reactor Safeguards,
14 as reported herein, is a record of the discussions
15 recorded at the meeting.
16

17 This transcript has not been reviewed,
18 corrected, and edited, and it may contain
19 inaccuracies.
20
21
22
23

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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APR1400 SUBCOMMITTEE

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THURSDAY

MAY 18, 2017

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

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

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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

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*Present via telephone

I-N-D-E-X

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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

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

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

17 The meeting was announced as an open to
18 public meeting. No request for making statements to
19 the subcommittee has been received by the public. A
20 transcript of the meeting is being kept and will be made
21 available, as stated in the Federal Register notice.
22 Therefore, I would request that participants in this
23 meeting use the microphones, and when I say
24 microphones, there's a little light on top, but that's
25 not what you press. There's a little electrostatic

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1 thing below that, which you press to make the light come
2 on green -- located throughout the meeting room when
3 addressing the subcommittee. Participants should
4 first identify themselves and speak with sufficient
5 clarity and volume so that they can be readily heard.
6 Also, if you're around, keep papers and pencils and
7 stuff off of the microphone because that makes the
8 person recording this unhappy.

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

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

22 STAFF OPENING REMARKS

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

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1 Mike McCoppin is out, so I'm covering two roles here.
2 Thank you for meeting again. We're down to our last
3 five chapters. We're doing one today, Chapter 9, and
4 Chapter 15 tomorrow. We look forward to finishing the
5 rest of them and finishing Phase 3. I wanted to point
6 out that today's presentation does not include Section
7 9.1.2. We've discussed this previously. That
8 section was not prepared.

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

16 KHNP OPENING REMARKS

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

23 DCD CHAPTER 9

24 MR. HAN: Thank you, Rob. Hi, I'm Young
25 Tae Han from KEPCO E&C. Let me start the presentation

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1 of Chapter 9, Auxiliary Systems. This slide covers the
2 contents of Chapter 9. This slide covers the section
3 overview, the title, and presenters. This slide
4 covers the list of submitted documents. This slide
5 covers the subsections of 9.1, Fuel Storage and
6 Handling. Subsection 9.1.1 is about criticality
7 safety of new and spent fuel storage.

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

17 Criticality is precluded by adequate
18 design and by administrative control procedures. The
19 right picture shows the layout of the auxiliary
20 building, the fuel handling area. The upper part shows
21 spent fuel pool, with Region 1 and Region 2. The lower
22 part shows the new fuel storage pit. Criticality
23 analyses are performed in accordance with the following
24 acceptance criteria. New fuel storage rack by 10 CFR
25 60.58 (b), Item (2) and (3). Keff must not exceed .95

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

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

8 MR. HAN: Yes.

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

12 MR. HAN: Yes.

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

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

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

21 MR. HAN: Optimum moderation condition
22 can be made with mist, the water not reach density above
23 1.24, not 1.

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

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

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

10 MR. HAN: For the spent fuel, it
11 considered burnup credit, and it should be lower than
12 1. Yes, spent fuel storage rack considered the credit
13 of boron. The water is borated water. It's about
14 2,000 ppm. If there's a boron dilution accident, the
15 Keff increases. If the boron does not exist in the
16 extreme cases, in that cases, it must remain below 1.
17 That's the criteria of the full density unborated
18 water, under 1.

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

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

25 MEMBER MARCH-LEUBA: It's at capacity?

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1 MR. HAN: Yes.

2 MEMBER MARCH-LEUBA: Okay, thank you.

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

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

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

9 MR. HAN: Yes.

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

19 MR. HAN: Region 2.

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

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

25 MR. SCHULTZ: Just 1?

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1 MR. HAN: Yes.

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

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

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

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

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

15 MR. HAN: Of course, yes.

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

17 MR. HAN: Of course.

18 MR. SCHULTZ: -- shortly after startup?

19 MR. HAN: Yes.

20 MR. SCHULTZ: Okay, thank you.

21 MEMBER SUNSERI: I wanted to follow up
22 with that. I have similar questions. It's a common
23 practice, as you approach the refuel, to be able to move
24 the new fuel from the new fuel storage vault into the
25 pool to facilitate the core load. Presuming you bring

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1 all the new fuel assemblies into the spent fuel pool,
2 with the other core offloaded, getting ready to go back
3 in, are you still meeting these criteria?

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

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

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

15 MEMBER SUNSERI: Correct.

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

18 MEMBER SUNSERI: Correct.

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

22 MEMBER SUNSERI: Correct.

23 MR. SISK: Then as you're staged with one
24 third of the new core to go in, now you're saying I'm
25 going to take the fuel out of the reactor vessel and

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1 put it into the pool, with the one-third core also in
2 the pool, at the same time?

3 MEMBER SUNSERI: Correct.

4 MR. SISK: The question then becomes --

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

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

9 MR. HAN: Still no.

10 MR. SISK: I'm sorry?

11 MR. HAN: I'm confused.

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

15 (Simultaneous speaking.)

16 MEMBER SUNSERI: I'm talking about the
17 reload.

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

21 MEMBER MARCH-LEUBA: In the spent fuel?

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

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

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

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

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

8 (Simultaneous speaking.)

9 MEMBER STETKAR: That's the
10 configuration.

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

13 MR. HAN: Yes.

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

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

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1 under regulatory limit.

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

9 PARTICIPANT: Okay, thank you.

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

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

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

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

11 Biases and uncertainties from depletion
12 calculation, along with those from mechanical
13 tolerances and variations in the design parameters, are
14 considered in the Keff. This is the end of Section
15 9.1.1. Next section will be proceeded by Mingyu Kim.

16 MR. M. KIM: Thank you, Mr. Han. Good
17 morning, ladies and gentlemen. My name is Mingyu Kim
18 in KEPCO E&C. I will continue my presentation with
19 Section 9.1.3 regarding the spent fuel pool cooling and
20 cleanup systems. This system -- I'm sorry; I missed
21 a slide. This system removes the decay heat generated
22 by the spent fuel assemblies stored in the spent fuel
23 pool and purifies the water of spent fuel pool, IRWST,
24 and many other pools. The spent fuel pool cooling
25 system is safety related, and cleanup system is

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1 non-safety related and is composed of two 100 percent
2 capacity. To preclude minimum spent fuel pool water
3 level to provide proper shielding.

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

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

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

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

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

25 CHAIRMAN BALLINGER: That's what I

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1 thought, but I couldn't find the answer.

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

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

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

16 This section is for the light load handling
17 system. Light load handling system is means the fuel
18 handling system. The main function is to remove spent
19 fuel from the reactor and replace it with new fuel and
20 receive and store new fuel and store and ship spent fuel
21 and remove and replace. For the safety operation, this
22 system has the following design considerations. This
23 system operates under adequately safety condition
24 during natural phenomena, and the system is designed
25 in accordance with ANSI/ANS 57.1. This system also

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1 designed to prevent unacceptable radioactivity release
2 and unacceptable radiation exposure and criticality
3 accidents.

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

12 Next section is 9.1.5 is for overhead heavy
13 load handling system. This system performs non-safety
14 related function. This system handles critically
15 heavy loads in the fuel handling area of the auxiliary
16 building and the reactor vessel area of the reactor
17 containment building. The containment polar crane and
18 fuel handling area overhead crane transfer the largest
19 heavy load of the spent fuel shipping cask and to lift
20 the integrated head assembly and reactor vessel
21 internals during refueling, respectively. The
22 containment polar crane shall be designed to provide
23 single-failure-proof features, in accordance with the
24 requirement of NUREG-0554 and 0612. The fuel handling
25 area overhead crane handles critically heavy loads

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1 without single-failure-proof feature.

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

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

15 PARTICIPANT: METAMIC?

16 MR. SCHULTZ: Yes.

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

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

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

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1 pools.

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

4 MR. YESHNIK: Correct.

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

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

9 MEMBER BROWN: Give us your name, please.

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

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

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

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

5 MR. YESHNIK: Yes.

6 MR. SCHULTZ: Any deviations worthy of
7 note?

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

10 MR. SCHULTZ: Great, thank you.

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

13 MR. YESHNIK: Correct, not HT.

14 CHAIRMAN BALLINGER: Not HT.

15 MEMBER SKILLMAN: I would like to ask this
16 question. Let me divert your attention back to Slide
17 6, please.

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

21 PARTICIPANT: Excuse me, Rob, go ahead.

22 MR. SISK: Mr. Schultz is interested in (DCD)
23 9.1.2.4, on Page 9.1-17. There is a discussion on the coupon
24 surveillance program, the neutron absorbing material
25 of METAMIC. There is some area there for you to get

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1 some background on how APR1400 is addressing the
2 METAMIC issue.

3 MEMBER SKILLMAN: Thank you.

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

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

9 MR. M. KIM: Yes.

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

16 MR. M. KIM: Rack alignment?

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

23 If the racks are not aligned at original
24 construction, you have the capability of raking your
25 fuel assemblies and damaging them. My question is have

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1 you given consideration to the specificity of the
2 alignment of your racks, as they relate to your light
3 load handling system?

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

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

24 MR. OH: This is Andy Oh, KHNP Washington
25 Office. In addition to Mr. Kim's comment about the

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1 fuel handling machine, we also have some COL action
2 items for periodic inspection program of spent fuel
3 rack integrity to ensure that the design basis material
4 and geometric assumption remain valid during the
5 operating life of plant. That can also give you some
6 credit to the right place for that spent fuel in a
7 spent fuel pool rack.

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

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

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1 is it obtained?

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

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

8 PARTICIPANT: Right.

9 MR. SCHULTZ: Thank you.

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

13 MEMBER SKILLMAN: Thank you, Alex.

14 CHAIRMAN BALLINGER: Along those lines,
15 Dick was talking about going in. I'm talking about
16 coming out. I think I read that a spent fuel assembly
17 weighs about 1,700 pounds, round numbers, but that the
18 light load handling machine is incapable of going over
19 1,900 pounds. Is there a physical limit on the
20 machine, itself, that prevents you from applying an
21 enormous amount of force that would destroy an
22 assembly?

23 Is there a physical limit on the machine,
24 itself, not just a load cell limit, but a physical limit
25 on the ability of the machine to apply a force to pull

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1 something out of the rack which would destroy the
2 assembly?

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

5 PARTICIPANT: 2,000? Okay.

6 PARTICIPANT: Thank you.

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

9 MEMBER POWERS: Not going to get away that
10 easy.

11 MR. M. KIM: Okay.

12 MEMBER POWERS: Nice try.

13 PARTICIPANT: You're in trouble.

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

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

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

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

25 MEMBER POWERS: But it's just particulate

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1 material? You're not trying to keep the solvent levels
2 any particular concentration?

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

4 MEMBER POWERS: No.

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

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

11 MR. Y. KIM: Excuse me?

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

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

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

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

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

25 MEMBER POWERS: It would seem to me that

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

6 MR. SISK: Dissolved solids.

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

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

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

25 MEMBER SKILLMAN: I'm checking on the DCD.

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

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

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

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

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

22 MEMBER SKILLMAN: Approximately, yes.

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

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

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

22 MEMBER SUNSERI: I had a question about
23 that. When I look at your detailed drawing -- I know
24 you've got a simplified drawing on the next page -- in
25 the text of the DCD, it describes the flow path for the

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1 discharge of ESW pump to be continuous from the
2 discharge of the pump to the ultimate heat sink. I
3 don't understand how that can physically happen because
4 it takes suction off the ultimate heat sink, also.

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

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

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

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

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

25 PARTICIPANT: You go ahead.

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

4 MR. Y. KIM: Yes.

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

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

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

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

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

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

2 MEMBER SUNSERI: -- Page 278 of the DCD.

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

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

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

11 (Simultaneous speaking.)

12 PARTICIPANT: What is this thing here?

13 PARTICIPANT: That's a vent.

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

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

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

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

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

3 MEMBER SUNSERI: Are you look at Note 2?

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

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

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

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

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

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

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

22 MR. Y. KIM: In the reference plant for the
23 APR1400, we used sea water as the ultimate heat sink.
24 In that case, we made the vacuum breaker downstream of
25 the CCW exchanger. But in the APR1400 design, we have

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1 not decided that the application of the vacuum breaker
2 considering the ultimate heat sink.

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

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

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

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

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

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

21 The CCW supply to the RCP coolers is
22 isolated on the low low surge tank level signal. This
23 signal can be overridden by manual operation from the
24 MCR to protect the RCP seal. This is the schematic
25 diagram of the CCWS. The CCWS consists of two

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1 safety-related divisions, and each safety division
2 includes three CCW exchangers, one CCW surge tank, two
3 CCW pumps, and one chemical addition tank and the CCW
4 radiation monitor. Piping and instruments are also
5 included in the schematic diagram in the CCWS.

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

10 MR. Y. KIM: That's right.

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

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

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

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

25 MEMBER STETKAR: If I isolate component

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

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

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

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

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

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

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

23 MEMBER STETKAR: Three?

24 MR. OH: Three minutes.

25 MEMBER STETKAR: Thirty, three zero?

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1 MR. OH: No, three.

2 MEMBER STETKAR: Three?

3 MR. OH: Three.

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

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

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

20 Depending on the clearance on your seals,
21 you can get mechanical rubbing of those seals and damage
22 to the seals, such that even after you trip the pump,
23 that seal gap is open. That's the failure mode. It's
24 not the traditional loss of cooling to a stationary
25 reactor coolant pump. Anyway, take it back to your

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1 pump manufacturer. It's really a pump manufacturer
2 question. I don't recall whether I asked it when we
3 were talking about the reactor coolant pumps or not.

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

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

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

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

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

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

25 MR. SISK: Understood, thank you.

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

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

19 MEMBER STETKAR: That's the normal
20 practice?

21 MR. Y. KIM: That's right.

22 MEMBER STETKAR: The reason I ask this is
23 it's not consistent -- the PRA models for shutdown are
24 not consistent with that. The PRA models for shutdown
25 assume that one pump -- one CCW pump and one ESW pump

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1 is running all the time during the outage.

2 MR. Y. KIM: During the outage.

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

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

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

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

25 MEMBER STETKAR: No, this is just --

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

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

17 PARTICIPANT: Thank you.

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

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

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

16 MR. Y. KIM: Nuclear medications?

17 MEMBER SKILLMAN: Yes. I will leave it at
18 that. I would just simply suggest that if your
19 sanitary system ignores radioactive waste, you may be
20 surprised. Because in the cultures in which we live,
21 radioactive medications and radioactive procedures
22 have become very common. You will have workers who
23 will arrive who have either come out of a hospital or
24 come out of some treatment, and your sanitary systems
25 will all of a sudden be radioactive, when you didn't

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1 expect them to be. Unless you've designed capability
2 into those systems, you're going to be surprised.

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

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

16 The UHS supplies cooling water for at least
17 30 days for safe shutdown without makeup water under
18 the worst combination of adverse environmental
19 conditions. The UHS system consists of two
20 independent, redundant, safety-related divisions.
21 Each division removes 100 percent of design heat load
22 from ESWS. The UHS provides cooling capacity at 30
23 days without makeup water, assuming the worst
24 meteorological data.

25 The UHS basin screen in the cooling tower

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

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

20 Also, the condensate storage and transfer
21 system has no safety function. The WM system provides
22 the demineralized water to auxiliary feedwater storage
23 tank, condensate storage tank, reactor makeup water
24 tank, and so on. The CT system provides demineralized
25 water from the WM system and provide condensate by means

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1 of gravity to the following equipment, condenser
2 hotwell, auxiliary feedwater pump suction as alternate
3 non-safety backup supply, and miscellaneous condensate
4 makeup demands.

5 The WM system consists of 100 percent
6 demineralized water storage tank, two 100 percent
7 demineralized water transfer pumps, two 100 percent
8 membrane oxygen removal subsystem, associated piping,
9 and valves. The CT system consists of two 50 percent
10 capacity condensate storage tanks, associated piping,
11 and valves. Here is the simplified schematic diagram
12 of condensate storage facilities. Next, chilled water
13 system. APR1400 has two chilled water systems,
14 essential chilled water system and plant chilled water
15 system.

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

24 Design features. ECWS consists of two
25 independent and redundant divisions. Each division

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1 consists of two 100 percent capacity chillers, two 100
2 percent capacity pumps, a makeup pump, a compression
3 tank, and a chemical additive tank. ECWS consists of
4 central chilled water subsystem and compound building
5 chilled water subsystem. The central chilled water
6 subsystem within the building, reactor containment
7 building, and the turbine generator building, and the
8 compound building chilled water subsystem compound
9 building. The central chilled water subsystem
10 consists of four 33 percent capacity chillers, two 100
11 percent capacity pups, a compression tank, and chemical
12 additive tank. The compound building chilled water
13 subsystem consists of three 50 percent chillers, two
14 100 percent pumps, a compression tank, and a chemical
15 additive tank.

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

23 Turbine-driven auxiliary feedwater pumps
24 are safety related pumps. Why does the normal plant
25 chilled water system provide cooling for the safety

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1 related turbine-driven auxiliary feedwater pump room?

2 MR. H. KIM: I'll explain about. This
3 page explains to you safety related system, the cooled
4 area where safety related equipment is located.
5 Turbine driven, if pump is safety related and in usable
6 condition, however no safety related equipment is
7 installed in the room, it does not serve the cooling
8 function at the actual condition. The reason why
9 non-safety cooler is applied for the room is that room
10 is high energy line breaker area that ECWS system could
11 be damaged at the high energy line breaker area, a break
12 accident. We put safety related equipment installed,
13 for example, ECWS piping. ECWS is closed-loop system.
14 In the case of accident occurring
15 in the room, the ECWS piping will be broke. It will
16 be broken if the accident damaged the ECWS. When we
17 designed the ECWS, we considered this problem, and we
18 determined concept chiller, but we have another
19 alternative to issue of the operability, the turbine
20 driven pump full, we conducted heatup
21 calculation.

22 According to the result of heatup
23 calculation, the operability turbine driven pump is
24 qualified to guarantee the operating. The pump at room
25 temperature is the maximum temperature is expected 116

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1 Fahrenheit degrees for 24 hours (unintelligible)
2 including related instruments, such as flow
3 transmitter, pressure transmitter, this qualified at
4 the maximum temperature 116 Fahrenheit degree and for
5 24 hours. The turbine driven auxiliary pump is operable
6 at 24 hours.

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

12 (Simultaneous speaking.)

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

15 PARTICIPANT: Can I have --

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

24 MR. OH: This is Andy Oh, KHNP Washington
25 Office. A turbine driven pump center without any

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1 providing for cooling that room, we have some of the room
2 cooling calculation, and also, we provided that
3 material to the NRC. NRC audited that material and
4 based on the recert the turbine-driven pump can be
5 operated without any -- providing some room cooling.

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

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

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

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

21 MEMBER STETKAR: Not the same room? Okay.

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

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

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1 (Simultaneous speaking).

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

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

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

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

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

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

22 The removed heat is rejected to the TGBOCWS
23 system through TGBCCW heat exchange. TGBCCW system
24 includes the independent closed loop cooling system
25 that allows operation of air compressors when the TGBCCW

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1 system is not available. TGBCCW system consists of
2 three 50 percent heat exchangers, two 100 percent pumps,
3 one surge tank, one chemical addition tank, associated
4 piping, valves and instruments.

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

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

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

23 PARTICIPANT: Raw water system.

24 MEMBER STETKAR: Raw water system. I've
25 asked this question a couple of times, but since we're

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1 talking about water systems, I want to pull together the
2 information. The information I can find in the whole
3 DCD is that the raw water storage tank is the makeup
4 supply for the auxiliary feedwater system. Is that
5 correct?

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

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

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

20 MR. LIM: That's right.

21 MEMBER STETKAR: And it is the suction
22 supply for the other FLEX type makeup pumps. Those
23 makeup pumps and the ECSBS have requirements for a
24 certain amount of water inventory, and they have
25 requirements for a certain seismic design of the tank

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1 and the connected piping, so that they can survive the
2 nominal conditions that FLEX is designed for.

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

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

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

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

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

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

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1 should specify those minimum requirements.

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

9 MR. SISK: This is Rob Sisk. Just to build
10 on that, I understand what you're indicating, but in
11 19.3, there are two COL items. One of the COL items,
12 19.3.6, is to confirm that the design is robust with
13 respect to applicable hazards. It calls out things
14 like the seismic events, floods, high winds, missiles.
15 There is that COL item.

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

18 MR. SISK: COL 19.3.6. It's on Page
19 1.8-40.

20 MEMBER STETKAR: 1.8-

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

22 (Simultaneous speaking.)

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

24 MEMBER STETKAR: That's in DCD Section 1?

25 PARTICIPANT: Yes.

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

3 MR. SISK: COL 19.3.

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

9 PARTICIPANT: Is that Rev 1.

10 MR. OH: Yes.

11 (Simultaneous speaking.)

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

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

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

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

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

24 PARTICIPANT: Yes.

25 MEMBER STETKAR: -- the size of the tank?

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

20 MEMBER STETKAR: Okay, thank you.

21 MR. Y. KIM: Now, we can go to Section 9.3,
22 the process auxiliaries. This section covers the
23 process auxiliaries, such as compressed air and gas
24 systems, process sampling and post-accident sampling
25 system, equipment and floor drainage system, and

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1 chemical and volume control system. The first is
2 9.3.1, the compressed air and gas system.

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

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

24 Compressed gas system, such as high and low
25 pressure nitrogen subsystem and hydrogen subsystem and

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1 carbon dioxide subsystem provide compressed gas to
2 diverse usage point, such as purging, cooling,
3 blanketing and pressurizing and etc. Each subsystem
4 has pressure regulations and overpressure protection
5 provisions.

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

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

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

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

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

18 MEMBER SUNSERI: How many degrees? What?

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

21 MEMBER SUNSERI: Okay.

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

25 PARTICIPANT: Sure.

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

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

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

13 MR. Y. KIM: This is --

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

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

17 (Simultaneous speaking.)

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

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

22 MEMBER SUNSERI: -40 Fahrenheit?

23 MR. Y.C. KIM: Yes.

24 MEMBER SUNSERI: Thank you.

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

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1 please?

2 MEMBER STETKAR: I hope so.

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

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

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

23 MEMBER STETKAR: So the closed loop --

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

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1 MEMBER STETKAR: The closed loop is for all
2 three?

3 MR. Y. KIM: Yes, right.

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

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

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

15 MR. Y.C. KIM: Right.

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

19 MR. Y.C. KIM: Exactly right.

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

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

24 MEMBER STETKAR: This says --

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

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1 (Simultaneous speaking).

2 MEMBER STETKAR: Oh, you did?

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

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

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

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

25 The post-accident sampling system takes

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

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

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

23 MEMBER SUNSERI: Okay, thank you.

24 MEMBER STETKAR: But that means that the
25 operator must then somehow reset a safety related

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1 isolation signal to re-open the cooling water supply.
2 Is that true?

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

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

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

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

23 The system provisions, such as level
24 monitoring instruments and the leak (unintelligible)
25 for the detection of the leakage from the reactor

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1 coolant pressure boundary, as well as refueling pool,
2 IFWST, auxiliary feedwater storage tank, spent fuel
3 pool, refueling canal, and the cask loading pit. The
4 sumps and the sump pumps are located at lower levels to
5 facilitate transfer to the leakage waste management
6 system. Drain and discharges from sumps in the turbine
7 generator buildings are normally transferred to the
8 wastewater treatment facility for processing, but it
9 can be switched over to leakage waste management system
10 upon detection of radiation. The next is the --

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

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

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

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

24 MEMBER SKILLMAN: The question was what is
25 being removed? That was Dr. Powers' question. I kind

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1 of pushed that question because I've got experience
2 with, actually, failed fuel in the spent fuel pool. I'd
3 be curious how you take care of it at the design stage.

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

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

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

18 MR. SISK: Oh, is that yours?

19 MEMBER SKILLMAN: There are weepers and
20 leakers. Here's the deal. What you're doing is you're
21 defueling and you put the damaged fuel assembly or the
22 degraded fuel assembly in your fuel transfer carriage.
23 You transfer it across the spent fuel pool. You up-end
24 it, and now you've got a tea bag that's breathing cesium
25 and strontium and every other soluble isotope that is

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1 breathing out of that fuel assembly. You'd be
2 surprised, in a matter of hours, you begin to get
3 detectable counts in the spent fuel pool. If you get
4 six or eight of them, then you now have, actually, a
5 failed fuel challenge in your fuel handling building
6 because it affects the water and affects the airborne.

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

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

25 MEMBER SKILLMAN: Thank you. As long as

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

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

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

10 MR. SCHULTZ: Available?

11 MR. SISK: That's correct.

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

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

17 MR. SCHULTZ: Sure. Thank you.

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

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

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

24 MR. Y. KIM: I'll begin my presentation
25 with 9.3.4, the chemical and volume control system,

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1 shortly CVCS. The CVCS is designed to perform the
2 following functions. The next slide shows the
3 chemical flow diagram of the CVCS, but I'm going to
4 introduce the CVCS function at this slide. The CVCS
5 maintains the chemistry and the purity of the reactor
6 coolant during normal and shutdown operation.

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

14 The CVCS receives and stores and separates
15 nuclear waste for recycle or discharges to the nuclear
16 waste management system. It also controls the boron
17 concentration in the reactor coolant system to
18 compensate for the reactivity changes due to the
19 changes in the reactor coolant temperature, cooling or
20 up, and the variations and to provide shutdown margin
21 for maintenance and refueling operation. Also, the
22 CVCS provides auxiliary pressurizer spray for
23 pressurizer pressure control during the final stage of
24 the shutdown operation. It provides injection water
25 and the proper temperature, pressure, and purity for

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1 the reactor coolant pump seals and controls the
2 bleed-off from the reactor coolant pump seals.

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

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

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

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

23 MEMBER STETKAR: I'm still not sure
24 whether you answered my question. My question was if
25 the charging pump is running, centrifugal charging

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1 pump, and I do not have cooling for the minimum flow
2 heat exchanger, can the pump continue to run forever?
3 Minimum flow heat exchanger. On this drawing -- is it
4 shown on this drawing?

5 MEMBER SKILLMAN: Yes.

6 (Simultaneous speaking.)

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

10 MR. PARK: If CCW is --

11 PARTICIPANT: Yes, it's --

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

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

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

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

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

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

25 MEMBER STETKAR: Okay, that's just a

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1 question we'll leave on the record.

2 MR. PARK: (Simultaneous speaking.)

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

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

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1 isolated, and normal and reactor coolant pump seal
2 water return flow is isolated.

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

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

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1 suction?

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

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

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

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

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

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

21 MR. PARK: This is included in DCD Section
22 9.3.4.5.2, 9.3.4.5.3, Item C. It does include that
23 number.

24 MEMBER STETKAR: Yes, it doesn't include
25 the valve numbers, so I assumed that it was somehow with

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1 the air operated valves that are in the other flow
2 paths. If you're sure that those valves open, good.
3 It's on the record, and I'm happy.

4 CHAIRMAN BALLINGER: What section number?

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

7 CHAIRMAN BALLINGER: Is it 9.3.4.5.3?

8 MEMBER STETKAR: It is.

9 MR. PARK: Yes, right.

10 MEMBER STETKAR: Item No. C.

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

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

21 MEMBER STETKAR: There are subparts to the
22 question. The PRA model doesn't include any of this.
23 It doesn't include those valves opening automatically
24 or the dependencies, nor does it include any operator
25 actions to take manual control of charging flow to

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1 control pressurizer level, basically. It doesn't
2 include anything. Loss of instrument air is modeled
3 as a benign event. I was just establishing how the
4 system worked. I'm glad to hear that those valves open
5 automatically. I know that they're included in the
6 PRA.

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

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

16 PARTICIPANT: Yes, okay.

17 MEMBER STETKAR: Operator has to do
18 something.

19 PARTICIPANT: He's got to do something.

20 MEMBER STETKAR: As I said, this is -- the
21 problem is, here, as I had mentioned earlier, is that
22 one of the things that we try to do is to understand
23 how the whole plant works together. I'm obviously
24 interested in the PRA, also, to understand that the PRA
25 models the plant as it works. Anyway, we have this on

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1 the record. I'm glad to hear that those valves open
2 automatically. The PRA doesn't include them, nor does
3 it include operator actions.

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

9 (Simultaneous speaking.)

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

14 MEMBER SKILLMAN: Okay, thanks, Andy.

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

17 MR. HEO: My name is Heo Gun from KEPCO
18 E&C. Now, I am going to present Section 9.4, heating,
19 ventilation, and air conditioning systems. Section
20 9.4 consists of eight subsections, as shown in this
21 slide. From now on, I will explain each HVAC system.
22 Control room HVAC system. This system performs
23 following functions.

24 First, provide suitable environmental
25 conditions within control room envelope. Second,

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1 provides adequate protection against airborne
2 radioactivity and smoke from the outside. Third,
3 limit the radiation exposure to the personnel in the
4 CRE under accident conditions, to meet GDC 19. This
5 system consists of AHUs, ACUs, fans, and PACUs. The
6 HVAC equipment perform their functions as described in
7 this slide. Fuel handling area HVAC system.

8 This system performs following functions.
9 First, maintain suitable environmental conditions
10 within the fuel handling area. Second, maintain the
11 fuel handling area under slightly negative pressure
12 with respect to the surrounding areas. Third, control
13 the gaseous effluent release to the outside within
14 design limits. This system consists of two
15 subsystems, fuel handling area normal HVAC subsystem
16 and emergency HVAC subsystem. Fuel handling area
17 normal HVAC subsystem performs functions by AHU and ACU
18 with HEPA filter during normal operation. Fuel
19 handling area emergency HVAC subsystem performs
20 functions by ACU with carbon adsorber and cubicle
21 coolers during accidents. Auxiliary building clean
22 area HVAC system. This system performs the following
23 functions. First, maintain suitable environmental
24 conditions within the auxiliary building clean area.

25 Second, provide ventilation for the

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

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

24 Engineered safety feature ventilation
25 system. This system consists of four systems,

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1 emergency diesel generator area HVAC system,
2 electrical and I&C equipment areas HVAC system,
3 auxiliary building controlled area HVAC system, last,
4 essential service water building and component cooling
5 water heat exchanger building HVAC system. The design
6 of this system will be provided by COL applicant, if
7 required.

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

23 First, maintain suitable environmental
24 conditions within the electrical and I&C equipment
25 areas of the auxiliary building. Second, maintain the

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1 hydrogen gas concentration to less than 1 percent by
2 volume within the battery rooms. This system consists
3 of six subsystems. Electrical and I&C equipment areas
4 HVAC subsystem, Class 1E battery room HVAC subsystem,
5 and remote shutdown room HVAC subsystem perform
6 functions by fans and cubicle coolers during normal
7 operation and accident.

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

24 High energy line break are HVAC subsystem
25 performs functions by AHU, ACU, and cubicle coolers

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1 during normal operation. Reactor Containment HVAC and
2 purge system. First, I will explain reactor
3 containment building HVAC system. This system
4 performs following functions. First, maintain the
5 containment atmosphere temperature. Second, maintain
6 the temperature in the in-core instrumentation chase
7 and reactor cavity.

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

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

18 MR. HEO: Yes.

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

21 MR. HEO: RCFCs are non-safety related.

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

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1 safeguards actuation signal?

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

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

8 MR. HEO: (Simultaneous speaking)
9 correct.

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

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

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

19 MR. HEO: Correct.

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

22 MR. HEO: Reactor containment building
23 purge system. This system performs the following
24 functions. First, provide the proper atmosphere and
25 adequate ventilation for personnel before and during

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1 periods of personnel access. Second, control the
2 containment atmosphere pressure. Third, control the
3 gaseous effluent release to the outside within design
4 limits.

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

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

23 MR. HEO: The low volume purge system
24 operates intermittently during normal operation. The
25 low volume purge system operates when the containment

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1 pressure increases or for personnel access.

2 MEMBER STETKAR: I understand.

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

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

11 MR. HEO: I don't know.

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

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

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

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

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

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1 Thank you.

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

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

21 (Simultaneous speaking.)

22 MEMBER POWERS: I'd like to come back,
23 actually, to your Slide 39, but it's more of a
24 philosophical question than a specific design
25 question. If we have fires in the control room and

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1 release smoke, after you suppress the fire, you exhaust
2 the smoke, but how sensitive are the digital electronic
3 systems to the contamination by smoke?

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

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

17 MR. HEO: Please give me a second.

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

22 MEMBER STETKAR: It's not my job.

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

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

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

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

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

11 MEMBER POWERS: (Simultaneous speaking.)

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

23 MEMBER POWERS: (Simultaneous speaking)
24 consideration we put into reliability of control room
25 systems? It seems like this affects your redundancy

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1 and diversity of your systems because it's all in the
2 control room.

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

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

15 MR. SISK: It does, thank you.

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

18 MEMBER POWERS: It's not a comprehensive
19 answer.

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

23 MEMBER POWERS: And useful, as usual.

24 MEMBER SKILLMAN: I didn't research the
25 topic that Dana raises, but my experience is that CREVS

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1 normally takes care of the control room emergency
2 ventilation system as a pre-filter and a hogging filter
3 that will take out micron-size debris that is either
4 the electrostatic or the chemical agent that Dana's
5 talking about. I think that is probably in this
6 application somewhere. I haven't gone digging for
7 that.

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

24 MR. SISK: I would also offer just one
25 more. I don't want to derail our big philosophical

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1 discussion today. I would also indicate that the
2 equipment qualification programs involve I&C. They do
3 things like dew points and temperatures and weights.
4 As you look at these types of environments that the
5 equipment has to operate in, you have to take into
6 account (Simultaneous speaking).

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

12 MR. HEO: Mr. Lim will present Section
13 9.5.

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

16 MEMBER STETKAR: Microphone.

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

23 The primary objective of the fire
24 protection program is to minimize both the probability
25 of occurrence and the consequences of a fire through

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1 defense-in-depth. Another objective is to minimize
2 the radioactive releases to the environment in the
3 event of a fire. The concept of defense-in-depth
4 provides three purposes. First, to prevent fire from
5 starting.

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

21 For the integrated effort involved in
22 components, procedure, analysis and personnel used in
23 defining and carrying out all activity of fire
24 protection, the COL applicant is to establish a fire
25 protection program, including organization, training,

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1 and qualification of personnel, administrative
2 controls of combustibles and ignition sources,
3 firefighting procedures, and quality assurance.

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

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

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

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

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

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1 What do you have at Shin Kori?

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

9 PARTICIPANT: Fire department.

10 MR. OH: Yes, fire department on site.

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

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

23 Provide safe shutdown capabilities using
24 an MCR and RSR that are physically separated,
25 electrically isolated. Fire protection systems, such

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1 as fire protection water supply system, including water
2 storage tanks, pumps, and fire main (phonetic), and the
3 distribution system is designed in accordance with
4 Regulatory Guide 1.189 and NFPA codes.

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

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

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

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

18 MR. YOON: This is Jinkyoo Yoon. Let me
19 answer your question. In our APR1400, we have types
20 of fire detectors. One is smoke detect, second is heat
21 detect, and photoelectric smoke detector, something
22 like that. The other thing is there is choosable
23 flame-type (phonetic) detectors, flame type detectors,
24 something like that. We have been investigating
25 detectors for these fire areas or these fire points,

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1 and we have identified all of the information for
2 detectors by protection required.

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

8 MR. YOON: Yes. Basically, the location
9 of the fire detector is determined based on the
10 analysis. We also considered a requirement to
11 determine the types of fire detector based on SRP
12 (phonetic) 9.5 and Reg Guide 1.189 et cetera.

13 MR. SCHULTZ: Thank you.

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

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

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

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

5 MR. YOON: You mean scatter systems?

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

11 MR. YOON: Yes.

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

14 MR. YOON: Yes.

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

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

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

25 MR. YOON: Yes. The requirement is

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1 addressed in the Reg Guide 1.189. We got cabinet in
2 MCR and I&C equipment room. That cabinet has inside
3 cabinet smoke detectors.

4 MEMBER STETKAR: They do?

5 MR. YOON: Yes.

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

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

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1 (Simultaneous speaking).

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

4 MEMBER STETKAR: Systems are designed to
5 provide early warning to the operators, is about as good
6 --

7 (Simultaneous speaking.)

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

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

22 Any fire in the PRA, cabinet fires, they
23 just burn out the whole room. They take credit for the
24 under-floor detectors for cable fires. I'm
25 assuming -- they have, actually, pretty detailed fire

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1 models, not fire physics models, but I was pretty
2 impressed, quite honestly, with what they did in the
3 PRA for fire modeling for fire analysis.

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

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

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

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

23 MR. LIM: Now, here are the communication
24 systems. Communication systems provide reliable and
25 effective interplant communications and

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1 plant-to-offsite communications during all operating
2 or emergency conditions. During a LOOP, communication
3 systems are powered from a PNS bus. This PNS bus is
4 backed up by the AAC source during a LOOP.

5 In case of either AAC source failure during
6 a LOOP or station blackout condition, communication
7 systems are powered from one of the two dedicated,
8 16-hours rated, non-safety related batteries.
9 Communication systems are composed of plant, offsite,
10 and security communication systems. In more details,
11 plant communication systems are composed of evacuation
12 order address, public address, some powered
13 telephones, plant time synchronizing, local area
14 network, and a bunch of private networks and wireless
15 communication systems. Offsite communication systems
16 are composed of commercial telephone, local law
17 enforcement communication measures, and satellite
18 telephone system. Lastly, security communication
19 systems are composed of security telephones and
20 security wireless communication systems.

21 Now, here are lighting systems. I am
22 presenting the lighting systems, too. Lighting
23 systems provide adequate lighting during normal and
24 off-normal conditions, and are composed of normal,
25 emergency, and security lighting systems. Normal

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1 lighting system provides an entire plant during normal
2 plant operations and are powered from non-Class 1E 480
3 volts AC bus and PNS bus.

4 Emergency lighting system provides in
5 areas required for safe shutdown of the plant,
6 restoring the plant to normal operation, firefighting,
7 and safe movement of people during plant off-normal
8 condition and loss of normal power supply. In more
9 details, emergency AC lighting system is powered from
10 Class 1E 480 volts AC bus. This bus is backed up by
11 the Class 1E emergency diesel generators during a LOOP
12 and the AAC source during a station blackout.
13 Emergency DC lighting system is powered from non-Class
14 1E 125 volt DC station battery or self-contained
15 battery. Lastly, security lighting system provides in
16 all areas which require security lighting and is
17 powered from offsite for general security lighting and
18 from the security power system for security alarm
19 station.

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

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1 accordance with requirements. This system consists of
2 four redundant train.

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

19 The safety-related function is the
20 necessary cooling to dispel heat from the diesel engine
21 coolant and the lubricating oil to maintain temperature
22 within normal operating limits during operation
23 condition. The non-safety related section is part of
24 the preheating water circuit for engine standby.
25 Cooling water system is the closed-cycle cooling

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1 system. This is subdivided into low temperature water
2 subsystem and high temperature water subsystem.

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

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

25 MEMBER SUNSERI: Mr. Lim, I have a

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1 question here. I was just looking in the DCD. I had
2 asked a question earlier about instrument air dew
3 point, which -40 degrees Fahrenheit was provided, and
4 that seems very reasonable for instrument air. Your
5 DCD for the starting air compressor indicates that the
6 dew point is not more than 10 degrees C, which is 50
7 degrees Fahrenheit, in the normal condition, or 10
8 degrees Fahrenheit less than the ambient temperature.
9 I understand why you're doing that, keep the air less
10 than saturated, so you don't accumulate water in your
11 tank. But my question is what are the controls for the
12 engine, and do they use any pneumatics, and do those
13 pneumatics come off the starting air receiver?
14 Because if they do, then this would be wet, I would
15 think, for pneumatic controls. It referred to Chapter
16 8.3 for the controls, but I couldn't find it. I
17 couldn't find the details. I guess let's just start
18 with the easy question. Is the engine controlled with
19 pneumatics, or is there some other controls?

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

25 MEMBER SUNSERI: So the engine has

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

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

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

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

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

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1 content that you may regret. You may want to drop that
2 down by 20 or 30 degrees Fahrenheit.

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

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

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

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

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

22 MR. SISK: Let us do that.

23 MR. H. KIM: Let me explain by my
24 experience. We have three points, three signals: the
25 temperature lube oil, and also we can check out the

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1 power rating when the main control and local control.
2 I think I remember we don't have any kind of trip signal
3 from the air intake or the exhaust system because we
4 cannot calculate the flow of rate. But we can find the
5 system is okay or not by using the power rating.

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

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

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

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

18 MEMBER SKILLMAN: I didn't understand
19 your comment.

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

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

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

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

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

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

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

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

21 MEMBER SUNSERI: My final question is on
22 this topic right here. One of the COL items for this
23 piece of equipment was deferring the method for
24 starting the generator. You said there's a variety of
25 methods that you can start these things and what have

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1 you. I understand that. My question may be -- it
2 would seem to me that from a PRA perspective, there
3 might be some reliability differences in which method
4 you choose to start this thing. I don't know, John,
5 but I would imagine the reliability of this might affect
6 the PRA, ultimately, or have some influence on it.

7 MEMBER STETKAR: It does.

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

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

15 MEMBER SUNSERI: The AAC.

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

18 MEMBER SUNSERI: The AAC.

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

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

24 MR. OH: This is Andy Oh, KHNP Washington
25 Office. Our gas turbine generator, the reliability

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1 that is used in the PRA is we referenced by the
2 NUREG-6928. There's some startup -- the running
3 failure and the startup failure is divided, and there's
4 some source about that reliability. Currently, we are
5 using a generic source of the reliability.

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

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

13 CHAIRMAN BALLINGER: Any other questions
14 by members?

15 (No audible response.)

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

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

21 MEMBER STETKAR: Never mind.

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

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

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1 p.m.)

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

4 MR. WUNDER: Okay. Thank you, Mr.
5 Chairman, and good afternoon, gentlemen. I'm George
6 Wunder, project manager assigned to Chapter 9. And
7 we're here to present the results of the staff's phase
8 2 review of the auxiliary systems.

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

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

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

22 And from the materials and chemical
23 engineering branch Greg Makar and Andrew Yeshnik.
24 From the instrumentation control branch, Dawnmatthews
25 Kalathivettil. I thought I could get that out. And

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1 from the electrical engineering branch NRR will be
2 having Adakou Foli.

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

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

12 There are five sections to Chapter 9 on
13 which we will be presenting. However, Subsection
14 9.1.2 on new and spent fuel storage, and the seismic
15 evaluation thereof will not be presented today. But
16 will be presented with no open items when we give you
17 our phase 4 presentation.

18 Because of the large number of reviewers
19 we've decided to bring them up in groups to present on
20 the various sections. And we'll start with Section
21 9.1. And it is my pleasure to turn it over to Alexandra
22 Burja. Alex.

23 MS. BURJA: Thank you, George. Good
24 afternoon, everybody. Again, my name is Alex Burja.
25 I'm from the reactor systems branch. And I'll present

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1 to you the staff's review of DCD Section 9.1.1,
2 Criticality Safety of New and Spent Fuel Storage.

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

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

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

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

25 MEMBER SKILLMAN: Alex, is that 75 percent

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1 a commonly used, if you will, margin, the 25 percent
2 margin? Is it common to use 75 versus 85 or 90?

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

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

12 MEMBER SKILLMAN: Yes.

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

16 MEMBER SKILLMAN: That's fine.

17 MS. BURJA: Okay.

18 MEMBER SKILLMAN: Thank you. Thank you.

19 MS. BURJA: No problem. In addition, the
20 staff noted that SRP Section 9.1.1 states that the
21 design and layout of the fuel storage facilities should
22 be such that fuel assemblies can only be inserted
23 into design locations.

24 However, for both the new and spent fuel
25 storage racks it's possible to stick an assembly

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1 outside the rack. But the applicant has provided
2 justification through separate criticality analyses
3 that this configuration is acceptable, and criticality
4 is still precluded in those situations.

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

9 In terms of storage rack materials the
10 staff notes that applicant uses typical materials, type
11 3 or 4 stainless steel for both rack types, with the
12 addition of the METAMIC neutron absorber for the spent
13 fuel racks.

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

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

24 The staff also notes that generic letter
25 16-01 on the monitoring of neutron absorbers in spent

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1 fuel pools had no impact on this review. Because the
2 applicant is implementing a monitoring program
3 consistent with that laid out in the Generic Aging
4 Lessons Learned, or GALL Report.

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

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

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

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

23 MS. BURJA: By KHNP.

24 MEMBER MARCH-LEUBA: Okay.

25 MS. BURJA: In the staff's SER there is

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

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

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

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

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

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

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

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

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

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

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

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

11 In addition, the staff noted that the APR
12 1400 may operate at some periods of time with rods in.
13 And this can actually increase reactivity in a fuel
14 assembly relative to un rodded operation, due to the
15 preferential absorption of thermal neutrons, and
16 hardening of the spectrum, which can enhance fissile
17 plutonium production.

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

22 In addition, many of you are probably aware
23 of the thermal conductivity degradation issues that the
24 staff and applicant have been working out. The
25 applicant has stated that this issue will not impact

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1 the fuel temperature assumed in the depletion analysis.

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

5 MR. SCHULTZ: So, Alex --

6 MS. BURJA: Yes.

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

12 MS. BURJA: That's correct. So, the
13 applicant assumes a bounding fuel temperature for the
14 --

15 MR. SCHULTZ: Yes, okay.

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

19 MEMBER SKILLMAN: But they can
20 demonstrate --

21 MS. BURJA: -- the new evaluation.

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

25 MS. BURJA: That's correct.

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1 MR. SCHULTZ: Okay. Thank you.

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

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

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

11 MS. BURJA: I agree.

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

16 MS. BURJA: Yes.

17 MEMBER MARCH-LEUBA: In bounding?

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

19 MEMBER MARCH-LEUBA: But --

20 MS. BURJA: Next slide, please.

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

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

3 MEMBER MARCH-LEUBA: Yes.

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

7 MEMBER MARCH-LEUBA: Okay.

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

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

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

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

25 The applicant also considered damaged fuel

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1 as the normal condition in a separate spent fuel pool,
2 Region I model. And finally, the applicants provided
3 an RAI response that actually had some criticality
4 analyses for normal conditions of fuel handling, which
5 showed no criticality issues there.

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

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

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

25 And again, the applicants showed through

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1 an RAI response conditions of abnormal fuel handling.
2 And showed that criticality was precluded, even in
3 those situations.

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

9 The staff also ensured that the abnormal
10 conditions model --

11 MEMBER POWERS: How substantial?

12 MS. BURJA: Substantial?

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

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

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

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

4 MS. BURJA: That's a good question that I
5 --

6 MEMBER POWERS: Have to disappear
7 completely?

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

12 MEMBER POWERS: Well, I'm sure that's what
13 --

14 MS. BURJA: -- the racks.

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

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

20 MR. LU: This is Shanlai Lu --

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

23 MR. LU: -- from the staff. And I think
24 the, let me try to answer that question. I think the
25 spent fuel pool rack, including the neutron absorber,

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1 has been defined according to the certain seismic
2 characterization to satisfy that one.

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

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

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

18 MS. BURJA: Agreed.

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

24 They would, you know, they'd follow their
25 SRP review and check, you know, what the applicant's

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1 given, and confirm that. So, that type of look at
2 things would typically be beyond, you know, what we
3 would normally look for.

4 MEMBER POWERS: How unfortunate.

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

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

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

23 Overall the approach for the abnormal
24 conditions was consistent with the SRP, and in
25 compliance with 10 CFR 50.68, and therefore,

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1 acceptable.

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

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

11 The staff also used the ENDF B-VII
12 continuous energy cross sections as opposed to the
13 multi-group cross sections. The key difference there
14 being that continuous energy cross sections typically
15 produce more accurate results, because there is not a
16 need for cross section or resonance processing.

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

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

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

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

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

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

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

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

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

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

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

18 MS. BURJA: Yes. For the --

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

21 MS. BURJA: Yes.

22 MEMBER MARCH-LEUBA: -- cross section.

23 MS. BURJA: It totally depends on the
24 physics of the problem and the layout of the racks,
25 where that region of optimum moderation occurs. But

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1 for this one it appeared in this range. And it agreed
2 with what the applicant presented as well.

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

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

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

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

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

18 MS. BURJA: Yes.

19 MEMBER MARCH-LEUBA: So, you assume that
20 they use the whole pool for refueling, which is I'm sure
21 --

22 MS. BURJA: Yes. I mean --

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

25 MS. BURJA: Right. So, the assumption is

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1 that the racks are filled to capacity for this analysis.

2 MEMBER MARCH-LEUBA: For the fresh fuel?

3 MS. BURJA: Mm hmm.

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

6 MS. BURJA: This is with SCALE.

7 MEMBER MARCH-LEUBA: Oh, with SCALE.

8 MS. BURJA: Yes.

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

11 MS. BURJA: It did take awhile, yes.

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

14 MS. BURJA: Sure.

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

18 MS. BURJA: Mm hmm.

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

24 (Laughter)

25 PARTICIPANT: All for emphasis.

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1 MEMBER SUNSERI: Does it make a
2 difference?

3 PARTICIPANT: It's awful, right?

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

11 MEMBER SUNSERI: Thank you.

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

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

23 Region II is a little bit different.
24 Because there are only storage tubes in diagonal
25 locations. So, the staff had to do a two by two model

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1 here to accurately replicate the accurate layout. And
2 there are periodic boundary conditions on the sides of
3 the Region II model.

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

8 MS. BURJA: That's correct.

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

11 MS. BURJA: Yes.

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

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

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

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1 MEMBER MARCH-LEUBA: Yes. Thanks.

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

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

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

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

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

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1 MS. BURJA: Sure.

2 MEMBER MARCH-LEUBA: Once you put two or
3 three bundles you're essentially infinite. I mean, a
4 bundle doesn't see five bundles further away, except
5 for leakage a little bit. So, this tells me that if
6 you put fresh fuel in Region II, your K-effective of
7 1.2?

8 PARTICIPANT: Can be.

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

11 MS. BURJA: Right. That --

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

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

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

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

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

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

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1 models --

2 MEMBER MARCH-LEUBA: Yes.

3 MS. BURJA: -- for Region --

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

5 MS. BURJA: Okay. Yes, there you go.

6 So, yes. In Region I there are neutron absorber panels
7 on all sides. And then there's the additional spacing
8 to kind of decouple. And in Region II there are only,
9 you know, diagonal locations for the neutron absorbers.

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

13 MS. BURJA: This is --

14 MEMBER MARCH-LEUBA: Something to think
15 about.

16 MS. BURJA: This is true.

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

19 MS. BURJA: That's a good consideration.

20 MEMBER MARCH-LEUBA: Okay.

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

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1 presented in Tier 2.

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

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

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

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

23 However, before the staff can make its
24 ultimate safety finding with regard 10 CFR 50.68 and GDC
25 62 the applicant must docket information confirming

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1 that thermal conductivity degradation doesn't affect
2 the field depletion temperature. And the staff's
3 structural and seismic evaluation must show that
4 mechanical and seismic events will not affect
5 criticality.

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

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

11 MS. BURJA: Sure.

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

14 PARTICIPANT: Microphone. Mic.

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

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

22 MR. HERNANDEZ: Good afternoon. My
23 name's Raul Hernandez, the reviewer for the nuclear
24 plant. And I'll be presenting the staff evaluation of
25 the spent pool cooling and cleanup system. The

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1 applicant already provided you guys with a description
2 of the spent fuel pool system. So, I'm not going to
3 repeat all of that.

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

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

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

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

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1 exception of one.

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

8 MEMBER SKILLMAN: Yes.

9 MR. HERNANDEZ: Yes.

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

12 MR. HERNANDEZ: Yes.

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

15 MR. HERNANDEZ: Yes.

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

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

22 MEMBER SKILLMAN: Okay.

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

25 MEMBER SKILLMAN: Okay. Thank you.

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

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

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

24 Example is then from the use of high load
25 handling equipment include misplacement of the fuel

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1 assembly in the core, or in the spent fuel pool, or fuel
2 handling accident either in the containment building
3 or in the fuel handling area auxiliary building.

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

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

11 PARTICIPANT: Microphone.

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

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

21 SRP 9.1.4 require light load handling
22 equipment only to be classified as seismic category 1,
23 category 2. While SRP 9.1.5 require heavy load
24 handling equipment to be capable of handling the load,
25 in addition to being seismic category 2. What this

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1 mean is to include a design picture to stop any ongoing
2 motion, and the capability to hold the load during an
3 SSC event.

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

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

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

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

25 The latest respond are found acceptable.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

22 MR. HERNANDEZ: Yes.

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

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

11 PARTICIPANT: Five second rule.

12 PARTICIPANT: Okay. Your turn.

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

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

20 MR. HERNANDEZ: Yes.

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

25 MEMBER POWERS: It's the plastic sandwich

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1 wraps that get you here. They're invisible once
2 they're here in the pool.

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

6 (Off microphone comments)

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

11 (Off microphone comments)

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

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

23 The staff review was in accordance with the
24 SRP, which includes the system's design conformance
25 with the applicable regulatory requirements, initial

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1 testing, ITAAC, technical specification, and the COL
2 information items.

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

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

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

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

25 MR. STUBBS: Okay. Thank you, Chang.

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

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

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

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

23 So, based on that we felt that it was in,
24 it complied with GDCs 2 and 4. And we also found that,
25 the system to be capable of providing the necessary heat

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1 cool, the necessary cooling and heat removal capability
2 to support the safety related functions, even assuming
3 a single failure and the loss of site power.

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

10 MEMBER SKILLMAN: Angelo, I do have a
11 question.

12 MR. STUBBS: Yes, sir.

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

15 MR. STUBBS: Okay.

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

18 MR. STUBBS: Okay.

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

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1 MR. STUBBS: Okay.

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

8 MR. STUBBS: Okay.

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

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

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

21 MEMBER SKILLMAN: Get rid of the worms?

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

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

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

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

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

24 MR. STUBBS: Right.

25 MEMBER SKILLMAN: And there will be

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

4 MR. STUBBS: Right.

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

7 MR. STUBBS: Right.

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

11 MR. STUBBS: Right, right.

12 MEMBER SKILLMAN: -- normal degradation
13 over time.

14 MR. STUBBS: Right.

15 MEMBER SKILLMAN: That's pretty vague

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

22 MEMBER SKILLMAN: Thank you, Angelo.
23 Thank you.

24 MR. STUBBS: Okay. If there's no other
25 questions on that we'll move on to the next system,

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1 which is domestic water and sanitary drain system.
2 This is really two systems I guess. And what they do
3 is provide potable water for domestic use and human
4 consumption, and a collection transfer site sanitary
5 waste for treatment, and a discharge during normal
6 operation.

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

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

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

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

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1 to.

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

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

11 MR. STUBBS: Okay.

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

18 MR. STUBBS: Okay.

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

24 MR. STUBBS: Right.

25 MEMBER SKILLMAN: -- brings workers who

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

5 MR. STUBBS: Right.

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

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

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

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

22 MEMBER SKILLMAN: And I'm fast to agree
23 that this is not, if you will, an overall safety issue,
24 particularly for the plant. But to the extent that the
25 plant and we as an industry are seen as allowing

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1 radioactivity to get loose into the environment, this
2 becomes an issue.

3 MR. STUBBS: Yes.

4 MEMBER SKILLMAN: And hence, I raise the
5 question.

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

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

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

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

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1 items.

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

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

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

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

23 In response to a staff RAI the applicant
24 added a COL information item in the DCD markups for COL
25 applicants to provide the design provisions to permit

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1 operation and in service testing and inspection, based
2 on the type of UHS design.

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

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

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

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

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

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

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

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

25 And we also looked at -- and I think we

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

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

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

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

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1 be handled by the drain system.

2 And they also had information about
3 20.1406 about minimization of contamination. We
4 reviewed it, and we found that they took appropriate
5 measures to ensure that 10 CFR 20.1406 was being met.
6 And we found the system design acceptable, and we have
7 no open items for the system. Is there any questions?

8 (No audible response)

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

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

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

24 We also looked to ensure whether there was
25 the failure of non-safety-related portions that could

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1 adversely interact with safety related portions. An
2 example of this would be the portions of the plant
3 chilled water system. The non-safety plant chilled
4 water systems that are in the aux building are designed
5 to Seismic Category 2 criteria.

6 We also looked at the ITAAC,
7 pre-operational testing, as well as the tech specs for
8 this system. We issued multiple RAIs. All of them
9 are resolved. There are five remaining confirmatory
10 items that will be addressed when we look at the Rev
11 1 of the DCD.

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

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

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

23 MEMBER STETKAR: Okay.

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

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1 MEMBER STETKAR: I'll wait.

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

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

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

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

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

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1 endorsed a particular one.

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

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

13 (No audible response)

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

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

22 The samples have to be taken from the
23 proper locations, there has to be enough information
24 gathered. And it has to be done in a way that provides
25 representative samples and samples that are safe and

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1 don't harm people or the environment.

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

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

7 MALE PARTICIPANT: Oh, I'm sorry.

8 MR. MAKAR: The sampling locations and
9 capabilities are related to several things. There's
10 the reactor coolant, pressure boundary, so measuring
11 things like pH, ionic conductivity in the water, solid
12 oxygen content are important. There's, of course,
13 boron for reactivity control.

14 There in the post-accident phase there'll
15 be chemical additives that are both for ion retention,
16 protection of the materials from degradation. And
17 then there's also the monitoring of radioactivity.

18 MEMBER SKILLMAN: Greg, let me ask this.
19 In your review or in the staff's review of this system,
20 what consideration was given to PASS, post-accident
21 sampling system, after an accident where you had
22 significant fuel degradation? I'm talking 100, 200,
23 300 microcuries per cc of basically cesium and
24 strontium.

25 MR. MAKAR: I don't know. It's not clear

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1 to me from the safety evaluation that was done. The
2 reviewer is one of those people that has moved on. And
3 I would have to go back and look at our -- I think I
4 would look at our guidance, what guidance we used to
5 come to our findings and see how that particularly was
6 addressed. But I'm sorry, I don't know any --

7 MEMBER SKILLMAN: Well, let me just set a
8 background for my questions so you can understand the
9 context. Very often, the sample lines come into a
10 sample sink. You have, perhaps, a couple for a steam
11 generator at various locations and for feedwater at
12 various locations.

13 Then there might be one or two for the
14 reactor cooling system in that same sample sink. And
15 that's in a hooded environment, probably off the
16 radiation protection area, off the RadCon area.

17 But if you really have an accident, if you
18 pull water out of the reactor coolant system sample,
19 you may have to evacuate the entire area. Because if
20 you've truly had some amount of fuel failure, the almost
21 instant background radiation will go to R per hour, in
22 some cases 100 R per hour.

23 And so, to me, the issue is, when you talk
24 about a post-accident sampling system, one must
25 anticipate that you've had an accident of sufficient

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1 seriousness that you can, in fact, get that sample
2 somehow.

3 I will tell you at TMI 2, during the
4 accident, we couldn't go near the PASS. I mean, we were
5 just overwhelmed. It just literally knocked our socks
6 off. We couldn't go near it.

7 And that was one of the reasons we went for
8 such a long time without an ability to describe what
9 happened other than to say we know we lost a lot of fuel.
10 We don't know how much.

11 So as I look at a design cert, and what this
12 might, unfortunately, ultimately be used for, for it
13 to be useful, it needs to be in a place where people
14 can actually use it. So it's going to be -- it should
15 be something different than just a spigot in your sample
16 sink. Because if you've truly had a fuel failure
17 accident, and you try to go to that spigot, you'll never
18 go back. You've lost the system. You see my point?

19 If you really, really need it, then it
20 needs to be somewhere else where you could really
21 confine what might come out of the PASS, both gas and
22 water.

23 MR. MAKAR: Okay. And it's been awhile
24 since we incorporated the Three Mile Island action
25 plan. And so --

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1 MEMBER SKILLMAN: Well, it may be part of
2 that. I don't --

3 MR. MAKAR: Okay. I was going to ask
4 that. Are you thinking it's not addressed by that, or
5 I just don't know that it's addressed by that?

6 MEMBER SKILLMAN: I don't know, sir. I
7 honestly don't know. And I wasn't trying to trick you
8 here. I'm just saying if the PASS is going to be used
9 at all, it's got to be in a place where it's usable after
10 the condition for which that system was intended.

11 MR. MAKAR: Well, I think, you know,
12 considering we have a conclusion that it meets that
13 guidance.

14 MEMBER SKILLMAN: And I think --

15 MR. MAKAR: But I need to go back and --

16 MEMBER SKILLMAN: Take a look at it.

17 MR. MAKAR: -- make sure that it addresses
18 that.

19 MEMBER SKILLMAN: Thank you.

20 MR. MAKAR: Understand.

21 MEMBER SKILLMAN: Thanks.

22 MR. MAKAR: Okay. So in addition to
23 taking samples, this system, since it's connected to
24 other systems, it has to have the seismic and quality
25 design requirements that meet those systems so there's

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1 no vulnerability to them. And we have to be able to
2 detect and control leakage outside containment. And
3 as I mentioned, there has to be that containment
4 isolation function.

5 Next slide, please, George. We have
6 regulatory guides, we have Three Mile Island action
7 plan in our regulations and guidance that address all
8 of these items.

9 And so with respect to the sampling lines
10 and containment isolation, those valves are designed
11 to close on containment isolation actuation signals,
12 and they are designed to fail in the closed position
13 which meets our requirements.

14 They are also capable of collecting liquid
15 and gaseous samples from many sources, not only those
16 addressed in the guidance documents and the water
17 chemistry guidelines but some additional locations as
18 well.

19 And those procedures include things to
20 make the samples -- ensure the samples are
21 representative, like heating the lines or extending the
22 lines to allow decay of N16, and the shielding, and
23 hoods in the collection areas.

24 Based on the drawings and the table in the
25 DCD, tables in the DCD, we concluded that the system

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1 is designed to seismic and quality requirements of the
2 systems to which it's connected. And there are some
3 COL items to address, the programs for leak detection,
4 contamination control, as well as to maintain the
5 records of the as-built condition of the system.

6 MR. SCHULTZ: Yes. The current SER that
7 we have, version that we have, does suggest that there's
8 some guidance provided related to NUREG-0737 but that
9 the COL's responsible for implementation. So it would
10 be good for you to review the details of what has been
11 provided by the design applicant and determine whether
12 or not you feel the COL can implement appropriately to
13 address what --

14 MR. MAKAR: Okay, thank you.

15 MR. SCHULTZ: -- Mr. Skillman has
16 indicated here.

17 MR. MAKAR: Thank you. And I want to add
18 we have no open or confirmatory items here. We did have
19 -- the safety evaluation does say that we didn't reach
20 a conclusion at the time that it was written about the
21 seismic and quality requirements. But we have done
22 that since then.

23 MEMBER SKILLMAN: Dr. Schultz's comment
24 is accurate. That is on Page 9-148 of your safety
25 evaluation, okay. Thank you.

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1 MR. MAKAR: If nothing else, I'll turn it
2 back to Raul.

3 MR. HERNANDEZ: Yes. I'll be talking
4 about the equipment and floor drain system. The staff
5 focused its review on the equipment floor drain systems
6 to ensure that the system cannot adversely impact
7 safety related SSEs. Portions of the system where it
8 could impact safety related components were classified
9 as safety related.

10 The staff followed the guidance of SRP
11 9.3.3. And issues -- at the time of issuing the SE,
12 there was one open item. But as of now, all RAIS have
13 been closed out. The open item has been resolved.

14 Any questions in this section?

15 No? And Shanlai Lu will continue with the
16 CVCS system.

17 MR. LU: Right, Shanlai Lu from reactor
18 system. And another reviewer on this section, but the
19 reviewer is Matt Thomas, and he's not available to give
20 the presentation. So I am going to have to give the
21 presentation to the committee.

22 So in terms of the chemical and the volume
23 control system, the staff did review that on a design
24 basis, the safety related design basis of the CVCS in
25 terms of the functionality. We reviewed the

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1 functional design basis and the system of design
2 operational modes for different, you know, reactor in
3 modes there too. The system response is for different
4 accidents, component details, including
5 instrumentation and the controls, materials, and then
6 chemical aspects.

7 In terms of the protections the system
8 provided, and then we reviewed the protections used for
9 boric acid precipitation, a flow into the cavitation
10 protection for the charging pumps, seismic
11 certification, and purifying pewter components,
12 control of venting and draining, and contamination
13 minimization.

14 And we also reviewed the protection about
15 the vacuum condition in the tanks, the water control
16 tanks, and the material and chemistry compatibility.

17 In addition, I think that we also reviewed
18 testing, taking certification, and the surveillance
19 requirements of the CVCS. So that's the review scope
20 of this section. So next page.

21 We did issue RAIs. The total number of
22 RAIs we had about nine RAIs. If you check the SER you
23 can see that one. At this point, all of the RAIs have
24 been responded by KHNP, very detailed responses. We
25 were happy.

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1 And the first three actually were related
2 to the isolation schemes of the different injection
3 lines, charging lines, seal injection line, IRWST
4 makeup line, the reactor cooling pump, during
5 accidents.

6 And we also particularly reviewed that
7 volume control tank and the inward buckling protection,
8 because there is a possibility of vacuum.

9 And then I would review the use of EPRI
10 guideline for controlling water chemistry, how they are
11 going to operate in the CVCS. That part we also
12 reviewed, the treatment of dissolved oxygen, a whole
13 bunch of chemicals, hydrogen, sulfate. So that's the
14 RAIs we asked, the Number 4, the PH control procedures
15 and the standard chemical specifications.

16 So at this point of the version you saw,
17 that you guys have, there is no open items. We closed.
18 Everything was fine.

19 But we answered a question in Chapter 15,
20 which is related to the boron dilution. And that part
21 was declared as part of Phase 2. It was an open item.
22 The resolution of that open item could, could, 50/50
23 percent chance of impact as part of SER.

24 Because that resolution right now is still
25 ongoing. We are planning write direction to close that

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1 particular RAI in Chapter 15. But the outcome of the
2 closure might have, you know, trigger the additional
3 justification of the fresh water source pump and the
4 valve.

5 So that part, as part of our presentation,
6 we just wanted to identify there was still a link here.
7 The reason is because when we give you guys the SER,
8 Phase 2 SER, at that time, the resolution of the
9 particular RAI in Chapter 15 was still ongoing. So we
10 did not know what might be the change.

11 So right now, there was a potential change.
12 We may come back to say, okay, the fresh water source
13 valve, isolation valve, needs to be either safety
14 graded or not safety graded. And how the, you know,
15 what relevant technical certification might need to be
16 changed. So that's one right now. I just want to --
17 as a reminder, at this point.

18 MEMBER SKILLMAN: What is the status of
19 that valve right now? Is it locked closed --

20 MR. LU: Okay, it's --

21 MEMBER SKILLMAN: -- fully lock closed.

22 MR. LU: No, no. It's a valve can be
23 controlled from the control room. So that during the
24 operation and the mode four, mode five, that can be used
25 to supply the fresh water. And what we found that I

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1 can't give you -- well, tomorrow we are going to be here
2 to talk about Chapter 15 which is one of the items we
3 can -- I can give you a nutshell of another issue.

4 It is that, once you have fresh water comes
5 in, and then you have dilution, in the Mode 4 and Mode
6 5. So the question becomes the dilution will trigger
7 the leak critically, okay. And then currently we did
8 have the questions about the, you know, boron dilution
9 analysis. We found that it may not be conservative
10 enough. So there is a possibility we are going to
11 mandate the isolation of fresh water source during Mode
12 4 and the Mode 5 operation.

13 So if we do that, I think the specification
14 change and there might be also the detection of whether
15 the control room can see that valve or not, all right.

16 If they can see the valve, or the signal,
17 and then whether that should be safety graded or not
18 safety graded, so that's the determination. We have
19 not reached closure with the KHNP yet. I don't think
20 it's going to be a, you know, show stopper of design
21 issue. It's just that the documentation, we never
22 cleared it out.

23 MEMBER SKILLMAN: Thank you.

24 MR. LU: So that's just a reminder here.

25 Next page. So overall, based on the

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1 current review, I think the staff has reached some whole
2 new findings.

3 In terms of design basis, CVCS has probably
4 the safety related design basis. Functionality-wise,
5 the system functional design has included all the
6 components necessary for that cooling the system,
7 chemical and volume control. The CVCS charging pumps
8 adequate for coping with station blackout event.
9 Components, instrumentation, controls are
10 appropriate, adequate chemistry and purity control.

11 Protection, it does provide the intended
12 protection. It has the protection against boric acid
13 precipitation, cavitation, and the minimum flow
14 protection for the charging pumps.

15 Appropriate seismic classification has
16 been completed for the CVCS, purifying equipment
17 appropriate protected, CVCS leakage control adequate
18 to minimize the contamination. And the volume control
19 tank did have the adequate protection of the structure
20 against a possible vacuum condition.

21 And then the Applicant has already
22 provided adequate testing, technical specifications,
23 and the surveillance requirements, okay.

24 So the conclusion here, at this point,
25 besides as a reminder, and I think as part of Phase 2

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1 review, established conclusion that the CVCS has been
2 designed appropriately for chemical and volume
3 control. APR1400 application includes a proper ITAAC
4 and technical specifications, and no open items, except
5 that reminder.

6 We may take actions after we -- depends on
7 the outcome of that resolution of that open item. So
8 that's the conclusion of the chemical and the volume
9 control system review. Any questions?

10 (No audible response)

11 MR. LU: Okay.

12 MR. WUNDER: If there are no questions,
13 we're ready for our next panel, a very small panel. I'm
14 joined now by Diane Jackson. She is the heating,
15 ventilation, and air conditioning branch who comes with
16 her own hand-made name tag.

17 CHAIRMAN BALLINGER: Are you the heat-up
18 person?

19 MS. JACKSON: I think I am. But I
20 hopefully won't disappoint you too much. I am Diane
21 Jackson. I recently took over as the first line
22 supervisor for containment and ventilation systems.

23 Unfortunately, the reviewer of this
24 section, Danny Chien, was not able to be here today.
25 On Tuesday, he called me and said I'm in the hospital.

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1 And he's doing okay but clearly not making it in this
2 week. So I quickly reviewed his slides in his --

3 MEMBER POWERS: He's still alive. It's
4 no excuse.

5 MS. JACKSON: He is.

6 (Laughter)

7 MS. JACKSON: I didn't drag him in. It
8 wasn't drug testing or anything, you know. So I just
9 wanted to give you that preface. If there are
10 questions, I'd be happy -- that I can't answer, I'd be
11 happy to take them back. And we'll get you a more
12 thorough answer.

13 So we're going to talk about ventilation
14 systems this afternoon. I'm going to talk about
15 control room ventilation, fuel handling, compound
16 building, and emergency safety features ventilation
17 system.

18 So the first one up is the control room HVAC
19 system. We reviewed it to determine if it is capable
20 of maintaining suitable environmental conditions for
21 personnel and equipment, a little typo there, under
22 normal and accident conditions.

23 We looked for the normal compliance for,
24 you know, seismic, missiles -- obviously shared systems
25 don't apply to APR1400 -- control room habitability,

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1 and control of radio release.

2 We also, you know, there's a non-safety
3 related part of this, safety related part. The
4 non-safety related isolates on an ESF actuation system.
5 The non-safety part looks to keep a positive pressure.
6 Oops, wait, no. For the emergency part, it's a
7 positive pressure.

8 For normal stuff they are looking to make
9 sure, and in emergency, that there is conditioned air.
10 So it's proper temperature, and humidity, and all that
11 kind of good stuff, so the operators can do their jobs.

12 For our safety findings, we found that they
13 met all of the regulations. We did note, in the ITAAC,
14 that it had just said the control room will maintain
15 a positive pressure and kind of just left it at that.

16 Danny didn't think that was quite
17 sufficient, so he pushed them a little bit in the ITAAC
18 and in the FSAR. It now says it will be maintained at
19 a minimum of 0.125 inch water gauge positive pressure
20 with respect to the surrounding area. So, you know,
21 it pushes the envelope to make sure that we have a little
22 bit of margin there.

23 We're waiting just for the next rev of the
24 FSAR to make sure that it's in there, as we had agreed,
25 and they had supplied a markup for it. So our

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1 conclusion is it complies with all the design criteria,
2 and it's capable of performing its intended function.

3 MR. SCHULTZ: Is that value to be a
4 technical specification, do you know?

5 MS. JACKSON: I don't think so. I think
6 it's an ITAAC.

7 MR. SCHULTZ: Okay. Thank you.

8 MS. JACKSON: I don't think, I know. And
9 it will be an ITAAC but not a tech spec, okay.

10 Next one if the fuel handling area which
11 is SRP Section 9.4.2. We're looking to see that the
12 system is capable of preventing the spread of airborne
13 contamination and maintaining the fuel handling area
14 if there are airborne concentration below the
15 regulatory limits for normal and accident conditions.

16 Of course, we look at all the normal GDCs,
17 seismic, control of radiological release, 61 airborne
18 radiological reactivity, release of it, lack of release
19 of it.

20 So again, for the non-safety related in
21 normal ops, we want to maintain a suitable environment
22 for both the operators as they're moving around the
23 spent fuel area, as well as the equipment, that it
24 doesn't get too warm there.

25 For the fuel handling area, it is

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1 maintained at a slightly negative pressure to make sure
2 everything is kept in. For the safety related
3 functions, they have to isolate everything. They have
4 cooling to the spent fuel pool heat exchanger rooms.
5 And it starts to maintain its negative pressure, of
6 course, and it looks to remove the iodine and any
7 particulates.

8 Let's see, for the staff findings, a pretty
9 minor one, but I guess it's a general one. He found
10 this through a number of different areas in the ITAAC.
11 There was nothing to say that they would verify the
12 capability of the heating coils, so that was put in as
13 an ITAAC issue.

14 And it will be in accordance with ASME AG-1,
15 Section CA. With that, Danny was satisfied and felt
16 like it could meet and perform its intended functions
17 during normal and accident conditions.

18 Okay, compound building HVAC system.
19 It's pretty much a non-safety related system except for
20 the safety related cubicle coolers for the motor-driven
21 aux feedwater or pump room. And there's one other
22 room, an auxiliary room or something.

23 MEMBER STETKAR: Back up.

24 MS. JACKSON: Yes?

25 MEMBER STETKAR: How does the compound

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1 building HVAC system affect the motor-driven auxiliary
2 feedwater pumps which are out in the aux building?

3 MS. JACKSON: You know, I was trying to --
4 I didn't get a chance to look at the layout of it to
5 see how it is. But that is one of its functions.

6 MEMBER STETKAR: Really.

7 MS. JACKSON: Is it --

8 MEMBER STETKAR: Okay.

9 MS. JACKSON: -- in the HAVC system, so
10 they are safety-related. And they're in two of these
11 rooms.

12 Okay. In our staff findings, they found
13 they didn't provide a carbon absorber, air cleaning
14 unit, or HEPA filter maximum air flow ratings. They
15 had come up with this 45,000 cubic feet per minute
16 design. And what's in REG Guide 1.140 says you should
17 have a max flow rate of 30,000 cubic feet per minute,
18 unless you use multiple units.

19 So go to the next slide. This kind of
20 continues on. They changed the layout of their filters
21 to be three by ten, so there's now 30 of these. And
22 it is higher than what the Reg Guide recommends.

23 But from what I could tell, because of
24 particularly the in-place testing, to say is it working
25 and functioning properly, and they can continuously

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1 monitor this, they said, okay, it is -- it's acceptable.

2 They also -- that was their number one
3 thing. And they changed those configurations. I
4 don't know what the original configuration was, but it
5 looks like they added additional filters to make sure
6 that it was a nice wide area and perhaps less
7 differential pressure going through it.

8 With that change, he was satisfied that the
9 HVAC system for the compound building complied and
10 would meet its intended function.

11 MEMBER STETKAR: Ma'am, just to clarify
12 the record --

13 MS. JACKSON: Yes?

14 MEMBER STETKAR: -- and indulge me, just
15 so we get it on there, can you confirm how and where
16 the compound building HVAC system interfaces at all
17 with the -- you said auxiliary feed -- motor driven
18 auxiliary feed waterwater pumps, I believe.

19 MS. JACKSON: It's the chillers for the
20 room is what it says.

21 MEMBER STETKAR: Yes. I'm not finding
22 that anywhere.

23 MS. JACKSON: Are you in the -- I don't
24 have the --

25 MEMBER STETKAR: I'm in the DCD.

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1 MS. JACKSON: Okay. I don't have the DCD
2 in front of me. I have the SE in front of me.

3 MEMBER STETKAR: Well, that's why I'm
4 asking you to confirm it. Because the SE might have
5 an error it.

6 MS. JACKSON: Okay. Hang on. Okay.

7 MEMBER STETKAR: I'll just leave it at
8 that.

9 MS. JACKSON: It is -- well, this section
10 is labeled aux building clean area HVAC system, and
11 compound building HVAC system.

12 MEMBER STETKAR: Okay. Well, aux
13 building clean area HVAC system, I guarantee you, has
14 something to do with the auxiliary feedwater pumps.

15 MS. JACKSON: Yes.

16 MEMBER STETKAR: Compound building, not
17 so much.

18 MS. JACKSON: Okay. You got me on this
19 one. We put them together because there's normally --

20 MEMBER STETKAR: Yes, yes.

21 MS. JACKSON: -- a lot of compound --

22 MEMBER STETKAR: Okay, fine.

23 MS. JACKSON: -- buildings out --

24 MEMBER STETKAR: I just wanted to make
25 sure that the transcript is --

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1 MS. JACKSON: Is accurate. I appreciate
2 that. Thank you. Okay, so I don't have a question,
3 so I can stop, right?

4 Engineered safety feature ventilation
5 system, we reviewed this to make sure it was capable
6 of maintaining a suitable and controlled environment
7 for the ESF components following anticipated
8 transients and design basis accidents. We evaluated
9 them for the normal regulations.

10 It is -- the ESF ventilation system has
11 really three sub-systems. It's the emergency diesel
12 generator rooms, the electrical and INC rooms, aux
13 building controlled area emergency exhaust system.
14 And it also lists the essential service water and
15 component cooling. But that is a COL item, so it's
16 really only three.

17 So what he found is -- the only thing he
18 found that was outside of what he expected was that,
19 again, the heating coils' capacity was not in the ITAAC,
20 so that has been added, or will be added, and is waiting
21 as a confirmatory item. And just as before, it will
22 meet ASME AG1, Section CA 5400 so that it falls along
23 into the appropriate criteria.

24 With that, he was satisfied and the staff
25 is satisfied that it is capable of performing its

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1 intended function under normal and accident
2 operations. Okay.

3 MEMBER MARCH-LEUBA: Going back to the
4 positive pressure, you said the requirement is 0.15
5 PSI?

6 MS. JACKSON: Excuse me?

7 MEMBER MARCH-LEUBA: The positive
8 pressure in the control room, early in your
9 presentation, you first said a requirement of how much?

10 MS. JACKSON: It was 0.125.

11 MEMBER MARCH-LEUBA: 0.125 PSI?

12 MS. JACKSON: Inches, water gauge.

13 MEMBER MARCH-LEUBA: Oh, inches of water.

14 MS. JACKSON: And water gauge.

15 MEMBER MARCH-LEUBA: Okay. All right.

16 MS. JACKSON: I --

17 MEMBER MARCH-LEUBA: I can't really put
18 the force across the door. I just want recognition on
19 the force across the door and you can't open it.

20 MEMBER STETKAR: Well, you can't open it,
21 I can.

22 (Laughter.)

23 MS. JACKSON: All right. Thank you very
24 much.

25 MR. WUNDER: Thank you so much. And if

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1 you're ready, we can bring up our last group which is
2 as large as the last one was small.

3 CHAIRMAN BALLINGER: I think we probably
4 are. We're way ahead of schedule, but we're scheduled
5 for a break at 3:15, but it looks like we'll have a
6 recess close to 3:15.

7 Okay. And for Section 9.5, I am joined by
8 Bob Vettori, Deanna Zhang, who is pinch-hitting for
9 Dawn Matthews, and Adakou Foli, and Thinh Dinh. And
10 Bob will start off, please.

11 MR. VETTORI: Thank you. Bob Vettori,
12 Plant Systems Branch.

13 CHAIRMAN BALLINGER: Thank you.

14 MR. VETTORI: The review of the fire
15 protection program consisted of the review of Sections
16 9.5.1 of the DCD and also Appendix 9.5A which is titled
17 Fire Hazard Analysis.

18 The APR1400 fire protection program uses
19 the concept of defense-in-depth to achieve the required
20 degree of safety. First, as they said, this is to
21 prevent or minimize potential for fire to occur,
22 second, if a fire should occur, rapidly detect,
23 control, and hopefully extinguish, and lastly to
24 protect the structure, systems, and components
25 important to safety so that a fire will not prevent the

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1 safe shutdown of the plant.

2 During this review, the staff asked 43
3 RAIs. To date, all have been adequately answered.
4 With incorporation of the confirmatory items in the
5 next revision of the DCD, we will be able to conclude
6 that the sections of the DCD related to fire protection
7 include sufficient information to find that the design
8 conforms to the reg guidance in Reg Guide 1.189.

9 This concludes my presentation on the fire
10 protection program. Are there any questions?

11 (No audible response)

12 MR. VETTORI: If not, I'll turn the
13 presentation to Deanna who will discuss the
14 communications system.

15 MS. ZHANG: Mine's not quite so short. So
16 again, my name is Deanna Zhang. I'm the lead INC
17 reviewer for the APR1400. And as George had mentioned,
18 I'm here on behalf of Dawn Matthews to discuss the
19 staff's review of Section 9.5.2 which is on
20 communication systems.

21 She's actually off getting married. So I
22 don't know who drew the short end of the stick here.
23 So the communication system first mentioned is
24 non-safety related. It's a non-safety related
25 structure, system, and component.

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1 And for the onsite communication systems,
2 they consist of the paging phone system, the evacuation
3 alarm address system, the public address system, the
4 sound-powered telephone system, the telecom system,
5 the plant time-synchronization system, the local area
6 networks, and the VPN, and the wireless communication
7 system.

8 All site communication systems consist of
9 the commercial telephone system, the local law
10 enforcement communication system, the emergency
11 telephone system, and the satellite telephone system.

12 So the staff's review focused on verifying
13 that these systems provide reliable and effective
14 communications, both within plant buildings, between
15 different plant buildings, and as well as with external
16 locations during all plant conditions.

17 The review also verified that reliable
18 backup, alternating current, and battery power are
19 available in case of loss of off-site power or station
20 blackout conditions.

21 Next slide. So the staff, in general,
22 found the communication systems conformed to the
23 applicable NRC regulations except for two cases in
24 which the staff wrote subsequent RAIs to resolve these
25 open items. And I will go into it in more detail in

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1 the next two slides.

2 Next slide, please. So for the first open
3 item, the Applicant stated that because the
4 communication systems are classified as non-safety,
5 these systems are not required to meet 10 CFR Part 50,
6 GDCs 1 through 4.

7 However, based on the APR1400
8 probabilistic risk assessment results, it appears that
9 the communication system availability is an implicit
10 assumption. So as such, the staff requested the
11 Applicant to justify why the communication systems are
12 not classified as risk-significant and do not need to
13 comply with the aforementioned GDCs.

14 So in the Applicant's response, KHNP
15 stated that a reliability assurance program expert
16 panel will be established to determine whether the
17 communication systems are risk significant or not.
18 And the results will inform whether the communication
19 systems need to meet these aforementioned GDCs.

20 However, to date the staff has not received
21 an update on that response providing information as far
22 as whether this panel has been established and the
23 results of the assessment there. So the staff is
24 issuing a follow-up RAI to get that information.

25 Next slide. The second open item has to

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1 do with one consistency issue in the DCD, particular
2 in Tier 1, as well as another issue with the initial
3 test program.

4 So in DCD Revision 0, Tier 1, the Applicant
5 used the term functional arrangement of communication
6 systems. And it was not clear to the staff what the
7 functional arrangement of the communication systems,
8 what that meant. Because it was not described in Tier
9 1. So the staff asked the Applicant to either describe
10 it, add a definition in Tier 1, or provide supplemental
11 information to support use of that term.

12 However, the Applicant's response did not
13 add any clarity. And I think they used another term
14 that the staff also found there was no definition for
15 in Tier 1. So as such, the staff identified this as
16 an open item in the SER.

17 In addition, the Applicant also claimed
18 that the COL Applicant will address any initial test
19 requirements for the communication systems and provide
20 a corresponding COL item. However, based on the staff
21 understanding, the plant communication system is not
22 site-specific. Therefore, the communication system
23 should be included in the initial test program of the
24 DC Application.

25 Further, an initial test was proposed for

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1 the security communication system. Therefore, it is
2 not clear why there is an inconsistency for security
3 communication systems versus communication systems in
4 general. Therefore, the staff issued a subsequent RAI
5 to track this issue.

6 So that concludes my presentation. And if
7 there are no questions --

8 MEMBER SKILLMAN: I do have a question.

9 MS. ZHANG: Okay.

10 MEMBER SKILLMAN: And I would start with
11 this observation. Twenty-five or 30 years ago, most
12 of the communication in the plant was through the sound
13 powered phones, through the intercom systems or those
14 types of systems.

15 And leap ahead about ten years, the
16 operators were wearing equipment very much like what
17 the law enforcement men and women are using today, which
18 is a walkie talkie with a microphone on the chest or
19 close to the mouth.

20 In the last number of years, a lot of
21 communication is with personal phones, iPads, personal
22 communication devices. So there has been this change
23 in technology that's available to everyone in the
24 world, in fact.

25 But that change in technology has worked

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1 its way into the plants. And you now have an aux
2 operator who's out in the yard calling the shift manager
3 on a cell phone, a personal phone.

4 How is that type of communication
5 considered in your evaluation?

6 MS. ZHANG: Well, the design
7 certification did not include personal cell phones as
8 a communication system that's credited in the design.
9 Therefore, if any operator chooses to use that, that
10 had not been described in the application itself.

11 MEMBER SKILLMAN: Fair enough. Thank
12 you. Okay.

13 MS. FOLI: Okay. My name is Adakou Foli.
14 I will talk about the lighting system. The lighting
15 systems are designed to provide illumination during
16 normal and off-normal plant conditions. The systems
17 include the normal lighting and emergency lighting
18 systems.

19 The normal lighting system provides
20 general illumination for the plant during normal plant
21 operation. The emergency lighting system, consisting
22 of the AC and DC systems, provide illumination in areas
23 including for safe shutdown of the plant, fire
24 fighting, and access valves.

25 The staff reviewed the normal and

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1 emergency lighting systems to ensure that the systems
2 would perform the designed function during all plant
3 operating conditions. Specifically, the staff
4 reviewed the capability of the normal and emergency
5 lighting system to provide adequate illumination and
6 to operate without adversely impacting the operation,
7 control, and maintenance of security systems.

8 Based on the staff review of the
9 illumination, and the seismic category of the lighting
10 system, and the isolation between known Class 1, and
11 Class 1 is circuit, the staff concluded that the normal
12 and emergency lighting systems are capable of
13 performing the design function without negatively
14 impacting security systems during all plant operating
15 conditions. Any questions?

16 MEMBER SKILLMAN: I do. On your safety
17 evaluation, you basically communicate the security
18 lighting is powered from offsite by the 480 VAC buses
19 and backed up by the AAC source upon route.

20 MS. FOLI: Yes.

21 MEMBER SKILLMAN: When I go up to your
22 description of the emergency AC lighting system, it is
23 provided to the main control room, the Rad waste control
24 room, the tech support center, operation support
25 center, the shutdown panel, the EDG room, Class 1A

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1 battery room, Class 1A switch gear room, and our access
2 aisles. No word about powering the lighting around the
3 gas turbine generator.

4 MS. FOLI: It is. We asked that question.
5 Actually, if you follow --

6 MEMBER SKILLMAN: Oh, really?

7 MS. FOLI: Yes.

8 MEMBER SKILLMAN: I didn't --

9 MS. FOLI: Yes. And they say that we
10 have, I think, the DC lighting.

11 MEMBER SKILLMAN: In there?

12 MS. FOLI: In the AC building.

13 MEMBER SKILLMAN: Well done. I didn't
14 see that.

15 MS. FOLI: Yes.

16 MEMBER SKILLMAN: Okay.

17 MS. FOLI: It's in the --

18 MEMBER SKILLMAN: Thank you.

19 MS. FOLI: Yes.

20 MEMBER SKILLMAN: Thank you. No further
21 questions.

22 MR. DINH: Okay. My name is Thinh Dinh
23 from the Plant System Branch. I'm the technical
24 reviewer for the emergency diesel engine support
25 system. The emergency diesel engine support system

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1 consists of five sub-systems.

2 The fuel oil system provides storage and
3 continued supply of fuel for the four Class 1 EDGs
4 following the loss of offsite power event.

5 Cooling water system provides cooling
6 water to maintain the temperature of the EDG within
7 optimum range during standby and through an operation
8 condition, starting a system, provide compressed air to
9 facilitate EDG fast-start capability, the engine
10 lubricating system, store and deliver clean lubricating
11 oil to the EDG moving parts during standby and full
12 operation condition.

13 And, lastly, the engine combustion air
14 intake and exhaust system would provide reliable,
15 quality combustion air and removal of exhaust
16 combustion products for EDG operations.

17 The key design features of the engine
18 support system are each train has a separate and
19 independent emergency diesel engine support system for
20 each of the four EDGs.

21 Emergency diesel engine support systems
22 are designed to function during and after a safe
23 shutdown earthquake event and protected from natural
24 phenomena, internal flood, missile, pipe break, and
25 interaction with non-seismic systems in the vicinity.

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1 Their seven-day fuel oil capacity,
2 instrumentation, and alarms are provided to monitor the
3 operation of the emergency diesel engine support
4 system, the capability to isolate the system, or piping
5 components including isolation portions of the system
6 for excessive leakage of component malfunction to
7 maintain the system's safety function.

8 Provisions are made to allow for functional
9 testing, periodic inspection, and maintenance of the
10 emergency diesel engine support system.

11 Staff review will conclude that the diesel
12 support system in -- the staff review, the diesel
13 support system in accordance with SRP 9.5.4 through
14 9.5.8, the systems are designed, fabricated, and tested
15 to qualify standards in accordance with applicable NRC
16 guidance, providing adequate assurance that the Class
17 1 EDG can perform the intended functions during a loss
18 of outside power event.

19 They are independent and separate. And
20 components are not shared between the EDG. Any single
21 active failure will not prevent the other redundant EDG
22 from performing their safety function.

23 The EDG and their associate support system
24 are physically separated and designed to function
25 during and after a safe shutdown earthquake event

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1 protected from natural phenomena, internal floods,
2 missiles, pipe break, and interaction with other
3 non-seismic system in the vicinity.

4 Therefore, they are reasonable to expect
5 above accident conditions will not lead to loss of more
6 than one EDG at a time. Their provision for functional
7 testing, periodic inspection, and maintenance of the
8 emergency diesel engine support system ensure
9 reliability as a system.

10 There is one last standing open item at the
11 time of the SER, however we have received additional
12 information from the Applicant to close this out in the
13 next -- the review of the next revision. May I answer
14 any questions that you may have?

15 MEMBER SKILLMAN: Yes. What is the item
16 that was just addressed? Was it the consumption rate?

17 MR. DINH: Yes, the consumption rate was
18 missing from the ITAAC. And we asked for that, and we
19 just received that.

20 MEMBER SKILLMAN: Okay, thank you.

21 MR. DINH: Sure. Okay, there's nothing
22 else?

23 MS. ZHANG: No.

24 MR. DINH: We move to -- I don't know what
25 the next section is.

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1 MEMBER STETKAR: Did you look at -- I know
2 that the design has the fuel oil supply for the, I'll
3 call it the flex gas turbine generator, for lack of a
4 better term, coming from the day tank from the emergency
5 diesel generator, right?

6 MR. DINH: I think they have a separate --

7 MEMBER STETKAR: Shake your -- no, shake
8 your head yes.

9 (Laughter.)

10 MR. DINH: Well, I'm not a reviewer of
11 those so --

12 MEMBER STETKAR: Well, but no. But you're
13 a reviewer on the diesels, right?

14 MR. DINH: Right.

15 MEMBER STETKAR: Okay. Fuel system is
16 part of the diesel?

17 MR. DINH: Yes.

18 MEMBER STETKAR: Okay. So I'm looking at
19 a drawing here. And unfortunately, the diesel fuel oil
20 system drawing in the DCD shows Train A and says all the
21 others are the same.

22 So if I look at the Fukushima technical
23 report, it says that I can supply the flex gas turbine
24 generator from any of the four emergency diesel
25 generator day tanks. And if I look at the building

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1 layout, I can kind of see how I do that from the two
2 diesel generators that are in the diesel generator
3 building, not so clear from the ones that are in the aux
4 building, unless they got really long pipes.

5 So can somebody tell me how I can connect
6 the gas turbine generator to the diesel generators that
7 are in the aux building?

8 MR. DINH: I have to get back on that.

9 MEMBER STETKAR: Because this fuel -- see,
10 this fuel oil drawing just shows a little pipe going out.
11 And it says emergency diesel generator building. And
12 there's a little dash line that says yard. And I get
13 that for the emergency diesel generator building.
14 Yes?

15 MR. KIM: This is Yong Cheol Kim from KEPCO
16 E&C. We have a providence to connect the line from the
17 day tank to flex in emergency diesel building, not aux
18 building.

19 MEMBER STETKAR: Not the aux? Well, but,
20 okay. Now I'm a bit confused. Because in the
21 technical report which I have been told I am to assume
22 is part of the design certification, the technical
23 report gives me a table that lists four valve numbers,
24 one from each emergency diesel.

25 And I know two of those emergency diesels

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1 are in the aux building. So can I connect the flex gas
2 turbine to the diesels in the aux building or not?

3 MR. LIM: This is Dunam Lim. The
4 technical report, the table in the technical report is
5 revised to original one.

6 MEMBER STETKAR: Okey dokey.

7 Didn't see that one. Thank you. I was
8 trying to see if the staff -- again, we try to connect
9 a lot of the dots and all that sort of thing. So thank
10 you. Okay.

11 MR. VETTORI: Gas turbine generator
12 facility, again, I'm Bob Vettori, Plant Systems Branch.
13 I'll be giving the presentation for the staff's review
14 of Section 9, 5.9, gas turbine generator facility. The
15 individual who performed the review is not available at
16 this time.

17 The gas turbine generator provides power to
18 the set of required shutdown load to bring the plant to
19 safe shutdown during a station blackout.

20 The objectives of the review were to
21 determine if the gas turbine generator support systems
22 have the capability to support gas turbine generator
23 operation, independent of the emergency diesel
24 generators, and to determine if the systems support
25 operation of the gas turbine generator for 16 hours of

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1 station blackout coping time.

2 The staff's review was based on the
3 requirements of 10 CFR 50.63 and the guidance in Reg
4 Guide 1.155. The staff finds that the support systems
5 are diverse and independent of the emergency diesel
6 generators and that the gas turbine generator has
7 sufficient fuel oil to support the 16 hour station
8 blackout coping time.

9 There were two open items in the safety
10 evaluation. Staff has received supplemental
11 information from the Applicant. And with the
12 incorporation of this information in the next revision
13 of the DCD, we will be able to close out these two open
14 items. This concludes my presentation. Are there any
15 questions?

16 (No audible response)

17 MR. WUNDER: That concludes the staff's
18 presentation on Chapter 9, Auxiliary Systems.

19 CHAIRMAN BALLINGER: Well, thank you very
20 much.

21 (Off the record comments)

22 MR. SCHULTZ: Tell him I've got a question
23 for George, just perhaps to help the committee.

24 The Applicant has provided their four page
25 attachment which lists, I presume, their current

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1 understanding of open items, many of which are, you
2 know, we've submitted a response to the staff. And I'm
3 not sure if they've received a response from the staff
4 on each of those or not, or they're all addressed in or
5 to be addressed in Rev 1.

6 Does the staff have a similar list of where
7 things stand? Because today, we've gotten a number of
8 items that have been --

9 MR. WUNDER: We do. And we've recently
10 met with the Applicant on this so that we have a common
11 understanding of what's left to be done --

12 MR. SCHULTZ: Good.

13 MR. WUNDER: -- in Phase 4 to resolve all
14 open items and get you a clean SER, with no open items
15 and only confirmatory items, sometime in the fall.

16 MR. SCHULTZ: Okay. Thank you.

17 CHAIRMAN BALLINGER: Okay. Now, we're
18 finished with today's presentations with the exception
19 of asking if there are comments from people in the room.
20 Are there any comments? I have to speak into this
21 without looking in the back of my head. Is there
22 anybody in the room that would like to make a comment?
23 Okay, five second rule? Is there anybody on the phone
24 line that would like to make a comment?

25 MALE PARTICIPANT: It's open.

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1 CHAIRMAN BALLINGER: It's open.

2 MS. BANERJEE: This is Maitri. And did we
3 do KHNP's 9.5A?

4 MEMBER STETKAR: Maitri, give your full
5 name since nobody else knows who you are.

6 MS. BANERJEE: Of course. Yes, this is
7 Maitri Banerjee, ACRS staff. I have a question which
8 is did we allow KHNP to present 9.5A, the fire hazards
9 analysis, the remaining slides, before we broke for
10 lunch?

11 CHAIRMAN BALLINGER: We would have allowed
12 to, but they didn't want to.

13 MS. BANERJEE: Oh, I'm sorry. I didn't
14 follow that.

15 MEMBER STETKAR: And in fairness, on the
16 record, we didn't ask them to.

17 CHAIRMAN BALLINGER: And we didn't ask
18 them to.

19 MS. BANERJEE: Okay.

20 CHAIRMAN BALLINGER: Other comments from
21 the people on the phone line?

22 (No audible response)

23 CHAIRMAN BALLINGER: Hearing none, I think
24 I'm probably going to make a mistake by going around the
25 room. Not making a mistake? Can we go around the table

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1 and ask for any final comments for today? None from
2 you?

3 MEMBER BROWN: I have no additional
4 comments.

5 CHAIRMAN BALLINGER: Jose?

6 MEMBER MARCH-LEUBA: Yes. I'd like to
7 agree with Dr. Powers when he said earlier that the staff
8 has done a very -- an excellent job doing this review,
9 especially on the criticality safety on the spent fuel
10 pool. I was very impressed.

11 MEMBER STETKAR: Nothing more?

12 CHAIRMAN BALLINGER: Mr. Stetkar? Matt?

13 MEMBER SUNSERI: I appreciate all the
14 presentations from the staff, and the Applicant, and
15 attention to my questions that I asked. Thank you.

16 MEMBER POWERS: No additional comments?

17 CHAIRMAN BALLINGER: Okay.

18 MEMBER SKILLMAN: Thank you, George, and
19 to the staff, and to each one who has participated.
20 Thank you also to the KHNP team, very well done. Thank
21 you.

22 I would like to raise one point regarding
23 the air start tank dew point. We raised this with KHNP,
24 would like to raise it with the staff.

25 The safety evaluation communicates that

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1 the dew point is not more than ten degrees centigrade,
2 50 Fahrenheit, when installed in a normally controlled
3 21C 70 degree Fahrenheit environment. And the dew
4 point is controlled to at least 5.5C less, 10 degrees
5 Fahrenheit less than the lowest expected ambient
6 temperature.

7 I would like to suggest that that number
8 probably needs to be challenged. My view is that that
9 number is too moist. And as the air compressors
10 compress the air for the diesel start, that number, I
11 believe, will ensure water in those storage tanks. If
12 that number is dropped to minus 20, minus 30 Fahrenheit,
13 you'll have a nice dry tank.

14 The operating experience has been that when
15 the moist air expands, takes on this latent heat
16 expansion, and it will freeze in the solenoid orifice.
17 It's happened at several plants.

18 What they've done is gone in after the
19 event, why didn't the diesel start, and they found the
20 piping absolutely pristine clean. Unless they catch it
21 in the first several minutes, then they find that
22 there's water in the solenoid, starting solenoid, which
23 meant that there was an ice puck in there.

24 So it's not something that's immediately
25 intuitive, but when you think of the gas expanding, it's

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1 chilling. And it will freeze on the second start or the
2 third start attempt.

3 So you might want to consider standard
4 review plan for the NUREG and determine whether or not
5 you want to require that that temperature be dropped,
6 10, 15, 20 degrees Fahrenheit. Thank you.

7 CHAIRMAN BALLINGER: Steve?

8 MR. SCHULTZ: Thank you, Ron. I wanted to
9 thank KHNP and also the staff for the presentations
10 today.

11 My general comment is that, based on what
12 we've heard today and what's been presented in materials
13 in preparation for this meeting, is that both the
14 Applicant and the staff are working very diligently to
15 address quite a large number of different issues that
16 have been raised by the staff.

17 The staff has demonstrated enthusiasm
18 under which they're proceeding to challenge both
19 themselves as well as the Applicant to assure a good
20 product in the end. And, George, as you just responded,
21 that by this fall a number of other items are going to
22 be addressed.

23 I would just encourage both the Applicant
24 as well as the staff to continue with that enthusiasm,
25 and don't hold back on challenging each other and

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1 responding appropriately to assure that these design
2 improvements, if they're needed, are in fact made before
3 the final approval.

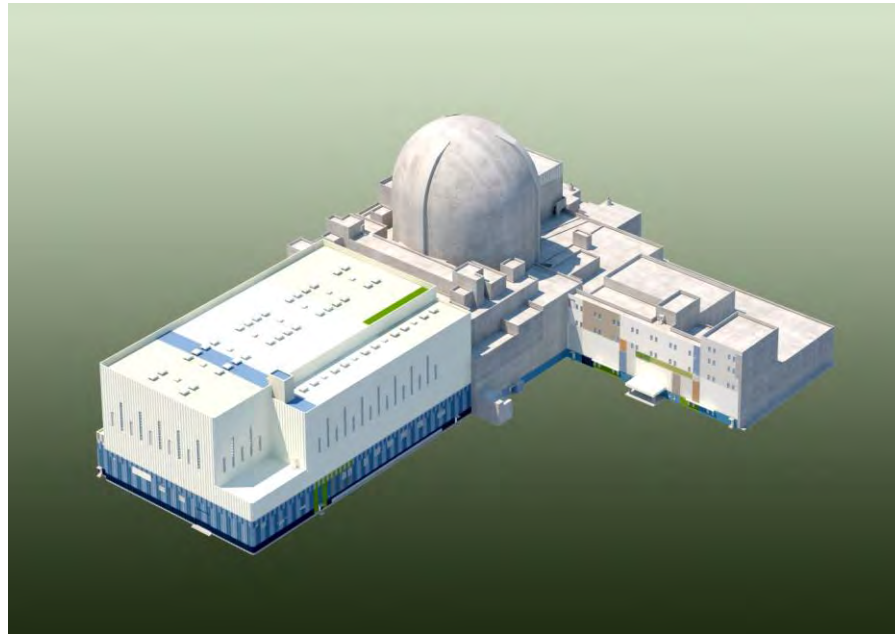
4 CHAIRMAN BALLINGER: Thank you very much.
5 If there are no further comments, we are adjourned until
6 0800, 0830 tomorrow morning.

7 (Whereupon, the above-entitled matter went
8 off the record at 3:32 p.m.)

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APR1400 DCA

Chapter 9: Auxiliary Systems



KEPCO/KHNP
May 18, 2017

Contents

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Overview of Chapter 9

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Section Summary

9.1 Fuel Storage and Handling

9.2 Water Systems

9.3 Process Auxiliaries

9.4 Heating, Ventilation and Air Conditioning Systems

9.5 Other Auxiliary Systems

Appendix 9.5A Fire Hazard Analysis

3

Summary

Overview of Chapter 9

□ Section Overview

Section	Title	Presenter
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

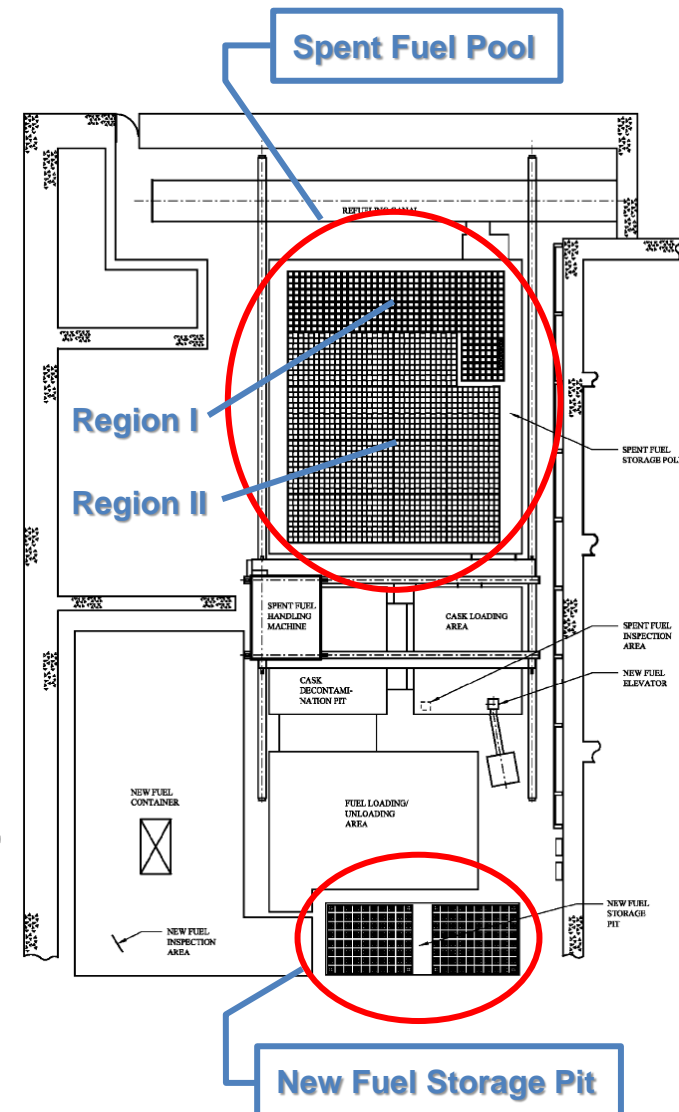
Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-P/NP	APR1400 Design Control Document Tier 2: Chapter 9 Auxiliary Systems	1	DCD	N/A
APR1400-K-X-IT-14001-P/NP	APR1400 Design Control Document Tier 1	1	DCD	N/A
APR1400-Z-A-NR-14011	Criticality Analysis of New and Spent Fuel Storage 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™)
- ❑ Criticality is precluded by adequate design and by administrative control procedures



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)
 - $K_{eff}^* \leq 0.95$ with full density unborated water
 - $K_{eff}^* \leq 0.98$ with optimum moderation condition
- Spent Fuel Storage Rack by 10CFR50.68 (b) item (4)
 - $K_{eff}^* \leq 0.95$ with borated water
 - $K_{eff}^* < 1.0$ with full density unborated water

* K_{eff} 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™
 - 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™
 - 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

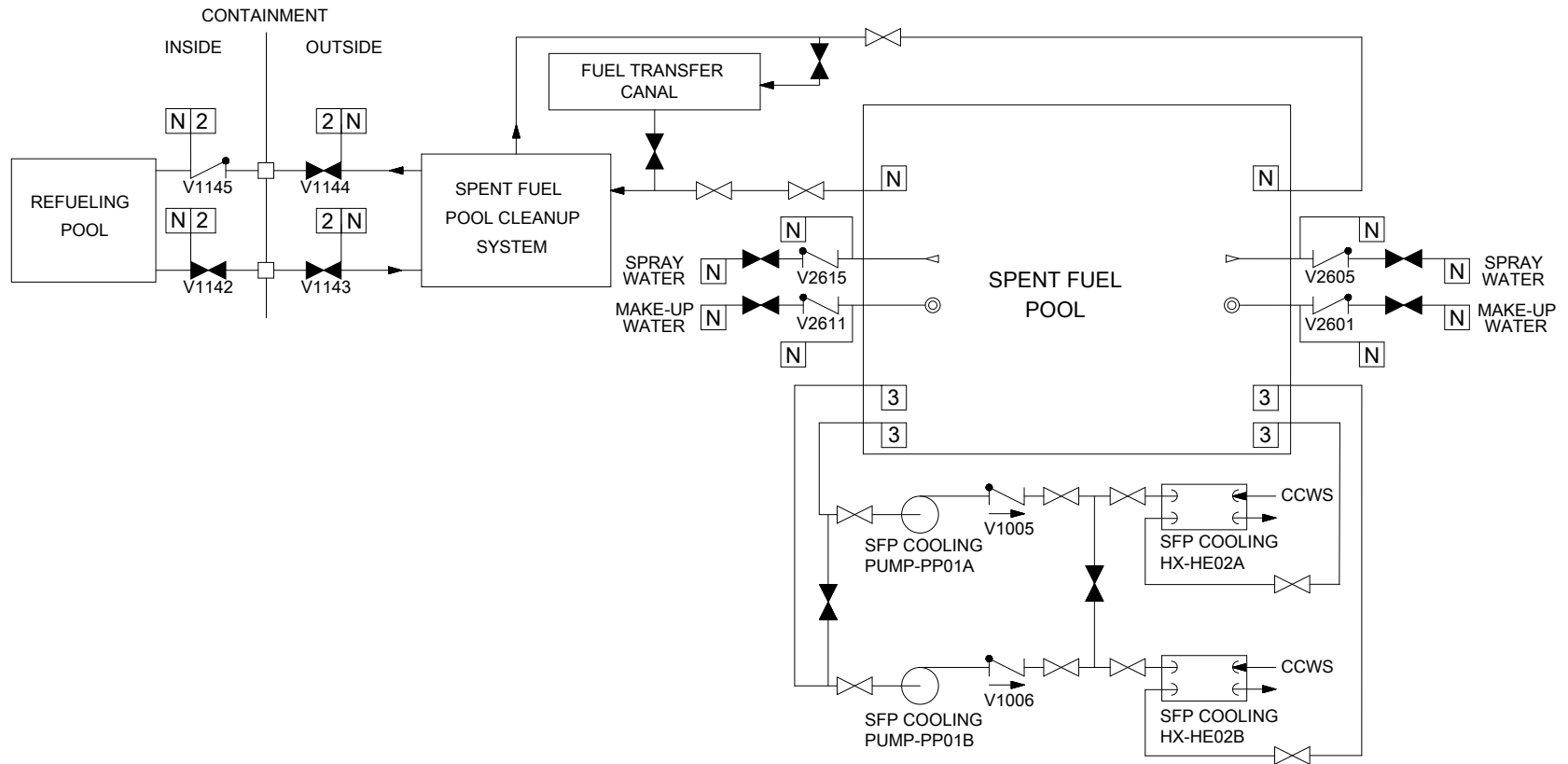
□ Function

- 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



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

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)

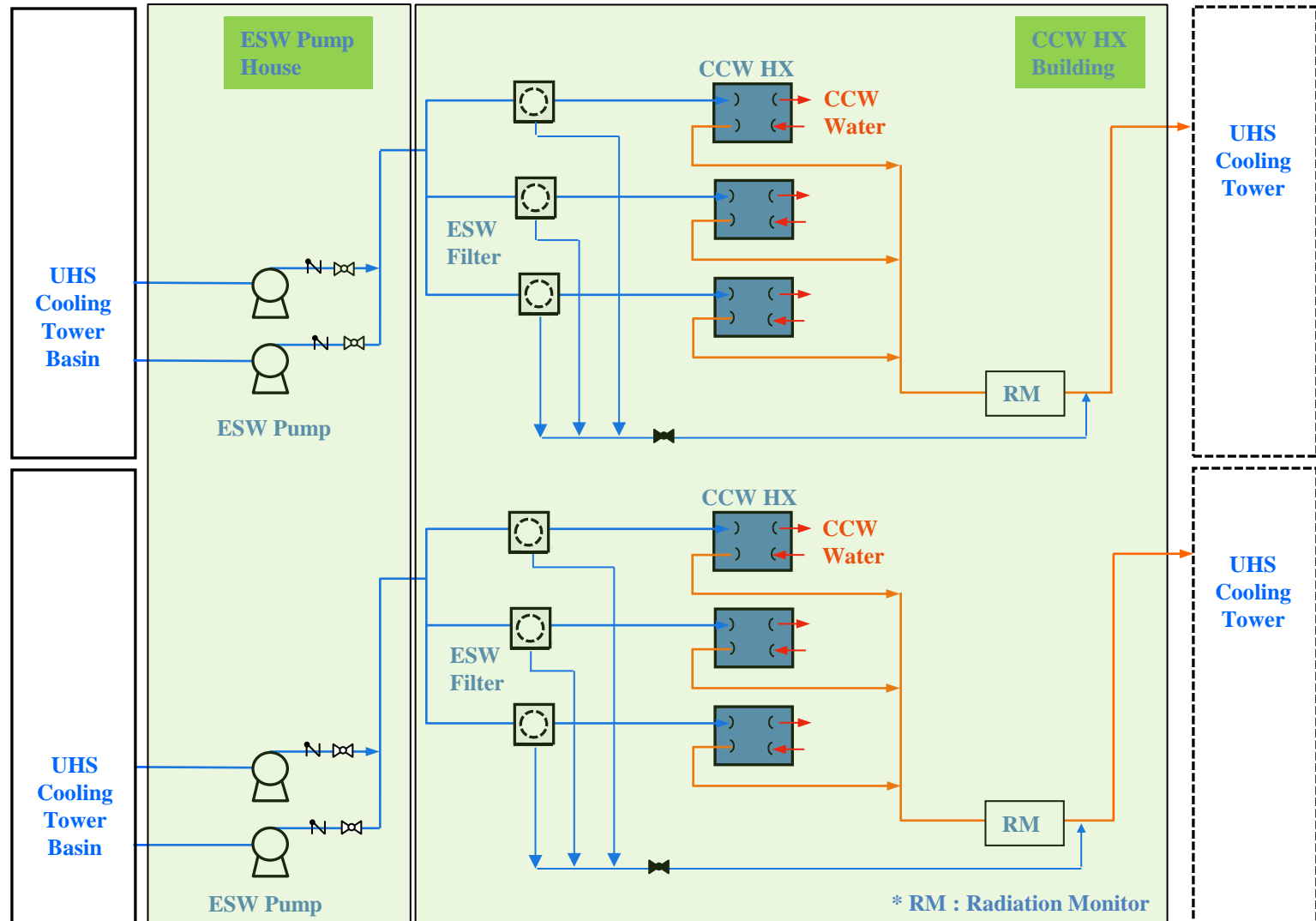
□ Function

- 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)



9.2.2 Component Cooling Water System (CCWS)

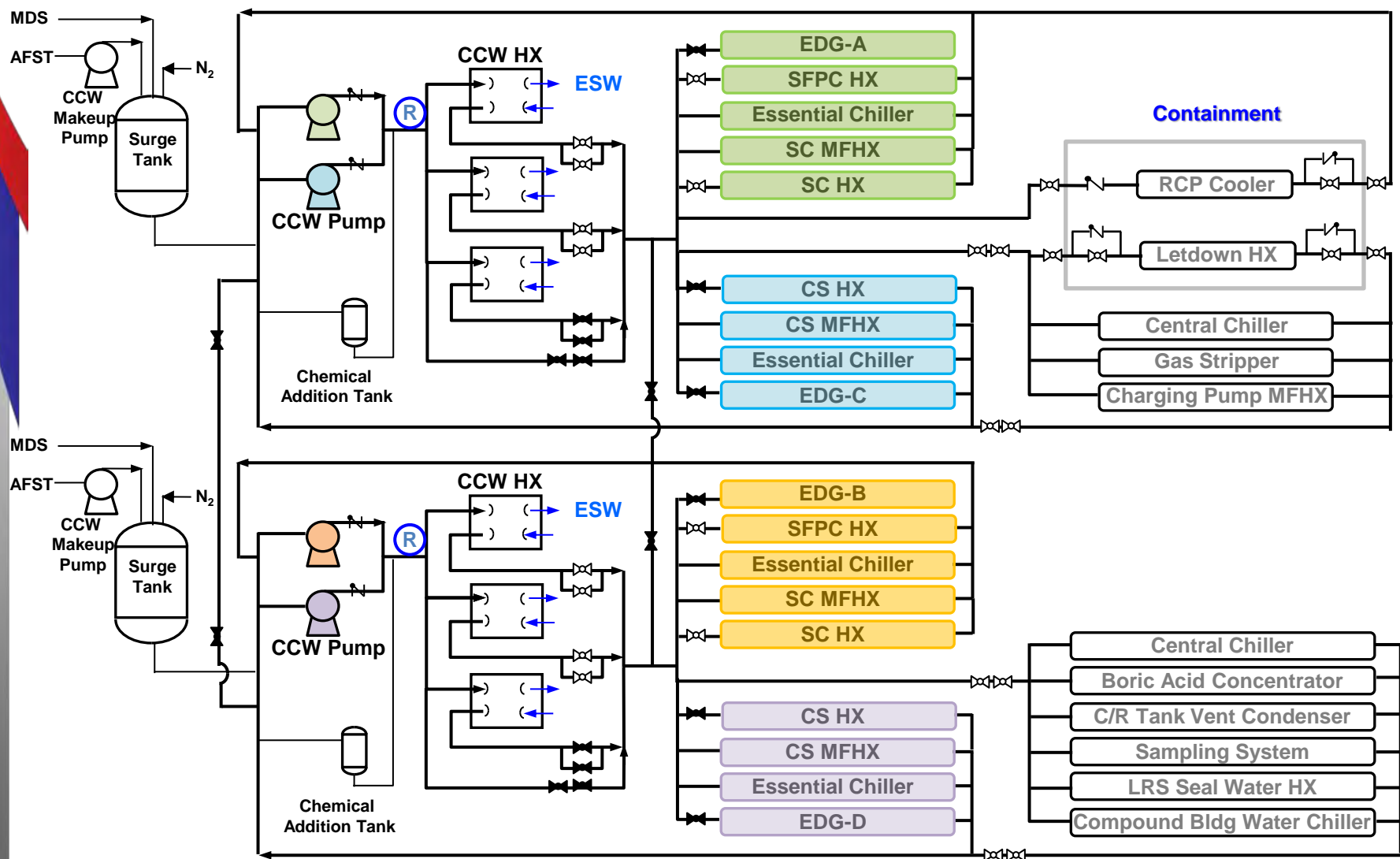
□ Function

- 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.

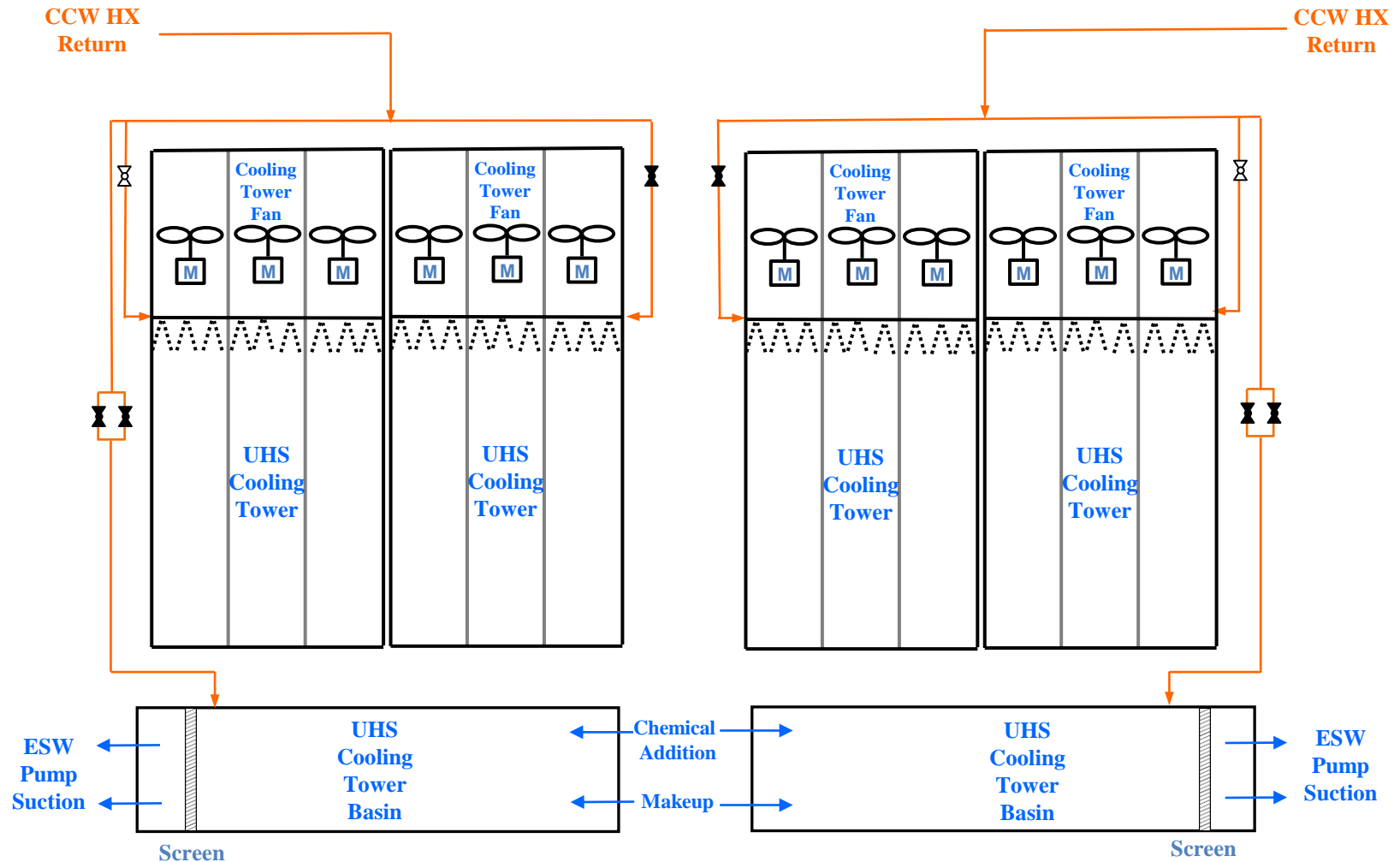
❑ Function of UHS cooling tower system

- 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)



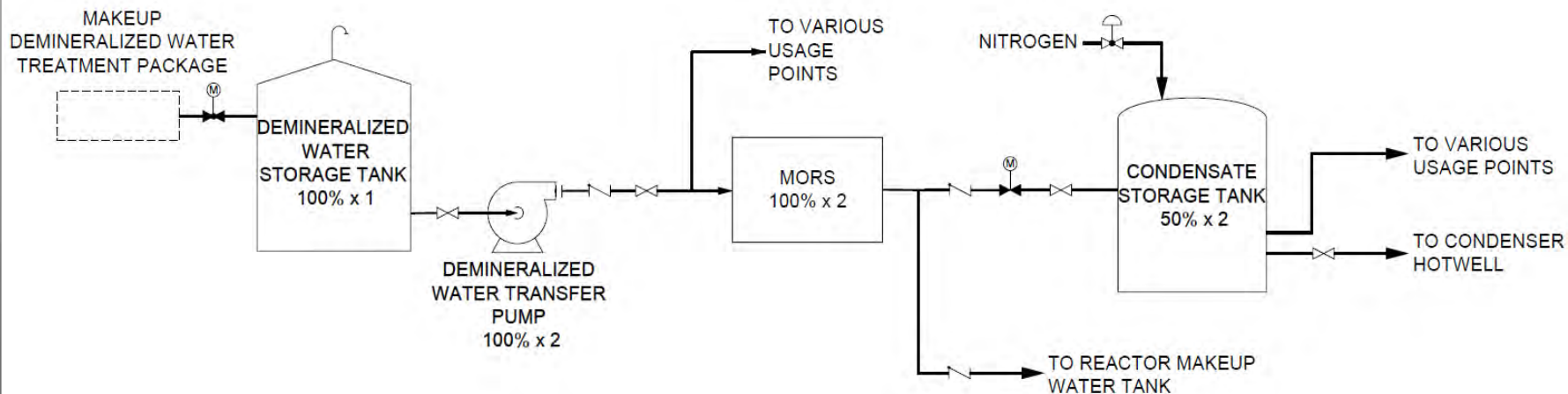
9.2.6 Condensate Storage Facilities (CSFs)

- ❑ **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.

Turbine Generator Building Closed Cooling

9.2.8 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

Turbine Generator Building Open Cooling 9.2.9 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

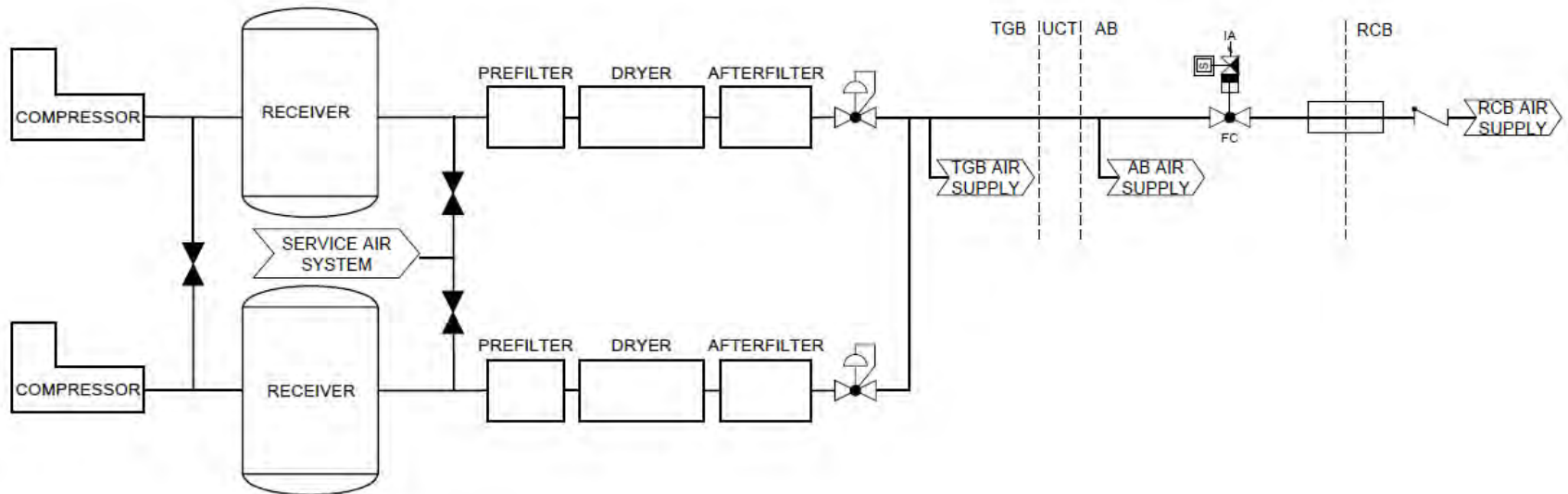
- 9.3.1 Compressed Air and Gas Systems
- 9.3.2 Process and Post-Accident Sampling System
- 9.3.3 Equipment and Floor Drainage Systems
- 9.3.4 Chemical and Volume Control System

9.3.1 Compressed Air and Gas Systems

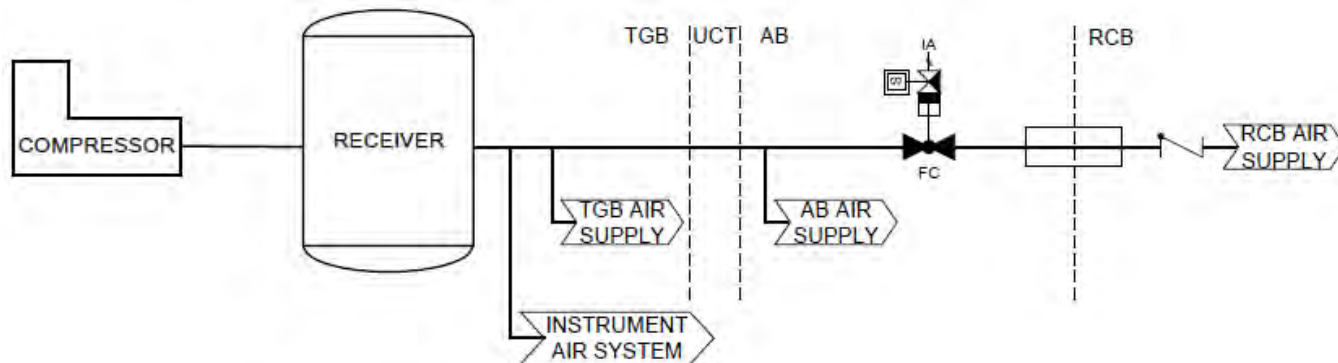
- ❑ **Perform no safety-related function, except for containment isolation**
- ❑ **Design Features**
 - Instrument Air System (IA)
 - Two 100% trains with an air compressor, an air receiver, one set of air dryers, and an air filtering unit in each train
 - The safety-related AOVs fail in safe position 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

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)

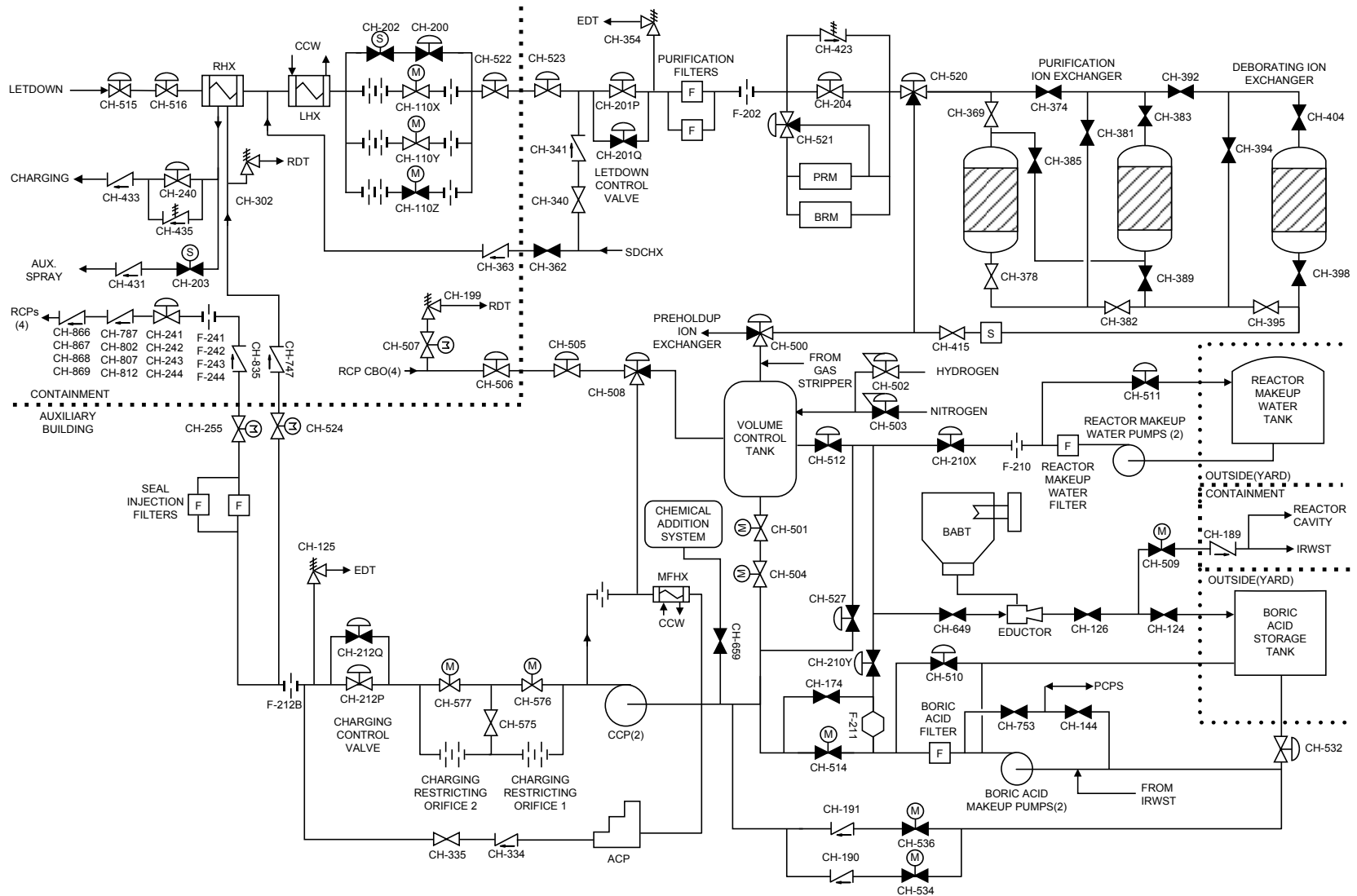
□ CVCS Functions:

- 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 Control Room HVAC SystemSystem
- 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

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

Emergency Diesel Engine Starting Air System (EDESAS)

9.5.6

❑ 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

Emergency Diesel Engine Combustion

9.5.8 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

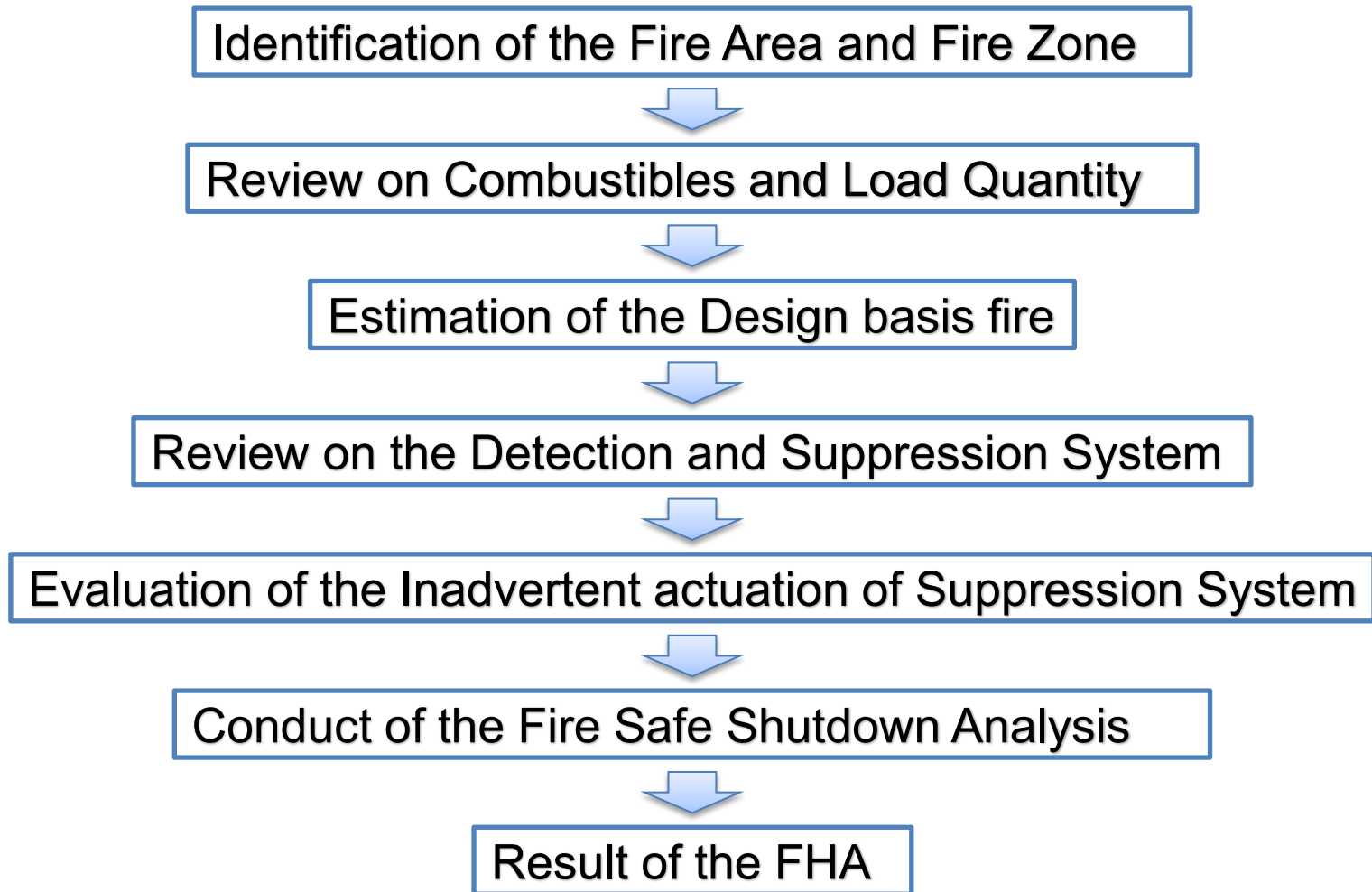
- The potential in-situ and transient fire hazards.
- The capability to safely shutdown the reactor and minimize and control the release of radioactivity to the environment
- The appropriate measures for fire prevention, fire detection, fire suppression, and fire confinement

□ Regulatory Basis

- R.G 1.189, Rev.2
- NFPA Codes
- ANSI/IEEE Std. 383
- NEI 00-01, Rev.2

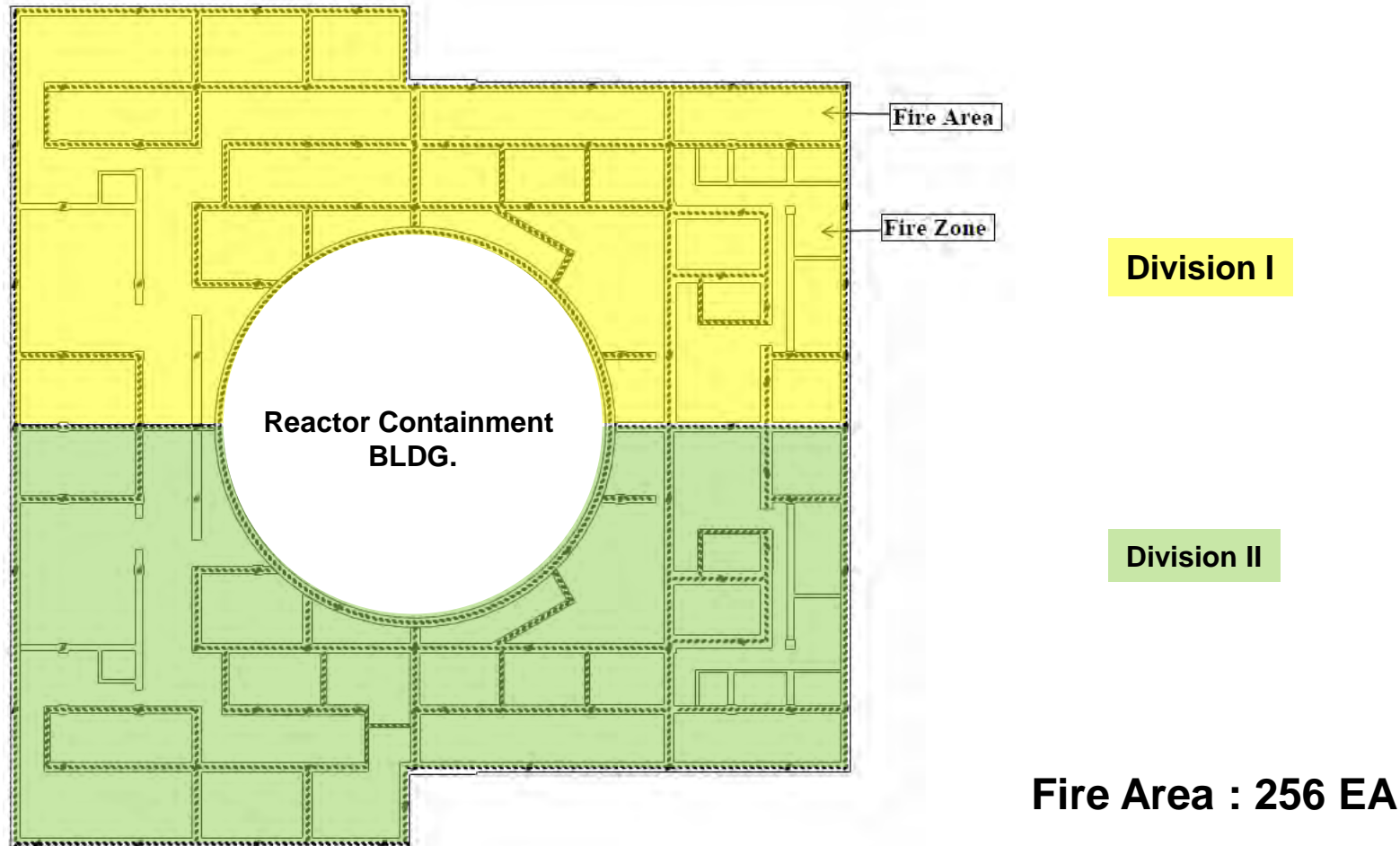
App. 9.5A.1 Introduction

□ The Flow Chart of the FHA Methodology



App. 9.5A.2 Analysis Methodology

□ Example of Fire Area and Fire Zone



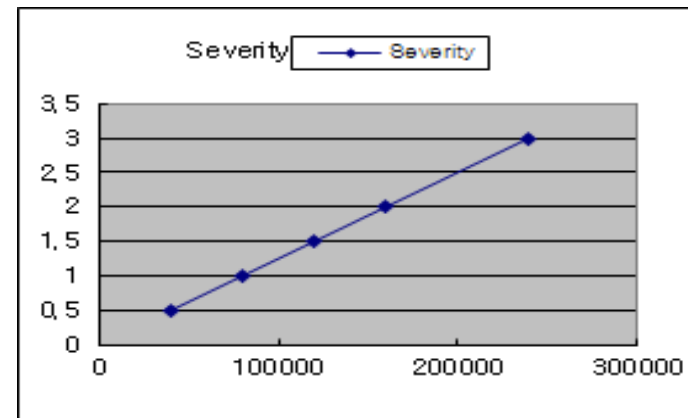
Example of Reactor Containment / Auxiliary Building

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 [$\text{m}^2(\text{ft}^2)$]
- 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	COL	Combined License
AB	Auxiliary Building	CPIAS	Containment Purge Isolation Actuation Signal
ACU	Air Cleaning Unit	CRE	Control Room Envelope
AFST	Auxiliary Feedwater Storage Tank	CS	Containment Spray
AHU	Air Handling Unit	CSFs	Condensate Storage Facilities
ANS	American Nuclear Society	CST	Condensate Storage Tank
ANSI	American National Standard Institute	CT	Condensate Storage And Transfer System
AOV	Air Operated Valve	CVCS	Chemical and Volume Control System
BAST	Boric Acid Storage Tank	CW	Circulating Water Pump
C/R	Condensate Receiver	DWST	Demineralized Water Storage Tank
CCW	Component Cooling Water	ECWS	Essential Chilled Water System
CCWS	Component Cooling Water System	EDECAIES	Emergency Diesel Engine Combustion Air Intake And Exhaust System
CEDM	Control Element Drive Mechanism	EDECWS	Emergency Diesel Engine Cooling Water System
CIAS	Containment Isolation Actuation Signal		
CIV	Containment Isolation Valve		
CLP	Cask Loading Pit		

Acronyms

EDEFOS	Emergency Diesel Engine Fuel Oil System	HEPA	High Efficiency Particulate Air
EDELS	Emergency Diesel Engine Lubrication System	HT	High Temperature
EDESAS	Emergency Diesel Engine Starting Air System	I&C	Instrumentation and Control
EDG	Emergency Diesel Generator	IA	Instrument Air System
EFDS	Equipment and Floor Drainage System	IEEE	Institute of Electrical and Electronics Engineers
EPRI	Electric Power Research Institute	IHA	Integrated Head Assembly
ESF	Engineered Safety Features	IRWST	In-containment Refueling Water Storage Tank
ESW	Essential Service Water	LLHS	Light Load Handling System
ESWS	Essential Service Water System	LOOP	loss of offsite power
FHA	Fire Hazard Analysis	LRS	Liquid Radwaste System
FPP	Fire Protection Program	LT	Low Temperature
FSSA	Fire Safe Shutdown Analysis	LWMS	Liquid Waste Management System
GTG	Gas Turbine Generator	MCR	Main Control Room
HELB	High Energy Line Break	MDS	Makeup Demineralizer System

Acronyms

MFHX	Mini-Flow Heat Exchanger	RCS	Reactor Coolant System
M/G set	Motor Generator set	RSR	Remote Shutdown Room
MORS	Membrane Oxygen Removal Subsystem	RG	Regulatory Guide
NFPA	National Fire Protection Association	RV	Reactor Vessel
NPSH	Net Positive Suction Head	SA	Service Air System
NPSS	Normal Primary Sampling System	SBO	station blackout
OHLHS	Overhead Heavy Load Handling System	SC	Shutdown Cooling
PACU	Packaged Air Conditioning Unit	SFP	Spent Fuel Pool
PASS	Post-Accident Sampling System	SFPC	Spent Fuel Pool Cooling
PCWS	Plant Chilled Water System	SFPCCS	Spent Fuel Pool Cooling and Cleanup System
PNS	permanent non-safety	SG	Steam Generator
PRA	Probabilistic Risk Assessment	SRP	Standard Review Plan
PWR	Pressurized Water Reactor	SSCs	Structure, System, Components
RCFC	Reactor Containment Fan Cooler	SSE	Safe Shutdown Earthquake
RCB	Reactor Containment Building		
RCP	Reactor Coolant Pump		

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
TGBOCW S	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



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

Staff Review Team

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- Dennis Andrukat, SPSB
- Thinh Dinh, SPSB
- Andrea Meyer, SPSB
- Greg Makar, MCB
- Andrew Yeshnik, MCB
- Nan Chien, SCVB
- Dawnmatthews Kalathiveettil, ICE
- Adakou Foli, NRR/EEB

Chapter 9: Auxiliary Systems

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Fuel Storage and Handling	Alexandra Burja, SRSB Raul Hernandez, SPSB Hien Le, SPSB
Water Systems	Chang Li, SPSB Ryan Nolan, SPSB Angelo Stubbs, SPSB Robert Vettori, SPSB
Process Auxiliaries	Dennis Andrukat, SPSB Raul Hernandez, SPSB Greg Makar, MCB Shanlai Lu, SRSB
Heating, Ventilation, and Air Conditioning Systems	Nan Chien, SCVB
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

- 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 4°C (density = 1 g/cm³)
 - 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

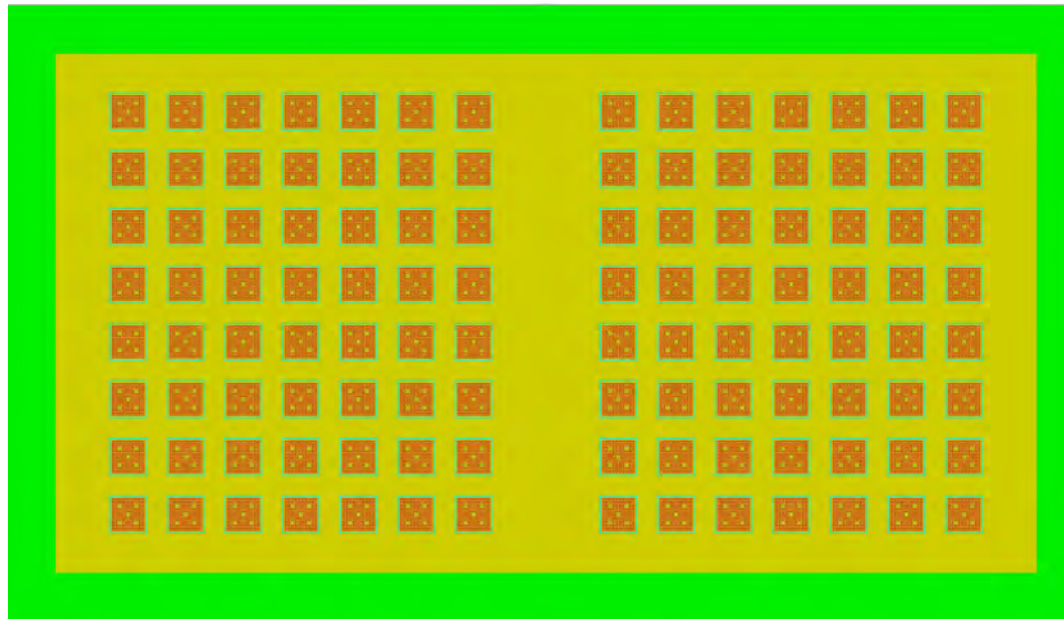
- The staff found the approach consistent with SRP Section 9.1.1 and the analysis results in compliance with 10 CFR 50.68 and therefore acceptable.

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)

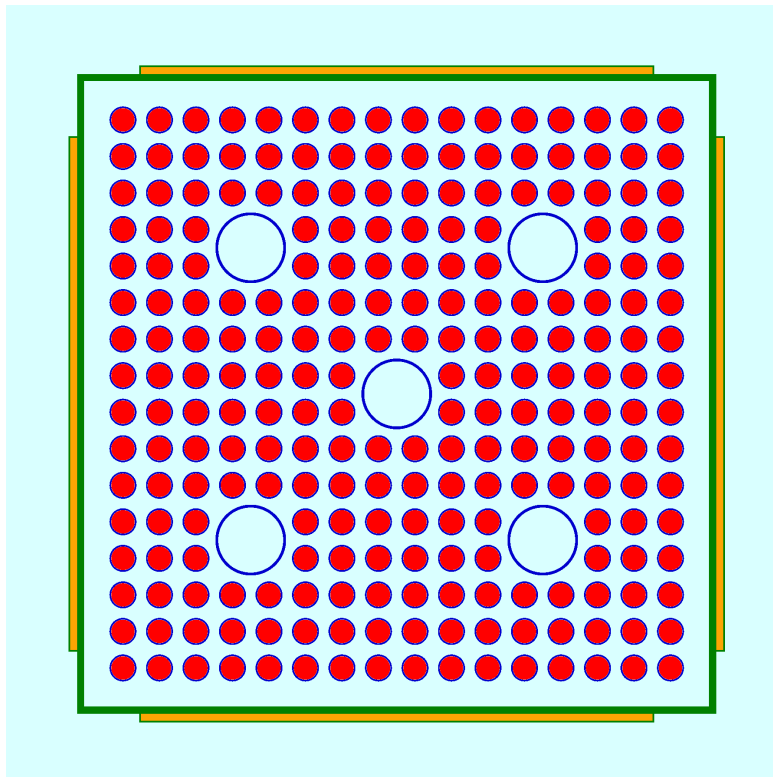
Water Density	Staff Results	
0.13 g/cm ³	0.91313 ± 0.00013	
0.14 g/cm ³	0.91424 ± 0.00015	
0.15 g/cm ³	0.91407 ± 0.00017	
1.00 g/cm ³	0.89904 ± 0.00015	

- 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

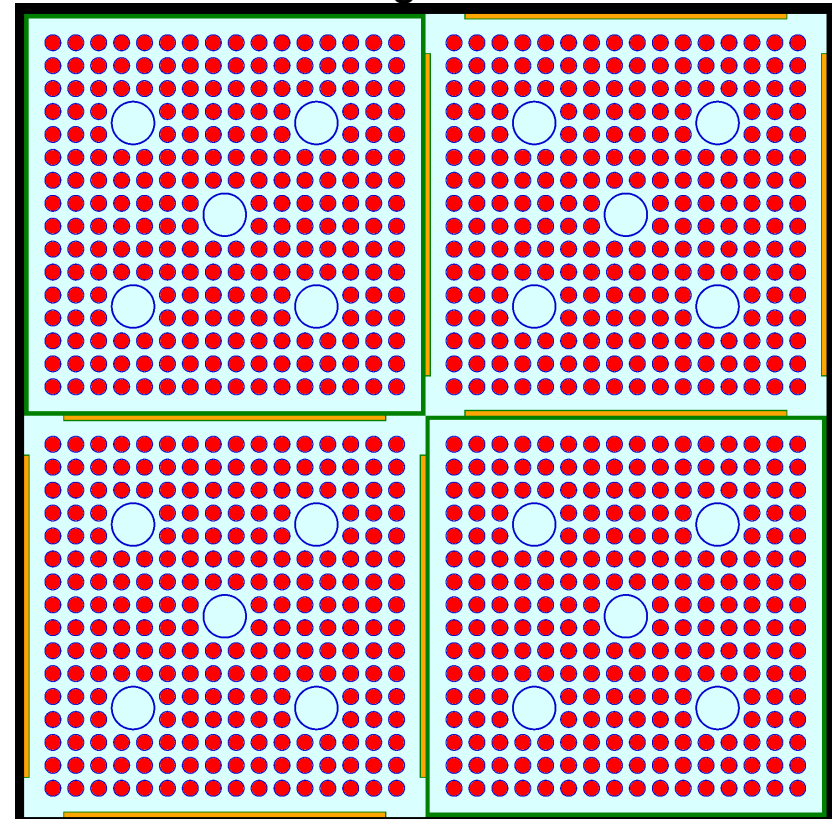
Criticality Safety of New and Spent Fuel Storage

- 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
 - $k_{\text{eff}} > 1.0$ 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

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**

Chemical and Volume Control System

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

Non-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