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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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APR1400 SUBCOMMITTEE

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TUESDAY

OCTOBER 17, 2017

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Matthew Sunseri and Ronald G. Ballinger, Co-Chairs, presiding.

COMMITTEE MEMBERS:

MATTHEW SUNSERI, Co-Chair

RONALD G. BALLINGER, Co-Chair

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

MICHAEL L. CORRADINI, Member

JOSE MARCH-LEUBA, Member

DANA A. POWERS, Member

JOY L. REMPE, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

ALSO PRESENT:

ANDREA D. VEIL, ACRS Executive Director

TONY AHN, KHNP

JOON-HWAN CHOI, KEPCO-E&C

ANTONIO DIAS, NRO

ADAKOU FOLI, NRR

CHE-WUNG HA, KHNP

SEOKHWAN HUR, KEPCO E&C*

KYEUNGMO HWANG, KHNP*

KYOUNG-WOONG KANG, KEPCO-AE

SANGHO KANG, KEPCO E&C

STORM KAUFFMAN, MPR

JUNGHO KIM, KHNP

YOUNGKI KIM, KEPCO E&C

YUNHO KIM, KHNP

DAEHEON LIM, KEPCO E&C

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TANIA MARTINEZ-NAVEDO, NRR

MATTHEW A. MITCHELL, NRO

RYAN NOLAN, NRO

ANDY OH, KHNP

SHEILA RAY, NRR

FANTA SACKO, NRR

CAYETANO SANTOS, NRO

ROB SISK, Westinghouse

SWAGATA SOM, NRR

JAMES STECKEL, NRO

ANGELO STUBBS, NRO

ROBERT SWEENEY, KHNP

DAVE WAGNER, KHNP

WILLIAM WARD, NRO

GEORGE WUNDER, NRO

ANDREW YESHNIK, NRO

*Present via telephone

T-A-B-L-E O-F C-O-N-T-E-N-T-S

P R O C E E D I N G S

8:30 a.m.

CO-CHAIR SUNSERI: Good morning, everyone. The meeting is now called to order. This is a meeting of the APR1400 Subcommittee of the Advisory Committee on Reactor Safeguards. I am Matt Sunseri, co-chairman of the APR1400 Subcommittee. ACRS members in attendance are Dick Skillman, Dana Powers, Ron Ballinger, Dennis Bley, John Stetkar, Jose March-Leuba and Joy Rempe. Christopher Brown is the Designated Federal Official for this meeting.

The purpose of today's meeting is for the subcommittee to receive briefings from Korea Electric Power Corporation and Korea Hydro-Nuclear Power Company, Limited regarding their design certification application and the NRC staff regarding their safety evaluation report with no open items specific to Chapters 8, Electric Power, and Chapters 10, Steam and Power Conversion System.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act. The ACRS section of the U.S. NRC public website provides our charter, bylaws, letter reports and full transcripts of full and subcommittee meetings, including slides presented at the meeting. The

committee only speaks through its published full-committee letter reports. Therefore, any comments provided today are to be considered individual comments from ACRS members, and not to be considered remarks of the full committee.

We hold meetings to gather information to support our deliberations. Interested parties who wish to provide comment can contact our office, requesting time after the meetings announced in the public -- as announced in the published Federal Register. That said, we also set aside ten minute for comments from public members attending, or listening to our meetings. Written comments are also welcome.

The rules for participation in today's meeting were announced in Federal Register on Wednesday, October 11th, 2017. The meeting was announced as open, closed to public meeting. This mean that the chairman can close the meeting as needed to protect information proprietary to KHNP or its vendors.

We ask for those that own the proprietary information, should we near that threshold, that you'll let us know and then we can take appropriate action. There have been no requests for making a statement to the committee has been received from the public. A transcript of the meeting is being kept and will be

made available, as stated in the Federal Register notice. Therefore, I request that participants in this meeting use the microphones located throughout the meeting room. When addressing the subcommittee, participants should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

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

I would request now that meeting attendees or participants silence their cell phones or other electronic devices. And one more point to make -- our staff does its best working with the Applicant and the NRC staff -- they help us create agendas for these meetings even though we don't see the content until just days before the meeting. Most of the time we get a pretty accurate agenda, but sometimes we are off a little bit. And I think today is one of those situations where we will have plenty of time for the

deliberations today.

Nonetheless, I plan to run this meeting with the same discipline as if we had just the amount -- just the right amount of time. So we will proceed through here deliberately. But I do expect that we are going to finish early. So Bill and Rob, I ask that you have your presenters ready to go in advance of the scheduled time so we can make appropriate pace. So with that I will ask Bill Ward, NRO Project Manager, to introduce the presenters and start the briefing.

MR. WARD: Thank you, Mr. Chairman. We are pleased to be here today. The -- the first meeting of Phase 5. A lot of hard work has gone into getting to this point. And we look forward to presenting all the chapters over the next couple of months. I am sure that it will be a quick day today. We try to limit, I think both on staff and the KHNP side, to the changes that have occurred since Phase 3. But we will happily talk about anything that was discussed previously.

CO-CHAIR SUNSERI: And before we get into the presentation, I would like to identify that Charlie Brown has joined the subcommittee meeting. Rob, up to you now.

MR. SISK: Thank you, Chairman. Rob Sisk, Westinghouse, consultant to KHNP. I do also want to

echo -- I do also want to echo Bill Ward's comment that we are very pleased and excited to be entering into Phase 5 -- the review of the SER with no open items and today with Chapter 8 and 10 and look forward to completing these activities. So without any further delays, I would like to introduce Mr. Kang to take us through Chapter 8.

MR. KANG: Good morning, ladies and gentleman. I am Kyoung-Woong Kang, technical analyst from KEPCO E&C, currently serving as design side technical leader of the APR1400 latent power system. This is my third presentation in front of ACRS member.

But whenever I deliver presentation, I feel a little bit nervous. So please help me feel at home. From now on I present to you the current status of DCD Tier 2, Chapter 8 designed to be from the standpoint of this applicant focusing on major technical issues which caused open items and how the issues have been addressed through interactions with NRC staff.

My presentation start with some of the DCD Tier 2 to Chapter 8. And I will speak about technical issues which caused open items and the previous Phase 2 staff evaluation and how KHNP have addressed issues for the resolution of the open items. After that I will finish my presentation by summing up the current

status of Chapter 8.

In order to refresh your memory on the DCD Tier 2 to Chapter 8, electric power system, I would like to show you major contents of Chapter 8. Chapter 8 consists of four sections. Chapter -- section 8.1 provides introduction to the APR1400 electric power system, offsite power system and onsite power system. And also this drives design basis of the APR1400 electric power system.

Section 8.2 provides descriptions on design features of the offsite power systems such as transmission network, switchyard, offsite power circuit to the onsite AC power system. And the section does get design component -- conformance of the offsite power system with the 10 CFR 50 applicable regulated guides.

Section 8.3 provides descriptions on the design features of the onsite AC and DC power system including power distribution increment like -- buses transformers, battery chargers, inverters, cabling, et cetera. And onsite power sources like D/G generator, batteries, and so forth. And the section discusses design components of the onsite AC and DC power system with 10CFR50 and applicable regulated guides.

Section 8.4 describes the APR1400 strategies to complete a station blackout and is in conformance with 10CFR50 and applicable regulated guides.

The APR1400 electric power system is described in DCD Tier 2, Chapter 8 and Tier 1, Section 2.6. The latest version of DCD Tier 1 and 2 were released to NRC on March 17th, this year -- March 12, this year -- sorry. Technical report onsite power system analysis, which demonstrates adequacy of the APR1400 electric power system under various plant operation modes has been provided to NRC. The latest version of the technical report, onsite power system analysis, Region 2 was submitted on March 17th, this year.

To date, 77 REI questions have been raised for Chapter 8. And all of the questions have been responded to with no pending items and no additional questions being expected currently. This is a list of open items identified in Chapter 8, Safety Evaluation Reports of Phase 2. There are five open items in total. But four open items stemmed from the same issue, compliance with SECY-91-078. So technically there were two issues, first, to address.

First open item is serious compliance with SECY-91-078. Three REIs have dealt with this single

issue, and I said, open items were identified in a different part of Phase 2, Safety Evaluation Report, due to this issue. Point of this issue are SECY-91-078 requires at least one offsite power circuit should be supplied directly to each redundant safety division with no intervening non-safety buses so that the offsite source can power the safety buses upon the failure of any non-safety buses.

APR1400 design does not have an intervening non-safety bus in the current offsite power configuration. However -- okay.

PARTICIPANT: The screen went out.

MR. KANG: However -

PARTICIPANT: It's rebooting.

MR. KANG: All right. I can move on, no problem.

(Laughter.)

MR. KANG: However, the design does include -- does include transformer windings commonly connected to Class 1E and non-Class 1E buses. Initially KHNP considered that APR1400 offsite power configuration released a minimum requirements of SECY-91-078. But the staff didn't see the proposed design was in conformance with staff's intention of the SECY paper.

So in RAI 8426 KHNP was requested to provide detailed justification how the APR1400 offsite power system design properly meets the requirements of GDC 17 and SECY-91-078. Okay.

CO-CHAIR SUNSERI: Before you move on, can you just give us a real --

(Pause.)

MR. KANG: In the response to --

CO-CHAIR SUNSERI: Just a minute. I have a question. Can you just give us a real overview of how that transformer winding issue was dealt with. I know there was concern about the intervening safety buses and -- and that involved non-safety coming off of one of the windings, right? So how did -- how was that resolved?

MR. KANG: Basically, SECY-91-078 pointed out intervening buses between offsite power circuit and Class 1E safety buses. So often a -- or intervening buses -- one safety intervening buses, there's no way to supply offsite power to those safety buses. So in SECY-91-078 the staff requested that at least one offsite circuits should be supplied to the Class 1E safety buses -- both the divisions -- upon a failure of any non-safety buses.

But when it comes to the APR1400 offsite

power -- offsite power design, we have no intervening buses. But we have common transformer windings to safety buses and non-safety buses. Upon a failure of any non-safety buses by secure isolation of the faulted bus, we can provide supply from any offsite power circuit to safety buses in both divisions. So we believed we -- our design satisfies minimum requirements of SECY-91-078.

So basically SECY-91-078 has been set up on the basis of EPRI ALWR design. In EPRI ALWR design there is one -- there is non-safety intervening buses. But our design is different from their design. But staff has --

CO-CHAIR SUNSERI: Okay, so I think what you said is --

(Simultaneous speaking.)

MR. KANG: Nevertheless, staff has concerns of the common transformer winding. So we demonstrated by analysis, no supply, FMEA that we properly addressed those staff's concerns in SECY-91-078.

MEMBER STETKAR: I think -- I think what you did is you installed another breaker in series to each 4.16 KV and 13.8 KV non-safety bus. Didn't you do that?

MR. KANG: Sorry?

MEMBER STETKAR: Did -- I think to resolve the staff's concern -

MR. KANG: Yes.

MEMBER STETKAR: The design was modified to install a second protection circuit breaker in series --

MR. KANG: Yes.

MEMBER STETKAR: To each 4.16 KV and 13.8 KV non-safety bus. Is that correct?

MR. KANG: Correct.

MEMBER STETKAR: Okay. I will ask the staff about that when they come up.

MR. KANG: I have to check, next slide. In the response to RAI 8426 KHNP provided a detailed explanation on how the proposed APR1400 electric power system design complies with GDC 17 and SECY-91-078. In the response, KHNP justified compliance of the APR1400 design with SECY-91-078 by comparing the offsite power system configurations of APR1400 and EPRI ALWR in terms of SECY compliance. Because SECY-91-078 requirements have been set upon the basis of EPRI ALWR similar design.

Here is a proper -- a failure mode and a fact analysis with demonstrate that organized --

failure -- non-safety bus or connection, the APR1400 offsite power system will note lose its ability to supply the safety loads of bus divisions and also shows that the APR1400 design provides higher level -- availability than that of EPRI ALWR due to the double breakers in service as John Stetkar mentioned.

In addition, KHNP provided detailed descriptions in how the proposed design properly addressed the staff-raised concerns of common transformer windings to the Class 1E and non-Class 1E buses as shown below. After that, staff considered the response as acceptable and issued RAI 8730, requesting the Applicant for -- incorporation into the DCD in compliance of offsite power system that GDC 17 and SECY-91-078.

In the response to -- I am sorry. In the response to the RAI 8730 KHNP provided a mark-up of DCD Tier 1 and Tier 2 as necessary, including descriptions of the APR1400 design compliance with GDC 17 and SECY-91-078 and revised descriptions of verification program in order for the COL applicant to verify as-built design conforms to the required design features. For your information, I tested -- this is the mark-up in the response to RAI 8730 at the end of this presentation material.

Display come back again. By the response above, four open items related to this issue were resolved. Next one. The second open item issue is Open Phase Condition. Two RAIs have dealt with this issue, which was being tracked as open item 8.02-1. Point of issue -- this issue -- are regard to design vulnerability -- a vulnerability described in Bulletin Letter 2012-01.

The Applicant should explain how its electrical system design would detect, alarm and respond to open phase conditions with or without high impedance ground. KHNP decided that the COL applicant would choose a specific type of PC detection and protection features, which is technically feasible and efficient among multiple application solution -- applicable solutions for the APR1400 at the time of size-specific design by the COL applicants.

In RAI 8521, the staff requested that descriptions and the DCD should have sufficient details so that the COL applicant can implement a design to detect, alarm and mitigate against OPCs. In the response to RAI 8521 -- in the -- in the response to RAI 8521, KHNP has provided a formal response including a result of design vulnerability study including unbalanced load flow, a study into multiple operating

scenarios with open phased conditions, minimal required design features, open phased detection system to be installed in the primary side of MT transformer and standby aux transformers.

The DCD mark-up, which incorporate the design features of OPD system, and this is the COL items and ITAAC. Following the response, the staff issued RAI 8729 which has requested the Applicant for further information on protective features as follows. After the issuance of RAI 8729, staff notified KHNP that the details of OPC protection features to be applied for the APR1400 can be deferred to the COL application phase.

Okay. Based on the staff notification about OPC projects and features, KHNP decide to defer the detailed design of OPC detection and protection features -- the so-called OPDP System -- to the COL application phase. This is because currently there are multiple technical solutions of OPCs which can be out for the APR1400 draft. And there will be more and better solution in the future. The solution could be provided in Class 1E or non-Class 1E system depending upon the open phase detection method. One technically feasible solution among multiple candidates is to satisfy the functional requirements of the OPDP system

as stipulated in the DCD will be chosen in the COL application phase.

Accordingly, KHNP provided response to RAI 8729 including description of compliance of OPC protection features with BTP 8-9 and revised DCD mark-up reflecting deferral policy of the detailed design of the OPC detection and protection features. By the response above one open item related to this issue was resolved.

Okay, currently Chapter 8 is on a success path for completion on schedule. A draft ASER with open items -- without open items was issued as of September 18th, this year. Five open items which were identified in Phase 2 and 3 have been resolved with adequate and sufficient discussion with staff.

In the course of -- as a resolution of the open items, there have been changes of DCD Tier 2 Chapter 8 as -- the DCD Tier 2 Chapter 8 as reviewed in mark-up in response to RAIs will be incorporated into the next revision, Revision 2, of the DCD. That's all. Any questions?

CO-CHAIR SUNSERI: Thank you.

MR. SISK: So that completes the presentation on Chapter 8 for KHNP APR1400. We will entertain any questions or withdraw to the --

MEMBER STETKAR: I have several. And I'll -- I'll just run through these in the sequence that I wrote them down because they -- they kind of follow the sequence of Chapter 8. Some of these are continuations of questions that I raised during the -- the Phase 2 meeting that KHNP or the staff said well, we will get back to you later. It's now later. Some of them are new ones that I noted in changes to either the DCD or the SER.

The first one is with regard to the power supplies for valves -- excuse me -- associated with the pilot-operated safety relief valves on the pressurizer. The DCD was expanded in Section 8.3.1.2.3 to address conformance with TMI action plan requirements to address these power supplies. In -- in the DCD it says for the APR1400 there is no power operated relief valve or block valve which requires any electrical power. And that statement is used as a basis for saying we comply with the TMI Action Plan requirements because we don't have a PORV or a block valve.

Well, I disagree with that statement. You have pilot-operated safety relief valves. For each pilot-operated safety relief valve in the vent line from the pilot valve -- the pilot valve is

pressure-actuated, it is not electrically actuated. But in the vent line from each pilot valve there is a motor-operated isolation valve. The purpose of that motor-operated isolation valve is to close if the pilot valve opens spuriously, or if it sticks open.

If you close the motor-operated valve you block the vent path and the main POSRV goes closed. I submit that that is the same function as a block valve. It stops steam relief through the POSRV. So I -- I don't understand why you say you do not have block valves. In the control for each POSRV there is also two series -- normally closed -- motor-operated valves that can be opened by the operator to directly vent the piston from the POSRV, allowing the POSRV to open.

I submit that the function of those two motor-operated valves is precisely the same as my being able to open somebody else's POSRV from the main control room. So I do not understand why, simply because what you call these things don't look like somebody else's PORV, you do not need to satisfy these requirements. Could you explain that, please?

(No audible response.)

MEMBER STETKAR: And I will certainly ask the staff that, prepare yourselves, because you have accepted this -- the fact that they don't have something

called a PORV.

So just explain why you don't need to meet these requirements. And, as a follow-on, I want to know precisely what the power supplies are to each one of those motor-operated valves for each one of the pilot-operated safety valves to confirm that they are indeed from a reliable power supply, which is the intent of the TMI action plan. You obviously don't have that detailed information available today.

MR. KANG: I am sorry. To be honest, we do -- we have -- in Chapter 8 there are some interface information. So this is part of interface information, but --

MEMBER STETKAR: That's right, and that's -- the reason I bring this up is one of the functions that the ACRS serves is to look at the entire design in an integrated fashion. So we look in particular at these interfaces between mechanical-electrical, between different chapters of the DCD and the SER. And that's -- that's the reason that I bring this up.

MR. KANG: That's right. Remember, this part is taken from the response from the KEPCO system design -- the Chapter 5 side. So --

MEMBER STETKAR: Okay.

MR. SISK: This is Rob Sisk. The

individual who would need to respond to this is not available today.

(Simultaneous speaking.)

MEMBER STETKAR: I mean the key -- the key, Rob -

MR. SISK: So we have taken the note.

MEMBER STETKAR: Yes. The key, if you get it from the transcript, is that there seems to be reliance on some preconceived notion of what is meant by something that is called a PORV rather than an examination of this design to look at the functional elements of this design with respect to the intent of the regulation in 10 CFR 50.34. And I don't know whether it's an interface problem, or a naming problem or something. But it's obvious that we don't have the right people here today to answer it. So.

MR. SISK: Thank you for the comment. And we did -- looking at -- again, repeating back -- looking at the function versus the title, if you will, or the naming and the intent of -- of that.

MEMBER STETKAR: Yes, and the -- and the intent of -- this is a regulation. So it's not just a reg. guide or something like that.

Okay, that was my first one. I am going to ask the staff about that because they were pretty

happy with what you said. They just repeated it back. Let me ask you again about load shedding. We discussed this during our first meeting. And when I -- what I mean -- say load shedding, in particular DC load shedding.

We discussed it during our first meeting. And the DCD has been enhanced in this area to provide information about specific loads that are -- specific loads that I think are shed at particular times. And to orient you, I will first talk about non-Class 1E loads. So if you -- if you look in the DCD at Table 8.3.2.2, give me a minute why I get the table here.

MR. KANG: Eight point three -

MEMBER STETKAR: 8.3.2-2.

MR. KANG: Okay.

MEMBER STETKAR: I didn't copy the whole table, so I need to -- there it is.

MR. KANG: I found it.

MEMBER STETKAR: Okay. Now these are -- and -- and I'm just -- I will just for the sake of argument look at the first page first. That table now specifies a particular load profile, if I can call it that, for individual loads. And I -- I understand, I think, the load profile. But as best as I can tell from that table, there are -- most of the instrument

power inverter loads seem to be shed at 30 minutes. If I look at the last entry in the table.

MR. KANG: Correct, correct.

MEMBER STETKAR: It seems that they're -- most of them are shed at 30 minutes. And it seems that all of the rest of the loads, except for emergency lighting, are shed at two hours.

MR. KANG: Correct.

MEMBER STETKAR: And -- and that's the way that you achieve the eventual eight-hour battery time --

MR. KANG: Correct.

MEMBER STETKAR: In particular for only emergency lighting. Is that correct?

MR. KANG: Correct. Because -- it is because emergency lighting should be supplied by battery backup according to Regulated Guide 1.189.

(Pause.)

MEMBER STETKAR: I think that's where we got -- 1.189 is fire -- fire protection.

(Simultaneous speaking.)

MR. KANG: According to Regulation Guide 1.189, the emergency lighting shall be backed-up.

MEMBER STETKAR: Oh. You know, you have -- you have to excuse me because my eyes glaze over

with regulatory guides and regulations. I just -- I just try to understand designs. Are these loads shed automatically? Or are they shed manually? Do the operators --

MR. KANG: Manually according administrative program. Shedding program.

MEMBER STETKAR: But personnel in the plant, operators I will call them, need to go out in the plant and manually disconnect these loads?

MR. KANG: Yes, and personnel -- should they go to the power distribution board and manually shed as required.

MEMBER STETKAR: Okay. Do you know whether those activities to shed loads are included in your PRA to extend the battery lives? You probably don't know that. I do. They're not.

(Laughter.)

MEMBER STETKAR: So I am curious whether these activities to extend the non-essential battery lives out to eight hours -- if they require manual actions, why does the PRA not account for those actions? Because the PRA does account for offsite power recovery as a function of time. And it presumes that these batteries are available for at least eight hours.

(No audible response.)

MEMBER STETKAR: This is a -- that's more of a PRA question, but I need it to understand how the plant actually worked before I could say this on the record.

MR. KANG: I cannot say definitely, but this is batteries for non-Class 1E, this is -

(Simultaneous speaking.)

MR. KANG: The PRA may not be.

MEMBER STETKAR: No, I understand that. The PRA is supposed to look at the whole plant. And we have a good visual aid here because earlier, when this non-Class 1E display -- one of a redundant set of displays went blank -- you suddenly got rather confused.

And if I am in the main control room and a good fraction of my non-Class 1E, non-safety related displays go blank, it might affect my thought process and my ability to continue to respond to actions effectively, despite the fact that I might have my small subset of safety-related displays available.

So there's -- there's both a -- both a physical effect that if I do not shed these loads the batteries will die at -- sometime earlier than eight hours. I don't know exactly well, because it depends on when you don't shed particular loads. If the

batteries are dead, that may affect your ability to recover offsite power, because offsite power recovery depends on non-Class 1E DC power. So that's a physical dependence.

If you do shed the loads, there is a potential effect on human performance in the main control room due to loss of the non-1E displays, instrumentation and so forth in the main control room. So as I said, that's the -- the second parts of the question are really PRA related. And I understand we don't have PRA people here today. But I wanted to make sure that I understood what these tables were telling me. Because we did not have the detailed timing information in the previous version of the DCD. We have that timing information.

MR. KANG: Right.

MEMBER STETKAR: So that now I know for the non-1E batteries there -- there's a two-stage load shedding, one at 30 minutes and one at -- one at two hours. And that the only loads that are preserved are the emergency lighting loads after two hours.

MR. KANG: Yes.

MEMBER STETKAR: Let me make some notes here. We have enough time so -- it will help me to scribble a couple of notes.

(Pause.)

MEMBER STETKAR: It's also interesting that the DCD does not mention anything about load shedding, except for these tables. I mean, you have to -- you have to infer what's going on from the table. It does -- the DCD simply says that the battery life is eight hours. It doesn't say that the battery life is eight hours provided that you manually go shed loads at thirty minutes and two hours.

CO-CHAIR SUNSERI: Yes, that -- that almost sounds like something that should be identified as a COL action that those actions get proceduralized and trained on and everything else.

MEMBER STETKAR: You'd think, wouldn't you. Again, I -- I tend not to look at -- kind of procedurally, the things. But you're right, Matt, it -- it certainly would seem that way. Let me --

(Pause.)

MEMBER STETKAR: I take a lot of notes. And the good thing about taking notes is I have them to refer to. The bad thing is I need to find the right ones because -- because honestly a lot -- a lot of the updates to the DCD and the SER did resolve some -- several of the questions that I had from earlier. So I -- need to thumb through the ones that are still

applicable.

The next one that I had -- and this is -- in order. There was an expanded discussion in the Rev. 1 of the DCD about quality assurance for the alternate, alternating current gas turbine generator -- the AAC GTG. And as best as I can tell -- I want to confirm this -- it seems to say that 10 CFR 50, Appendix B -- Bravo -- quality assurance will apply for that AAC GTG. Is that accurate?

MR. KANG: AAC GTG is part of this -- is classified into the risk significance, non-safety equipment.

MEMBER STETKAR: Yes.

MR. KANG: So according to Chapter 17.45, 10 CFR -- instead of 10 CFR 50, Appendix B -- especially QA program, which is dedicated to risk-significant, non-safety equipment will be applied instead of 10 CFR 50, Appendix B. So, that --

MEMBER STETKAR: I'm --

MR. KANG: So Chapter 8 -- QAPD -- quality assurance -- QAPD program will be applied to the risk-significant, non-safety -- safety equipment like AAC GTG.

MEMBER STETKAR: Okay, I -- I'm not -

MR. KANG: So it is stated in Table 3.2-1,

if you look at --

MEMBER STETKAR: I didn't look at Table 3.2-1, I -- I looked at -- in DCD I looked at Table 8.4.2-1. Let me pull it up here so I have it. Under the quality assurance in that table. It says the quality assurance of the AAC GTG follows the QA program for the APR1400 design certification described in DCD Tier 2, Section 17.5, which applies the requirements of 10 CFR 50, Appendix B. That's -- that's what got me confused.

Because I am very familiar with the -- I will call it enhanced quality assurance for non -- for risk-significant non-safety related equipment.

MR. KANG: If you look at DCD 202 -- subsection 8.4.2.2 the -- I think it's guidance for the AAC GTG is described in Chapter 7.

MEMBER STETKAR: I see that. I -- the reason I ask this question is I wanted to understand -- I -- I am not sure that I understand the entry in that table. When I read the entry in that table, 8.4.2-1, I suddenly thought that I understood that you were applying Appendix B to the AAC GTG. Now the reason I bring this up, in the SER the staff specifically says the Applicant further clarified that the QA program applies to requirements of 10 CFR 50, Appendix B. So

maybe the staff didn't understand your intent, either. So I will ask the staff about this. But your intent, to be clear -

MR. KANG: Mr. Stetkar, this appendix B is not Appendix B of 10 CFR 50. This is Appendix B to Regulatory Guide 1.155.

MEMBER STETKAR: I --

MR. KANG: It's different Appendix B.

MEMBER STETKAR: You basically want to say on the record that it's Appendix A of Regulatory Guide 1.155 that specifies the augmented the quality assurance, not Appendix B of Regulatory Guide 1.155. And, I am sorry, in the table it says 10 CFR 50, Appendix B.

(Pause.)

MEMBER STETKAR: I will ask the staff about this one. But your intent is that -

(Simultaneous speaking.)

MR. KANG: We will look at -

MEMBER STETKAR: It's just the augmented quality assurance. And that makes sense to me. Honestly, that makes sense to me. The wording, however, in the DCD might get you into trouble. And I want to make sure that I understand the staff's interpretation of that wording. Because otherwise we

get into a situation where a COL applicant suddenly has to apply 10 CFR 50, Appendix B or take an exception -- or whatever you call it -- to the certified design.

MR. SISK: This is Rob Sisk. I just wanted to confirm, we took the note. We're going to check the conformance on the language. I think the intent is as stated. I don't think you understand the intent.

(Simultaneous speaking.)

MEMBER STETKAR: And that makes sense. I mean, that's what everybody does. Because the follow-on question was, if you're going to apply Appendix B -- 10 CFR 50, Appendix B, to only the gas turbine generator, it seems like you would need to apply it to the entire power supply chain -- the circuit breakers, the bus work and so forth.

MR. KANG: Mr. Stetkar, did you see Table 8.4 -- 8.4.2-1.

MEMBER STETKAR: Yes.

MR. SISK: That's what he's looking at.

MEMBER STETKAR: That's -- that's what I just quoted from.

MR. KANG: Okay, all right. Yes.

MEMBER STETKAR: The -- I was -- I was searching for something else. But -- but what I was -- what I was quoting from is the last entry in that

table. It says quality assurance.

MR. KANG: Quality assurance, yes.

MEMBER STETKAR: My interpretation -- when I read that, my interpretation said that it applies 10 CFR 50, Appendix B. And I had a -- I had a minor question about that when I read this and I thought it was perhaps just a -- a wording interpretation, but then in the SER I found that the staff explicitly said that 10 CFR Appendix B -- from -- 10 CFR 50, Appendix B is applied to AAC GTG. So I will ask the staff about this. I just wanted -- you may want to be careful about the wording in that table.

(Laughter.)

MR. KANG: Okay, I got the point.

MEMBER STETKAR: To point to the appropriate appendix of Regulatory Guide 1.155 to be very clear. But --

PARTICIPANT: All right, I think -

MEMBER STETKAR: That's -- we beat that one enough.

PARTICIPANT: Yes, let's move on to the next one.

(Pause.)

MEMBER STETKAR: I want to clarify the discussion in the Rev. 1 of the DCD -- elaborates a

bit more on coping with a extended station blackout, I will call it. Loss of all AC power.

Let me see if I understand the intent of your coping strategy, first. Are you familiar with it so -- I will put it on the record anyway, but it's my understanding, as I read through Chapter 8 and in particular Chapter 19.3 -- which talks more about the -- the actual strategy -- that the strategy is for the first phase up to eight hours of the coping strategy you basically take credit for the turbine-drive auxiliary feedwater pump.

MR. KANG: Correct.

MEMBER STETKAR: And the available DC power. And in the second phase, from eight hours to 72 hours, you take credit for re-energizing a 480-volt bus on either train A or train B from one of two onsite portable 480-volt gas turbine generators.

MR. KANG: Okay.

MEMBER STETKAR: And that in Phase 3 you finally take credit for mobilizing an offsite -- bringing in from somewhere a 4.16 kV diesel -- gas turbine generator -- or some power supply. Okay? So that the only onsite mobile power supplies that you have are the two 480-volt portable gas turbine generators. Is that --

MR. KANG: Right.

MEMBER STETKAR: Okay. That's what I thought I understood. I will then ask -- then my question is to the staff because I am not sure that I got that from the staff's conclusion.

(Pause.)

MEMBER STETKAR: I think most of the other questions that I have are more oriented towards staff interpretations in the SER, so don't run away in case we need some factual information. But I think that's all I have for -

(Simultaneous speaking.)

CO-CHAIR SUNSERI: All right, great. Thanks, John. Any other members have any comments before we release them to get to the staff?

(No audible response.)

CO-CHAIR SUNSERI: All right. Well thank you for your presentation and we will ask the staff to come up now for Chapter 8.

MR. SISK: Thank you.

(Pause.)

CO-CHAIR SUNSERI: Okay, thank you for being prepared to start early. So over to you, George.

MR. WUNDER: Thank you, Mr. Chairman. Lady and gentleman of the committee, I am George Wunder.

I am the project manager assigned to Chapter 8 for the APR1400 design certification review. We will be presenting our safety evaluation with no open items for Chapter 8 today. Since a safety evaluation has been previously presented to the subcommittee, we are going to concentrate on the closure of open items. But we believe we have technical staff available to discuss any questions on -- on the remainder of the chapter that you may have.

We've got a very small but able panel today and it consists of Sheila Ray of the Electrical Engineering branch. And I will turn it over to her. Sheila?

MS. RAY: Thank you, George. As George mentioned, my name is Sheila Ray. I am presenting on behalf of my other colleagues who worked on the APR1400 DCD review. And some of them are in the audience. Slide two.

The APR1400 electric power system consists of the offsite system and onsite AC and DC systems. During the staff's review in phase 2 there were two open items. Both issues were closed in Phase 4 and today I will discuss the open items and the resolution of these items.

The open items are conformance with

SECY-91-078 and open phase conditions. Next slide. Regarding conformance with SECY-91-078 there are two policy issues. First, there should be an alternate power source of the non-safety loads. The APR1400 design meets this criteria since offsite power can connect through the SAT to provide power to non-safety buses.

The second policy issue is that at least one offsite circuit to each redundant Class 1E division should be supplied from offsite power with no intervening non-safety buses. The APR1400 has the common transformer winding on the UATs and the SATs that feeds both non-safety and safety buses. Staff's position was that a failure in the non-safety system could impact the safety buses. The Applicant provided a failure modes and effects analysis to demonstrate that a failure of the non-safety bus or connection will not impact the safety bus.

Staff had three concerns associated with the common transformer windings. One, voltage regulation of the safety buses. Two, transients caused by non-safety loads impacting the safety buses. And three, failure points between the offsite power supply and safety buses.

Slide four. For the first issue of voltage

regulation of the safety buses, on-load tap changers on the transformers maintain the voltage of the safety-related buses. Secondly, regarding transients, the Applicant demonstrated through the large motor-starting study, bus transfer study and FMEA that the Class 1E equipment will be able to perform their intended function under various scenarios and transients.

Staff verified the assumptions and methodology of the studies during an audit. Lastly, bus transfer will allow transfer of power to an alternate power supply or diesel generator, and thus the safety buses will be able to perform their intended function.

In addition, ITAAC number 26 was added to ensure that the COL applicant verify that Class 1E loads will not fail due to transients on the non-Class 1E electrical equipment during non-Class 1E large motor starting or re-acceleration. Slide five. Additional ITAAC ensure that the safety buses will be able to perform their intended function. These include ITAAC 20 for short-circuit faults on non-1E buses not affecting the safety system. ITAAC number 8 on bus transfer and new ITAAC number 26 discussed on the previous slide.

The staff finds that the electrical design meets the policy issues addressed in SECY-91-078 and the open item is resolved.

MEMBER STETKAR: Let me ask you to stop here. We had quite a bit of discussion about this in the previous meeting. So KHNP has added another circuit breaker in the series for each of those non-safety related buses to address the staff's concerns about one particular type of transient that the staff felt couldn't be protected with the previous design. Has -- we like to say, I hope we do, that we use risk information to help us in our reviews and our conclusions about nuclear power plant safety.

I am always concerned about adding new circuit breakers in series because that tends to me to double the likelihood that I might drop something. And it adds new protection and control signals that can be vulnerable to things like fires and spurious signals. So has the staff taken a look at this from the risk perspective to confirm that, indeed, the -- the new design that the staff has basically -- I don't want to say required, but instigated -- that that design actually has a lower risk to the plant compared to the previous design? Do you know that?

MS. RAY: So we did not evaluate risk

information.

MEMBER STETKAR: So why didn't you?

(No audible response.)

MEMBER STETKAR: Because we do have risk-informed regulation.

MS. RAY: I understand that. For our resolution of this issue we evaluated the FMEA and analyses to verify that there are no impacts on the safety-related system.

(Pause.)

MEMBER STETKAR: We have many examples of people following the rote rules and individuals' interpretations of regulations. When we examine those examples in the context of an integrated risk assessment, we often find that indeed simply following the rules and people's interpretation of a particular rule gets us into trouble. There are many examples in risk assessment of this. I have -- can give them to you if you want.

And all I am asking is has the staff taken a holistic view of -- of this new design? And I don't know the answer. I didn't do the analysis. It's not my job to sit here and do a risk assessment. But it strikes me that the staff ought to at least consider the fact that something added to the design --

especially in this type of configuration -- might actually have a detrimental effect on risk rather than simply adherence to a particular interpretation of one part of a SECY paper.

MS. RAY: I understand your comment. I would have to get back to you on the evaluation of risk. But we did evaluate the assumptions and the methodology of the studies we are relying on in an audit. So we feel confident that the -- there will be no impacts to the safety buses as a result of a failure on the non-safety system.

MEMBER SKILLMAN: I'd like to join John in his concern. Let me ask a question, if I might, please, Sheila.

The tap changers, are the tap changers automatic or manual?

MS. RAY: I believe they are automatic.

MEMBER SKILLMAN: What do you know about the reliability of those automatic tap changers?

MS. RAY: We don't have information on the reliability of the tap changers. I would differ --

MEMBER SKILLMAN: Okay. Just hold on.

MS. RAY: Sure.

MEMBER SKILLMAN: But those tap changers

are indexing the voltage for that safety valve.

MS. RAY: Correct.

MEMBER SKILLMAN: That ought to be something that we would know very, very well in your failure modes and effects analysis. Let me push a little bit further.

I've got firsthand experience of the combined winding on a transformer. It was an aux transformer, a major aux transformer that was 13.2 down to 6.2, the ECCS voltage. And our problem was we continued to get gassing and that tank continued to pressurize, and pressurized. And what we learned, we idled, we took the transformer offline and we learned that there was a ground in the tank. But that took out 50 percent of our ECCS buses. But a very subtle impact, but we did not safety grade and not-safety grade on that transformer. That was our safety-grade transformer.

It seems that, at least it seems to me that in the failure modes and effects analysis, understanding the voltage regulation, its dependability, and understanding what could be a not-safety winding affecting a safety winding should be very prominent in your choice to accept this design.

That's what John is pointing to.

MS. RAY: I would also add, we did have at least one RAI on transformer protection where we did ask the relays that were included to protect the transformer, and that information was included in the DCD. And I also have --

MEMBER STETKAR: Just to clarify, what I'm actually pointing to is not that. I'm pointing to the reliability of the non-safety-related power supplies that have an effect on risk, and the effects of new protection and control signals input to those breakers that might have some sort of feedback effect, but not Dick's concern about the shared winding.

I'm personally -- this is a Subcommittee meeting -- I'm personally fine with the shared winding, provided that you have adequate frequency and voltage protection signals on what may be a single feeder breaker to the non-safety buses.

MS. RAY: I understand your comment.

MEMBER STETKAR: And that's my concern. But Dick said, well, that's what I was -- I have concerns about tap changers also in terms of their reliability for the overall transformer, but that's a little bit of a different issue.

MS. RAY: Thank you for the clarification. What I was trying to address with Member Skillman's comment was the staff did evaluate protection of the transformer. And my colleague Swagata Som may have some additional information.

MEMBER STETKAR: Okay. Please.

MS. SOM: Yes, this is Swagata Som, and I'm one of the reviewers.

With respect to your question on the on-load tap changer, if the on-load tap changer is not working, then that will be detected by the undervoltage. And if the undervoltage goes to a certain limit in the protection system, the UAT, or the unit auxiliary transformer, will be transferred to the station auxiliary transformer and, then, it will not interrupt the power flow to the safety system.

MEMBER SKILLMAN: Thank you.

One final question. On failure of the tank, which is the tank that is feeding both safety and not-safety, if there is a failure in that tank such as the whole tank for the transformer is taken out, are you depending upon the redundancy feature of the system to carry the plant?

MS. RAY: Well, if I understand correctly,

there will be a bus transfer, and you also have the emergency diesel generators to pick up the safety loads. So, there is defense-in-depth and redundancy.

MEMBER SKILLMAN: Does the diesel feed this transformer tank?

MS. RAY: No, but the safety loads are --

MEMBER SKILLMAN: Transferred out?

MS. RAY: -- are powered by the diesel. Or, before you get to the diesel, you would transfer to the SATs.

MEMBER SKILLMAN: Okay. Thank you.

MS. MARTINEZ-NAVEDO: If I may, good morning. My name is Tania Martinez-Navedo. I'm the Branch Chief for the Electrical Engineering, New Reactors, and License Renewal Branch.

I just wanted to add a quick comment to Mr. Stetkar's question. For the electrical engineering technical reviewers, we typically use the SRP for our review. And it's based on a deterministic approach. While we do consider risk-informed approaches if the applicants provide them, as directed by Commission policy, our current guidance only has guidance per se on deterministic reviews.

If an applicant offers risk-informed

approaches, electrical engineer reviewers will take a look at defense-in-depth and safety margins because that's the deterministic piece of a holistic approach. So, as of this point, the reviewers for the Chapter 8 only concentrated on the deterministic review because that was the information offered by the applicant.

MEMBER STETKAR: Thanks. For the record, because this is a public meeting, I think we have to be careful about the use of the phrase "risk-informed" when the staff talks about reviews. The applicant did not and does not propose that this is a risk-informed application in the sense that they are relying on the models or the results of their PRA as a basis, as part of their license and basis. And therefore, the staff, because of that, has not reviewed this application in the context of a risk-informed licensing application.

An example of a risk-informed licensing application is a risk-informed fire protection program known under 10 CFR 50. -- I don't remember -- 48 I think it is, but whatever the heck it is. But that's a specific application that says we are using the risk assessment as part of our basis for submitting this license. KHNP is not doing that.

I'm asking a broader question of the NRC

staff because the NRC says that we want to use risk information to help our technical and licensing reviews. That is not a regulatory compliance question. I'm asking, does the staff look at something in the design, especially a change, and ask themselves, gee, does this improve risk or make risk worse? That is the staff's own internal process of using risk information, not the use of a licensing basis.

And I'll be quiet there. It's on the record.

MEMBER BLEY: And I, finally, want to add to it just a little bit, John, because I fear some people hear that and say, "Oh, I have to do the whole PRA to get these kind of conclusions."

And the kind of things I think John is pointing to are the kind that have bothered me. And we learned it during PRA. If you have a real integrator who is in charge of the design/development, they look at the interfaces among systems, that sort of thing, to see if there's something funny there. Good engineering. But the PRA points that out, too. Those things affect risk. That brings it up.

A very simple example. The plant has three diesel generators. It sounds like a good idea. But,

under the rules that were developed, thinking of two-phase redundancy, somebody hooks up the pumps that fill the day tanks, two off of one diesel, one off of the other. You've essentially reduced a three-diesel system to at two-diesel system. Does that affect risk? Sure, it does. But could a good engineering thought say something is unbalanced about this; does that make sense? It is kind of that sort of stuff we're getting in it.

MEMBER STETKAR: And by the way, Dennis' example satisfied all of the regulations and satisfied a failure modes and effects analysis that focuses only on single failures. That design was, in fact, single-failure proof and it satisfied all the regulations. On the other hand, from an integrated engineering perspective --

MEMBER BLEY: A silly design.

MEMBER STETKAR: -- it was, yes, a silly design.

(Laughter.)

CO-CHAIR SUNSERI: All right. Any other questions from the Subcommittee?

(No response.)

All right. Then -- no? Yes, Charlie?

MEMBER BROWN: Excuse me. Did we finish the other one through the open-phase part? No?

MS. RAY: We're getting there, yes.

MEMBER BROWN: Oh, okay. I thought for a minute you were going to pick up your tablet and walk off.

MS. RAY: No, no.

MEMBER BROWN: I'll wait. Go ahead and finish.

MS. RAY: Thank you.

Slide 6. The second open item is regarding open-phase conditions, and the staff's position is outlined in BTP 8-9.

The applicant provided an open-phase detection and protection system. The OPDP system provides detection of open-phase conditions, alarm in the main control room and RSR, and protection features.

The first COL item 8.28, the COL applicant will determine the specific type of system and address the guidance in BTP 8-9. Furthermore, ITAACs were added to ensure the OPDP system functions as designed.

Next slide.

Since the applicant has provided a COL item and ITAAC to ensure the OPDP system provides detection,

alarm in the main control room and RSR, as well as protection features, the staff finds the issue resolved and closed. Currently, Chapter 8 has three confirmatory items on the open items as well as one on the Alternate AC Support Systems.

And that was all I had. I will take any question.

MEMBER BROWN: Okay. Yes, I do have a question. I want through and looked at the response to the RAI and Section 8 in Tier 2 and, then, Section 8.2.1.2. Down about five or six paragraphs it talks about, "During all plant operation, the OPD" -- there's a bunch of editorials. They changed "OPDP" to all kinds of good stuff.

MS. RAY: Right.

MEMBER BROWN: So, "During all plant operation, the OPDP system provides continuous monitoring and self-diagnostics for the surveillance functions to ensure the system maintains the capability or providing protection."

There's an addition that they pasted in that says, "provides continuous monitoring and self-diagnostics of its system if practicable," which sounds like somebody is going to determine if it's not

practicable; then, therefore, it won't be done. That was an added markup, in addition to all the other stuff with what I call somewhat, not a whole lot of detail, but it says you've got to provide alarms and shift systems. But that one particular add seems to say the COL can come back and say it's not practical to do this; therefore, we're not going to have one. That's my overinterpretation or underinterpretation, and there was no comment; that's left in.

MS. RAY: I will --

MEMBER BLEY: I would have deleted that.

MS. RAY: I will take a look at that. But, from the way staff had interpreted, it was that OPDP system will be included. But I will take a look at that.

MEMBER BROWN: That "if practicable," that's a very clear statement that leaves it open to some interpretation they can come in and say, "Hey, it allows us to determine that." And then, you're left hanging, you know, with a bag in your court --

MS. RAY: I understand.

MEMBER BROWN: -- and a big fight.

MS. RAY: I do understand.

MEMBER BLEY: And it's after the fact,

because all the rest of the verification of this is done by -- I don't know -- dozens of ITAACs, a lot of ITAACs for the COL to determine.

MS. RAY: Right.

MEMBER BROWN: And all the requirements are fundamentally determined by the COL --

MS. RAY: Correct.

MEMBER BROWN: -- other than you've got to have a system.

MS. RAY: Correct, for this issue.

MEMBER BROWN: So, anyway, that was my observation, the only comment I had on the whole thing.

MS. RAY: I will take a further look at that.

MEMBER BROWN: Thank you.

MS. RAY: And we can provide comments at the full Committee.

MEMBER BROWN: Thank you very much.

CO-CHAIR SUNSERI: Anyone else? John, you look like you --

MEMBER STETKAR: I don't know. I lost track. I'm trying to find references.

Are you done?

MS. RAY: With the presentation, yes.

MEMBER STETKAR: Yes, okay.

MS. RAY: But we'll entertain all the questions.

MEMBER STETKAR: Sorry.

All right. You heard some of my comments that are on the record already. I won't necessarily repeat all of them.

MS. RAY: I can provide some comments on your questions if you would like.

MEMBER STETKAR: Okay, if you want to do that, that's fine, if you have some of them. Do you want to go through kind of topic by topic or --

MS. RAY: Sure. Regarding your question on the power supplies of the motor-operated valves --

MEMBER STETKAR: Yes.

MS. RAY: -- we did consult with other branches on whether power was needed, and our understanding was that power was not needed. So, we have consulted with our other branches. We can look into it further, but I believe the function that is not our area on the vent line with the motor-operated isolation valve, I cannot speak to the function of that. We would have to consult with our other colleagues on that issue.

MEMBER STETKAR: Okay. Again, I get it to some extent and I don't get it to another extent, but my comment is on the record and I won't belabor it. Please look at the functions of those valves and the intent of the regulations.

MS. RAY: I understand your comment. We'll have to discuss with our mechanical colleagues who have evaluated the valves to look at the function.

MEMBER STETKAR: My biggest concern was that in your section now -- and I'll point -- of the Safety Evaluation, it just simply says, the applicant stated that for the APR 1400 design there is no power-operated relief valve or block valves which requires any electrical power. Then, there's a couple of sentences in between. "Thus, the staff determined that the applicant conforms with 10 CFR 50.34(f)."

So, you made the determination --

MS. RAY: Correct.

MEMBER STETKAR: Not somebody else.

MS. RAY: And that is based on our discussions with our colleagues as well.

MEMBER STETKAR: Okay. I'm sure --

MS. RAY: Pardon me? I'm sorry, was there a comment on that or? Oh, okay. Sorry. On your

comment on the quality assurance for the Alternate AC, the GTG, our understanding is that they do meet Reg Guide 1.155 and that they do not meet the quality assurance criteria in Appendix B, 10 CFR Part 50, Appendix B.

I don't know if my colleague who was the lead --

MEMBER STETKAR: Well, the reason I stumbled across that is I stumbled across it when I read the table in the DCD, as you heard earlier. But, then, when I came back and read the SER -- I'll point you to the section. I hate these long section numbers, but it's 8.4(d), as in David, (a)(5). There's a discussion about responses to RAIs and things like that. But, finally, it says, "The applicant further clarified that the quality assurance program applies the requirements of 10 CFR 50, Appendix B. The AAC GTG and its support systems are covered by the quality assurance program for the DC as described in DCD Tier 2, Section 17.5, and the staff's evaluation is in Section 17.5 of this report. The staff determined that the AAC power source is part of the quality assurance program for the DCD, which is acceptable per the guidance of Reg Guide 1.155."

So, I keep hanging up on why are we talking about 10 CFR Appendix B if their intent is not to apply that and your understanding is that they won't apply it.

MS. RAY: I'll have my colleague --

MEMBER STETKAR: You know, why don't you just say that they're going to apply Appendix A of Reg Guide 1.155, or whatever that quality assurance is.

MS. FOLI: This is Adakou Foli.

I reviewed that from 8.4. Reg Guide 1.155 says that, if equipment is covered by another quality assurance, but the one in Appendix B of 10 CFR --

MEMBER STETKAR: Right.

MS. FOLI: -- that's acceptable. They shouldn't --

MEMBER STETKAR: That's --

MS. FOLI: Okay.

MEMBER STETKAR: That's exactly right, and that's my whole point, that if the staff is interpreting that this gas turbine generator will be covered under 10 CFR 50, Appendix B, that is acceptable in Reg Guide 1.155 because it is a higher bar in terms of quality assurance.

I'm trying to get at the notion of, does

the staff believe today that that gas turbine generator will have 10 CFR 50, Appendix B, applied to it? That's a yes or no. If the answer is no, I'm confused about all of the verbiage in the SER. If the answer is, yes, you do believe it, that's not what I'm hearing from the applicant.

So, I want to know whether you believe whether 10 CFR 50, Appendix B, will be applied to that gas turbine generator.

MS. FOLI: That's what I believe. That's why I wrote --

MEMBER STETKAR: You do?

MS. FOLI: Yes.

MEMBER STETKAR: Ah. So now, we have a point of confusion, which is what I'm looking for. No, I'm serious, because if that's the staff's interpretation -- and that was my interpretation from the staff when I read the SER, and, indeed, it is consistent with Reg Guide 1.155. It says, if a piece of equipment meets a higher bar for quality assurance, that's fine with us, but if it doesn't meet that higher bar, it at least needs to meet the lower bar in that. And I get that. That's fine.

But we now have a situation where the staff

has written a Safety Evaluation that, in my opinion, presumes that those quality assurance requirements will be applied, and if a combined license applicant comes in and says, "Oh, wait a minute. I don't think I have to apply this," you're going to have to take an exception or you're going to have to have a further discussion.

From our earlier discussion this morning, despite the confusing words in that table -- to me, confusing -- it seems that KHNP's intent is that 10 CFR 50, Appendix B, does not apply for that gas turbine generator. So, I think there needs to be a bit of a resolution on this and clarity.

MS. RAY: We can take a further look at that and we can discuss with you at the full Committee.

MEMBER STETKAR: Okay.

MS. RAY: And I believe there as one additional question you had on ELAP, Extended Loss of Power, and the power sources. We did evaluate that in Chapter 19.3. However, in Chapter 8 we did evaluate the sizing and the capacity and capability of the Class 1E batteries and we verified those assumptions and methodology during the audit, that they meet the applicable standards for the sizing.

MEMBER STETKAR: I got that. Bear with

me here; I'm lost again.

MS. RAY: Sure.

CO-CHAIR SUNSERI: You were looking at the three --

MEMBER STETKAR: Yes, yes, I'm looking. Most of you are too young to remember the old show "Columbo," but it always comes to mind, fiddling around with little scraps of paper and muttering to myself.

(Laughter.)

MEMBER BLEY: What kind of car do you drive?

(Laughter.)

MEMBER STETKAR: Don't go there. I used to drive a Columbo-looking car.

(Laughter.)

MEMBER STETKAR: The confusion that I had in the SER -- and I think it's okay. In Section 8.3.1(d), as in David, (b), as in boy, it says, "The APR engages two types of mobile gas turbine generators to cope with each phase of mitigation strategies for beyond-design-basis external events. Two redundant 480 volt and one 4.16 kV mobile GTG are credited to power the Class 1E load center and switchgear, respectively."

What I'm hanging up on are the logical "each phase" and the word "and".

MS. RAY: I understand --

MEMBER STETKAR: And indeed, they take credit for one of 240-volt gas turbine generators for phase 2, and they take credit for one offsite 460-volt for phase 3. So, I just want to make sure that -- I may be hanging up a bit on the logical construct of the words "cope with each phase".

MS. RAY: I understand your comment, and I think we are in the same understanding --

MEMBER STETKAR: This one I think I understand. I think I know that you understand the phasing right.

MS. RAY: I think we will take a look at that.

MEMBER STETKAR: Take a look at the wording.

MS. RAY: And that was, if I could clarify, that was in 8.3.1-delta-bravo?

MEMBER STETKAR: That was, yes. Yes.

MS. RAY: We will take a look at that sentence.

MEMBER STETKAR: Just take a look at the

sentence and think in terms of little Venn diagrams.

MS. RAY: We will make it more clear.

MEMBER STETKAR: Okay.

MS. RAY: Thank you for the question.

MEMBER STETKAR: Again, I don't want somebody getting ultimately in the COL in a trap where the COL says, yes, we're going to provide the two 480 --

MS. RAY: Correct.

MEMBER STETKAR: -- the two 480-volt ones onsite and not a 4.16 kV, and the staff, from Chapter 8, coming back and saying, "Yes, but..."

MS. RAY: Correct. And we will also, if we didn't there, we will make a reference to Chapter 19.3, our evaluation of --

MEMBER STETKAR: Yes, and you did not. I mean, I just happened to know where that analysis was. Okay. That one, I think we're all in agreement.

Do you have any more? You said you had a few.

MS. RAY: Those were all the questions I had noted.

MEMBER BLEY: I have on going back to what John had raised. My brain may have turned off; I might have missed it. I did hear you discuss the relief valve

not needing power and the kind of, at least to me, disturbing discussion of electricals can't know the function of a valve. When I went to engineering school -- it's been a long time ago; maybe they don't anymore -- anybody in electrical at least had to take some mechanical courses and, through the courses, ought to be able to understand that.

But John had asked a question about the block, there being no block valve. And I don't think you addressed that.

MS. RAY: So, I would have to take that question and refer that to our friends in mechanical.

MEMBER BLEY: Very disturbing, but okay.

MS. RAY: It's not that we're completely unfamiliar with mechanical. However, we do rely on them to let us know the things that need power, at least considering the valves.

MEMBER BLEY: Well, one could argue you don't need power to have the relief valve work. But, if you had power, you could shut this thing that they don't call a block valve, which makes it a block valve.

MEMBER STETKAR: And you can open up the other two series motor-operated valves and make the valve open, which, to me, sounds like I can walk up

to another designed PORV and make it open. So, that's the open -- the design seems to satisfy the notion of I can push buttons and make the thing open, and I can push buttons that will prevent it from sticking, not every possible failure mode from sticking open, but many failure modes from sticking open. To me, those operate the valve and block valve functions, but that's just me.

CO-CHAIR SUNSERI: You had other questions?

MEMBER STETKAR: I do. You're good at moving us along, but I'm good at stalling.

I have to look at it. Bear with me here.

Okay. I think that, you know, we discussed the load shedding earlier. I'm not going to go back through that. I think the staff does acknowledge the fact that load shedding is required. In fact, that's where I found it initially. So, kudos to the staff for digging into that and finding the fact that it's required. I would be surprised that it's not mentioned in the DCD, and as Matt mentioned, I'm surprised that there isn't -- I don't think there is; I don't know. You would know. Is there a specific COL item that says that they need to develop procedures for that?

MS. RAY: There is --

MEMBER STETKAR: And the answer says, you know, the answer might be, well, the COL has to develop procedures for everything and it's just one more of those things.

MS. RAY: That is correct, Chapter 13 does have a COL item regarding development of procedures.

MEMBER STETKAR: Procedures.

MS. RAY: It's generic.

MEMBER STETKAR: So, in principle, this comes under that generic?

MS. RAY: Yes, that is correct.

MEMBER STETKAR: Yes, I get it.

Two what may be, I hope, administrative and maybe editorial things. In Section 8.3.2(d)(I), where you discuss conformance with Reg Guide 1.153, that section was changed a bit. And it discusses 125-volt DC batteries for train A and train B. The previous version of the SER also contained a discussion about the batteries for train C and train D, the bigger batteries. That doesn't exist anymore in this section. And I don't know whether that was an oversight or whether it was an intentional deletion.

MS. RAY: I can't remember the --

MEMBER STETKAR: You may want to go back and take a look at that.

MS. RAY: I can't remember off the top of my head, but I understand your comment and I will take a look at why --

MEMBER STETKAR: Take a look at it, because there were two or three paragraphs that talked about the other batteries.

MS. RAY: I will take a look at why the discussion on the batteries for train C and D were deleted.

MEMBER STETKAR: Okay. It really doesn't make too much difference, I don't think, but I'm just curious.

There is still a reference to a confirmatory item in this version of the DCD.

MS. RAY: That is correct.

MEMBER STETKAR: Okay.

MS. RAY: There should be a number of confirmatory items for the SECY paper, the conformance to SECY 91-078 for open phase as well as one on Alternate AC Support Systems.

MEMBER STETKAR: I thought that there was only one in --

MS. RAY: If you look at slide 7 of the presentation, we listed the RAIs and the question numbers for the confirmatory items.

MEMBER STETKAR: Okay. Never mind. I must have missed those other words, but I'll not highlight this one, then, because I missed the other ones, I guess.

Now one last question, and I didn't bring it up with KHNP. Bear with me; I just closed it.

The applicant in this revision of the DCD -- I'm looking at, to orient you, I'm looking at table 8.3.1-2 of the DCD, which is the diesel generator loading and load sequencing table. In this version of the DCD, the applicant changed the loads and the loading sequence on the diesels compared to the previous version of the DCD. In particular, what they did is they added the cooling tower fans as a load that is sequenced onto the diesels. And, in fact, it's the second load that comes on to each of the diesels. Because of that, they, then, changed the timing of successive loads and they reversed the order of a couple of loads compared to the preceding sequence.

Did you look at that and did you confirm that the loading sequence that now appears here is

consistent with any loading sequences that are presumed in the Safety Analyses in Chapter either 6 or 15? I don't know where this is relevant for design-basis events.

MS. RAY: So, we did look at, during the audit we looked at the assumptions and methodology for the capability of the diesel. We did not verify with our Chapter 15 friends on accident analyses on the impact of the change in the sequence.

MEMBER STETKAR: Yes, and I have no idea whether a few seconds difference on loading makes a difference, but it's just curious to me that it wasn't highlighted anywhere.

MS. RAY: I understand your comment. I would have to discuss with my colleagues who reviewed Chapter 15. They can probably address the impact of that change on shutdown capability or reactor systems. Unfortunately, I don't have that information.

MEMBER STETKAR: Okay.

MS. RAY: But I will pass that on to our Chapter 15 colleagues.

MEMBER STETKAR: Do you have any idea why they added the -- I mean, in some general idea, I know why they put the cooling tower fan on there, because,

oh, it's the ultimate heat sink. But why, in particular, they put it where they put it, as opposed to different parts of the -- again, it's more of a curiosity for me in terms of why they chose this revised loading sequence.

MS. RAY: I understand your comment. I would have to refer that question to the applicant. I personally don't know why they have included -- or the reason for the change.

MEMBER STETKAR: Yes, okay. I mean, I know why the fan is in there kind of conceptually, but it was -- anyway, it's on the record.

MS. RAY: I don't know if the applicant has anything to add or not on that question, but I personally cannot provide any information.

MEMBER STETKAR: Okay. That's all I had, Matt.

CO-CHAIR SUNSERI: Thank you, John.

Any other members, comments?

(No response.)

CO-CHAIR SUNSERI: And the staff is done with your presentation?

MS. RAY: That is correct.

CO-CHAIR SUNSERI: All right. So, we are

going to take a 15-minute break at this point in time. We're going to recess until 25 after.

(Whereupon, the above-entitled matter went off the record at 10:09 a.m. and resumed at 10:25 a.m.)

CO-CHAIR SUNSERI: Okay, we're back in session. We're going to continue with the presentations, and we appreciate KHNP being ready early to present Chapter 10.

MR. SISK: Thank you, Mr. Chairman.

Before we get started, I do want to make note. We have a subject matter expert that will be online. So, I know we typically keep the line muted for a bit, but we would like to ask that the line be open, so the subject matter expert can interact as appropriate to answer questions or to interact with the ACRS.

CO-CHAIR SUNSERI: Okay. The staff informs me that we've made that accommodation.

MR. SISK: Thank you, sir.

With that being said, then we will move on then. And I would like to introduce Mr. Joon-Hwan Choi, and he will lead us through Chapter 10. And, of course, on my right hand is Mr. Storm Kauffman, who will be also providing support for the chapter.

So, Mr. Choi?

MR. CHOI: Good morning, ladies and gentlemen.

Let me introduce myself to you. My name is Joon-Hwan Choi. I have worked in KEPCO-E&C since 1996.

This presentation appears on the previous ACRS Chapter 10 presentation, conducted on October 4th, 2016, as to Chapter 10, where we briefly described the actions taken to close off now 10 will be discussed.

CO-CHAIR SUNSERI: Can you swing your microphone around a little bit, so we can hear a little better?

MR. SISK: We've got one here.

MR. CHOI: This slide shows the contents of the presentation that consists of what will be in Chapter 10, summary of open items, current status, and attachment. Overview of Chapter 10 consists of a section overview, list of submitted documents, a summary of RAIs, and a list of open items.

Chapter 10 section overview. Section 10.1 is a summary description, and 10.2 is turbine generator. 10.3 is the main steam system. 10.4, other features of the steam and power conversion system, and major contents are follows as shown.

This slide shows the list of submitted documents and RAI summaries. KHNP has submitted two documents regarding Chapter 10 which are APR 1400 DCD Tier 2 and Tier 1.

RAI summary for Chapter 10 is as follows: 71 questions were issued by NRC staff and 71 questions have responded by KHNP and no pending response.

There were 17 open items. Four open items were in 10.2 are related to our turbine generator. Three open items, 10.3, are related to the main steam system, and five open items that are 10.3.6 are related to the flow. And one open item of 10.4.8 is related to the steam generator blowdown system. And one open item of 10.4.9 is related to the reliability analysis of the Auxiliary Feedwater System. But this open item is transferred to Chapter 19 and it will be presented in Chapter 19. And two open items, 10.4.10, are related to the auxiliary steam system, and one open item of 10.4 is related to the COL items of Reg Guide 4.21.

For now, Mr. Kauffman will present the COL open items related to Section 10.2.

MR. KAUFFMAN: Good morning.

I'm Storm Kauffman, and as just mentioned, I will be discussing Section 10.2 regarding the turbine

generator.

The turbine generator is not safety-related. However, the NRC has quite a bit of guidance on expectations for the turbine generator design, and most of what I'll be discussing is how we have attempted to provide the information necessary for the staff review in accordance with that guidance.

What has made this a bit difficult is that the APR 1400 does not have a specific turbine generator design. So, we have taken the approach of providing functional requirements, COL items, and descriptive material to explain our expectations for how a turbine vendor selected by the COL applicant would, in fact, meet the requirements/guidance for turbine generator protection against overspeed.

Most of what we have provided is regarding what we consider acceptable, but we've had some work in striking the appropriate balance of detail, not to overspecify, but provide enough information for the staff review and to ensure that the final design selected by the COL applicant is going to meet the NRC expectations at the time of that review.

The open items dealt mostly with level of detail. The staff was looking for more information.

As I said, we were trying to provide the right balance of information.

As a result of the staff review and the previous meeting with the ACRS Subcommittee a year ago, we made a number of changes to the DCD to address level of detail, inconsistencies, and the expectations defined in the COL items. I'll go through each one of these fairly quickly and stop me, please, if you've got questions, which I'm sure Member Stetkar will.

The first open item regards the overspeed trip design. As I said, the staff was looking for detailed information on how the overspeed trips are performed and what components and subsystems are involved in implementing those trips.

Our resolution was to provide direction in the COL items regarding the required level of detail provided by the applicant, the COL applicant. And instead of a turbine design being specified, we've provided functional requirements for things or for how to address diversity, redundancy, independence. As I've said, we also tried to reconcile inconsistencies previously noted by the Subcommittee and the staff.

The next item regards the trip block design. Again, the staff was looking for more detail

and schematics. Without a turbine design, we can't provide those detailed schematics, but, instead, we clarified the COL item to make the requirement for those graphics and detailed information to be provided by the COL applicant.

We also emphasized how to meet the various functional requirements of independence, failsafe operation, redundancies, and meeting the single-failure criterion. For example, independence, we specified the failure of one overspeed protection system will not propagate to others and cause a failure of the redundant overspeed protection.

Failsafe is implemented by assuring or specifying that the failure of hydraulic piping that might affect the operability of the trip system will result in a trip by itself.

Redundancy, we had some discussion with Member Stetkar before about inconsistencies in the arrangement of the trip valves or steam stop valves. We've clarified that they are in series. There's not a crosstie that results in bypassing one of the series stop valves.

Single-failure criterion, we specified that single failures are addressed through redundancy

and independence, and not only will most single failure prevent an overspeed trip, but also that no single failure should cause an overspeed.

The third item was in regards to common-cause failure, which is largely addressed through separation and diversity. We assured that --

MEMBER BROWN: Storm?

MR. KAUFFMAN: Yes?

MEMBER BROWN: Can you back up a slide, going back to the overspeed?

I looked back and went through Rev. 1 of the DCD, Tier 2, and you all added a bunch of description relative to the overspeed trip functions, the electronic as well as the mechanical. And there's a figure that you added, 10.2.2-2, which is just fine.

But one area that I missed, or maybe didn't see, was power supply redundancy and independence, feeding the two separate channels. Like you've got a primary electronic overspeed trip and a backup electronic overspeed trip system, and they're all shown as physically and electrically independent on your figure.

MR. KAUFFMAN: Uh-hum.

MEMBER BROWN: However, the power supply

for those was not discussed. In other words, does each of the electronic, both primary and secondary, do they have their own independent --

MR. KAUFFMAN: Yes.

MEMBER BROWN: -- redundant power supplies? In other words, one set of redundant parallel pipes does not feed both the primary and the backup?

MR. KAUFFMAN: There was a question on that the last time.

MEMBER BROWN: I asked that question.

MR. KAUFFMAN: Right. And I remembered the question, tried to address it in the descriptive material, to say that each of the independent systems has its own power supply and is in its own cabinet.

MEMBER BROWN: They don't share power supplies between them?

MR. KAUFFMAN: Right.

MEMBER BROWN: Okay. I missed that when I went through it. That's why I wanted to ask the question.

MR. KAUFFMAN: Okay. I can point you to the specific section, but I'd like to do that on break.

MEMBER BROWN: Well, finish your

presentations.

MR. KAUFFMAN: Okay.

MEMBER BROWN: I can probably find that. I'll go look again while I'm browsing through here.

MR. KAUFFMAN: Okay.

MEMBER BROWN: But you've answered my question. Thank you.

MR. KAUFFMAN: All right. I'd like to note, though, you had another comment about use of active sensors.

MEMBER BROWN: Yes.

MR. KAUFFMAN: We changed that, too. So, we don't specify active sensors.

MEMBER BROWN: Okay. Yes, but it implies that they're --

MR. KAUFFMAN: They're diverse.

MEMBER BROWN: They're diverse and --

MR. KAUFFMAN: But it doesn't require that they be active. In fact --

MEMBER BROWN: They could be passive?

MR. KAUFFMAN: -- I took aboard your comment that active is not necessarily the best choice.

MEMBER BROWN: Yes. These appear to be -- you don't say "passive," either. If you just

have wire and iron, that's kind of passive. That's the best approach. I don't call that active. Wire and iron is wire and iron.

Thank you.

MR. KAUFFMAN: Okay. Thank you.

On common-cause failure, then, we addressed it by, as I was just implying, diversity and separation. Diversity, for example, we have three separate systems that trip the turbine generator on overspeed. There's a normal turbine generator control system. There is a mechanical trip system, and, finally, an electrical overspeed trip system. And all of them are independent.

And again, from a functional requirements standpoint, because we don't have wiring diagrams, our requirement is to make sure that failures can't propagate from one system to another.

That, finally, takes me to -- I jumped over that slide. The last open item had to do with the manual turbine trip, and that was really just a terminology problem. There was always a manual turbine trip in the APR 1400, but it was called the emergency trip. So, the staff asked for confirmation of that and clarification. We did clarify the language in the DCD,

that it's now referred to as the manual emergency trip. It's designed to trip the turbine from either the main control room or from the turbine pedestal, and it's required to have the capability to do that despite any single failure.

That's my discussion on 10.2.

MEMBER STETKAR: Let me ask you a few questions.

I understand the tightrope that you're trying to walk between detail and functional requirements, and it's a pretty thin-diameter-type tightrope, I think. I happen to be an advocate personally of specifying functional requirements for these types of things in the DCD without excruciating design detail, but that's my personal opinion. It's not necessarily shared by others.

When I read the revised DCD, it upfront says what you said, that the intent is to specify functional requirements, and you discussed those this morning: that apply for the certified design and that any proposed turbine vendor should meet those functional requirements. How they meet it is up to them, as long as they satisfy the turbine overspeed frequency assessment, once that is done. And I get

it. It's the combined license applicant's responsibility to do that, as is pretty much done in all of the certified designs.

However, in the revised DCD, there seems to me a lot of detail hidden in the DCD that might really narrow down my entire spectrum of proposed vendors to perhaps one that could meet these requirements. And it's not even clear to me whether one can meet the requirements the way they are written. So, let me go through a few examples and get some feedback from you.

In the discussion of the mechanical overspeed trip system, it's noted that a trip can occur from any of the following reasons: mechanical, the rotating device that expands and hits something. I get that. That's pretty standard. The second one is "emergency manual trip activation at the turbine front standard by de-energizing a solenoid that moves the trip linkages". How do you de-energize a solenoid that moves the mechanical trip linkages? I haven't seen one that does that.

MR. KAUFFMAN: Now that you've --

MEMBER STETKAR: How do you do that?

MR. KAUFFMAN: The solenoid is holding a spring-actuated linkage in a --

MEMBER STETKAR: Huh?

MR. KAUFFMAN: -- stored energy position. So, when you de-energize the solenoid, the linkage releases --

MEMBER STETKAR: No, I get how I in my one-vendor turbine design could make that happen. It's not clear to me that Joe's turbine --

MR. KAUFFMAN: I agree --

MEMBER STETKAR: -- has that type of design.

MR. KAUFFMAN: I agree --

MEMBER STETKAR: I'll use the term "Joe's turbine" several times here.

So, this seems to be a very -- my point is, I understand how it can work. My point is that, if your intent is to specify functional requirements, why are you specifying the fact that the turbine design must have a solenoid that is released to, then, release a mechanical linkage? Because I can still satisfy a mechanical trip design without doing that in Joe's turbine.

MR. KAUFFMAN: The answer to this question is probably going to be the answer to several of the ones that you have. Despite the fact that we specify

functional requirements, we had opinions on the appropriate way to implement some of these things that may, in fact, eliminate Joe's turbine and force you to buy Matt's turbine.

Another example of that is whether or not there is a mechanical overspeed trip or to electrical overspeed trips. From the standpoint of diversity, reliability --

MEMBER STETKAR: But, see, the concept, in my opinion now, a functional concept of having a mechanical overspeed trip, the functional concept of having the mechanical overspeed trip kick in first --

MR. KAUFFMAN: Uh-hum.

MEMBER STETKAR: -- and the functional requirement of having two, I'll call it redundant, if not diverse, electrical overspeed trips, to me is a functional requirement that tells me you want somebody to provide that. How I plum it and wire it together is my business if I want to sell you my turbine. I need to know that I need to have those functional requirements. So, I don't necessarily need to know that I have to have a solenoid that de-energizes a spring-loaded mechanical linkage as part of my emergency manual trip activation at the front pedestal.

I have seen designs where the emergency manual trip activation at the front pedestal looks like a freaking plunger that you push that opens up a dump valve and that could satisfy a manual emergency mechanical overspeed trip function at the front pedestal. Joe's turbine might have one of those.

But you, by specifying the fact that I've got to have a solenoid with a spring-loaded mechanical linkage has now either made me redesign my turbine or eliminated me as a vendor.

MR. KAUFFMAN: It is a potential constraint.

MEMBER STETKAR: Okay.

MR. KAUFFMAN: The guidance or the description was intended to address some historical experience with complicated or long mechanical linkages not functioning properly.

MEMBER STETKAR: I'm don't want to talk about details of engineering a particular turbine trip system here. I don't want to do that. I'm trying to respond to your notion that the functional design of the turbine overspeed trip system is described in the DCD and it's left up to the vendor to provide a turbine trip system that meets the basic functional design

and -- "and" -- meets the requirement that the frequency of an overspeed trip is less than 10 to the minus 5 event per year.

MR. KAUFFMAN: I understand the comment. We will take it under advisement.

MEMBER STETKAR: And I don't know whether you wanted -- there were several of these, and I don't -- Matt, do you want to belabor this? Want to get them on the record or what? Because that's one. There are like three or four others.

CO-CHAIR SUNSERI: So, what it sounds to me like the situation that's being described here is in lack of a technical design which would be fully described, KHNP is saying they're advocating a functional description, but, in reality, it's a hybrid. They have some functional, some technical elements mixed in, which confuses -- I guess could be points of confusion.

MEMBER STETKAR: In my personal opinion, it may constrain a proposed vendor so finely, such that perhaps one, and only one, vendor can meet all of the design elements as they're described in the DCD.

CO-CHAIR SUNSERI: Yes.

MEMBER STETKAR: And this one was just the

first one. I mean, there are several others that are kind of hidden in the words.

CO-CHAIR SUNSERI: Right.

MEMBER STETKAR: And when you think about different design options --

CO-CHAIR SUNSERI: Yes.

MEMBER STETKAR: -- there are different ways of meeting the proposed function.

CO-CHAIR SUNSERI: So, I guess I would just ask, John, does it really matter from a safety aspect? I mean, so if they write their spec in a way that constrains it to one vendor, do we really care? I mean, it is one vendor that will be safe, right?

MEMBER STETKAR: I care if I'm a combined license applicant because, if I want to buy Joe's turbine, I now must take exceptions to the DCD because I can't meet all of these details. It would be a pain for me, and it could be a safety aspect if elements of the design can't meet the turbine overspeed criteria.

MEMBER BLEY: I think the thing I'm a little concerned about -- I mean, somebody could come in with a design that specifies everything, turbine and its package. This one says, essentially, you can buy the turbine at the COL stage, but if you overspecify

it -- and I'm not sure if that's driven by the applicant or by questions from various parties pushing in this direction. It seems we've got a conflicted kind of situation here. Is it a safety issue? Probably not. But I wouldn't want this Committee driving a design in a certain direction if it's not being driven on strictly safety issues.

MEMBER STETKAR: Well, and especially the reason I raised it is that the revised section of the report in the beginning emphasizes what Storm said. It is that the intent of the DCD is simply to specify functional requirements --

CO-CHAIR SUNSERI: Uh-hum, right.

MEMBER STETKAR: -- that should be met by any proposed vendor.

CO-CHAIR SUNSERI: Right. So, in light of those clarifications, John, I would suggest, then, that we do go through your items.

MEMBER STETKAR: Okay.

CO-CHAIR SUNSERI: Because if the applicant wants to clean them up, then they have a full slate --

MEMBER STETKAR: Yes, let me just sort of run through them. Again, I don't want to get into the

whys and the wherefores of the specifics, but the ones that I found.

In that same section that discusses the mechanical overspeed trip, it says there's an "emergency manual trip activation from the control room by de-energizing the solenoid that moves the trip linkages". So, that says that both of those manual emergency trips have something to do with electrical.

In a different section it says that the ETS, the emergency trip system, closes all of the valves to shut down the turbine on the following signals: manual emergency trip in the control room, manual emergency trip on standard.

So, in one place I'm calling it an electrical trip and in another place I'm calling it part of the manual trip system. That could be minor.

In another section under diversity of the mechanical and electrical overspeed trips -- so, we're trying to argue about the fact that the mechanical is diverse from the electrical. A purely mechanical overspeed trip is available in conjunction with a normal control and electrical overspeed trips. Power is required to keep the mechanical trip solenoid valve energized.

Now, okay, you can argue that de-energizing a solenoid valve is a diverse thing, but, to me, it's not purely mechanical if you're talking about de-energizing a solenoid valve because there can be things that can prevent that from happening.

The section that talks about the electrical overspeed trip system says, "Trip signals are processed by both the primary and backup unit to determine trip validity based on two of three volting," which is a functional requirement to me, "either of which, then, opens contacts to de-energize both solenoids for the master trip valve." I now have a design that has a single master trip valve with two solenoids attached to it.

And then, when I talk about the non-returned check valves in the extraction steam lines, to get you oriented, I'm not talking now about turbine overspeed, but it's part of the same basic protection system. "An extraction relay dump valve under normal operating conditions aligns the incoming instrument air supply to the operators of the air-assisted spring-closed non-return valves." I now have specified a design that has a single dump valve that must be supplied by instrument error. I could

have a hydraulic dump valve. I could have numerous dump valves. They could be electrical. They could be -- who knows what there?

So, those are the four places and kind of subsets of places where I found what I think is perhaps overspecification of design details that might unnecessarily constrain the design and might lead to unusual dependencies that might not have been thought about clearly.

So now, if we want to think about the nexus to integrated safety or risk, if some of those power-supplied dependencies could be affected by turbine building fires, could be affected by spurious signals from turbine building fires, could affect instrument error reliability, I'm now getting into pretty subtle parts of the design that, indeed, if you don't think about them carefully enough, could affect overall plant safety. I don't think personally that it might be important, but I don't see the need for those constraints.

MR. KAUFFMAN: Thank you, I think those are good observations and I understand your point.

MR. CHOI: From now, I will explain three of the items for the mainstream system. Rev Number

10.3-1, which is related to RAI A57 General.

This is 10.3-5, and that's there to review Section 10.3 for description all-flow paths, the venture of the mainstream line, SIV and mainstream stop valves, as specified in 10.3, Sections 352, 35E were found incomplete or missing.

Therefore, we have to include their complete tabulation description in the response to this REI, which should provide a new table with the information required in SRP 10.3 Section35E in DCD.

By the responsible of 10.3 was resolved.

The third number 10.3-2, which is related to RAI 8570 Question 10.3-4, and that's there because the explanation of how the of the discharge piping from the MSADV and the MSV can perform their function, discharging steam to the atmosphere during a seismic event where a seismic crespitation (phonetic) is seismic too.

In the response to this SRI, we had to provide the response from the piping to MSAV and the MSSV does not have a safety-related function and it maintains structural integrity in the event of SSE.

However, NRC considered the refund as not acceptable and needs to follow A714 from 10.3-7.

In RAI A714, and that's there because the region of the crespitation to sizeable amounts of water, the concentration of electricity to actually handle the discharged steam from the and the MSADV and the MSSV.

In the response to the REI, it should provide a response to the discharge piping could be maintained as a seismic activity because of function its capable of to ensure the right piping.

And MSSV and MSADV show piping material revised from A-106 Grade B to Grade C to meet the functional capability, by the response of 9.10.3-2 as a result.

10.3-3, which is the Rev to the RAI 8575 Question 10.3-6, and in this we decided to include I10 incorporate into -- for questions associated with potential water steamhammer questions with NUREG-0927.

We should provide a list of items to be incorporated into the operating and maintenance procedures necessary to the direct water steamhammer, as specified in NUREG-0927. By the response of 10.3-3, it was resolved.

From now, I present the five elements for FHG. Number 10.3.6-1, which is Rev. I 8649 Question

10.3 6-24.

The ASM Code Section 11 Thompson Condition specifies the ten steps for 55A be filed with Rev. Guide 1.147 and condition on the user of ASM cases.

This is there because it suggests the state is on -- it should be Tier Two or at the end of COL Item 10, which can provide the response the firing sentence was edited to the end of COL Item 10.

By the response of 10.3.6.-1 was a result of this. Number 10.3.6-2 which is Rev. 2RA8649 Question 10.3.6-25. And that's there because we revised the simplified core items as follows.

In the response to ASARI, we should provide the response to NRC appropriate sentence while edited in the DCD subsection 10.3.7.

By the response of 9.10.3.6-2 was resolved.

Number 10.3.6-3, which is the Rev. to the RAI A649 Question 10.3.6-26. And that's there to answer the following question.

What materials are utilized for the carbon steel portion of the downcomer feedwater line between the chrome-moly portion of the same line.

And the carbon steel portion of the downcomer feedwater line between the chrome-moly steel

pusher, subject to service inspection. And the response to this RAI, which is to provide the following response.

The seven-hour hit of the valve is A106 Grade B, and in the OPR1000 design, chrome or steel was in the main control valve and the main line, which contained shock-bending portion susceptible to a FAC.

On the RAI, in the APR protein designs, carbon steel is utilized within the main fidelity control valve and the main steel line, which do not have a shockbending process.

The covers to push out of the downcomer feeder line begin when the chrome steel push, and that's subject to a monthly service inspection.

And in services inspection, there is degradation on the anti-eroding area and we've made many tests to see if the frequency of this action is open beyond the experiment.

By the response of 9.10.3.6-3, as a result.

10.3.6-4, which is the RAI A649 Question 10.3.6 as follows. And that's there, we tested that to the following question.

The steam to economize the feeder line should be comparable to the passable grade of the

diversity in the downcomer feedwater line.

Why the use of FAC susceptible carbon steel in the subject portion of the economized feeder line?

It's to ensure the insulated piping degradation does not occur in the economized feeder line.

In the response to this RAI, in the APR1400 design, it covers utilizing the audition sequence of six inches to provide a greater within the main conserver and the main steam valve line.

Accordingly, the FACC susceptibility conclusion is not necessarily within the economized downcomer feedwater line.

In addition, the first susceptible portion of the period, our colleagues inspected as part of a long-term inspection within the economizer and the downcomer feedwater line.

By the response of 9.10.3.6 was resolved. 10.3.6-5 which is RAI A671 Question 10.3.6.28.

The standard aims to answer the following question, the reason of roomable repeating. And the diagram from the Table 10.3.2.

In the response to this RAI, we issued the following response. The title of the chapter 10.3.6.03

is a flow-exit conclusion, the flow velocity are not susceptible to FSG.

These actions are more commonly used vocalized on energy, therefore, materials and size for valves has been excluded in table.

And the 15 are included in the tables. By the response of 19, we resolved it.

MEMBER STETKAR: Can I stop you there? This is a different topic. We had some discussion of this in the previous Committee meeting.

The DCD and the staff's SER, in the area of flow-accelerated corrosion, focused on margins in the design for a nominal 40-year design life on the secondary side of the plant, apparently.

The DCD seems to indicate that the plant is designed for a 60-year design life. So, are you planning to replace all of the secondary piping after 40 years?

My basic question is why doesn't the DCD specify flow-accelerated corrosion margins for a 60-year design life?

Because all of the margins that are specified in there and all of the discussions consistently say consideration of 40-year life.

MR. CHOI: I think SME is on the line, so he will answer the question.

MEMBER STETKAR: Oh, very good. He should be able to just speak and we can hear him.

DR. HWANG: Hello, we thought first to reconsider the corrosion that happens in 40 years. The NRI, the UT invitation data, so we calculated the corrosion a allowance is 0.05.

And we recalculated during 50 years. At the time, the corrosion allowance was calculated about 0.06. Eventually, we considered the corrosion around 0.06. This is my answer.

MEMBER STETKAR: Okay, just for clarity, the 0.06 does not apply for 50, 5-0, years or 60, 6-0, years? I thought that you said 50, 5-0?

DR. HWANG: 60 years.

MEMBER STETKAR: 60, 6-0? Okay. Then, why in the DCD doesn't it say that? Because I can read you back the sentence that you just mentioned.

It says the additional thickness of 0.889 millimeters, 0.035 inches for the portion of the steam system piping, and 1.524 millimeters, 0.06 inches for the portion of the water system piping in the design are applied in consider of the 40 years of design life.

And if those margins were indeed applied in consideration of 60 years --

DR. HWANG: Originally, I considered a corrosion allowance of 40 years.

However, the corrosion allowance is very similar between 40 years and 50 years. So, I just described 40 years.

MEMBER STETKAR: But, again, if I am now going to buy a plant and have it, the whole secondary side of the plant, constructed as a combined license Applicant, and I redo all of my corrosion allowances to account for the actual design-as-built configuration of the piping systems with the material that is specified for that.

Am I to consider a 40-year life or a 60-year life in the DCD?

DR. HWANG: Please wait a moment, I have a consult with another guy. Please wait.

CO-CHAIR BALLINGER: If I recall, this precise question was asked the last time, I mean, almost word for word.

MEMBER STETKAR: WE discussed this earlier.

CO-CHAIR BALLINGER: Word for word.

MEMBER STETKAR: Part of the reason I bring it up, though, is that the Staff is still hanging their SER on the 40-year life also, as being adequate.

MR. HUR: This is Seokhwan Hur from KEPCO E&C.

Configuration has a design life for 50 years, design life for the pressure boundary. But aside of the pressure boundary, we specified that at 40 years.

So, that's why the DCD describe it in such a way. 40 years would be the size of the threshold.

MEMBER STETKAR: That certainly clarifies the intent, and I guess it's on the record. Seems a bit odd to be personally, but if that's the intent, that's the intent.

CO-CHAIR BALLINGER: I sort of feel compelled to say something about this. I've held out.

I mean, what we're seeing here is not a safety issue, but it's a tradeoff, I think, between cost and the functionality.

This problem can easily be solved by just changing the materials or adding a little chrome.

So, what we're doing here is we're transferring the cost, we're reducing the cost, because

A-106 and all these other materials are pretty cheap, to a COLA Applicant, who will have to augment the inspection system and add all of these.

They'll have all these pipes that would normally, these A-106 pipes will have to be in the FAC inspection plan.

So, going forward, they're going to have a large inspection constellation with these materials when at the construction stage, if they just specify the slightly different material, the population that would require inspection would be greatly reduced.

And the design life would be easily much longer.

So, really, the tradeoff is there, so it's an engineering decision, but it's kind of, my personal opinion, it is kind of -- I don't know.

CO-CHAIR SUNSERI: What are we talking about?

CO-CHAIR BALLINGER: No engineering decisions.

CO-CHAIR SUNSERI: But what we're looking at, though, is they want to take a license for 40 years. If they wanted to run for another 20, they'll submit a subsequent license request.

And if they maintain the plant properly, they'll get that.

MEMBER BROWN: To the uninitiated, since I'm just an electrical guy listening to this interchange, is the conclusion that the 40 years as stated in the DCD is correct, even after going through John's iteration in the 0.06?

Theoretically, one answer said it covers 60 years, but it doesn't really because the DCD is 40 but the pressure boundary is 60.

So, something has to be done at the 40-year point in order to take another leap forward. That's the conclusion I got out of this.

Is that correct?

MEMBER SKILLMAN: Actually, I think -- this is Dick Skillman -- I think there are two, reactor coolant and system pressure boundary is designed for 60.

The secondary is 40.

MEMBER BROWN: I'm just trying to get a conclusion, a firm conclusion, stated before we leave here as to where we end it.

MEMBER BLEY: And then if you bought one of these and you want to go to 60 years, you're going

to have to do something --

MEMBER BROWN: -- for the secondary client. I just wanted to make sure that was clear, thank you.

CO-CHAIR BALLINGER: And by the way, the uncertainty, FAC rates makes the difference between 0.05 and 0.06 kind of moot anyway.

In our business that would be considered very good if we can do that.

MEMBER REMPE: But, Ron, also to your comment, you mentioned a lot inspections, are those inspections going to occur during the first 40 years?

Or just to prepare for the subsequent licenses?

CO-CHAIR BALLINGER: Oh, they're continuous.

MEMBER REMPE: So, in ALARA --

CO-CHAIR BALLINGER: There's a fact program, that's right. Well, but it's a secondary system.

It's not ALARA. This all secondary, secondary systems.

MEMBER REMPE: It's secondary but there's no exposure for personnel going in there at all?

CO-CHAIR BALLINGER: One hopes not.

(Laughter.)

MEMBER STETKAR: How much spare fuel do you have? How many holes in the steam generator? You've got to have some fail fuels --

CO-CHAIR BALLINGER: But what worries me about this, and again, this is a personal opinion, is that FAC failures are the only things that have actually killed people in our business.

So, while it's not a safety issue, that is the phenomenon that has actually killed people.

MEMBER SKILLMAN: The bulk of the FAC effort is out in the turbine building.

It's in the extraction lines, extraction chamber, and particularly, where there's a large drop in pressure, you get two-phased flow.

And like Ron says, those failures can be catastrophic and lethal. And those have happened.

MR. SISK: I feel obligated I guess as well. We have captured the vote, we understand.

I think we've explained the design as it is, but we'll certainly take the comments of the ACRS under advisement.

And thank you.

MEMBER STETKAR: Just, again, for the record, this is not the ACRS. These are individual Member comments.

MR. SISK: Thank you for that correction.

MR. CHOI: Number 10.2.4.8-1, which is related to RAI 8596 Question 10.2 4.8-6, which is related to the Signal Blowdown System.

And that's to provide additional information addressing the missing actuation signals and the Blowdown Flash Tank High-High Level Actuation Signal. And that is the signal that activates the -- in DCD Chapter 7, for consistency and gravity.

The response to this RAI was to provide our own response to the actuation signals, where we indicated in this figure, and we have a detailed description for the actuation of contaminant variables, provided in the DCD Chapter 7.

The issue of 1910.4.8 was resolved. The next one of the items is relating to assistance analysis.

This area was transported to RAI for 1A-A34A Question 19-35 of Chapter 19. The questions are represented in Chapter 19.

10.4.10 is one which is Rev. RAI 8506

Question 10.10-1.

The NRC gives accreditation of the actual design of the system piping with regard to meeting the requirement of 10.20.1406, minimization of a continuation.

The risk points to this RAI can provide the response to the system that will be designing the main embedded or embedded piping and you have the piping in an underground concrete tunnel.

But the risk points of 19.10.10-1 was resolved.

For Item Number 10.4.10-2, which is related to RAI 856 Question 10.10-2.

The standard attempts to classify the design classification process for the original existing system component and the piping within the reactor containment building.

The response to this is to provide a response that the piping components for original existing systems in the reactor containment building will be classified as size in the quality group D.

By the response above, 19.10.4.10-2 was resolved too.

For Item 10.4-3, the original system is

designed in accordance with 10.21406 and 4.21 with the mutation in minimization of contamination, with an associated commitment to require the co-op to establish procedure and maintenance procedures for the existing systems.

We reviewed the Item 10.41 and found that there are similar commitments just for the system, and components that have comparable design feature.

The steps of this core item can be consolidated into single and encompassing commitment to minimize deportation.

For this CD, tier two, DCD, Chapter 11 and 12. We're beginning to take on this issue for resolution.

The issue I was discussing, the clarification of first core items for Chapter 11 and 12, the steps are just the acceptability for both approaching maintaining existing configuration or eliminate the respective core item for each program, if you can maintain the separate core items for each system for this program in order to minimize changes to the DCD.

By the response of 1910.4, the issue was resolved.

Next, the current status for Chapter 10. Chapter 10 is complete but the direction report without open item was issued as of September 18 -- 23rd, 17.

17 of 19 were identified in Phase Three have been resolved with the etiquette and the subsequent discussion.

Changes in Chapter 10 was reviewed and marked in response to NRC's RAIs, and will be incorporated into the next revision of DCDR2. This is the end of my presentation.

Thank you.

CO-CHAIR SUNSERI: Thank you. Any other Committee comments or questions?

MEMBER STETKAR: Yes.

CO-CHAIR SUNSERI: That's surprising.

MEMBER STETKAR: Back on your slide, 25, you don't need to go to it, regarding the auxiliary feedwater system reliability analysis, on your slide, you noted that it was transferred to Chapter 19.

However, in the revised decided, DCD, there is a table, 10.4.9-6, that lists the results from that analysis. And there are numbers in the table.

My question about that table is one of the line items in that table addresses auxiliary feedwater

reliability for a loss of offsite power (offsite power recovery considered). What does that mean?

That sounds like it is an analysis that accounts both for the support systems for auxiliary feedwater, AC power, DC power for the motor-driven pumps, for example.

And somehow offsite power recovery is part of this number.

It's Table 10.4.9-6. So, you see it says loss of offsite power loop, offsite power recovery considered?

And the number, just for the record, is 7.80e to the -5.

The only reason that the number is relevant is the statement is made that this confirms that the auxiliary feedwater system unreliability is less than 1e to the -4.

7.80e to the -45 is somewhat less than 1.000e to the -4.

Now, if that analysis is accounting for some sort of recovery of offsite power with some sort of model for recovery of offsite power to achieve that number, that would be interesting.

You're going to have to check with the

Chapter 19 folks. I just wanted to get it on the record because I understand why it's a Chapter 19 issue.

But what I'm trying to understand is -- I'm going to ask the Staff about this later because this is my very personal opinion, this notion of standalone numbers in a box for something that's given a name.

In this case, the name is auxiliary feedwater system; outside of the context of the entire risk assessment is both meaningless and dangerous because what's in and outside of that box may not be very clearly identified.

In this case, there seems to be implication that the tentacles reach fairly far outside of a box that you might say is the auxiliary feedwater system.

So, the latter part of that comment is what's the use of these numbers in isolation to begin with? But apparently, the Staff demands that they be published.

So, if they're published, then we need to better understand what the scope of that analysis includes.

And that's the only relevant to Chapter 10, but it's because the numbers appear in Chapter 10,

and they're shown in Chapter 10 as evidence that, indeed, the reliability is better than 1e to the -4 on availability.

Hence, it's kind of a Chapter 10-ish question.

MR. SISK: I appreciate that. Again, I'm Rob Sisk here.

But I think there was some discussion of that relative to does it belong in 10? Does it belong in 19? And when you get some of these interfacing or related issues.

MEMBER STETKAR: Well, okay, I don't want to start talking about Chapter 19 because we have a whole other meeting on Chapter 19.

But Chapter 19 typically does not publish standalone unavailability estimates on a system-by-system basis.

You don't get an unavailability of the high- pressure injection system. You don't get an unavailability of the accumulators as a standalone system in Chapter 19 even.

I mean, you can derive that information if you have the entire risk assessment, but that information is not typically published in Chapter 19,

nor, is it relevant in Chapter 19 outside the context of the whole risk assessment.

I don't care if the accumulators are guaranteed to fit if they have no effect whatsoever on risk.

CO-CHAIR SUNSERI: Anything else, John?

MEMBER STETKAR: Yes, I'm sorry, two other things, Matt.

In the updated version of the DCDD, there's a discussion of -- I'm trying to make this short.

Condensate overflow, it's in Section 10.4.1.5 but it also appears in Section 10.4.7, and it says the condenser hotwell level is maintained by receiving condensate from condensate storage tank, and directing the condensate overflow to the condensate overflow storage sump.

That says that if I get a high level in the condenser, I dump water into a sump, rather than returning it back to the condensate storage tank.

That's a little bit different from those designs and it's the only mention that I could find of this condensate overflow storage sump.

And again, is this a safety issue? No, because I doubt that I could fill up the turbine building

from the condensate system by just overflowing the condensate system into the turbine building basement.

But it could affect me as a COL Applicant because now I apparently need to have this separate condensate overflow sump in my turbine building.

So, I was curious what the condensate overflow sump is and why it appeared in Rev. 1 of the DCD, when it wasn't mentioned at all in Rev. 0 of the DCD?

This thing appeared in Rev. 1.

MR. CHOI: Let me answer the question. The condensate overflow storage sump is held for the overflow from the condenser from the...When the overflow is occurred...

MR. OH: This is Andy Oh, KHNP. Member Stetkar, what's your question?

Is it for condensation overflow sump as the function overflow sump? Or why we have sump overflow sump? That's your question?

I want to --

MEMBER STETKAR: MY question was kind of a two-part question.

First of all, the first mention of this condensate overflow sump I think appears in DCD Rev.

1.

I don't think it was mentioned in Rev.0, but I'm not sure about that.

The second question is why do I have a separate sump for condensate overflow? What's the function of that sump?

Many, many plant designs that I'm familiar with, if I have high level in the condenser, simply returns the excess flow from the discharge to the condensate pumps, back to the condensate storage tank, rather than a sump in the turbine building.

That can a) fill up and flood the basement of the turbine building if the overflow sticks open. Or result in a design requirement to have this other sump.

I'm curious why do we have this sump?

MR. OH: My understanding for the API-1400 is our condensation storage tank for the API-1400 is that we only need condensation for the water for the hotwell.

There's no return to the condensation storage tank.

MEMBER STETKAR: That's my understanding from what I discovered about the condensate overflow

sump.

MR. OH: So, that's the reason, is the condensation storage tank is only providing water to the hotwell. But there's no return to the condensation storage tank.

MEMBER STETKAR: So, if I fill up the hotwell, I get high level in the hotwell, high level, pump water in, pump water in, pump water in, I get high level.

That water, then, in this design overflows into a sump in the turbine building? Is that correct?

MR. OH: Yes, that's the condensation --

(Simultaneous Speaking.)

MR. OH: -- the storage sump that would have to go through the sump, not to return to the condensation storage tank.

MEMBER STETKAR: Okay, so if that's your design, that's your design.

So, I fill up the basement of the turbine building with water every time I get a high level in the main condenser hotwell. Period.

Thanks. I just wanted to make sure I understood the design. So, when I build one of these things, I've got make sure I do that.

MR. OH: Next question?

MEMBER STETKAR: Next question is regarding turbine building floods.

I don't think I can fill up the turbine building completely from the condensate storage tank, so I think the turbine building is big enough to not do that.

However, I can fill up the turbine building if I break one of the seals on the main condenser water box so that I fill it up with circulating water, main condenser cooling water, if you will.

And we discussed some of this in the previous meeting, where I understand that at grade level, which is nominally -- first of all, I understand that if there was no water relief, and I put all of the main condenser cooling water from your nominal design into the turbine building, it would fil up to an elevation of 104 feet, which is four feet above grade.

Is that correct? Hearing no answer, I'll continue.

MR. SISK: We're going to have to go back and get that number. We don't have that not number.

MEMBER STETKAR: It's in the DCD, it uses the word -- it says the flood height due to failure

of main condenser in the turbine generator building is determined as four feet from elevation 100 feet 0 inches.

In later discussions, NESER, I understand that four feet from means four feet from in the positive direction, meaning 104 feet, so that if I just fill it up, it's 104 feet.

However, I do know that you have flood relief panels at grade level, at 100 feet, that are supposed to open and prevent the water from exceeding grade level.

So, you basically fill it to grade level and it then flows outside. I got that.

In the previous Subcommittee Meeting, we noted that there are a couple of rooms in the turbine building that have equipment that may be affected by flooding.

And in particular, there is a non-safety switchgear room located below grade. The floor of the room is at elevation 73feet so about 27 feet below grade.

And that there is a non-safety switchgear room and a battery room located at grade level. Their floor is 100 feet.

I asked about those earlier and the -- I'm

trying to look at the answer here -- the conclusion was that the flood protection is not required for those rooms.

And I asked about why is the protection not required, and my notes say you were going to get back to us.

My concern, obviously, is if the flood relief panel is going to open up and we do flood up and those rooms flood, I don't know what's lost. I don't know what electrical systems are lost.

I don't believe that PRA -- and this is a question between the design and the PRA -- I don't believe that the PRA looks at that for example.

So, I still have a question about what equipment is located in the switchgear room located well below grade level, and in the AC switchgear room and the battery room, that are located at grade level, that would ostensibly not flood if the relief panels open up, but could flood if they don't.

MR. SISK: This is Rob Sisk. And just to get clarity, are you asking a safety question?

Or is this again a protection asset question that you're --

MEMBER STETKAR: No, no, no. This is a

potential safety question because I don't know -- they are clearly non-safety electrical rooms.

But we have ample experience from risk assessment, the so-called non-safety-related risk-significant issue. That non- safety-related electrical systems can be important to overall risk.

So, this is not protection of licensing basis, quote, unquote, safety-related equipment. It might be protection of non-safety-related equipment that may or may not be important to risk.

I just don't know because I have no idea what's in those rooms.

MR. SISK: I have a better understanding of what you're looking at. Thank you.

CO-CHAIR SUNSERI: So, is that it, John?

MEMBER STETKAR: That is it, thank you.

CO-CHAIR SUNSERI: Okay, anyone else? All right, well, we are maintaining being significantly ahead of schedule.

I guess my preference here would be to start the NRC Staff Briefing in Chapter 10, if you all are ready for that?

We'll see how far we'll go and if it looks like it's going to go significantly past 12:30 p.m.,

then we'll reassess and take lunch. But I would like to try to run and adjourn before we take our lunch break.

So, let's bring the Staff up. All right, George, you may proceed when you're ready.

MR. WUNDER: Thank you, Mr. Chairman.

I also have Chapter 10, and I am now joined by Angelo Stubbs and Ryan Nolan of the Plant Systems Branch, and by Andrew Yeshnik and Greg Makar, who are in the Materials and Chemical Engineering Branch.

Dennis Andrukat of the Plant Systems Branch was not able to make it today so I'll be presenting his slides on the auxiliary steam system, if you have any questions on his areas of expertise for auxiliaries, and I believe floor drains.

While we've got some pretty smart people here and we may be able to address them, or we may have to take them as look-ups.

We'll start with Section 10.2 on the turbine generator, and again, we're going to focus mainly on closure of open items, but we will address any questions you may have on any other areas.

So, I'll turn it over to Angelo Stubbs. Angelo, please?

MR. STUBBS: Okay, thank you, George. Can

you hear me? Okay, good morning.

My name's Angelo Stubbs and I'm a Senior Reactor Systems Engineer in the Plant Systems Branch.

And today, I'll be discuss the open items we've identified in our Phase 2 SER issued last year, and the areas of the main turbine generator system, and later on, an auxiliary feedwater system.

And then the APR1400 DCD revisions did not specifically address how the first redundancy and independency considerations would be incorporated into the design of the turbine generator overspeed control system.

And they did not provide sufficient information on the manual control or manual trip of the turbine of how single-failure criteria would be satisfied with the design.

Instead, what the Applicant provided was a COL item that had the COL Applicant address these design issues.

So, moving on to the first open item, 10.2-1, because the DCD does not contain sufficient information on the turbinal speed protection system or conform to the guidance and our standard viewplan, with respect to the relevant diversity redundance and

dependency considerations, we asked RAIs.

And we solved this open item.

The Applicant provided the Staff with additional information in response to our RAIs and revised Section 10.2 of the DCD to include detailed functional performance descriptions for the turbine generator control system, the manual trip system and emergency trip system, with specified design requirements.

So, they also revised COL item 1022 to instruct COL Applicant to provide schematics for the turbine generator overspeed protection system, showing all the speed components and interfaces once the turbine is selected.

The Staff reviewed the information provided by the Applicant and determined that the turbine generator's overspeed design system will have sufficient redundancy, diversity, and independence to satisfy the SRP guidance.

And therefore, it will satisfy the intent of GC4 criteria.

Okay, so next slide. The second item was included SER because the DCDD likes sufficient information on further overspeed protection and design,

and how it will be seen with failure criteria.

The response to that open item, the Applicant revised the DCD to include the discussion in Section 102232 and revised the COL item so that now it specifies the schematics information once the turbine design is selected.

Will be sufficient to provide and allow enough information to allow us to assess the ability of this turbine to withstand a single failure without loss of function.

Staff reviewed the information provided and determined it was not information added in the DCD, along with the required COL item would ensure our abilities to see that single-failure criteria satisfied. And, therefore, we would be intended to -- in that area. Next slide. Okay.

The third open item included an SER because the DCD lacked sufficient information on protection, or how to oversee protection reform to SRB guidance with respect to addressing considerations for comment cause and comment failure.

In response to this open item, the Applicant made revisions to DCD in Sections 1011 and 102232 indicating the overspeed efficient would be

fully independent and will make use of the first components and technology.

And we determined the precisions will be included in designs protected against the common cause of failure, as specified in the DCD, would be sufficient to bring them in compliance with our guidance as far as 10.2 and, thus, meet the GDC4 requirements for that.

And the last slide on this topic, the fourth slide, is the open item, because there was lack of sufficient information to see that they conformed with the manual control, the manual trip, systems to be used.

In response to this open item, they indicated that the DCD will have a manual emergency trip system such that no single failure will prevent the manual trip of the system, for failure to manual trip system.

And they also included -- they also indicated the automated manual trip does not prevent a successive -- that automated manual trips are basically independent of the other trip systems and reactors, independent of the normal overspeed trip systems.

And it was available to be tripped from the turbine, locally from the turbine or from the manual

control room.

They also had language in this item L102 to have the schematics for those systems provided at the COL stage, and our review of that, we thought there was adequate provisions in place in regards to manual control and manual trip, that we concluded that the design, once the COL comes in, will be consistent with our guidance and meet the requirements of DCD-4.

So, that's the conclusion for Section 10-2 overview of that, how we close out open items.

So, now, the questions?

MEMBER STETKAR: Yes, this is just, it's probably an editorial thing but I'm surprised that it's still in there.

In Section 10.2-D, as in David, A as in Alpha, of the SER, you note that it is also stated in that Section.

And that Section is the DCD Section, 10.2.2.3.4.

It's also stated in that Section of the DCD that the MSVs, CVs, ISVs, and IVs, are tested at a frequency of once in three months and service testing and functional checks are performed periodically.

MSVs, CVs, ISVs, and IVs, are exercised

at least once within quarterly intervals by closing each valve and observing the remote valve position indicator for fully-closed position status.

And in Revision 1 of the DCD, the Applicant removed that quarterly testing interval that was originally specified in Revision 0, and simply says that the valves will be tested at a frequency that is determined by the eventual COL Applicant's turbine overspeed evaluation.

So, the turbine overspeed evaluation derives the testing frequency to provide confidence in the valve failure rates that are used in that.

So, I'm curious whether first of all, is this simply an editorial oversight, that that quarterly testing interval still appears in the SER?

And if it's just an editorial oversight, I want to be sure that the Staff does agree with the proposed program in the DCD where the testing interval is derived from the turbine overspeed analysis.

MR. STUBBS: Okay, so your first question, it was oversight because this was something that we discussed last time a year ago on that 90-day frequency and applicability of it.

MEMBER STETKAR: We did, but at that time,

the DCD specifically said that the testing would be performed once a quarter.

And I asked the question of the Applicant at that time whether that was prudent given the operating experience with inadvertent trips of the turbine and inadvertent plant shutdowns as a result too-frequent testing.

So, that question was focused more on the Applicant, and they have since revised the DCD to remove that specification.

MR. STUBBS: I have to get back to you on -- I know many of the previous cases, the 90 days was the frequency that we've been using at other applications.

But that was something that determined probably at some later -- with more information on the design than we have on this particular design.

As they stated, we don't have a design to actually look at here, and if that, in combination, that there's not COL, we're trying to feel our way to make sure that we have enough information to --

MEMBER STETKAR: Again, I want to be sure that my pointing out specific words and sentences are not misinterpreted.

I'm trying to understand whether or not the Staff is okay with a testing interval based on the eventual turbine overspeed analysis.

And if you're okay with that, then the concern is specifying the quarterly testing interval in a safety evaluation report of this certified design may have implications later for combine license Applicant who says, well, I can get away with testing once every seven and a half months or something like that.

Because now I have a safety evaluation that says I have to do it once a quarter.

MR. STUBBS: Okay, I'll have to get back to you on that.

MEMBER STETKAR: Well, that's the real concern, is that are we now at a place where what's written in the SER is at odds with what's written in the DCD.

And how will that be interpreted by a subsequent eventual license holder for one of these things?

MR. STUBBS: I'll have to get back to you on that because this review is sort of with the turbine missile probability in Section 3.5 and the turbine rotor

integrity.

So, I have to make sure where we stand on that and make sure that SER reflects accurately what we're doing.

MEMBER STETKAR: Just check that because it may just be a simple holdover, or it may not.

MR. STUBBS: Okay, thank you.

MR. WUNDER: If there are no further questions, we'll move onto Ryan Nolan and the main steam system.

MR. NOLAN: Thanks, George. So, I'm Ryan Nolan. I will be presenting the Main Steam System Section open items.

For open item 1031, the DCD lacked a description of the flow paths that branch off of the main steam lines, downstream to the MSIVs.

In response to the RAI, the Applicant provided a table containing that descriptive information we were looking for.

We reviewed the information provided by the Applicant and we determined it to be acceptable, and it was consistent with the information that is specified in the SRP.

In addition, the downstream valves of the

MSIV, they were determined to be capable to isolate steam flow and, therefore, prevent a blowdown of a intact steam generator.

So, we found the table to be acceptable.

For open item 1032, the DCDD lacks sufficient information on how the discharge piping of the main steam atmospheric dump valves and the main steam safety valves can perform their function of discharging steam to the atmosphere, given their classification of Seismic Category 2.

And in response to the RAI, the Applicant stated that a piping analysis was performed of the functional capability of the discharge piping.

And it was showing that plastic deformation does not occur and it does not challenge the safety function of the main steam safety valves, and the atmosphere dump valves.

The Staff determined the analysis to be reasonable and concluded that the Applicant has demonstrated the functional capabilities for these discharge pipes to maintain their integrity.

And we also find that the seismic classification was consistent with the guidance of Rev Guide 1.29.

And that concludes the two open items I'll be presenting.

MR. WUNDER: Okay, if there are no questions, we'll move onto Section 10.3.6. and Andrew Yeshnik.

MR. YESHNIK: Good morning, my name is Andrew Yeshnik.

I am a Materials Engineer in the Materials and Chemical Engineering Branch, and I'll be talking to you about Section 10.3.6, which is steam and feedwater materials.

There are five open items and they came to be grouped into three separate categories.

The first category is the COL item on the Flow Accelerated Corrosion Program. The second is material selection for piping near the feedwater isolation valve. Last is completeness of the FSAR tables, which contain the material specifications.

The Agency has discussed these open items at length so I'll just provide you a quick summary.

For the COL item, the COL item has been revised, and in the recent revision of the FSAR, the new language is consistent with the Staff's guidance. So, the Staff finds the open items responses acceptable.

For the second topic, the original submittal of the DCD had an error in it. The OPR1000 utilized chrome-moly materials for a portion of the feedwater system that was susceptible to flow corrosion.

This design feature has been eliminated in the APR1400 so the Staff finds that the questions are no longer relevant, and these two open items are resolved.

Finally, the Staff or the Applicant has updated FSAR tables 10.3.2-2-3-4. Those tables are now complete and accurate.

The justification that the Applicant gave for removing the valves is consistent with check works. And the safety-related valves are still required to meet OM Code in Section 11 requirements.

So, the Staff finds the responses acceptable.

And there are three confirmed items that are still open and it will be resolved when the Applicant has information on the DCD.

MR. MAKAR: I'm Greg Makar to talk about the steam generator blowdown system.

At our first meeting, we listed the types

of designs, the design features that we review for that system, and describe the one open item we had at the time, which was related to clarification and consistency in the description of signals that close the containment isolation valves.

And there appear to be some inconsistencies between Tier 1, Tier 2 tables and figures, and the text.

And we had help from the Instrumentation, Controls and Electronics Engineering Branch to work through this.

There were no design changes required to address the issue, and at the time we were here last year, we had almost resolved this with an understanding from the Applicant on how they -- where the inconsistencies were.

And so we had an understanding of the design, and they shortly after that meeting, submitted a revised RAI response. That addressed these inconsistencies.

There were some revisions to a Tier 1 figure or Tier 2 figure. They added a subset -- well, to Chapter 7 in the subsection on actuated systems, they added a description of the types of signals that actuate the containment isolation valves.

So, that addressed all of our questions, and we confirmed that those changes, and all the others from our review on the system, were addressed in Revision 1 of the DCD.

And so all of those issues are now resolved.

MR. WUNDER: And if there are no questions on that section, we'll go back to Angelo Stubbs for the auxiliary feedwater system.

MR. STUBBS: Okay, there's one open item in Section 1049 and it dealt with information that was referencing Revision 0 of the application. But when we looked to where the reference was pointing to, the information wasn't there.

And that had to do with the auxiliary feedwater system reliability, which they indicated was in compliance with the TMI action item, which NUREG-0737 indicated that it should be.

In the original application, it referenced that there was information in Chapter 19 about it. That information wasn't there.

We've since issued RAIs and we've had public meetings, and we came to a resolution for this by having them put the information in Chapter 19. And that's why this will be addressed.

They have already in the past put some information in the PRA notebook.

We've had our PRA people interact with them and they know the information is going to be coming and they'll be more closely reviewing that and they'll be including that as part of their review of Chapter 19.

So, this draft closed out this item by updating that -- or actually, it's still going to be confirmed.

But recently, we've had RAI response back from them, which indicates that the FSAR in Chapter 10 would be revised and the information would not be referenced in Chapter 19.

And they indicated that unavailability would be within a range to meet the NUREG requirements.

So, we found that it met the requirement and the update of the DCD would be confirmatory, and that's just where the status of this open item is now.

MEMBER STETKAR: Angelo, we've now wasted the Subcommittee's time, the Staff's time, the Applicant's time, on this number thing for, I don't know, how many person hours have been allocated to it.

Let me ask you a point blank question.

What does the Staff do with this magic number? What does the Staff do with this magic number that is, as you say, required by a NUREG?

It's not required by a regulation. What does the staff do with it?

Suppose that I'm an Applicant that comes in for a loss of offsite hours, and my mean unavailability of my auxiliary feedwater system is 2.67e to the -4 for a loss of offsite power, because I have not accounted for recovery of offsite power.

Or I've not accounted for something else that could make the number magically below 10 to the -4.

And yet, with my 2.64e to the -4 unavailability, I still have very low risk.

What does the Staff do? Does the Staff require me to do something to reduce my unavailability below 1e to the -4? And why?

What does the Staff do with this number that we're talking about here and requiring people to calculate? What do you do with it?

MR. STUBBS: Well, I think you do two things. You say this and this. I think by itself it's not that meaningful.

But if we have this number, now we're going to look for, like you said, what does that number mean in the bigger picture?

Does that get us to a point where we're going to have an increased risk?

MEMBER STETKAR: They have to by law. By law, by regulation now, 10C, Part 52. By law, they have to do a risk assessment.

That risk assessment has to consider all contributions for all modes of operation. So, by law, not a NUREG, by law, they have to do a risk assessment. Part of that risk assessment would include the auxiliary feedwater system.

I'm asking you, separately from what they have to do by law, why do they have to calculate this number?

Because there must be some reason for them to calculate this number that the Staff uses in terms of their safety analysis evaluation.

And if there isn't a reason, why are we forcing them to calculate this number?

And why are we spending to review the number and ask questions about the number and do audits of the number?

Why are we doing that?

MR. STUBBS: Okay, well, I want to say one thing first. You're asking the question why are we -- the open item was because they pointed to information that wasn't there.

We're trying to verify the information in their application. If they didn't come in with it, we didn't access it.

This was already information there, so once the information there, we review it to see whether it's accurate and whether it's supported.

MR. DIAS: Can I say something? My name is Antonio Dias. I'm the Branch Systems Branch Chief.

And this open item is really an unfortunately result of what we started literally as a separate editorial issue.

And reviewing Chapter 10, there is a point where they're saying this is discussing Chapter 19. Well, Angelo goes there and it's not there.

So, he basically asks the questions so what it is? If it is, then I cannot find it. And that's how it all started, okay?

I wish it had been resolved much, much sooner.

You know, if it really is what now is going to be in Chapter 19, probably this would never have been a question and would never develop into an open item.

As far as what people do with those numbers, I think there's a historical reason. I cannot answer to this.

I have heard from my management that probably it's something that should be revisited, that the stage of productivity and analysis nowadays probably would question the need for these numbers to come up, okay?

But I don't know enough of that to be saying much more than what I just did.

MEMBER STETKAR: Thank you, that puts it in some context.

MR. WUNDER: And I will be finishing up with Dennis's slides on the aux steam system.

Our Phase 2 review of the aux steam system found that the system meets all applicable regulatory criteria with the exception of three open items.

The first, related to the requirements to minimize contamination, as detailed in Rev Guide 4.21 relative to buried piping.

In Revision 0 of the DCD, we found some ambiguities regarding the absence or minimization of buried piping, so we issued an RAI.

The Applicant responded that the system would be designed with a minimum of buried piping, and furthermore, the buried piping would be routed in concrete tunnel.

That has features for collection and detection of leakage.

This change was contained in Revision 1 to the DCD. The Staff found it to be acceptable and considers the issue now closed.

The second open item went to seismic group classification of the non-safety-related aux steam system components in piping within the containment.

The Staff found in Revision 0 there was not sufficient information to demonstrate how the design conformed to the guidance in Rev Guide 1.29. And again, we issued an RAI.

In response, the Applicant stated that the non-safety-related components and piping within the containment building will be classified as Seismic Category 2, Quality Group D.

And they provided a DCD markup to this

effect. The Staff here identified that Revision 1 to the DCD has incorporated this change.

We find it acceptable and consider the issue resolved and closed.

And the last open item went to operational procedures and satisfied 10 CFR 20.1406, and is related to minimization of contamination and generation of radioactive waste.

This was kind of a crosscutting issue, and we determined after some discussion internally that it was probably best resolved in Chapter 11 and 12.

So, Dennis worked with the Chapter 11 and 12 reviewers, and the Applicant submitted COL information items in those two Chapters that we have determined are sufficient to ensure conformance with the regulation.

The Staff finds this acceptable and considers this item to be resolved.

This completes the Staff presentation on Chapter 10, and I would like to open it up for any questions at all on any aspects of the Chapter?

CO-CHAIR SUNSERI: Anything else from the Subcommittee?

All right, now we'll ask for public

comments, and first off, we'll start with anybody in the room that would like to make a public comment?

There's no one in the room that's coming to the microphone so we will open the phone line for public comment from those listening in.

Anyone listening in, would you care to make a comment?

All right, no Members of the public listening in care to make a comment, so we will now close the phone lines and turn to Subcommittee Members for any final thoughts or comments?

We'll begin with Charlie Brown.

MEMBER BROWN: I have no additional comments.

CO-CHAIR SUNSERI: Thank you, Charlie. Jose?

MR. JOSE: I don't have any.

CO-CHAIR SUNSERI: Okay, John?

MEMBER STETKAR: Nothing more. I said enough.

MEMBER BLEY: Nothing more from me.

CO-CHAIR SUNSERI: My Co-Chair, Ron?

CO-CHAIR BALLINGER: No, nothing more.

CO-CHAIR SUNSERI: Dana? Dick?

MEMBER SKILLMAN: No further comment, thank you.

CO-CHAIR SUNSERI: And Mike?

MEMBER CORRADINI: No, no comment.

CO-CHAIR SUNSERI: Okay, I thought you were sitting behind Peter Riccardella.

MEMBER CORRADINI: I picked the Italian.

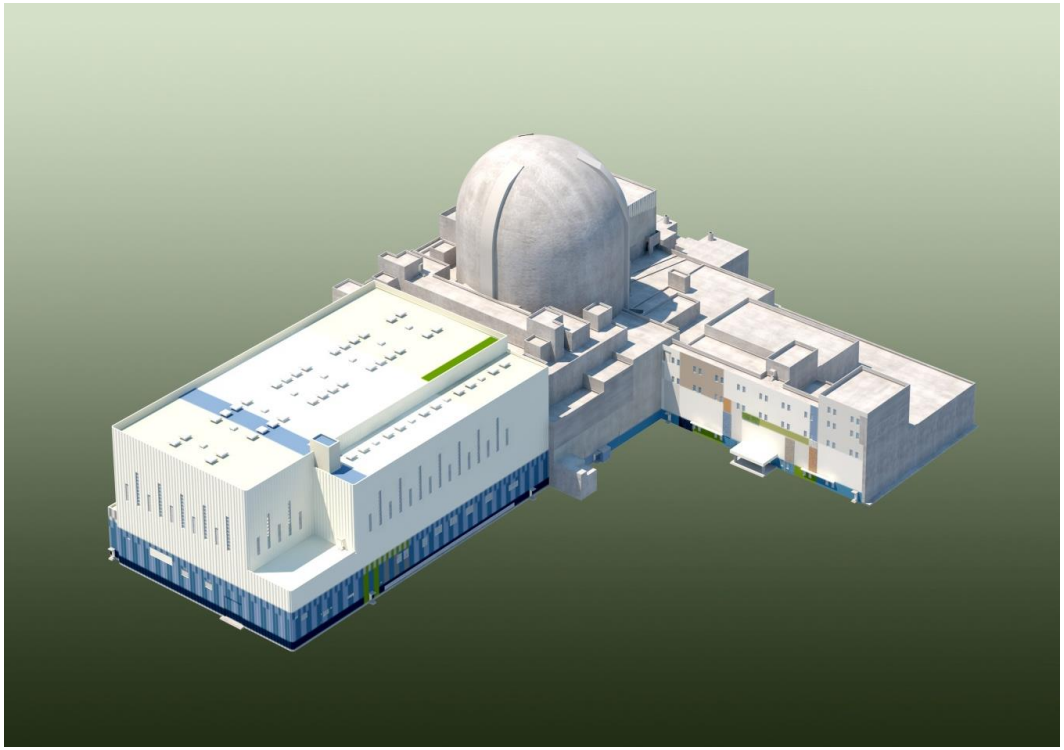
CO-CHAIR SUNSERI: Thank you very much. So, I would just like to offer my appreciation to the Staff and the Applicant for today's presentations.

And with no further comments, we will adjourn this meeting. Thank you.

(Whereupon, the above-entitled matter went off the record at 12:10 p.m.)

1

APR1400 DCA
Chapter 8: Electric Power System



KEPCO/KHNP

October 17, 2017

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Overview of Chapter 8

Section	Title	Major Contents
8.1	Introduction	• Introduction to APR1400 electric power system (offsite power system and onsite power system) • Design bases
8.2	Offsite Power System	• Design features of the offsite power system including transmission network, switchyard, offsite power system components and circuits, etc. • Conformance with 10CFR50 and NRC regulatory guides
8.3	Onsite Power System	• Design features of the onsite Class 1E and non-Class 1E AC and DC power system including power distribution equipment, onsite power sources (D/G, batteries), etc. • Conformance with 10CFR50 and NRC regulatory guides
8.4	Station Blackout (SBO)	• Descriptions on APR1400 strategies to cope with a Station Blackout (SBO) • Conformance with 10CFR50 and NRC regulatory guides

Overview of Chapter 8

❖ List of Submitted Documents for Electric Power System

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier 2: Chapter 8 Electric Power	1 (03/10/17)	DCD	-
APR1400-K-X-IT-14001-P & NP	APR1400 Design Control Document Tier 1, Section 2.6	1 (03/10/17)	DCD	-
APR1400-E-E-NR-14001-P & NP	Technical Report: Onsite AC Power System Analysis	2 (03/17/17)	TER	ML17094A137

❖ Summary of RAIs

No. of Questions	No. of Responses	Pending Response
77	77	0

Overview of Chapter 8

❖ List of Open Items

Open Item Number	Related RAI	Title	ADAMS Accession #
08.01-1	RAI 8426, 08.01-14 RAI 8730, 08.01-21	Compliance with SECY-91-078	ML17153A256
08.01-2	RAI 8540, 08.01-18	Compliance with SECY-91-078	ML17153A256 (note)
08.02-1	RAI 8521, 08.02-11 RAI 8729, 08.02-12	Open Phase Conditions	ML17192A542
08.02-2	RAI 8426, 08.01-14 RAI 8730, 08.01-21	Compliance with SECY-91-078	ML17153A256
08.03.01-1	RAI 8426, 08.01-14 RAI 8730, 08.01-21	Compliance with SECY-91-078	ML17153A256

Note) Open item 08.01-2 was resolved by the response to RAI 8730 (08.01-21)

Summary of Open Items

❖ Open Item: Compliance with SECY-91-078

- Related RAIs
  - RAI 8426 (08.01-14), RAI 8540 (08.01-18), and RAI 8730 (08.01-21)
- Open item references: 08.01-1; 08.01-2; 08.02-2; and 08.03-1
- Description of issue
  - SECY-91-078 requires at least one offsite circuit should be supplied directly to each redundant safety division with no intervening non-safety buses, so that the offsite source can power the safety buses upon a failure of any non-safety bus.
  - The APR1400 does NOT have an intervening non-safety bus in the offsite power configuration. However, the it does include transformer windings commonly connected to Class 1E and non-Class 1E buses.
  - KHNP was requested to provide detail explanation how the APR1400 offsite power system design properly meet the requirements in GDC 17 and SECY-91-0078.

Summary of Open Items

- Resolution:
  - In response to **RAI 8426**, KHNP provided a detailed explanation on how the proposed APR1400 electric power system design complies with GDC 17 and SECY-91-078 including:
    - ✓ comparison of APR1400 and EPRI ALWR offsite power system configurations in view of SECY-91-078 compliance
    - ✓ a failure modes and effects analysis (**FMEA**) which demonstrates that a failure of a non-safety bus or connection will not degrade the availability of the offsite power below an acceptable level, and also shows that the APR1400 offsite power system provides higher level of availability than that of EPRI ALWR, in the event of a failure of non-safety bus or connection.
  - KHNP also provided how the proposed design properly addresses the concerns (shown below) of common transformer windings to the Class 1E buses and non-Class 1E buses.
    - ✓ voltage regulation of the Class 1E buses
    - ✓ transients caused by non-safety loads impacting the safety buses
    - ✓ failure points between the offsite power supply and the safety buses

Summary of Open Items

- The staff considered the response as acceptable and issued **RAI 8730** requesting that the applicant incorporate in the DCD, its justification to support that the APR1400 design is in compliance with GDC 17, and in conformance with SECY-91-078.
- In response to **RAI 8730**, KHNP provided mark-up of DCD Tier 1 and Tier 2, which include descriptions:
  - ✓ how the APR1400 design complies with GDC 17 and SECY-91-078; and
  - ✓ how these design features will be verified through the verification program (i.e., Tier 1, ITAAC and Tier 2, Chapter 14.3).
- By the response above, **four (4) open items** related to the issue **were resolved**.

Summary of Open Items

❖ Open Item: Open Phase Conditions (OPCs)

- Related RAIs
  - RAI 8521 (08.02-11), RAI 8729 (08.02-12)
- Open item reference: 08.02-1
- Description of issue
  - In regard to the design vulnerability described in BL 2012-01*, the applicant should explain how its electrical system design would detect, alarm, and respond to open phase conditions(OPCs), with/without a high impedance ground.

    **NRC Bulletin 2012-01 "Design Vulnerability in Electric Power System"*
  - A specific type of OPC detection (and protection) features will be chosen by the COL applicant.
  - The staff requested the descriptions in the DCD should have sufficient detail so that the COL applicant can implement design to detect, alarm and mitigate against OPCs.

Summary of Open Items

- Resolution
  - In response to **RAI 8521**, KHNP has provided a formal response including:
    - ✓ the result of design vulnerability study including unbalanced load flow study under multiple operating scenarios with OPCs;
    - ✓ the minimum required design features of open phase detection (OPD) system (to be installed on the primary side of the MT and SATs);
    - ✓ DCD mark-up which incorporates the design features of OPD system, necessary COL items, and ITAAC.
  - Following the response, the staff issued **RAI 8729**, which requested the applicant for further detail information on the protective features, specifically
    1) how the protection features meet the criteria in BTP 8-9, B.2.c.;
    2) how the protective actions to automatically protect the Class 1E system against OPC are in accordance with IEEE Std. 603-1991 and 10 CFR 50.55a(h)(3).
  - After the issuance of RAI 8729, the staff notified KHNP that the details of OPC protection features to be applied to the APR1400 can be deferred to the COL application phase.

Summary of Open Items

- Based on the staff's notification about OPC protection features, KHNP decided to defer the detailed design of OPC detection and protection features (so called OPDP system) to the COL application phase **(COL 8.2.(8))**.

  Note) The OPDP system would be provided in Class 1E or non-Class 1E system. Satisfying the functional requirements of the OPDP system as stipulated in the DCD, one technically feasible solution among multiple candidates will be chosen (by the COL applicant) in the COL application phase.

- Accordingly, KHNP provided a response to **RAI 8729**, including the following:
  - ✓ description of compliance of the OPC protection features with BTP 8-9, B.2.c, and IEEE 603;
  - ✓ revised DCD mark-up (reflecting deferral policy of the detailed design of OPC detection and protection features)
- By the response above, **one (1) open item** related to the issue **was resolved**.

Current Status

- **Chapter 8 is complete.**
  - **KHNP continues to monitor Chapter 8 to assure any conforming changes are addressed.**

- **A draft ASER for Chapter 8 without open items was issued as of September 18, 2017.**
  - **5 open items, that were identified in Phase 2 and 3, have been resolved with adequate and sufficient discussion with the staff.**

- **Changes in Chapter 8 as reviewed and marked-up in response to the RAIs will be incorporated into the next revision (Rev.2) of the DCD.**

Attachment: Acronyms (1/2)

- AC : Alternating Current
- ALWR: Advanced Light Water Reactor
- BTP: Branch Technical Position
- CFR: Code of Federal Regulations
- COL : Combined License
- COLA : Combined License Applicant
- D/G : Diesel Generator
- DC: Design Certification or Direct Current
- DCD: Design Control Document
- EPRI: Electric Power Research Institute
- FMEA: Failure Modes and Effects Analysis
- GDC: General Design Criteria
- IEEE: Institute of Electrical and Electronics Engineers
- ITAAC: Inspections, Tests, Analyses and Acceptance Criteria
- MT: Main Transformer
- NPP: Nuclear Power Plant
- NRC: U.S. Nuclear Regulatory Commission

Attachment : Acronyms (2/2)

- OPC: Open Phase Condition
- OPDP: Open Phase Detection and Protection
- PPS: Preferred Power Supply
- RAI: Request for Additional Information
- SAT: Standby Auxiliary Transformer
- SER: Safety Evaluation Report

Attachment : List of COL Item related to OIs

COL Identifier	Description
COL 8.2(6)	The COL applicant is to provide a high-impedance ground fault detection feature that provides an alarm in the MCR upon detection of a high-impedance ground fault at the primary side of MT or SATs.
COL 8.2(8)	The COL applicant is to determine the specific type of the OPDP system, which properly address and meet the requirements of B.1. and B.2. of Branch Technical Position (BTP) 8-9, taking into account the site specific design configuration, installation condition, (field) performance testing and qualification status, and operation experiences of the OPDP system. The COL applicant is also to provide the detailed design of the OPDP system selected for the APR1400 site. The COL applicant is to perform a field simulation on the site specific design of the offsite power system to ensure that the settings of the OPDP system are adequate and appropriate for the site.

Attachment: DCD Mark-up for RAI 8730 (1/4)

21. The post-fire safe shutdown circuit analysis provides assurance that one success path of shutdown SSCs remains free of fire damage.

22. The Class 1E cables are sized considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.

23. Monitoring of primary side of the MT and SATs to detect the following open phase conditions (OPCs) is provided by the transformer dedicated open phase detection (OPD) system over the full range of transformer loading from no load to full load:

    - loss of one phase with and without a high-impedance ground fault condition; and
    - loss of two phases without a high-impedance ground fault condition.

24. Upon detection of an OPC with or without a high-impedance ground fault, the transformer dedicated OPD system sends an alarm in the main control room.

25. In case an OPC with or without a high-impedance ground fault on the primary side of the MT or SATs occurs while the transformer(s) is (are) under loading condition, the Class 1E medium voltage switchgear buses are automatically separated from the degraded offsite power source. If the condition occurs on the primary side of MT, the Class 1E medium voltage switchgear buses are automatically transferred to the alternate offsite power source (from the SATs) after the buses are disconnected from the normal offsite power source (from the UATs).

2.6.1.2 Inspection, Test, Analyses, and Acceptance Criteria

Table 2.6.1-3 specifies the inspections, tests, analyses, and associated acceptance criteria for the ac electrical power distribution system.

Add 26. Transients due to failures or incidental operation of the non-Class 1E electrical equipment will not cause failure of the Class 1E loads.

Table 2.6.1-3 (8 of 8)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
25. In case an OPC with or without a high-impedance ground fault on the primary side of the MT or SATs occurs while the transformer(s) is (are) under loading condition, the Class 1E medium voltage switchgear buses are automatically separated from the degraded offsite power source. If the condition occurs on the primary side of MT, the Class 1E medium voltage switchgear buses are automatically transferred to the alternate offsite power source (from the SATs) after the buses are disconnected from the normal offsite power source (from the UATs).	25. Tests will be performed using simulated signals to verify that as-built Class 1E medium voltage switchgear buses are automatically separated from the degraded offsite power source and, in case of an OPC on the primary side of the MT, transferred to the alternate offsite power source (from the SATs).	25. Each as-built Class 1E medium voltage switchgear buses are automatically disconnected and, in case of an OPC on the primary side of the MT, transferred to the alternate offsite power source (from the SATs).
26. Transients due to failures or incidental operation of the non-Class 1E electrical equipment will not result in failure of the Class 1E loads.	26.a Analyses will be performed to verify that the voltage variation at the Class 1E buses is maintained within acceptable limits during the non-Class 1E large motor starting condition.	26.a A report exists and concludes that the voltage variation at the Class 1E buses is maintained within acceptable limits during the non-Class 1E large motor starting condition.
	26.b Analyses will be performed to verify that the transient effect of re-acceleration of the non-Class 1E motors do not hinder the re-acceleration of the Class 1E motors during a bus transfer.	26.b A report exists and concludes that the transient effect of re-acceleration of the non-Class 1E motors do not hinder the re-acceleration of the Class 1E motors during a bus transfer.

Attachment: DCD Mark-up for RAI 8730 (2/4)

b. When the normal preferred power supply is not available, the alternate preferred power supply maintains its availability.

c. The switchyard buses where the preferred power source circuits are connected are arranged as follows:

1) Any incoming or outgoing transmission line for one preferred power source circuit can be switched without affecting the other preferred power source circuit.

2) When there is upon a failure or presence of transients on non-Class 1E buses. Discussion on the impact of faults or transients of non-Class 1E electrical equipment on the Class 1E buses is described in Subsection 8.3.1.1.2.3.

Add

8.2.1.3 Offsite Power System Components and Circuits

The offsite power system components consist of the MG, IPB, GCB, MT, two UATs, and two SATs. The MG is connected to the transmission network when the generator reaches rated speed and output voltage, and paralleling to the transmission network is accomplished automatically or manually by using the synchroscope and synchronizer. In the event that the MG is not in service, this system is used to supply power from the transmission network to the station auxiliaries.

The APR1400 design includes two offsite circuits to each independent safety train that is supplied directly from an offsite power source with no intervening non-safety buses, thereby permitting the offsite source to supply power to safety buses ~~regardless of failure of non-safety buses.~~ This design feature complies with GDC 17 and the staff's position in SECY-91-078 (Reference 29). The preferred power supply system has provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the MG or loss of power from the onsite electric power sources. Two physically independent circuits connect the switchyard to the APR1400.

Delete

Each preferred power source has the capacity and capability to permit functioning of structures, systems, and components important to safety and all other auxiliary systems under normal, abnormal, and accident conditions. The normal preferred power circuit is connected to the high-voltage side of the MT. During power operation mode, the GCB is closed and the MG is connected to the transmission system through the MT and also supplies power to the UATs. The alternate preferred power circuit is connected to the

feed incoming breaker and to provide a permissive for closing of the alternate feed incoming breaker to preclude unintended bus transfer. In case the fast transfer is not successful, residual transfer is performed automatically. The fast and residual transfer on each bus are permitted only when the alternate preferred power source from the SATs is available and the protection relay for the bus is not tripped.

~~The COL applicant is to provide a bus transfer study of the onsite power system. Based on the bus transfer study, the COL applicant is also to provide final relay selection and settings for the bus transfer (COL 8.3(2)).~~ Delete (move to Subsection 8.3.1.3.9)

The onsite ac power system consists of the 13.8 kV and 4.16 kV switchgears, 480V load centers, and 480V motor control centers (MCCs). The configuration of the onsite ac power system and offsite power system is shown in Figure 8.1-1.

8.3.1.1.1 Non-Class 1E Onsite AC Power System

There are two 3-winding UATs and two 3-winding SATs in the APR1400, and each transformer provides 13.8 kV and 4.16 kV power. During normal plant operation, two non-Class 1E 13.8 kV switchgears, one non-Class 1E 4.16 kV switchgear, and one PNS 4.16 kV switchgear are powered from a UAT in each division. One non-Class 1E AAC 4.16 kV switchgear can be aligned to either of PNS 4.16 kV switchgears.

The AAC GTG is automatically started by a starting signal from an undervoltage relay and supplies power to two PNS buses (division I and division II) manually during a LOOP. The loads that are not safety-related, but require operation during a LOOP, are connected to these buses manually. The AAC source is provided with diverse starting mechanisms compared to the Class 1E EDG. The AAC source is selected to minimize common-mode failures with the Class 1E EDG. The AAC source rating is adequate to meet the load requirements shown in Tables 8.3.1-4 and 8.3.1-5 during an SBO or LOOP conditions.

Two independent circuit breakers (referred to as double incoming circuit breakers), connected in series, are used as a set of incoming breakers for all non-Class 1E 13.8 kV and 4.16 kV switchgear incomers, thereby significantly reducing the probability of failure of the non-Class 1E incoming breakers in case of bus fault. Of the two independent circuit breakers, only one breaker is used for switching operation and protection and the other only for protection as shown in Figure 8.3.1-1.

Attachment: DCD Mark-up for RAI 8730 (3/4)

preferred power sources and connected to its dedicated Class 1E EDG by the load sequencer.

The four independent Class 1E buses of the onsite power system and the connection between the onsite and offsite power systems are provided with physical separation and electrical isolation. The arrangement is shown in Figure 8.3.1-1.

Following a LOOP, the associated Class 1E EDGs are started and the safety buses are isolated from offsite sources and fed solely from the associated EDG. The four load sequencers (one for each Class 1E bus) used for bus load shedding and load sequencing are independent from one another. The Class 1E 4.16 kV bus degraded voltage relay scheme is designed to meet the requirements of Branch Technical Position (BTP) 8-6 (Reference 8). The protective relay scheme is described in detail in Subsection 8.3.1.1.3.11.

Non-Class 1E loads are connected to the Class 1E bus by Class 1E isolation devices. The isolation devices meet Regulatory Position (1) of RG 1.75. Periodic testing of the isolation devices (e.g., visual inspection of fuses and fuse holders, circuit breaker operability tests, etc.) is performed during every refueling outage to demonstrate that the overall coordination scheme under multiple faults of non-safety related loads remains within the limits specified in the design criteria. Pressurizer heater backup groups are provided power from the Class 1E 4.16 kV bus in accordance with 10 CFR 50.34 (Reference 9). Emergency ac lighting is powered from the Class 1E 480V MCC buses. Emergency lighting is described in Subsection 9.5.3.

The physical separation between the redundant equipment, including cables and raceways, is designed in accordance with IEEE Std. 384 as endorsed by NRC RG 1.75. The design criteria for the cable designs are described in Subsection 8.3.1.1.10. The identification of onsite power system components, including cables and raceways, is described in Subsection 8.3.1.1.10.

Add

8.3.1.1.2.4 System Capacity and Capability

The Class 1E and non-Class 1E onsite power system is designed such that the Class 1E loads will not fail upon a failure or presence of transients on non-Class 1E electrical equipment. In the event of a fault on non-Class 1E buses, the faulted bus is securely isolated by protective devices while the other Class 1E and non-Class 1E buses remain connected to the offsite power source by proper coordination of protective devices. In case of a fault at UAT or SAT winding or its connection to the Class 1E and non-Class 1E buses, the faulted non-Class 1E equipment or circuit is properly isolated by protective devices and the power supply to Class 1E buses is automatically transferred to the SATs or EDGs. The operational occurrences and incidental conditions of the non-Class 1E power system, such as voltage regulation, large motor starting, re-acceleration of motors during bus transfer, and short circuit conditions, are evaluated by the electrical power system studies as described in Subsection 8.3.1.3 to demonstrate that the Class 1E onsite ac power system retains its intended function during the operational and incidental conditions caused or affected by the non-Class 1E offsite and onsite power systems. This design feature properly satisfies GDC 17 and the staff position in SECY-91-078 (Reference 29).

designed in accordance with the human factors engineering design criteria and implementation methods as described in Chapter 18.

Testing of the onsite ac power system is described in Subsection 8.3.1.1.6.

Load sequence testing for LOOP or combined LOOP and LOCA is performed during the plant shutdown condition. EDG testing capability is described in Subsection 8.3.1.1.3.7.

8.3.1.3.8 Grounding

The grounding system complies with the guidelines in IEEE Std. 665 and IEEE Std. 1050, as endorsed by RG 1.204. The grounding system consists of station grounding, system grounding, equipment grounding, safety grounding, and instrumentation grounding.

The station grounding consisting of interconnected bare copper conductors is provided to protect personnel and equipment from the hazard voltages. System grounding is intended to provide grounds of neutral points of MG, UATs, SATs, load center transformers, EDG, and AAC GTG. Equipment grounding is provided for the ground fault return path via the raceway system. Safety grounding is for protecting personnel from injury and property from damage. Instrumentation grounding is intended to establish the signal reference and minimize degradation of instrumentation signals by grounding signal cable shields, instrumentation applications, and signal return conductors. Guidelines for the design of the grounding system are described in Subsection 8.3.1.1.8. The COL applicant is to provide the analysis for the station and switchyard grounding system with underlying assumptions, based on the site-specific parameters including soil resistivity and site layout (COL 8.3(12)).

8.3.2 DC Power System

8.3.2.1 System Description

The onsite dc power system includes the dc power sources and their distribution systems and auxiliary supporting systems that are provided to supply motive or control power to the safety-related and non-safety-related equipment. Batteries and battery chargers serve as the power sources for the dc power system, and inverters convert dc power to ac power for I&C power as required. These three components when combined provide an u

Add

8.3.1.3.9 Bus Transfer Study

Analysis is performed to check if fast bus transfer is expected on each bus upon a fault on the normal offsite power source and to demonstrate the bus transfer (fast transfer or residual voltage transfer) will be performed successfully at each bus without failure of motor re-acceleration in the Class 1E and non-Class 1E power system. The COL applicant is to provide a bus transfer study of the onsite power system. Based on the bus transfer study, the COL applicant is also to provide final relay selection and settings for the bus transfer (COL 8.3(2)).

Attachment: DCD Mark-up for RAI 8730 (4/4)

1) To verify that Class 1E equipment is seismic Category I and that equipment located in a harsh environment is qualified.

b. Redundancy and independence

1) To verify the Class 1E divisional assignments and independence of electric power by both inspections and tests

c. Capacity and capability

Add

2) To verify by analysis that the transients or failures occurring in the non-Class 1E buses will not cause failure of the Class 1E (ESF) loads.

1) To verify adequate sizing of the electrical system equipment and its ability to respond to postulated events (e.g., automatically in the times needed to support the accident analyses)

2) To verify by analysis the ability of the as-built electrical system and installed equipment (e.g., diesel generators, transformers, switchgear, direct current systems, and batteries) to power the loads, including tests to demonstrate the operation of equipment

3) To verify the initiation of the Class 1E equipment necessary to mitigate postulated events for which the equipment is credited (e.g., loss-of-coolant accident [LOCA], loss of offsite power [LOOP], and degraded voltage conditions)

4) To verify by analysis how the as-built electrical power system responds to a LOCA, LOOP, combinations of LOCA and LOOP (including LOCA with delayed LOOP as well as LOOP with delayed LOCA), and degraded voltage, including tests to demonstrate the actuation of the electrical equipment in response to postulated events

d. Electrical protection features

1) To analyze the ability of the as-built electrical system equipment to withstand and clear electrical faults.

2) To analyze the protection feature coordination and verify its ability to limit the loss of equipment attributable to postulated faults.

e. Displays, controls, and alarms

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Korea Hydro Nuclear Power Co., Ltd (KHNP)
APR1400 Design Certification Application Review

Safety Evaluation with No Open Items:

Chapter 8 ELECTRIC POWER

OCTOBER 17, 2017

Technical Topics
Chapter 8 – Electric Power

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Technical Topics

- The APR1400 electric power system is the source of power for station auxiliaries during normal operation, and for the reactor protection system (RPS) and engineered safety features (ESF) during abnormal and accident conditions.

- The Electric Power System comprises of the following systems:
  - Offsite power system
  - Onsite AC power system, including 4 Class 1E trains each with a Class 1E emergency diesel generator, and Alternate AC source
  - Onsite DC Power System, including 4 trains of Class 1E 125Vdc, non-Class 1E 125Vdc system, and non-Class 1E 250Vdc system

- Staff Review and Conclusions:
  - In the Phase 2 review the staff concluded that the DCD application, Chapter 8 met all applicable regulatory criteria with the exception of the following open items:
    - Conformance with SECY 91-078
    - Open Phase Conditions

Technical Topics
Chapter 8 – Electric Power

U.S.NRC
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Open Item - #1

- **Conformance with SECY 91-078 -** To satisfy GDC 17, SRP 8.2, SRP 8.3, and Commission approved SECY-91-078 "EPRI's Requirements Document and Additional Evolutionary LWR Certification Issues," the following are required:
  - Policy Issue 1 - An alternate power source to non-safety loads, unless it can be demonstrated that the design will ensure that transients for loss of non-safety power events that are less severe than those associated with the turbine-trip-only.
    - The applicant explained that the alternate power source to the non-safety loads is through the standby auxiliary transformers (SATs).
  - Policy Issue 2 - At least one offsite circuit to each redundant Class 1E (safety) division should be supplied directly from one of the offsite power sources with no intervening non-Class 1E (non safety-related) buses in such a manner that the offsite source can power the safety buses if any non-safety bus should fail.
    - The applicant provided a failure mode effects analysis (FMEA) to demonstrate that a failure of a non-safety bus or connection will not impact the safety bus.
    - The staff's concerns associated with feeding both safety and non-safety loads from the same transformer winding include (1) voltage regulation of the safety buses, (2) transients caused by non-safety loads impacting the safety buses, and (3) failure points between the offsite power supply and the safety buses.

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Open Item - #1

- **Conformance with SECY 91-078 -**
  - (1) Voltage regulation of the safety buses
    - The on-load tap changers at the primary side of the unit auxiliary transformers (UATs) and SATs ensure that the medium voltage safety buses are maintained in an acceptable range.
  - (2) Transients caused by non-safety loads impacting the safety buses
    - Transients such as motor starting, motor re-acceleration during a bus transfer, and short circuit on a non-safety bus were assessed and the studies showed that the safety systems would be able to perform their intended function.
  - (3) Failure points between the offsite power supply and the safety buses.
    - An electrical fault (short circuit fault or ground fault) on a connection to safety or non-safety bus will be detected by UAT (or SAT) relays and allows transfer of power to the alternate power supply or to the EDG power source.
  - The applicant added DCD Tier 1, Table 2.6.1-3, ITAAC Item 26 for the COL applicant to verify that the Class 1E loads will not fail due to transients on non-Class 1E electrical equipment during non-Class 1E large motor starting or re-acceleration.

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Open Item - #1

- **Conformance with SECY 91-078 -**
  - The APR1400 design is in compliance with GDC 17 and in conformance to the guidance in SECY-91-078. Specifically,
    - (1) the applicant will assure that short-circuit faults on the non-Class 1E buses will not affect the Class 1E buses with existing ITAAC 20,
    - (2) existing ITAAC 8 will assure that medium voltage Class 1E buses can be automatically transferred satisfactorily to the alternate preferred offsite power supply should the normal preferred offsite power supply not be available, and
    - (3) the new ITAAC 26 will verify by analysis that large motor starting, and the bus transfer during motor re-acceleration can be accomplished such that the Class 1E equipment will be able to perform its intended function.

Resolution of Open Item #1

Thus, the staff finds that the APR1400 electrical design conforms to SECY-91-078 since 1) there is an alternate source to feed the non-safety loads and 2) the safety buses and equipment will be able to perform their intended function.

Technical Topics
Chapter 8 – Electric Power
Open Item- #2

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- **Open Phase Conditions**– Requested that the applicant explain how its electrical system design would detect, alarm, and respond to a open phase conditions, with/without a high impedance ground
  - Per 10 CFR 52.47(a)(3), the applicant must include principal design criteria for the facility.
  - Staff has determined that, in order to meet the requirements of GDC 17, the applicant should describe how its electrical system design would detect, alarm, and respond to open phase conditions, with/without a high impedance ground.
  - Staff finds that the applicant's open phase detection and protection (OPDP) system detects open phase conditions on the primary side of the MT and SATs and conforms to the Branch Technical Position (BTP) 8-9 for detection of open phase conditions and alarm in the main control room.
  - Regarding the protection features for open phase conditions per BTP 8-9, the applicant provided COL Item 8.2(8) in which the COL applicant is to determine the specific type of OPDP system (i.e. Class 1E or non-Class 1E) and address the guidance in BTP 8-9.
  - Three ITAAC were added to ensure:
    - The OPDP system can detect an open phase condition.
    - The OPDP system can provide an alarm in the MCR upon detection of an open phase condition.
    - Class 1E medium voltage buses are automatically separated from the degraded offsite source, transferred to the alternate power source or onsite standby source.

Resolution of Open Item #2

The OPDP system conforms to BTP 8-9 since it provides detection, alarm in the MCR, and protection features in that the Class 1E medium voltage buses will transfer to a power source without an open phase condition.

The OPDP system ensures that the safety buses are not affected since the COL applicant will determine an OPDP system that meets the requirements in BTP 8-9.

Conclusion

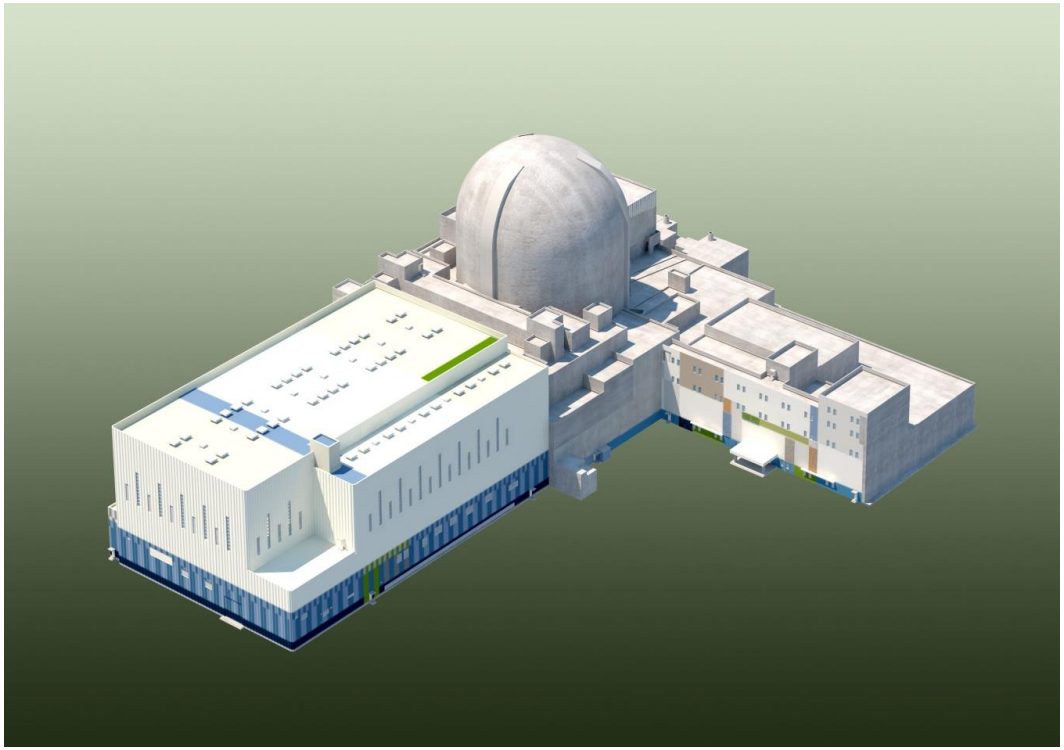
The staff has determined that all open items are closed and DCD Chapter 8 meets all applicable regulatory criteria. The following three confirmatory items are being tracked for incorporation in Revision 2 of the DCD:

RAI 8730, Question 08.01-21 – SECY 91-078

RAI 8729, Question 08.02-12 – Open Phase Conditions

RAI 8525, Question 08.04-15(c) – Alternate AC Support Systems

APR1400 DCA
Chapter 10: Steam and Power Conversion System



KEPCO/KHNP

October 17, 2017

Contents

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Overview of Chapter 10

Section Overview

Section	Title	Major Contents
10.1	Summary Description	• Introduction of the steam and power conversion system and major process system of steam and power conversion system
10.2	Turbine Generator	• The Turbine Generator(T/G) converts the energy of the steam produced in the two steam generators (SGs) into mechanical shaft power and then into electrical energy.
10.3	Main Steam System	• Design features of the main steam system including safety evaluation, inspection and testing requirements, secondary water chemistry and steam and feedwater system material etc.
10.4	Other Features of the Steam and Power Conversion System	• Design feature of the main condensers, condenser vacuum system, turbine steam seal system, turbine bypass system, circulating water system, condensate polishing system condensate and feedwater system, steam generator blowdown system, auxiliary feedwater system and auxiliary steam system

Overview of Chapter 10

List of Submitted Documents

Document No.	Title	Rev.	Type	ADAMS Accession No.
APR1400-K-X-FS-14002-NP	APR1400 Design Control Document Tier2 : Chapter 10 Steam and Power Conversion System	1	DCD	
APR1400-K-X-IT-14001-P	APR1400 Design Control Document Tier 1	1	DCD	

Summary of RAIs

No. of Questions	No. of Responses	Pending Response
71	71	0

Overview of Chapter 10

- **List of Open Items**

Open Item Number	RAI No.	Title	ADAMS Accession No.
10.2-1	RAI 8050, Question 10.02-2	Diversity/Redundancy/Independence	ML16312A535
10.2-2	RAI 8050, Question 10.02-4	Fail Safe and Single Failure	ML16312A535
10.2-3	RAI 8050, Question 10.02-5	Common Cause and Mode Failure	ML16312A535
10.2-4	RAI 8050, Question 10.02-3	Manual Turbine Trip	ML16312A535
10.3-1	RAI 8570, Question 10.03-5	Table including information required in SRP 10.3, Section III.5.E	ML16175A678
10.3-2	RAI 8570, Question 10.03-4	Seismic Category for the discharge piping of the MSADVs and MSSVs	ML16181A250
	RAI 8714, Question 10.03-7		ML17018A373
10.3-3	RAI 8575, Question 10.03-6	Operating and maintenance procedures necessary to address water (steam) hammer.	ML16153A485
10.3.6-1	RAI 8649, Question 10.03.06-24	Add the conditions of 10 CFR 50.55a(b)(5) on ASME Code Case N-597-2	ML16242A433
10.3.6-2	RAI 8649, Question 10.03.06-25	Revise the COL item 10.3(3)	ML16242A433

Overview of Chapter 10

- **List of Open Items (cont.)**

Open Item Number	RAI No.	Title	ADAMS Accession No.
10.3.6-3	RAI 8649, Question 10.03.06-26	Carbon steel portions of downcomer feedwater line between the chrome-moly portions	ML16315A367
10.3.6-4	RAI 8649, Question 10.03.06-27	FAC-susceptible carbon steel in the subject portion of the economizer feedwater line	ML16271A336
10.3.6-5	RAI 8671, Question 10.03.06-28	Removal of Valves and flanges from Tables	ML16272A466
10.4.8-1	RAI 8596, Question 10.04.08-6	Additional information about control signals that activate the CIVs in SGBS	ML16285A524
10.4.9-1	RAI 8664, Question 10.04.09-8 (Transferred to RAI 418-8348, Q.19-45)	AFWS reliability analysis	N/A
10.4.10-1	RAI 8556, Question 10.04.10-1	Auxiliary Steam System	ML16168A470
10.4.10-2	RAI 8556, Question 10.04.10-2	Auxiliary Steam System	ML16168A470
10.4-3	N/A (Related to RAI 8307, Q. 09.02.02-3)	Similar COL Items addressing RG 4.21 radiological monitoring program for various DCD chapters	N/A

Summary of Open Items

❖ RAI 8050, Question 10.02-2 (Open Item 10.02-1)

- Overspeed Trip Design

- Date of issue: Jul. 27, 2015
- Description of issue:

  - Provide information on how overspeed trips are performed and what components and subsystems are used in implementing these overspeed trip systems. In addition, describe how the turbine steam inlet valves and associated hydraulic fluid systems and solenoid valves function in tripping the turbine.

- Point of discussion:

  - More detail is needed regarding how principles of single failure tolerance, separation, diversity, etc. are met.

Summary of Open Items

❖ RAI 8050, Question 10.02-2 (Open Item 10.02-1 (cont.))

- Resolution:
  - COL Items identify required actions and information.
  - In lieu of turbine design being specified, functional requirements for the T/G system and its overspeed protection are identified.
  - To address staff concern for more detail without the TG design available, discussion of diversity, redundancy, independence, etc. has been expanded.
  - Inconsistencies noted previously by the subcommittee have been addressed.

- Impact: DCD subsections are revised (10.1.1, 10.2, 10.2.1.2, 10.2.2, 10.2.3.5, 10.2.5 Combined License Information item (2), Table 10.2.2-2, Figure 10.2.2-1, Figure 10.2.2-2, and Table 1.8-2)

- Reference : ML16312A535

- By the response above, open item 10.02-1 was resolved.

Summary of Open Items

❖ RAI 8050, Question 10.02-4 (Open Item 10.02-2)

- Trip Block Design

- Date of issue: Jul. 27, 2015
- Description of issue:

  - Provide adequate details of the turbine trip-block configuration. If the design uses a single trip block, provide information on single failure criteria for turbine overspeed, and justification on how it satisfies requirements for redundancy and diversity.

- Point of discussion:

  - More detail is needed regarding how principles of single failure tolerance, separation, diversity, etc. are met.

Summary of Open Items

❖ RAI 8050, Question 10.02-4 (Open Item 10.02-2 (cont.))

- Resolution:
  - In lieu of specifying a turbine design, functional requirements for T/G overspeed protection are identified. Information was added on diversity, redundancy, etc.:
    a. Independence – Failure of one overspeed protection system will not propagate to the others because of electrical isolation and physical separation.
    b. Fail safe – Failure of hydraulic piping that affects operability (e.g., between the trip block and valve actuator) cause closure of the turbine steam valves.
    c. Redundancy –
       i. Each turbine steam inlet line has two valves, closure of any one in each pair isolates that line.
       ii. Failure of any one component in overspeed protection systems will not prevent a turbine trip.
    d. Single failure criterion – single failures are addressed through redundancy and independence, and no single failure will cause a turbine to overspeed.
- Impact: DCD Subsections are revised. (10.2.2, 10.2.5 Combined License Information item (2), Figure 10.2.2)
- Reference : ML16312A535
- By the response above, open item 10.02-2 was resolved.

Summary of Open Items

❖ RAI 8050, Question 10.02-5 (Open Item 10.02-3) - CCF

- Date of issue: Jul. 27, 2015
- Description of issue:

  - Sufficient information is not provided regarding electrical and fluid flow paths, shared components, failure modes, and common cause failures (CCF).

  - Address how shared components and electrical and fluid flow paths consider failure modes and CCF vulnerabilities. For clarity, the response should include schematic diagrams that show the control fluid flow paths, piping and valves being actuated (e.g., turbine stop, intercept, and extraction non-return valves).

- Point of discussion:
  - Details should be provided regarding the design and testing requirements to minimize or eliminate CCF.
  - Information is needed regarding:
    - Single failure criteria for the turbine overspeed protection system..
    - Justification on how this satisfies the requirements for redundancy and diversity.

Summary of Open Items

❖ RAI 8050, Question 10.02-5 (Open Item 10.02-3 (cont.))

- Resolution:
  - More detail is being added to the functional requirements, such as:
    a. Diversity –
       i. Mechanical overspeed trip does not need electric power to trip the T/G.
       ii. Overspeed trips use diverse speed inputs, determine trip validity using different technology, and have different set points
    b. Redundancy – Any of three overspeed trips can actuate to drain control oil.
    c. Separation – Hydraulic control oil drain headers for redundant steam valves are separate and on opposite sides of the turbines.

- Impact: DCD Subsections are revised (10.2.2, 10.2.5 Combined License Information item (2), Figure 10.2.2-2 and Table 1.8-2)

- Reference : ML16312A535

- By the response above, open item 10.02-3 was resolved.

Summary of Open Items

- **RAI 8050, Question 10.02-3 (Open Item 10.02-4)**
  - **– Manual Turbine Trip**
    - Date of issue: Jul. 27, 2015
    - Description of issue:

      - No reference to or description of a manual turbine trip feature for the APR1400 turbine was found. The staff considers the manual turbine trip system as one of the diverse turbine protection systems under all modes of plant operations.

      - Provide detailed information regarding a manual control and/or manual turbine trip system. Include any hard wiring from the main control room (MCR) to the T/G, including a push button at the turbine pedestal
    - Point of discussion :

      - Information should be provided regarding a manual control and/or manual turbine trip system for the APR1400 T/G.

      - Identify use of any hard wiring from the main control room (MCR) to the T/G, including a push button at the turbine pedestal.

Summary of Open Items

❖ RAI 8050, Question 10.02-3 (Open Item 10.02-4 (cont.))

- Resolution:
  - Manual trips in the MCR and at the pedestal have always been included; for clarity, they have been relabeled from "emergency trip" to "manual emergency trip." Additional detail has also been provided:
    a. Emergency manual trip activation at the turbine front standard and from the MCR de-energizes a solenoid that moves the trip linkages.
    b. The manual emergency trip shall be designed such that no single failure (e.g., push button) will prevent a manual trip and that failure of the ETS to initiate an automatic trip does not prevent a successful manual trip.
    c. The physical implementation (e.g., hard wiring) shall be included in the schematic required by COL item 10.2(2).

- Impact: DCD Subsections 10.2.2.3.3 is revised

- Reference : ML16312A535

- By the response above, open item 10.02-4 was resolved.

Summary of Open Items

❖ RAI 8570, Question 10.03-5 (Open Item 10.3-1)

- Date of issue: April. 19, 2016
- Description of issue:
  - NRC staff reviewed DCD Tier 2, Section 10.3 for a description of all flow paths that branch off the main steam lines between MSIVs and the main turbine stop valves (TSVs) as specified in SRP 10.3, Section III.5.E. and find it incomplete or missing.
  - KHNP is requested to include in the complete tabulation and description.
- Resolution:
  - KHNP provided a new table including information required in SRP 10.3, Section III.5.E in the DCD Tier2, Subsection 10.3.2.2.1.
- Impact: DCD Tier2, Subsection 10.3.2.2.1 & Table 10.3.2-6
- Reference: ML16175A678
- By the response above, open item 10.3-1 was resolved.

Summary of Open Items

❖ RAI 8570, Question 10.03-4 (Open Item 10.3-2)

- Date of issue: April. 19, 2016
- Description of issue:
  - NRC staff requested that explanation of how the discharge piping of the MSADVs and MSSVs can perform their safety-related function of discharging steam to the atmosphere during a seismic event when its seismic classification is only Seismic Category II.
- Resolution:
  - KHNP provided the response that discharge piping from the outlet of the MSSVs and MSADVs does not have safety-related function and it maintains structural integrity in the event of an SSE.
  - NRC staff considered the response as not acceptable and issued follow-up RAI 8714, Q.10.3-7.
- Impact: None
- Reference: ML16181A250

Summary of Open Items

❖ RAI 8714, Question 10.03-7 (Open Item 10.3-2(cont.))

- Date of issue: November. 21, 2016

- Description of issue:
  - In RAI 8714, Q.10.3-7 , NRC staff requested the revision of the classification to Seismic Category I or demonstration of the ability to adequately handle the discharged steam from the MSADVs and MSSVs.

- Resolution :
  - KHNP provided the response that discharge piping could be maintained as Seismic Category II because its functional capability was assured by piping analysis.
  - And, MSSV and MSADV discharge piping material was revised from ASTM A-106 Gr. B to A-106 Gr. C to meet the functional capability.

- Impact: DCD Tier 2, Table 10.3.2-3 & Figure 10.3.2-1.

- Reference: ML17018A373

- By the response above, open item 10.3-2 was resolved.

Summary of Open Items

❖ RAI 8575, Question 10.03-6 (Open Item 10.3-3)

- Date of issue: April. 19, 2016
- Description of issue:
  - NRC staff requested revision of the DCD to include items to be incorporated into procedures necessary to address precautions associated with potential water/steam hammer consistent with NUREG-0927.
- Resolution:
  - KHNP provided the list of items to be incorporated into the operating and maintenance procedures necessary to address water (steam) hammer specified in NUREG-0927.
- Impact: DCD Tier 2, Subsection 10.3.2.3.5
- Reference: ML16153A485
- By the response above, open item 10.3-3 was resolved.

Summary of Open Items

❖ RAI 8649, Question 10.03.06-24 (Open Item 10.3.6-1)

- Date of issue: May. 24, 2016
- Description of issue:
  - The applicant references ASME code, Section XI, but does not integrate the terms and conditions specified in 10 CFR 50.55a(b)(5) regarding RG 1.147 and conditions on the use of ASME Code Cases.
  - NRC staff requested that applicant add the suggested statement to DCD Tier 2, Section 10.3.6.3 or add to the end of COL item 10.3(3)
- Resolution:
  - KHNP provided the response that the following sentence was added to the end of COL item 10.3(5).
    "The program shall incorporate the conditions of 10 CFR 50.55a(b)(5) on ASME Code Case N-597-2."
- Impact: DCD Tier 2, Table 1.8-2 and Subsection 10.3.7
- Reference: ML16242A433
- By the response above, open item 10.3.6-1 was resolved.

Summary of Open Items

❖ RAI 8649, Question 10.03.06-25 (Open Item 10.3.6-2)

- Date of issue: May. 24, 2016
- Description of issue:
  - NRC staff requested that the applicant revise and simplify COL item 10.3(3) as follows: " The COL applicant is to provide a description of the FAC monitoring program. The description is to address consistency with GL 89- 08 and NSAC-202L-R3 and provide a milestone schedule for implementation of the program."
- Resolution:
  - KHNP provided the response that the NRC staff suggested sentence was added in DCD subsection 10.3.7.
- Impact: DCD Tier 2, Table 1.8-2 and Subsection 10.3.7
- Reference: ML16242A433
- By the response above, open item 10.3.6-2 was resolved.

Summary of Open Items

❖ RAI 8649, Question 10.03.06-26 (Open Item 10.3.6-3)

- Date of issue: July. 26, 2016
- Description of issue: NRC staff requested the answer to the following questions.
  - What material specifications are utilized for the carbon steel portion of the downcomer feedwater line between the chrome-moly portions of the same line (including the Main Feedwater Isolation Valves and connected safety-related piping)?
  - Are the carbon steel portions of the downcomer feedwater line between the chrome-moly steel portions subject to augmented in-service inspection (ISI)?
- Resolution: KHNP provided the following response.
  - The material from feedwater heaters 7 outlet header to MSVH is ASTM A106 Gr. B
  - In the OPR1000 design, chrome-moly steel was utilized between the MFCV and MSVH line, which contain sharp bending portions susceptible to FAC.
  - On the other hand, in the APR1400 design, carbon steel is utilized between the MFCV and MSVH line, which do not have sharp bending portions.

Summary of Open Items

❖ RAI 8649, Question 10.03.06-26 (Open Item 10.3.6-3 (cont.))

- Resolution(cont.):
  - The carbon steel portions of the downcomer feedwater line between the chrome-moly steel portions are not subject to augmented in-service inspection (ISI)
  - ISI is performed to evaluate weld degradation on the entire welding area. UT thickness inspection is performed to evaluate component wear beyond the toe of the weld. Initial wall thickness is taken in components placed downstream of the MFCV and will be inspected periodically during plant operation.

- Impact: DCD Tier 2, Table 10.3.2-4 and Subsection 10.3.6.3

- Reference: ML16315A367

- By the response above, open item 10.3.6-3 was resolved.

Summary of Open Items

❖ RAI 8649, Question 10.03.06-27 (Open Item 10.3.6-4)

- Date of issue: July. 26, 2016
- Description of issue: NRC staff requested the explain to the following questions.
  - The flow velocity in the economizer feedwater line should be comparable to, and possibly greater than, the flow velocity in the downcomer feedwater line.
  - Why the use of FAC-susceptible carbon steel in the subject portion of the economizer feedwater line is adequate to ensure that FAC-related piping degradation does not occur in the economizer feedwater line.
- Resolution: KHNP provided the following response.
  - In the APR1400 design, carbon steel is utilized with an additional thickness of 0.06 in. to provide for greater corrosion allowance between the MFCV and MSVH line.
  - Accordingly, the FAC susceptibility comparison is not necessary between the economizer and the downcomer feedwater line. In addition, the FAC susceptible portions are periodically inspected as part of a long term inspection plan between the economizer and the downcomer feedwater line.
- Impact: None
- Reference: ML16271A336
- By the response above, open item 10.3.6-4 was resolved.

Summary of Open Items

❖ RAI 8671, Question 10.03.06-28 (Open Item 10.3.6-5)

- Date of issue: August. 12, 2016
- Description of issue: NRC staff requested the answer to the following question.
  - The reason of the removal of fittings, valves, and flanges from Tables 10.3.2-2, 10.3.2-3 and 10.3.2-4.
- Resolution: KHNP provided the following response.
  - The title of Chapter 10.3.6.3 is “Flow-Accelerated Corrosion”. The valves and flanges are not susceptible to FAC. Visual inspections are more commonly used if wear is localized on valves and flanges. Therefore, material and size for valves and flanges have been excluded in Tables 10.3.2-2, 10.3.2-3, and 10.3.2-4.
  - The fittings are included in the Tables.
- Impact: DCD Tier 2, Table 10.3.2-4
- Reference: ML16272A466
- By the response above, open item 10.3.6-5 was resolved.

Summary of Open Items

❖ RAI 8596, Question 10.04.08-6 (Open Item 10.4.8-1)

- Date of issue: May. 04, 2016
- Description of issue: NRC staff requested the following additional information
  - Address the missing actuation signals (HRAS and BFTHHLAS) in DCD Tier 1 Figure 2.7.1.8-1.
  - Address the specific signals that activate the CIVs in DCD chapter 7 for consistency and clarity.
- Resolution: KHNP provided the following response.
  - The actuation signals (HRAS and BFTHHLAS) will be indicated in DCD Figure 2.7.1.8-1 and the detailed description for the actuation of CIVs will be provided in DCD chapter 7 subsection 7.3.1.9.
- Impact: DCD Tier 1, Figure 2.7.1.8-1 and ACRONYM AND ABBREVIATION LIST, DCD Tier 2, Figure 10.4.8-1, and Subsection 7.3.1.9.
- Reference: ML16285A524
- By the response above, open item 10.4.8-1 was resolved.

Summary of Open Items

❖ RAI 8664, Question 10.04.09-8 (Open Item 10.4.9-1)

- Date of issue: Feb. 3, 2017
- Description of issue:
  - NRC staff requested that the applicant to provide a description of the AFWS reliability analysis.
- Resolution:
  - **This RAI was transferred to RAI 418-8348, Question 19-45 of Chapter 19 to be a consensus with NRC staff. (Conference call dated July 12, 2016)**
  - **It will be presented in Chapter 19.**
- By the resolution above, open item 10.4.9-1 was resolved.

Summary of Open Items

❖ RAI 8556, Question 10.04.10-1 (Open Item 10.4.10-1)

- Date of issue: May. 09, 2016
- Description of issue:
  - NRC staff requested to clarify the actual design of the auxiliary steam system piping with regards to meeting the requirements of 10 CFR 20.1406, "Minimization of contamination".
- Resolution:
  - KHNP provided the response that the auxiliary steam system will be designed with minimum embedded or buried piping and yard piping in an underground concrete tunnel.
- Impact: DCD Tier 2, Subsection 10.4.10 and Table 12.4-10
- Reference: ML16168A470
- By the response above, open item 10.4.10-1 was resolved.

Summary of Open Items

❖ RAI 8556, Question 10.04.10-2 (Open Item 10.4.10-2)

- Date of issue: May. 09, 2016
- Description of issue:
  - NRC staff requested to clarify the design classification for auxiliary steam system components and piping within the reactor containment building.
- Resolution:
  - KHNP provided the response that the non-safety related piping and components for auxiliary steam system within the reactor containment building will be classified as Seismic Category II and quality group D.
- Impact: DCD Tier 2, Table 3.2-1
- Reference: ML16168A470
- By the response above, open item 10.4.10-2 was resolved.

Summary of Open Items

❖ Open Item 10.4-3

- Description of Issue:
  - The auxiliary steam (AS) system is designed in accordance with 10 CFR 20.1406 and RG 4.21 with early leak detection and minimization of contamination with associated commitment to require the COL Applicant to establish operational procedures and maintenance programs for the AS system.
  - NRC staff reviewed the COL Item 10.4(1) and found that there are similar commitments exist for other system and components that have comparable design features.
  - NRC staff suggested that this COL Item can be consolidated into a singular and encompassing commitment to minimize duplication. The Staff reviewers for Tier 2 DCD Chapters 11 and 12 were designated to take on this issue for resolution.

- Resolution:
  - The issue was discussed in the clarification conference call between the NRC staff (for Chapters 11 and 12) and KHNP on May 24, 2016, as it relates to RAI 246-8307, Q. 09.02.02-3.

Summary of Open Items

❖ Open Item 10.4-3 (cont.)

- Resolution(cont.):
  - NRC staff suggested acceptability for both approaches: maintaining existing configuration, or eliminate the repetitive COL items for each program.
  - KHNP can maintain the separate COL Items for each system for these programs in order to minimize changes to the DCD.

- Impact: No DCD changes was required.

- Reference: ML16181A260

- By the response above, open item 10.4-3 was resolved.

Current Status

- **Chapter 10 is complete.**
  - **Chapter 10 is monitored to address conforming changes when necessary.**

- **A draft SER without Open Items was issued as of September 18, 2017.**
  - **Seventeen open items, that were identified in Phase 3, have been resolved with adequate and sufficient discussion with Staff.**

- **Changes in Chapter 10 as reviewed and marked-up in response to NRC's RAIs will be incorporated into the next revision (Rev.2) of the DCD, Tier 2.**

Attachment: Acronym

- FAC – Flow Accelerated Corrosion
- MSVH – Main Steam Valve House
- MSIV – Main Steam Isolation Valve
- MSADV – Main Steam Atmospheric Dump Valve
- MSSV – Main Steam Safety Valve
- SSE – Safe Shutdown Earthquake
- MFCV – Main Feedwater Control Valve
- RCS – Reactor Coolant System
- SRP – Standard Review Plan
- CIV – Containment Isolation Valve
- SGBS – Steam Generator Blowdown System
- HRAS - High Radiation Actuation Signal
- BFTHHLAS - Blowdown Flash Tank High-high Level Actuation Signal
- AFWS – Auxiliary Feedwater System
- T/G – Turbine Generator
- TGCS – Turbine Generator Control System
- EOTS –Electronic Overspeed Trip System
- CDI – Conceptual Design Information
- CCF – Common Cause Failures
- MCR – Main Control Room
- ETS –Emergency Trip System

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Presentation to the ACRS Subcommittee

Korea Hydro Nuclear Power Co., Ltd (KHNP) APR1400 Design Certification Application Review

Safety Evaluation with No Open Items:

Chapter 10 STEAM AND POWER CONVERSION SYSTEMS

October 17, 2017

Technical Topics
Section 10.2 – Main Turbine-Generator System

U.S.NRC
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Open Item 10.02-1

Issue: DCD lacked sufficient information on how the overspeed protection system conforms to SRP guidance with respect to satisfying relevant diversity, redundancy and independency considerations.

Resolution: A revised response to RAI 8050, Question 10.02-2 was provided and included:

- Revision of the DCD to include detailed functional performance descriptions of the TGCS, MOTS, and EOTS, along with specified design requirements.
- Addition of DCD Figure 10.2-2, “High Level Overspeed Protection Architecture”
- Revision of COL item 10.2(2) to instruct the COL applicant to provide schematics of the TG overspeed protection system showing all discrete components and interfaces once a turbine is selected.

Open Item Closure: The staff reviewed the information provided by the applicant and determined that the TG design and overspeed protection system will have sufficient redundancy, diversity and independency to satisfy the SRP guidance and therefore meet the intent of GDC 4 criteria.

Technical Topics
Section 10.2 – Main Turbine-Generator System

U.S.NRC
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Open Item 10.02-2

Issue: DCD lacked sufficient information on how the overspeed protection system conforms to SRP guidance with respect to satisfying single-failure criteria.

Resolution: A revised response RAI 8050 was provided and included:

- A revision of the DCD to include in Section 10.2.2.3.2, “Overspeed Protection,” a subsection about single failure criterion.
- COL Item 10.2(2) was revised and now specifies that the schematics and descriptive information, provided once a turbine design is selected, shall be sufficient to allow assessment of the TGCS and overspeed systems' ability to withstand a single failure without loss of function.

Open Item Closure: The staff reviewed the information provided by the applicant and determined that the design information added to DCD along with the revised COL item will ensure that the TG design will satisfy the single-failure criteria and therefore meet the intent of GDC 4.

Technical Topics
Section 10.2 – Main Turbine-Generator System

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Open Item 10.02-3

Issue: DCD lacked sufficient information on how the overspeed protection system conforms to SRP guidance with respect to addressing system design consideration used to combat common cause and common mode failure

Resolution: A revised response RAI 8050 was provided.

- DCD Section 10.1.1, "Protective Features," states that the mechanical and electrical overspeed trip systems are fully independent of each other in that the failure of one system does not preclude operation of the other.
- DCD Section 10.2.2.3.2, "Overspeed Protection," was revised to indicate that the TGCS and EOTS use diverse speed inputs, determine trip validity using different technology, have different set points, and actuate to drain hydraulic control oil to eliminate common cause failures from rendering the trip functions inoperable.

Open Item Closure: The staff reviewed the information provided by the applicant and . determined that design provisions will be included in the design to protect against common cause failures, as specified in the SRP guidance, and therefore meet the intent of GDC 4 in this regards.

Technical Topics
Section 10.2 – Main Turbine-Generator System

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Open Item 10.02-4

Issue: DCD lacked sufficient information on how the overspeed protection system conforms to SRP guidance concerning design consideration and implementation of the manual control and manual trip systems to be used.

Resolution: The applicant provided the staff with additional information in a revised response to RAI 8050, Question 10.02-2, by indicating in the DCD that the manual emergency trip shall be designed such that no single failure (e.g., push button) will prevent a manual trip and that failure of the ETS to initiate an automatic trip does not prevent a successful manual trip. The applicant also specified that the physical implementation (e.g., hard wiring) shall be included in the schematic required by COL item 10.2(2). In addition the DCD specifies that the turbine manual switches and associated linkages are tested during refueling outages prior to turbine start-ups, or if maintenance work could have affected functionality.

Open Item Closure: The staff reviewed the information provided by the applicant and finds that the design contains adequate provisions with regards to the manual control and manual trip systems and therefore meet the intent of GDC 4 criteria and SRP guidance in this regards.

Technical Topics
Section 10.3 – Main Steam System

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Open Item 10.03-1

Issue: DCD lacked sufficient description of all flowpaths that branch off the main steamlines between the MSIVs and TSVs as specified in SRP 10.3, Section III.5.E.

Resolution: A response to RAI 8570, Question 10.03-5 was provided and included a table containing descriptive information of branch piping of the MSS.

Open Item Closure: The staff reviewed the information provided by the applicant and determined it to be acceptable because the design of the branch piping and associated valves will preclude the blowdown of more than one steam generator during a main steamline break consistent with the guidance of SRP 10.3, Section III.5.E.

Technical Topics
Section 10.3 – Main Steam System

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Open Item 10.03-2

Issue: DCD lacked sufficient information on how the discharge piping of the MSADVs and MSSVs can perform their function of discharging steam to the atmosphere during a seismic event with a seismic classification of seismic Category II.

Resolution: A response to RAI 8714, Question 10.03-7 was provided and stated a piping analysis of the functional capability of the discharge piping was performed to show that plastic deformation does not occur such that it challenges the safety function of the MSSVs and MSADVs.

Open Item Closure: The staff determined the analysis to be reasonable and concludes that the applicant has demonstrated the functional capability of this piping will be maintained, and is consistent with the guidance of RG 1.29.

Technical Topics

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Section 10.3.6 – Steam and Feedwater Materials

Technical Topics

- 5 Open items in P2 SER which can be grouped into three topics:
  - COL Item 10.3(5) on Flow Accelerated Corrosion (FAC) program
  - Material selection of piping near the Feedwater Isolation Valve for FAC resistance
  - Completeness of FSAR Tables 10.3.2-2, 10.3.2-3 and 10.3.2-4.

Technical Topics

Section 10.3.6 – Steam and Feedwater materials

Open Items 10.3.6-1 and 10.3.6-2

- **COL Item 10.3(5), FAC program**
  - COL item is revised. The new language ensures that the FAC program will be consistent with staff guidance.
  - Staff finds the applicant's response acceptable.

Open Items 10.6.3 and 10.6.4

- **Feedwater material selection near Feedwater Isolation Valve**
  - Original submittal had an error. The OPR-1000 utilized chrome-moly steel for a portion of piping that contained a sharp bend. The APR-1400 plant is designed without the sharp bend. The staff questions on FAC resistance of materials near the isolation valve are no longer relevant.
  - Staff finds the applicant's response acceptable.

Open Item 10.3.6-5

- **Completeness of FSAR Tables 10.3.2-2, 10.3.2-3 and 10.3.2-4**
  - **Open item 10.3.6-5**
  - The FSAR Tables were revised to be complete and accurate. The ASME OM Code and ASME Code Section XI provide requirements for valves which ensure that FAC is prevented or detected.
  - Staff finds the applicant's response acceptable.

Technical Topics

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Section 10.3.6 – Steam and Feedwater materials

Conclusion

The staff has determined that all open items are closed and DCD Section 10.3.6 meets all applicable regulatory criteria. The following confirmatory items are being tracked for incorporation in Revision 2 of the DCD:

MCB-10.3.6-1

MCB-10.3.6-8

MCB 10.3.6-10

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Technical Topics

Section 10.4.8 – Steam Generator Blowdown System

Open Item 10.4.8-1

- **Description of Containment Isolation Valve (CIV) actuation signals**
  - Requested clarity and consistency in the description of the actuation signals in Tier 1 and Tier 2, and among tables, figures, and text
  - No design changes
  - Tier 1 and Tier 2 figures revised for consistency with text and tables
  - Description of signals that activate CIVs added to Tier 2 Chapter 7 (“Instrumentation and Controls”)
  - Staff finds the applicant’s response acceptable because it provides the consistency and clarity requested

Technical Topics
Section 10.4.9 – Auxiliary Feedwater System

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Open Item 10.4.9-1

Issue: In discussing compliance with Three Mile Island (TMI) Action Item II.E.1.1 of NUREG-0737 in Section 10.4.9 of the DCD, the applicant indicated that an AFWS reliability analysis was performed in accordance with Three Mile Island (TMI) Action Item II.E.1.1 of NUREG-0737, and that the AFWS is designed to have unavailability from 10^{-5} to 10^{-4} per demand as described in DCD Tier 2, Chapter 19. This information could not be found in Chapter 19 so resolution of this discrepancy was requested.

Resolution: The applicant responded to RAI 8664, Question 10.04.09-8, reaffirming that analyses performed for the APR1400 demonstrates an AFWS unreliability in the range of 10^{-4} to 10^{-5} per demand, and committed to including in Chapter 19 of the next revision of the DCD a description of the AFWS reliability analysis and results.

Open Item Closure: The staff closed the open item based on the commitment to include the referenced information in Chapter 19 of the DCD. The technical review of this matter will be addressed in the Chapter 19 review. The status of this item is changed to confirmatory.

Technical Topics
Section 10.4.10 – Auxiliary Steam System

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Open Item RAI 8556, Question 10.4.10-1

Issue: DCD showed inconsistencies with regard to how they meet RG 4.21. Specifically, whether there is no buried piping or buried piping will be minimized.

Resolution: A response to RAI 8556, Question 10.4.10-1 stated that the auxiliary steam system will be designed with minimum embedded or buried piping and that yard piping will be routed in an underground concrete tunnel that is designed with leakage collection and detection to minimize unintended contamination. DCD mark-up was provided.

Open Item Closure: Staff has reviewed and finds the response clarifies the acceptable option per RG 4.21. Staff has confirmed that DCD Rev 1 contains the acceptable mark-ups.

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Open Item RAI 8556, Question 10.4.10-2

Issue: DCD lacked information with regard to how they meet RG 1.29. Specifically, the seismic and quality group classifications of the auxiliary steam system components and piping within the reactor containment building.

Resolution: A response to RAI 8556, Question 10.4.10-2 stated that the non-safety related piping and components within the reactor containment building will be classified as seismic category II and quality group D. DCD mark-up was provided.

Open Item Closure: Staff has reviewed and finds the response provides classification information acceptable per RG 1.29. Staff has confirmed that DCD Rev 1 contains the acceptable mark-ups.

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Open Item 10.4-3

Issue: Chapter 10 COL Information Items were inconsistent regarding operational procedures and maintenance programs with leak detection and contamination control requirements to satisfy 10 CFR 20.1406. In addition, the COL Information Item 10.4(1), as a standalone statement, does not identify which plant systems under DCD Tier 2, Section 10.4 are applicable.

Resolution: These COL Information Items speak to the programmatic aspects of 10 CFR 20.1406, which fall under the review scope of Chapters 11 and 12. NRC Chapter 10 reviewers worked with Chapter 11 and 12 reviewers to ensure the Chapters 11 and 12 COL Information Items have been revised (see response to RAI 9.2.8-3) to ensure the proper programmatic aspects are covered for the entire plant.

Open Item Closure: The Chapter 10 reviewers relied on the Chapter 11 and 12 reviewers' acceptability of their COL Information Items. The staff notes that the programmatic aspects of meeting 10 CFR 20.1406 fall under Chapters 11 and 12.