



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

November 14, 2016

MEMORANDUM TO:   ACRS Members

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

SUBJECT:            CERTIFICATION OF THE MINUTES OF THE ACRS APR1400  
                          SUBCOMMITTEE ON SEPTEMBER 21-22, 2016, ROCKVILLE,  
                          MARYLAND

The minutes for the subject meeting were certified on November 9, 2016. Along with the transcripts and presentation materials, this is the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc with Attachment: A. Veil  
                          M. Banks



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

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

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

**SUBJECT:** CERTIFIED MINUTES OF THE ACRS APR1400 SUBCOMMITTEE  
MEETING ON SEPTEMBER 21-22, 2016

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on September 21-22, 2016, are an accurate record of the proceedings for that meeting.

***/RA/***

**November 9, 2016**

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Ronald Ballinger, Chairman  
APR1400 Subcommittee

Dated

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
MINUTES OF THE APR1400 SUBCOMMITTEE MEETING ON  
SEPTEMBER 21-22, 2016, ROCKVILLE, MD

The ACRS APR1400 Subcommittee held a meeting on September 21-22, 2016 in T2B1, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 8:30 a.m. on September 21 and adjourned at 9:31 a.m. on September 22. The meeting was open to the public.

No written comments or requests for time to make oral statements were received from members of the public related to this meeting.

ATTENDEES

ACRS Members/Staff:

R. Ballinger, Chairman	J. Stetkar, Member
P. Riccardella, Member	C. Brown, Member
J. Rempe, Member	Jose A. March-Leuba, Member
D. Skillman, Member	D. Powers, Member
Matthew Sunseri, Member	C. Brown, ACRS Staff (DFO)
Maitri Banerjee, ACRS Staff*	

KHNP, NRC Staff, Consultants & Other Attendees:

J. CIOCCO, NRO	WILLIAM WARD, NRO
BOB CALDWELL, NRO	JOHN BUDZYNSKI, NRO
LUISSETTE CANDELARIO, NRO	STEPHANIE DEVLIN-GILL, NRO
STEVEN DOWNEY, NRO	DAVID HEESTEL, NRO
MICHAEL LEE, NRO	JOHN HONCHARICK, NRO
CHANG-YANG LI, NRO	GREG MAKAR, NRO
MICHAEL D. MAZAIKA, NRO	ROBERT ROCHE-RIVERA, NRO
RICARDO RODRIGUEZ, NRO	TARUN ROY, NRO
JAMES STECKEL, NRO	ANGELO STUBBS, NRO
SESHAGIRI TAMMARA, NRO	VAUGHN THOMAS, NRO
JESSICA UMANA, NRO	DAN WIDREVITZ, NRO
JASON WHITE, NRO	
DAEGUN (TONY) AHN, KHNP	JIYONG(ANDY) OH, KHNP
JUNGHO KIM, KHNP	WOOCHONG CHON, KEPSCO NF
SEOK JEONG YUNE, KEPSCO E&C	JAMES ROSS, KHNP /AECOM
SEOKHWAN HUR, KEPSCO E&C	TAE HAN KIM, KEPSCO E&C
JUNG BOM JANG, KEPSCO E&C	GYUN DO JEONG, KHNP
HYGOK JEONG, KEPSCO E&C	JONGSOO KIM, KHNP

YONGSUN LEE, KEPCO E&C	KWANGIL LIM, KEPCO, E&C
YUNHO KIM, KHNP	KWANG-HOON KOH, KEPCO E&C
SUNGUOK KWON, KHNP	DONG-SU LEE, KHNP
DUK BIN SONG, KEPCO E&C	JEONG KWAN SUH, KHNP
MINSEOK KIM, KHNP	TAE SUN RO, KEPCO- E&C
SEOGNAM CHOI, KHNP	ROB SISK, WESTINGHOUSE

\*participating via telephone

## SUMMARY

The purpose of the meeting was for the ACRS members to receive a briefing on Korea Hydro and Nuclear Power Company (KHNP) design certification application (DCA) and NRC staff review specific to Tier 2 Chapters 2 and 5 and related information. The meeting transcripts are attached and contain a description of each matter discussed during the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

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

### DAY 1: September 21, 2016

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Chairman Ballinger started the meeting by introducing the ACRS members present. He noted the purpose of the meeting was to review KHNP DCA and staff review related to APR1400 Chapters 2 and 5.	6-8
After a short introduction by Mr. William Ward of NRO, Mr. Jeff Ciocco, the lead project manager for the NRC APR1400 DCA review team, started the staff presentation. Mr. Ciocco noted the staff was about a year and a half into the NRC's 42 month review schedule.	8-10
Mr. Yunho Kim, the technical project manager for APR1400, started the KHNP presentation by providing an overview of APR1400 DC project including the history of nuclear power in Korea, development of APR1400, project organization, design features and general arrangement for APR1400, DCA review status, and major differences between APR1400 and System 80+ design. He noted KEPCO and KHNP are the co-applicants of the project. Upon member Skillman's question he noted some design features of the APR Plus Design (1500 MWe) and the basis for the 16 hour station blackout (SBO) coping time for APR1400. He noted	10-26 Slides 1-16

the tests done for GSI-191.	
Mr. Kwang Hoon Koh, KEPCO E&C, started Chapter 2, Site Characteristics, presentation. Slides 30-33 contain a summary table.	28-29 Slides 1-7
Chairman Ballinger noted that NRO staff will not present Section 2.3, although KHNP will.	29-30
Mr. Dong-Su Lee, KHNP, started with outdoor air temperatures. Member Stetkar questioned the 81 degrees Fahrenheit value for the zero percent exceedance non-coincident wet bulb temperature for the essential service water system, and that it was very low to cover all US sites. He wanted to know what elements of the design limit that temperature. Mr. Rob Sisk, Westinghouse noted that they would answer at a later meeting.	30-34 55-57 Slides 8-9
Mr. Lee then addressed atmospheric dispersion factors. Member Skillman asked why Prairie Island was selected as the most limiting meteorological condition among six U.S. nuclear power plant sites for the purpose of calculating onsite design $\chi/Q$ values. Mr. Lee noted that resulting $\chi/Q$ values were increased by 50 percent to bound U.S. site meteorological data. Member Rempe asked why in their draft SER staff noted that often KHNP in Chapter 2 references the site boundary when they mean the exclusion area boundary (EAB). This was taken for follow-up.	34-38 Slides 10-12
Mr. Koh presented Section 2.4, Hydraulic Engineering. Member Stetkar asked which buildings need to be protected for ground water given the values of maximum design flood and ground water level. KHNP took this question for later follow-up.	38-40 Slides 13
Member Stetkar noted Section 2.4.4.2 (Unsteady Flow Analysis of Potential Dam Failures) references "artificially large floods," and wanted to know the meaning. He noted also, in Section 2.4.11 (Low Water Considerations) low flow in rivers and streams; low water resulting from surges, seiches, or tsunamis, were mentioned for a COL applicant to evaluate, but failure of downstream dams or other impoundments was not mentioned regarding impact on the essential cooling water supply, or ultimate heat sink, if the plant is constructed that way. He noted also that he could not find any discussion of groundwater chemistry, and if any limits need to be provided for protection of below-grade structures. KHNP took this question for later follow-up.	40-43
Mr. Koh presented DCD Section 2.5 that describes geology, seismology, and geotechnical engineering. He discussed how various response spectra are developed/used. KHNP to fix DCD Tier 2 Figures 2.0-1 and 2.0-2 (Tier 1 Figure 2.1-1 and 2.1-2) for certified seismic design response spectra by labeling the damping values.	43-46 Slides 14-18

<p>Mr. Koh discussed the qualification of soil and subsurface material, including backfill. Member Stetkar wanted to know which buildings were in the scope of the certified design. Two responses were provided that required additional clarification. Mr. Sisk stated that this would be covered in more detail during the Chapter 3, Sections 3.7 and 3.8 presentation. Member Stetkar pointed out that COL information items in Chapter 2 may need to be clarified also.</p> <p>Later in the meeting Andy Oh, KHNP, clarified the ESW and CCW systems are in scope for the APR 1400 (certified) design. However, the buildings' seismic analysis is out of scope. Member Stetkar reiterated his comment that information in Chapters 2 and 3 needs to be clear so that a COL applicant understands the scope of the certified design SSCs and criteria for subsurface soil, groundwater, etc. they must meet (i.e., the scope may not be limited to nuclear island only).</p>	<p>46-59 Slides 19-22</p> <p>59-60</p> <p>74-76</p>
<p>Member Stetkar noted in KHNP Slide 20, the maximum allowable differential settlement between buildings is 3-inches between the nuclear island base mat and the emergency diesel generator building, and the diesel fuel oil tank building. He wondered how this number is justified given there may be piping, ventilation lines and cables passing through. A discussion followed. It was pointed out that where piping is crossing in between buildings, the allowed settlement value was much less.</p>	<p>50-53</p>
<p>Chairman Ballinger asked for a clarification regarding a statement in DCD Section 2.1.1 that states a highway, railroad, or waterway may traverse the exclusion area but not close enough to the facility to interfere with normal operations. This was taken for future follow-up</p>	<p>53-54</p> <p>76-77</p>
<p>With a presentation on key RAIs and a summary, Mr. Lee concluded KHNP presentation on Chapter 2.</p>	<p>54-58</p>
<p>Mr. Tammara presented staff evaluation for Sections 2.1 and 2.2. Member Stetkar asked for a clarification regarding the staff acceptance of quantitative screening criterion to screen out design-basis events (DBE) caused by nearby industrial, transportation, military facilities and other human-related hazards, when RG 1.200 provides for adjustment to the criterion for designs with substantially lower risk profiles. It appears that staff did not have expertise available to answer the question.</p>	<p>60-72 Slides 8-9</p>
<p>Member Stetkar noted that staff SER Section 2.2.3.3 includes missiles more energetic than the tornado missile spectra, and pressure effects in excess of the design-basis tornado in types of hazards to be considered. He noted in some areas of US, particularly the SE, the hurricanes could provide conditions more stringent than tornados. He asked why hurricanes were not mentioned. Mr. Tammara referred to Section 2.3 reviewer. It appears that staff did not have expertise available to answer the question.</p>	<p>66-71</p>

<p>Mr. Mike Lee presented NRO review of Section 2.4, Hydrology. Member Stetkar repeated his question regarding which safety-related structures are within the scope of the DCD flood and ground water levels.</p>	<p>72-79 Slides 10-13</p>
<p>NRO Staff presentation on their review of Section 2.5 addressing the scope and findings. Mr. Rodriguez noted there was a recent RAI response that may have some impact into Section 2.5. Member Stetkar repeated his concern that the staff need to have COL information items in Chapters 2 and 3 SER to clearly state the scope of the DCD regarding structures like buildings and tunnels.</p>	<p>79-84 Slides 14-18</p>
<p>KHNP presentation of Chapter 5 – Mr. Minseok Kim, KHNP, discussed the reactor coolant system (RCS) functions, principal parameters, Code compliance, Overpressure Protection, Reactor Coolant Pressure Boundary (RCPB) Materials, ISI and IST, RCPB Leakage Detection, Reactor Vessel Materials, P-T limits, Pressurized Thermal Shock, Reactor Vessel Integrity, and RC Components (pumps, steam generator, pressurizer), Shutdown Cooling System, RC High Point Vents, and component supports.</p>	<p>85-91 Slides 1-7</p>
<p>Member Skillman inquired about the transients that are included in 60 year design life consideration of RCPB. He asked for information related to RCP reverse rotation conditions and on reverse flow delta T versus time that are included in the (fatigue) analysis in compliance with the Code. KHNP states that such transient was to be included in Section 3.9.1.</p>	<p>87-91</p>
<p>Member Skillman asked about the sizing basis of the reactor vessel head vent. When KHNP noted that natural circulation cooling analysis provides for the basis, Member Skillman asked if loop-seals in the cold leg were considered in that analysis.</p>	<p>92-94</p>
<p>Member Stetkar wanted to know under what conditions pilot operated safety relief valve (POSRV) discharge is directed to the containment atmosphere and not to the In-containment Refueling Water Storage Tank (IRWST) (normal discharge location), and why. KHNP clarified that IRWST is too small to maintain hydrogen concentration below flammability limits, hence for beyond-design basis accident (BDBA) conditions the discharge is sent to the containment atmosphere, for DBAs it goes to the IRWST.</p>	<p>94-97</p>
<p>Member Stetkar asked for assurance that the motor-operated three-way valves, on each of the two lines from the POSRVs to the IRWST, will not be blocked or severely restrict flow. KHNP took this as a follow-up item.</p>	<p>97-99</p>
<p>Member Skillman noted that DCD Tier 1, Figure 2.4.1-2, showed an alternate path of POSRV discharge to the Reactor Drain Tank (RDT), and asked where in DCD the RDT was discussed. He questioned the non-seismic design of POSRV piping to IRWST. It was noted that RTD, a part of CVCS, was discussed in Tier 2 Chapter 9 (and Tier 1, Section 2.4.6). The alternate line from POSRVs to the RDT is a path for valve leakage.</p>	<p>99-102</p>

Non-safety gas vent operation during plant startup and shutdown discharges to RDT.	
Mr. Kim restarted his presentation on overpressure protection of the RCS and steam generators. Member Stetkar inquired about the required shutdown cooling system alignment for low temperature overpressure protection (LTOP) condition. A discussion followed.	102-108 Slides 8-11
Mr. Kim addressed a question from the members raised at the April 20 ACRS meeting regarding ASME qualification of the POSRVs, and that they meet ASME Section III requirements. Chairman Ballinger asked about heat treatment for the spring material Alloy X750, a high-strength nickel-based alloy. He noted certain heat treatments for that material are very susceptible to cracking. This question was taken for future follow-up.	109-112
KHNP noted that Slide 9 needed to be revised.	114-115
Mr. Kim discussed the open items in NRC staff SER. Chairman Ballinger read a question from member Corradini (not present) regarding the LTOP transient over-pressure relief. He asked whether energy input assumptions were conservative, specifically, uncertainty in energy input and the relief valve settings. Response was held off.	116-119
Member Stetkar asked if POSRVs were rated for water relief (vice steam). The answer was "yes." However, the answer to the same question for MSRVs was "no," it is specified for steam release only.	119-120
Mr. Jongsoo Kim, KHNP, presented Section 5.2.3, RCPB Materials, including material specification and selection, fabrication and processing, and open items in staff SER. Upon member Powers' question discussion took place regarding avoidance of problems the Doral Plant in Belgium suffered with the reactor vessel forgings. Improved ultrasonic testing found quarter-sized flaws throughout the vessel, and hydrogen dissolution into the steel and an insufficient annealing time was noted as a possible cause. Member Powers voiced that chemical control may not be sufficient for forgings with low-alloy steel. Use of state-of-the-art ultrasonic detection technique was noted as paramount. The applicant (Mr. Sisk) stated that their evaluation of operating experience would address the issue and staff took it as a follow-up item.	120-136 Slides 12-16
Regarding Slide 13, "Austenitic Stainless Steel," upon Chairman Ballinger's question on definition of L-grade and a specification of less than 0.065% reduced carbon content a discussion took place on base and welding materials (3rd bullet).	125-128 Slide 13
Upon member Stetkar's question, Mr. Tae Han Kim, KEPCO E&C, stated that metallic insulation is used inside containment.	128-131

<p>Mr. Kim presented fabrication and processing of metallic materials. Chairman Ballinger wanted to know how ASTM A 262 is used for an as-welded structure. Mr. Kim noted that (performance of) welding material is ensured by welding qualification. Cleanliness specification, and an open item related to ensuring non-sensitization of materials were discussed.</p>	<p>131-136 Slide 15</p>
<p>Mr. Kim presented Section 5.2.4, In-service Inspection and Testing, including inspectability and inspector qualification requirements. Member Stetkar asked about accessibility to the RV bottom head due to high radiation dose rates in that area. In response Mr. Kim noted their experience in Korea.</p>	<p>136-138 Slide 17</p>
<p>Mr. Minseok Kim, KHNP, presented Section 5.2.5, Reactor Coolant Pressure Boundary Leakage Detection with a short discussion of identified and unidentified leakage.</p>	<p>138-139 Slide 18</p>
<p>Mr. Jongsoo Kim, KHNP, presented an introduction to Section 5.3, Reactor Vessel Materials, with a description of the regulatory and ASME requirements it meets. Mr. Seognam Choi then presented Section 5.3.2.1, Pressure-Temperature (P-T) Limits, for a vessel life of 60 years. He discussed the P-T limit curves, pressurizer thermal shock events, and upper-self energy up to end of life conditions.</p>	<p>139-142 Slides 19-23</p>
<p>Mr. Jongsoo Kim presented Section 5.3.3, Reactor Vessel Integrity. Regarding surveillance capsules removal schedule (Table 5.3-5), member Stetkar asked why capsules are not removed from symmetric locations around the reactor vessel (removal sequence being 217, 37, 224 and 323 degrees, with 217 degrees and 224 degrees being in close proximity). Also, two spare capsules are not located 180 degrees apart around the vessel as one would expect. KHNP took the question for future follow-up.</p>	<p>142-153 Slide 24</p>
<p>Mr. Kim presented Section 5.4.1, Reactor Coolant Pump (RCP). He responded to two questions members asked at the previous April briefing. These had to do with design provisions for inspecting the reactor coolant pump rotor, and details of RCP shaft seal system cooling by seal injection from CVCS and high-pressure cooler. Mr. Kim noted seal design was different from the existing plant due to improved motors.</p> <p>A long discussion followed member Stetkar's question regarding how long can the pump run with no component cooling water (CCW) with seal injection available before the operators must trip the pump to prevent seal damage, and what test has been performed to confirm that. This question was to be followed up the next day.</p>	<p>153-165 Slides 25-31</p>
<p>Member Sunseri noted reliability issues with US positive displacement pumps, the type used for the auxiliary charging pump. KHNP explained its use during hydrostatic testing and noted its diversity from the main centrifugal charging pumps.</p>	<p>165-168</p>

<p>Mr. Kim mentioned the pump seal test and discussed the motor, the flywheel and SER open items related to its fracture toughness with pending test results, operating experience, material yield strength, and flaw size acceptance criteria. Upon member Riccardella's question, Mr. Kim noted there was no key way in the flywheel.</p>	<p>168-171</p>
<p>Mr. Seognam Choi, KHNP, presented Section 5.4.2, Stream Generators (SGs). Chairman Ballinger described the San Onofre experience, where two steam generators showed different degradations in spite of being manufactured under the same specification. A long discussion followed, with Mr. Choi describing the improvements made to the OPR1000 design. It was noted that KHNP used the EPRI (TH) codes and the steam generators are the same as in Shin-Kori Unit 3.</p>	<p>171-180 Slides 32-34</p>
<p>Mr. Tae Han Kim, KEPCO E&amp;C, presented Section 5.4.7, Shutdown Cooling System. Member Stetkar asked if there was a manual isolation valve on the suction side of the containment spray pump. He was concerned about aligning a shutdown cooling pump to replace a containment spray pump without closing the suction valve from the IRWST. He also asked how the shutdown cooling pumps receive the automatic start signal from containment spray or safety injection. Mr. Kim described the valve interlock.</p>	<p>180-186 Slides 35, 36</p>
<p>Mr. Seognam Choi, KHNP, presented Section 5.4.2, Pressurizer. Member Stetkar had a question related to the basis for shutdown cooling system valve failure positions, given the valves are motor operated. KHNP took this as a follow-up item.</p>	<p>186-190 Slides 37-39</p>
<p>Mr. Kim presented reactor coolant system high point vents in Tier 2, Section 5.4.12. Member Stetkar wanted to see a drawing that shows all lines going into the IRWST and spargers. He mentioned manual valve V1430 in the RCGVS discharge to the IRWST, manual valve V212 in the line from reactor vessel head to the RCGVS, and manual valve V2300 in the connection from the pressurizer to RCGVS, and asked if those valves have position indication in the main control room, and the valves' repositioning requirements based on plant operating status. He also noted the PRA implication of solenoid valves failing closed after battery power is exhausted. He asked why POSRV leakage detection is not warranted.</p>	<p>190-203 Slide 40</p>
<p>Mr. Seognam Choi presented RCS Component Supports describing briefly the reactor vessel, steam generator, and pressurizer supports. Mr. Minseok Kim presented the summary and current status.</p>	<p>203-205 Slide 41-43</p>
<p>Although no formal presentation was scheduled on Appendix 5A, "Evaluation of the APR1400 Design and Intersystem LOCA Accident Challenges," member Stetkar noted that the analysis was a comprehensive assessment of interfacing system LOCA pathways. However, he noted</p>	<p>205-210</p>

that the auxiliary pressurizer spray line was not included, and asked for the reason. KHNP took this as a follow-up item. He also asked for the volume of the RDT and a reference was provided. He wanted KHNP to confirm the relief capacities of each main steam safety valve (5.3% of full power) and POSRV (3.5% of full power). This was also taken as a follow-up item.	
Chairman Ballinger asked for comments from the public. No comments came forth.	210-211
Chairman Ballinger asked for comments from the members. Member Stetkar noted that he was looking at integrated plant safety, how the design relates to success criteria and risk assessment, and how the risk assessment results feed back into the design. He asked for less emphasis on open RAIs and more emphasis on design technical information in future meetings. Member Riccardella noted that he was impressed by the incorporation of lessons learned from existing plants especially in the materials area.	211-213
Chairman Ballinger adjourned the meeting at 3:27 pm	214

## DAY 2: September 22, 2016

SIGNIFICANT ISSUES	
Issue	Reference Pages in Transcript
Chairman Ballinger started the second day of the meeting by introducing the ACRS members present, and noting the purpose of the meeting. He clarified that questions asked by ACRS members at the SC meeting are questions from each individual member alone and should not be taken as Committee position. And that the ACRS communicates through its letters only. Also questions from members are not RAIs.	220-221
Jessica Umana, NRO, stated the NRC staff presentation on their review of Chapter 5 by introducing the presenters and providing a summary of staff review. Mr. John Budzynski, NRO, presented staff review of Section 5.2.2, Overpressure Protection System, including a status of open items. Member Stetkar asked for a clarification of a statement in staff SER that noted a secondary temperature 230 degrees Fahrenheit, 110 degrees C greater than the RCS and found it to be more conservative than the 100 degrees Fahrenheit, 37 degrees C difference allowed by the technical specifications. He asked if it feasible to have a secondary temperature 230 degrees higher than the LTOP temperature of the primary system.	222-227 234-239 Slides 1-10

<p>Mr. Budzynski, NRO, presented staff review of Section 5.4.1, Reactor Coolant Pumps. He stated the pump and motor bearings were designed to withstand the loss of CCW for 30 minutes.</p> <p>Member Stetkar noted that for pump over-speed and flywheel analysis the applicant assumed a maximum LOCA break size of 4 inches after applying the leak-before-break (LBB) method. He asked if the flywheel would come apart if the break size is larger, like 12 inches. John Honcharik, NRO, responded by saying that bigger lines will probably be assumed to leak and not break. Mr. Matt Mitchell, NRO, noted LBB is used for the elimination of the dynamic effects of pipe rupture, and took the question for follow up.</p>	<p>227-234 Slides 11,12</p>
<p>Mr. Budzynski presented staff review of Section 5.4.7, Shutdown Cooling, including evaluation of gas accumulation. This resulted in an SER open item regarding NEI 09-10, in that it contains the most current gas management procedure, but was not referenced in the DCD. Member Rempe asked for elaboration on how staff found the KHNP response (dated March 17, 2016) to RAI 384-8100 (Question 05.04.07-3) on natural circulation (power-to-flow ratio test acceptance criterion) acceptable.</p>	<p>239-242 Slides 13,14</p>
<p>Mr. Budzynski addressed staff review of Section 5.4.12, RCS high point vents. Mr. Stetkar questioned a statement in staff SER regarding bumping the RCP to remove gas accumulation in SG tubes during a natural circulation event. Staff took this question for future follow up.</p>	<p>242-245 Slide 15</p>
<p>Mr. Darren Widrevitz, NRO, presented staff review of Section 5.2.3, reactor coolant pressure boundary materials.</p>	<p>245-246 Slide 16</p>
<p>Ms. Jessica Umana, NRO, presented staff review of Section 5.2.5, Reactor Coolant Pressure Boundary Leakage Detection. A discussion on technical specification (TS) allowable values of identified and unidentified leakage noted a typo in the SER. The typo had to do with SG leakage stated as 150 gallons per minute. It should be per day.</p>	<p>246-248 Slide 17</p>
<p>Mr. John Honcharik, NRO, presented staff review of Section 5.4.1.1, Reactor Coolant Pump Flywheel Integrity. He discussed the questions NRC reviewer asked and SER open items resulting from that. One question had to do with a failure analysis for the hub of the flywheel that has a place for a key. In a related question yesterday, from member Riccardella, KHNP stated there was no key in the actual design (P171 of transcript).</p>	<p>249-252 Slides 18-20</p>
<p>Mr. Greg Makar, NRO, presented Sections 5.4.2.1 and 5.4.2.2 on SG materials, and SG program. He noted the alignment of TS bases for SG leakage values related to that used in the accident analyses.</p>	<p>252-254 Slide 21</p>

Member Stetkar noted the applicant had established 900# (40% of RCS normal operating pressure) as design criteria for piping outside containment for systems like shutdown cooling system, containment spray and safety injection systems as a reason why interfacing system LOCA for these systems with the RCS did not need to be considered, and staff had accepted that in the SER. He asked if that reasoning was the only basis for staff acceptance of the position, and if that was a formal NRC regulatory position related to interfacing system LOCAs. He also noted a report titled PNNL 24783, "Expert Elicitation to Support Interfacing System Loss of Coolant Accident Modeling," and asked if it was still consistent with the NRC regulatory position, research position and so forth on susceptibility to interfacing system LOCAs.	254-259
Chairman Ballinger asked for comments from the public. No comments were offered.	259-260
After going through the members for additional comments, Chairman Ballinger adjourned the meeting at 9:31 a.m.	260-261

Following key follow-up issues resulted from questions and issues the members raised for which a response was not available at the meeting:

KEY FOLLOW-UP ISSUES	
Key Issues	Reference Pages in Transcript
KHNP to address design elements that limit the temperature of the zero percent exceedance non-coincident wet bulb temperature for the essential service water system to 81 degrees F.	31-33
Why in Chapter 2 KHNP references the site boundary when they mean the EAB.	36-38
Identify buildings that need to be protected for ground water given the values of maximum design flood and ground water levels.	38-40
Address the meaning of "artificially large floods" in DCD Section 2.4.4.2.	40
Address why failures of downstream dams or other impoundments was not mentioned regarding impact on the essential cooling water supply, or ultimate heat sink (re: DCD Section 2.4.11).	40-41
Address why ground water chemistry is not mentioned in the DCD (re: DCD Section 2.4.12).	41-43

KHNP to address in Chapter 3 presentation APR1400 buildings that are in the scope of the certified design.	47-50
Clarify statement in Section 2.1.1 that states a highway, railroad, or waterway may traverse the exclusion area but not close enough to the facility to interfere with normal operations.	53-54
Why hurricanes were not considered in SER Section 2.2.3.3, which considers tornado missile and pressure effects.	66-71
Inform ACRS staff if there was any change to staff SER Section 2.5 as a result of a recent RAI response post ACRS meeting.	84
Transients that are considered in 60 year design life analysis of RCS. Was RCP reverse rotation considered? Provide reverse flow delta T versus time that are included in the analysis (fatigue) in compliance with the Code.	87-89
If loop-seals in the cold leg were considered in the natural circulation cooling analysis.	93
Provide assurance that the motor-operated three-way valves, on each of the two lines from the POSRVs to the IRWST, will not be blocked or severely restrict flow.	97-99
Why piping from the POSRVs to the IRWST is non-seismic?	99
Describe what heat treatment is applied to the POSRV spring material Alloy X750.	110-112
Provide needed modification to KHNP Chapter 5 Slide #9.	114-115
Regarding the LTOP transient over-pressure relief what uncertainty assumptions in energy input and relief valve settings were used?	117-118
NRO staff to address problems Doral Plant in Belgium suffered regarding the forgings in their pressure vessel.	124-125
Reason behind selecting the locations of the four sample capsules and spares inside the RV.	143-153
If there a manual valve in the line between the junction of valve 340 and the suction of the containment spray pump.	183
Provide the basis for shutdown cooling system valve failure positions given the valves are motor operated.	187-190
Provide a drawing that shows all of the lines into the IRWST and location of the spargers.	191

Do manual valves V1430, V212, and V2300 in the RCGVS have position indication in the main control room, and if the valves are repositioned based on plant operating status.	196-198
Why POSRV leakage detection is not warranted?	201-203
Reason for not including the auxiliary pressurizer spray line in intersystem LOCA analysis (App. 5A).	206-207
Confirm the relief capacities of the each main steam safety valve (5.3% of full power) and POSRV (3.5% of full power).	209-210
Clarify a statement in staff SER that noted a secondary temperature 230 degrees Fahrenheit, 110 degrees C greater than the RCS and found it to be more conservative than the 100 degrees Fahrenheit, 37 degrees C difference allowed by the technical specifications.	225-227
Staff to elaborate on their basis for accepting the KHNP response (dated March 17, 2016) to RAI 384-8100 (Question 05.04.07-3) on natural circulation (power-to-flow ratio test acceptance criterion).	240-242
Clarify statement in staff SER regarding bumping the RCP to remove gas accumulation in SG tubes during a natural circulation event.	242-245
Member Stetkar's question on the basis for staff acceptance of KHNP position for not considering inter-system LOCAs for certain system piping and if an old PNNL report was still pertinent regarding NRC position.	254-259

Documents provided to the Subcommittee (CDs provided by KHNP)

1. APR1400 Design Description
2. APR1400 Design Control Document (Tier 1 and 2-Proprietary & Security Related Information)
3. APR1400 Topical Reports (Internal Use Only-Proprietary)
4. APR1400 Technical Reports (Proprietary)
5. System 80 Design DCD and SER
6. Staff SERs on Chapters 2 and 5

**Official Transcript of Proceedings**  
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NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

APR1400 SUBCOMMITTEE

+ + + + +

WEDNESDAY

SEPTEMBER 21, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

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

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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RONALD G. BALLINGER, Chairman

CHARLES H. BROWN, JR., Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Chairman

MATTHEW W. SUNSERI, Member

## DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER L. BROWN

## ALSO PRESENT:

TONY AHN, KHNP

JOHN BUDZYNSKI, NRO

BOB CALDWELL, NRO

LUISSETTE CANDELARIO, NRO

SEOGNAM CHOI, KHNP

WOOCHONG CHON, KEPCO NF

JEFF CIOCCO, NRO

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JUNGHO KIM, KHNP  
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\*Present via telephone

## A G E N D A

Opening Remarks and Objectives.....	6
Staff Opening Remarks.....	8
APR1400 Design Overview.....	11
Chapter 2.....	26
Break.....	55
Chapter 2 (Continued).....	56
Chapter 5.....	81
Break.....	110
Committee Discussion.....	110
Adjourn.....	203

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

8:30 a.m.

CHAIRMAN BALLINGER: The meeting will come to order. This is a meeting of the APR1400 Subcommittee on the Advisory -- of the Advisory Committee of Reactor Safeguards.

I'm Ron Ballinger, Chairman of the APR1400 Subcommittee. ACRS Members present are hopefully Pete Riccardella, Dick Skillman, Dana Powers, Matt Sunseri, John Stetkar, Jose March-Leuba, Joy Rempe, Chris Brown, not Chris Brown --

MEMBER BROWN: Charlie Brown.

CHAIRMAN BALLINGER: Charlie Brown, and whoever else might show up halfway through this.

The purpose of today's meeting is for the Subcommittee to receive briefings from -- by the way, Chris Brown is the Designated Federal Official.

The purpose of today's meeting is for the Subcommittee to receive briefings from KHNP regarding their Design Certification Application, and NRC Staff regarding their review of the Safety Evaluation, specifically Chapters 2, with the exception of 2.3, I think, Site Characteristics, and 5, Reactor Coolant and Connected Systems.

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1           During our Subcommittee meeting on  
2           April 20th and 21st we received an extensive  
3           briefing from KHNP on the overall design and  
4           various aspects of their application that is of  
5           interest to the ACRS Members.

6           The rules for participation in today's  
7           meeting were announced in the Federal Register on  
8           September 7th, 2016. The meeting was announced as  
9           an open/closed to public meeting. This means that  
10          we can close the meeting, as needed, to protect  
11          information proprietary to KHNP or its vendors, and  
12          you'll have to remind us if that's the case; if we  
13          ask a question which is -- goes into proprietary  
14          information, we can close the meeting. No requests  
15          for anybody making a statement to the Subcommittee  
16          has been received from the public.

17          A transcript of the meeting is being  
18          kept and will be made available as stated in the  
19          Federal Register Notice. Therefore, we request that  
20          participants in this meeting use the microphones,  
21          including myself, located throughout the meeting  
22          room when addressing the Subcommittee, and please  
23          identify yourself for the transcriber. Participants  
24          should first identify themselves, right, and speak  
25          with sufficient clarity and volume so that they can

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1 be readily heard.

2 While we have a bridge line established  
3 for interested members of the public to listen in,  
4 I would advise members of the public that are  
5 listening in to put your device on mute because we  
6 run the risk of getting circular feedback which is  
7 just -- makes it tough. The bridge line number and  
8 password were published in the agenda posted on the  
9 NRC website.

10 The public will have an opportunity to  
11 make a statement or provide comments at a  
12 designated time towards the end of the meeting. We  
13 request that the meeting attendees and participants  
14 silence your cell phones and other electronic  
15 devices.

16 I now invite Jeff Ciocco, NPO -- oops,  
17 who's going to do the introduction? Oh, Bill Ward,  
18 to introduce the presenters and start the briefing.

19 MR. WARD: Good morning. My name is Bill  
20 Ward. I'm the Acting Branch Chief of Licensing  
21 Branch 2, which is the branch managing the review  
22 of the APR1400 design.

23 I'd like to thank everybody for being  
24 here. We look forward to many more meetings. This  
25 is the first of all the Phase 2, Phase 3 ACRS

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1 meetings, Subcommittee meetings that we're having.  
2 Over the next several months we intend to get  
3 through all the chapters, and we look forward to  
4 many more.

5 MR. CIOCCO: Thank you, Bill. My name is  
6 Jeff Ciocco. I'm the Lead Project Manager for the  
7 APR1400 Design Certification Project. I also want  
8 to thank the Subcommittee Chair and your staff,  
9 which we've worked very closely over the past year  
10 and a half to establish this meeting, and as Bill  
11 said, the following Phase 3 meetings on the APR1400  
12 Design Certification Project.

13 This meeting is a very significant  
14 milestone for us in the review process in that we  
15 have begun completing our Phase 2 Safety Evaluation  
16 Reports with Open Items. Today is a small, albeit  
17 important sampling of the 22 Safety Evaluations  
18 that we're going to be presenting and you'll be  
19 reviewing over the next seven or nine months.

20 Back in April, I gave a project  
21 overview presentation to the ACRS, and KHNP and  
22 KEPCO gave a design overview, so I don't want to  
23 repeat everything that I said back then, but just  
24 briefly regarding this application.

25 We received the APR1400 Design

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1 Certification Application in December of 2014. We  
2 docketed the application in March of 2015, so right  
3 now we are about a year and a half into our 42-  
4 month review schedule leading to the potential  
5 issuance of the final Safety Evaluation Report and  
6 rulemaking.

7 This morning in KHNP's presentation on  
8 the design overview they have included the overall  
9 project schedule, so if you have any questions for  
10 me at that time, that would be a great point.

11 And, finally, I certainly want to thank  
12 our technical staff and project managers here today  
13 who are going to present and answer your questions  
14 on Chapters 2 and 5. They are the engines of our  
15 review. So thank you very much.

16 CHAIRMAN BALLINGER: KHNP?

17 MR. Y. KIM: I am Yunho Kim. I am  
18 technical project manager for APR1400, and we have  
19 just, of course, go through NRC's review for our  
20 (inaudible) document, so I think that we are  
21 ready to go through your review, so we will look  
22 forward to communicating with you.

23 MEMBER STETKAR: If you all could just  
24 either pull the microphones closer and make sure  
25 you speak up because all of our transcript comes

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1 from the microphones, so we need to make sure that  
2 you're loud enough so that we hear you on the  
3 transcript.

4 MR. Y. KIM: Yes.

5 MEMBER STETKAR: So be careful about  
6 that, please.

7 MR. Y. KIM: Yes, thank you. So I think  
8 that I am going to present my material?

9 CHAIRMAN BALLINGER: Yes.

10 MR. Y. KIM: Yes. Today, this morning  
11 I'm going to present overview of APR1400 DC  
12 project.

13 The application of Design Certification  
14 was done by KEPCO and KHNP. KEPCO and KHNP's co-  
15 applicant project. KEPCO is KHNP's mother company,  
16 and KHNP is the only Korean utility company in  
17 Korea, and also technical management, but this  
18 project was done by KHNP. So just to let you know  
19 that our applicant information.

20 Today, I'm going to present the first  
21 introduction as introduction. I'm going to present  
22 the (inaudible) overview of APR1400, and nuclear  
23 power plant in Korea. And, also, I will present  
24 history. After that, I am going to present design  
25 features and the general arrangement for APR1400.

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1 And also (inaudible) docketing our licensing  
2 material at December 2, 2014. We go through the  
3 review of NRC Staff, and I will summarize that  
4 review status. And, finally, I will summarize my  
5 presentation.

6 This list of materials that we  
7 presented last April, this year, for your  
8 understanding of APR1400. That is from I think the  
9 major design area of APR1400 was presented at that  
10 time. So going over the material overview of this  
11 project, this is same material that was done  
12 before, last April, so April you are interest in  
13 our design. You can see this material. I understand  
14 that this material is available, too.

15 First, let me introduce nuclear power  
16 plant in Korea. Currently, we have 24 units is in  
17 operation. Major site is that we have the Hanul,  
18 west side of Korea, and east side of Korea there  
19 are three major sites; first is Hanul site, second  
20 one is Wolsong site, and third site, Kori site. And  
21 we are now commissioning one unit, and the third  
22 unit is under construction, and six unit is  
23 planned. So one unit in commissioning, that's  
24 Shinkori 3. This is the reference plant for  
25 APR1400. We believe that this plant is commercial

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1 operation within a month. And three unit are under  
2 construction, and Shinkori 4 will be commissioning  
3 within next year. And Shin-Hanul 1 and 2, this is  
4 also APR1400, that is under construction. And all  
5 the remaining planning site is that where  
6 construction will be the APR1400 (inaudible) with  
7 more advanced design. We call the APR Plus Design,  
8 to be constructed, yes. So this is the current --  
9 our nuclear power plant.

10 Let me add that the Wolsong 1, 2, 3,  
11 and 4 are the CANDU type. This is slightly  
12 different from most of our pressurized water  
13 nuclear design.

14 MEMBER SKILLMAN: You know, for the  
15 planning units, the six units for 8600 megawatts,  
16 that is 200 megawatts more than six times 1400.

17 MR. Y. KIM: For the --

18 MEMBER SKILLMAN: So these are advanced  
19 units that are a higher power than 1400?

20 MR. Y. KIM: Right. Our current design  
21 APR1400 megawatt electricity, for APR Plus Design  
22 has more (inaudible) these 1500, so 100 more.

23 MEMBER SKILLMAN: Is the 1500 megawatt  
24 electric design the same basic design with some  
25 enhancements?

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1 MR. Y. KIM: Basic design may be similar  
2 plus some enhanced design is incorporated in there  
3 like passive cooling, that kind of thing is  
4 incorporated in APR Plus Design. Also, let me  
5 explain that like the instrument in core, in-core  
6 instrument is from down to top, but our new design  
7 comes from top to down, so that comes with  
8 (inaudible) incorporate, and also containment spray  
9 is -- containment cooling is done with a passive  
10 system, that kind of thing is incorporated -- will  
11 be incorporated in our APR Plus Design.

12 MEMBER SKILLMAN: Thank you.

13 MR. Y. KIM: Next I'm going to present  
14 our project organization. As I said earlier, KEPCO,  
15 KHNP is co-applicant on this project. KEPCO's role  
16 is that they provide funding for this project and  
17 that they determine the policy decision for this  
18 project. And KHNP is manager for this project in  
19 terms of technical management or quality assurance,  
20 that kind of thing is done by KHNP. So project  
21 management was done by KHNP, and the major design  
22 is done by Korea domestic company like fuel and  
23 core design is done by KEPCO Nuclear Fuel, we call  
24 KEPCO NF. NSSS design is done by KEPCO E&C. That is  
25 the -- and the balance of plant design is done by

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1 KEPCO E&CAE. AE stands for architectural  
2 engineering, SD stands for system design. And the  
3 major component like reactor vessel, steam  
4 generator, pressurizer, that kind of design is done  
5 by (inaudible).

6 Also, we have overseas consultation  
7 from Westinghouse, and AECOM. Westinghouse owns the  
8 combustion engineering design features our APR14  
9 design is based on, so we have mutual agreement,  
10 technology agreement with Westinghouse, so we share  
11 information. And from AECOM we have got licensing  
12 support. We have -- there are many licensing  
13 activities between NRC Staff and KHNP, so AECOM is  
14 supporter. And the thermal hydraulic test is done  
15 by KAERI. KAERI is Korea's major nuclear research  
16 and development facility, so we did TH test from  
17 KAERI like fluidic device. We have in the safety  
18 injection tank we have a fluidic device, so for  
19 that fluidic device some hydro tests, that is done  
20 by KAERI. This is the whole our project  
21 organization scheme.

22 Then let me brief our APR1400 Design  
23 Certification history and progress. APR1400 project  
24 for Design Certification goes back to 2009. KEPCO  
25 and KHNP determined to apply for Design

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1 Certification. We had long pre-application review  
2 period from 2010 to 2014. During the pre-  
3 application period, KHNP submitted five topical  
4 report which are quality assurance program, PLUS7  
5 Fuel design, critical heat flux correlation,  
6 fluidic device design, and the large break LOCA  
7 methodology. In large break LOCA we applied the  
8 best estimate.

9 Among these five topical report Staff  
10 issued the Draft Safety Evaluation Report for  
11 Quality Assurance Program, fluidic device, and  
12 critical heat flux topical report. We have NRC  
13 Staff issued three SER reports for these three  
14 topical reports.

15 For the remaining topical report, KHNP  
16 expects they will issue Draft SER once KHNP  
17 addresses that concern. I believe those will be  
18 also under your review.

19 In 2014, KHNP submitted design control  
20 document and the 51 technical report. We believe we  
21 have much complete information for APR1400 Design  
22 Certification. KHNP provided additional 19  
23 technical report (inaudible) which was done by  
24 March 2015. Since then, KHNP has more than 2000  
25 RAIs and several hundreds of action items which

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1 came from conference meeting or conference call,  
2 face-to-face meeting. KHNP believes most of them  
3 are addressed except for some open items that was  
4 described in our SER. KHNP believe these open  
5 items will be also addressed in the near future.  
6 This is the history and this picture was done at  
7 the time of we submit our application.

8 Next, let me brief development history  
9 of APR1400. APR1400 design was developed,  
10 development that go back to 1992. We developed this  
11 design almost 10 years. Our design is based on  
12 combustion engineering design so at that time in  
13 early 1990 we had the license agreement with -- at  
14 that time we call it ABB-CE. So our design is based  
15 on Palo Verde design in terms of NSSS design, and  
16 from core design we have anode number two C design.  
17 So based on this combustion engineering design we  
18 standardized our nuclear power plant design. At  
19 that time we call it Korean Standard Nuclear Power  
20 Plant, but we change it. The plant name for  
21 (inaudible) so we call it OPR 1000.

22 OPR 1000 has very much operating  
23 experience. Hanbit 3 and 4, Hanbit 5 and 6, Hanul 3  
24 and 4, Hanul 5 and 6. Those are the designed with  
25 OPR design in operation, and also we have some

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1 improved OPR 1000. That is just -- we call it  
2 improved, means some kind of economy benefit. We  
3 just reconfiguration some of the systems so we call  
4 it improved OPR 1000, but we think that that is the  
5 same (inaudible) of the OPR 1000. Shin-Kori 1 and 2  
6 is that we call it improved OPR 1000.

7 For this operation of OPR 1000 we have  
8 very much experience in our design, so based on  
9 this experience, accumulated experience we  
10 developed APR1400. So APR1400, also we call global  
11 marketing, we just (inaudible) for the URD document  
12 and System 8 Plus design, and for NRC project, we  
13 apply the latest code and standard. That is the  
14 basis of our APR1400 development.

15 Then next let me introduce our APR1400  
16 (inaudible) or just our current status of our  
17 APR1400 design. APR1400 design (inaudible) Shin-  
18 Kori 3 employees are so -- Shin-Kori 3 is almost --  
19 we put in the pure and we right now, as of today,  
20 right now we do the hot function test so we are  
21 almost done all the test, and we are waiting for  
22 our party's approval for commercial operation. So  
23 we think that APR1400 is a finished and complete  
24 design.

25 In the commercial operation is

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1 scheduled October 2016, as I mentioned earlier. And  
2 also we have APR1400 contract with UAE in Barakah,  
3 so in Barakah also design same as Shin-Kori 3 and  
4 4, and it is same as APR1400. This Barakah project,  
5 construction schedule is on schedule, so they will  
6 be also into operation next year, so that may be  
7 our current schedule. And Korea also, for Barakah  
8 project we have -- KHNP have contract with ENEC  
9 and we are going to support, all the operational  
10 people, maintenance people will be provided for  
11 operation of the Barakah project.

12 MEMBER REMPE: Excuse me. How many years  
13 did it take to construct Barakah?

14 MR. Y. KIM: Barakah, we have around 15  
15 months.

16 MEMBER REMPE: Fifteen months.

17 MR. Y. KIM: Yes.

18 MEMBER REMPE: Thank you.

19 MR. Y. KIM: The APR1400 design feature,  
20 this slide is the same as the one we are going to  
21 present in Chapter 5 presentation, so I just want  
22 to just touch it very briefly, and then I will hold  
23 it to more detailed explanation in Chapter 5  
24 presentation.

25 Basically, our APR1400, the lifetime

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1 you call it 60 years for major (inaudible). And we  
2 -- APR1400 is a two-loop plant, two steam  
3 generator, RCP, cold leg, and the one pressurizer.  
4 And let me touch -- let me skip this slide.

5 So basic approach for APR1400 design  
6 for NRC project, design certification project, you  
7 are going to retain (inaudible) as much as possible  
8 we can. So that is just to take the benefits of  
9 proven safety and performance. Also for design  
10 certification we have U.S. NRC guideline that is  
11 effective on August of 2014. This is six months  
12 before we are out of docketing date, so we just  
13 apply all the regulation guide effective on August  
14 2014.

15 Let me add some APR1400 design feature.  
16 That is a slide from Shin-Kori 3 and 4. One is that  
17 we -- the station blackout coping capability. With  
18 (inaudible) that capability, we applied gas turbine  
19 generator for alternate current source, and also we  
20 increased the battery capacity. That will increase  
21 our (inaudible) and also our (inaudible)  
22 capability. Also, we applied FLEX implementation  
23 such as standard pressure for water level  
24 measurement, and spent fuel spray, and the water  
25 hookup to supply cooling water from outside. Also,

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1 we add hookup for the primary side and the  
2 secondary side, so that kind of capability we kept  
3 in APR1400. And also --

4 MEMBER SKILLMAN: What is the basis of  
5 the 16-hour battery? What is the load?

6 MR. Y. KIM: Sixteen hour battery, that  
7 is based on -- plus in Shin-Kori 3 and 4 we have 8-  
8 hour battery capacity, but in terms of we are going  
9 to increase our (inaudible), and also we have some  
10 kind of -- based on the NRC RG 1.155, there is  
11 some guidance for nuclear power plant SBO coping  
12 time. So at that time, that is based on the  
13 emergency alternate current power system  
14 configuration, and also the reliability of  
15 emergency diesel generator, and also the frequency  
16 of loss of offsite power. That kind of basis on  
17 these category, that is our design is classified as  
18 P3 category, and the P3 category requires 16 hours.

19 MEMBER SKILLMAN: Thank you.

20 MEMBER STETKAR: We'll get into this  
21 once we've reviewed Chapter 8, but in fact, on the  
22 DCD they have four batteries. And I believe that  
23 trains A and B in the certified design are 8-hour  
24 batteries because they can be recharged from the  
25 alternate AC generator. Trains C and D are 16-hour

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1 batteries because they cannot be recharged from the  
2 alternate AC generator, at least not easily. Is  
3 that correct?

4 MR. Y. KIM: Right.

5 MEMBER SKILLMAN: Thank you.

6 CHAIRMAN BALLINGER: Are any of these  
7 enhancements, if you will, being fed into the UAE  
8 design, or is the UAE design strictly Shin-Kori  
9 Unit 3?

10 MR. Y. KIM: Well, this is based on --  
11 we just -- our objective is to apply for NRC  
12 design certification, so --

13 CHAIRMAN BALLINGER: Thank you.

14 MR. Y. KIM: -- we can say that. Like  
15 the aircraft impact is -- that is it depends on  
16 each country.

17 The second one is that we improve the  
18 tolerance part of beyond the design basis such as  
19 aircraft impact, and also loss of large area, and  
20 physical security requirement, so we incorporate  
21 all the U.S. requirement in our APR1400 design.

22 Also, one of the big issue is the GSI-  
23 191, as you know, so we did GSI-191 test for large  
24 break LOCA, and the upstream and the downstream  
25 test is done, and NRC Staff audited our facility,

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1 so I think we believe GSI-191, we successfully  
2 completed.

3 Also, we have diverse protection system  
4 for common cause failure, so usually plant  
5 protection system is word for core protection, but  
6 we also have diverse reactor protection system. And  
7 for the seismic design, until Shin-Kori 3 and 4  
8 design we applied the ASTM model. It's very crude,  
9 but for APR1400 design we applied finite element of  
10 this in our seismic design. This is, I think, a  
11 major difference from our Korean design, and for  
12 U.S. NRC APR1400 design.

13 And the next one is, let me explain  
14 about what is the difference between APR1400 System  
15 80+. In terms of containment respects, System 80+  
16 is spherical steel design and APR1400 is  
17 cylindrical pre-stressed concrete design. And in  
18 terms of thermal power there's a slight difference.

19 System 80+ is 3931 and APR 1400 4000 megawatts  
20 thermal. And we --- in hot leg temperature, we  
21 already decreased our hot leg temperature. And  
22 also, in terms of safety injection system we added  
23 a fluidic device in our safety injection system. I  
24 think we believe that with this fluidic device we  
25 can enhance for small break LOCA capability, coping

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1 capability. So just we will use (inaudible) the  
2 safety injection system.

3 And in terms of over-pressure  
4 protection system, System 80+ is equipped with  
5 pressure safety valve and two safety pressure  
6 system, but we incorporated this design feature  
7 into -- in one system. We call it POSRV, so POSRV  
8 does (inaudible) capability also depressurization  
9 system capability in our POSRV.

10 And in terms of reactor vessel overhead  
11 structure for our maintenance, maintenance  
12 convenience we applied integrator head assembly, so  
13 easily we can remove reactor vessel upper head  
14 system during the overhaul period. And also in  
15 terms in the severe accident we -- System 80+ is a  
16 cavity flooding system but we added power and in-  
17 vessel retention and reactor vessel cooling  
18 capability. For this design feature we can discuss  
19 in our separate chapter review time.

20 For general arrangement, this is -- our  
21 design certification is a single unit basis, and  
22 single unit base for reactor containment is  
23 surrounded by auxiliary building. In auxiliary  
24 building we have two EDG inside, two EDGs outside,  
25 and we have turbine building, and one compounded.

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1 This is the general arrangement for APR1400. And  
2 this shows the primary reactor coolant system. Most  
3 of this design is the same as the System 80+ except  
4 for the POSRV, as I explained earlier, that this  
5 has combined capability of safety relief and  
6 depressurization capability.

7 And our general equipment arrangement  
8 in Aux building is we have four quadrant, so we  
9 have some high function in one quadrant, but that  
10 does not protect, and that doesn't impact that  
11 safety injection pump is located for each quadrant,  
12 and shutdown pump, and the containment spray pump  
13 is located for each quadrant, and the component  
14 cooling pump is located for each quadrant. So we  
15 have this four quadrant design feature in our  
16 APR1400.

17 Then next let me explain about our  
18 APR1400 design certification review status. NRC is  
19 planning to have complete this design review within  
20 42 month schedule, so Phase 1, the target date was  
21 established by NRC, and Phase 1 is completed  
22 January this year. We believe they have  
23 successfully completed Phase 1, and we are now at  
24 the stage, final stage of Phase 2 stage, and the  
25 schedule is November 2016. So that maybe depend on

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1 each chapter progress, but we believe Chapter 2 and  
2 Chapter 5 is now reached its final stages so we are  
3 on the track. And Phase 3 and 4 is also, Chapter 2  
4 and 5 is underway, Phase 3 is underway, and Phase 4  
5 is underway, so NRC plan to complete Phase 4 review  
6 at end of 2017. So KHNP tried to support and meet  
7 this target schedule. We will work very hard to  
8 support this schedule.

9 So let me summarize for this APR1400  
10 project. APR1400 adopt proven technology from  
11 operation of OPR 1000, and so APR1400 use safety  
12 code for System 80+. So in terms of technical issue  
13 we have based on -- we have accumulated experience  
14 and also we have certified design code. And in  
15 Korea, APR1400 standard design was approved by Korean  
16 regulatory authority in 2002, and as I mentioned  
17 earlier, Shin-Kori 3 will be commercial operation  
18 soon, and Barakah also soon, so I think that  
19 APR1400 is essentially very complete design. So  
20 that is the message I want to give you this  
21 morning. Thank you.

22 CHAIRMAN BALLINGER: Thank you.  
23 Questions from the Committee Members? We're already  
24 a little bit behind, so we need to spend the time  
25 that's required but be mindful, please, of the

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1 time.

2 MEMBER REMPE: Mr. Subcommittee  
3 Chairman, I think --

4 CHAIRMAN BALLINGER: My schedule shows  
5 8:40 to 9. Oh, pardon my dyslexia.

6 (Laughter)

7 MEMBER STETKAR: We'll take care of the  
8 clock and the microphones. You just run the  
9 meeting.

10 CHAIRMAN BALLINGER: Can you change my  
11 diapers?

12 (Laughter)

13 MR. SISK: I think we're through with  
14 the overview, if there's any questions. Otherwise,  
15 we can move into Chapter 2 very quickly, so we are  
16 mindful of time, as well. So let's switch out.

17 CHAIRMAN BALLINGER: Yes.

18 MR. SISK: Okay. Are we ready, Mr.  
19 Chairman?

20 CHAIRMAN BALLINGER: Yes.

21 MR. SISK: I am Rob Sisk, Westinghouse.  
22 I'm just going to briefly, quickly introduce Mr.  
23 Kwanghoon Koh. He will lead us through the Chapter  
24 2 presentation. And with that, I'll turn it over to  
25 Mr. Koh.

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1 MR. KOH: Let me start. Good morning,  
2 ladies and gentlemen. My name is Kwanghoon Koh. I  
3 working for KEPCO E&C. I'm a civil engineering  
4 specialist. For today's presentation, civil  
5 engineering and the structural part will be  
6 presented by me, Kwang Koh, and the mechanical and  
7 nuclear engineering part will be presented by Mr.  
8 Dong-Su Lee. Now, I am going to present our work  
9 results entitled APR1400 Chapter 2, Site  
10 Characteristics. Next slide.

11 Presentation of Chapter 2, Site  
12 Characteristics and the summary of this  
13 presentation will be given. The documents for  
14 APR1400 are as follows; APR1400 DCD design control  
15 document, Tier 1 and Tier 2. After the meeting,  
16 many RAIs, number respond 33, number of open items  
17 is zero.

18 The scope of this Chapter 2 is as  
19 follows. Chapter 2 provides the five requirements  
20 for the APR1400 design, including geological,  
21 seismological, hydrological, and meteorological  
22 characteristics. The COLA is to come from -- to  
23 provide the site specific qualification.

24 This slide is for site characteristics.  
25 APR1400 is designed on the basis of a set of rules,

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1 to include a range of potential nuclear power plant  
2 sites in the United States. Table 20-1 is a summary  
3 identifying the APR1400 design.

4 This slide is for (inaudible). Section  
5 2.1 is geography and tomography, and Section 2.2 is  
6 called industrial transportation and military  
7 facilities. These two sections will provide the  
8 (inaudible) descriptions here. List of criteria for  
9 Chapter 2 is provided in the attachment.

10 Chapter 2.3 is for meteorology. Some  
11 (inaudible) snow, winter precipitation (inaudible).  
12 These are based on HMR, Hydro Meteorological Report  
13 and the SEG 7.

14 There are three wind related  
15 parameters, wind, tornado, and hurricane. These  
16 parameters are based on ASCE 7, tornado parameters  
17 are like these. These parameters are based on Reg.  
18 Guide 1.276, and the hurricane parameters are like  
19 this, and it is based on Reg. Guide 1.221.

20 These three parameters are found in  
21 most Continental weather. HVAC temperature  
22 and beyond design temperature and.

23 CHAIRMAN BALLINGER: I'm reminded by  
24 Chris that KHNP is presenting Chapter 2.3, but  
25 the Staff will not be presenting on Chapter 2.3, to

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1 my knowledge.

2 MR. CIOCCO: That's correct, not today.  
3 We will do that at the October 4th meeting.

4 CHAIRMAN BALLINGER: Right.

5 MR. CIOCCO: Our Senior Meteorologist  
6 wasn't available, but you have the Safety  
7 Evaluation which has all of our 2.3.

8 CHAIRMAN BALLINGER: Yes.

9 MR. CIOCCO: Thank you.

10 CHAIRMAN BALLINGER: Thank you.

11 MR. D. LEE: Thank you, sir. My name is  
12 Dong-Su Lee, who is the second presenter.

13 As you can see in this slide, the HVAC  
14 design temperatures here. The HVAC systems are  
15 designed applying outdoor air temperature specified  
16 in the FURD. The outdoor air temperatures are  
17 categorized into three conditions as is shown in  
18 this slide; 5 percent exceedance value, 1 percent  
19 exceedance value, and zero percent. The 5 percent  
20 annual exceedance values are used to design  
21 (inaudible) design, and 1 percent is non-safety  
22 related design, and the zero percent are used on  
23 safety-related design. Let's move onto next page.

24 In this page, we had correction on this  
25 slide due to some typos from the version we provide

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1 previously. In beyond design temperatures for power  
2 are categorized into two parts. First part is 5  
3 percent exceedance value for the circulating water  
4 system. Second one is zero percent exceedance value  
5 for essential service water system. Let's move on  
6 to the next page.

7 MEMBER STETKAR: Can we stop right  
8 there?

9 MR. D. LEE: Yes.

10 MEMBER STETKAR: The 81 degrees  
11 Fahrenheit, zero percent exceedance non-coincident  
12 wet bulb temperature for the essential service  
13 water system is very low for the United States.

14 MR. D. LEE: We know that.

15 MEMBER STETKAR: Okay. That's -- and  
16 I'll ask the Staff during our next meeting why they  
17 accept that. But if I look at several other designs  
18 that have been certified in the United States, that  
19 temperature tends to be in the 86 to 88 or 89  
20 degree range. I have an anecdote from the Staff SER  
21 on another certified design that said 21 percent of  
22 the weather stations in the United States had a  
23 zero percent exceedance non-coincident wet bulb  
24 temperature that exceeded 86 degrees Fahrenheit,  
25 which is 5 degrees higher than your's. So from the

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1 perspective of your design, what in your design  
2 limits that temperature to being so low? What  
3 specific elements of your design? Is it your design  
4 specifications for your essential service water  
5 cooling towers? Is it temperature limits on your  
6 component cooling water system? Is it chilled water  
7 systems for HVAC? What elements of your design  
8 limit that temperature?

9 MR. D. LEE: Okay, thank you. Let me  
10 first introduce that the key review items --

11 MEMBER STETKAR: That's -- I'm asking  
12 you -- I've read the RAIs. I'm asking you what  
13 elements of your design limit that temperature? I  
14 know that your RAI response says that it was  
15 accepted for the ABWR. The ABWR combined license  
16 for the South Texas plant, they had to increase it  
17 to 88.3 degrees Fahrenheit for that site. That is  
18 an extreme site, I will admit it, but I'm asking  
19 you what elements of your plant design, not  
20 politics, what elements of your plant design limit  
21 that temperature to 81 degrees Fahrenheit? Why can  
22 it not be something like 87 or 88 degrees  
23 Fahrenheit? And if you can't answer that, that's  
24 fine. We can take the answers at a later meeting,  
25 especially because we're covering Chapter 2.3 in

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1 another Subcommittee meeting.

2 MR. D. LEE: Thank you.

3 MEMBER STETKAR: But I'd like to know  
4 that clearly in terms of where your thermal-  
5 hydraulics limit that temperature.

6 MR. SISK: So let me kind of answer that  
7 a little, give you as precise answer, we can get  
8 back --

9 MEMBER STETKAR: Rob, turn your  
10 microphone on.

11 MR. SISK: This is Rob Sisk,  
12 Westinghouse. Thank you, John.

13 We need to go back and get you a --  
14 look at that question specifically.

15 MEMBER STETKAR: Yes.

16 MR. SISK: As we noted, you'll be  
17 talking to 2.3 at a later time. If we don't have an  
18 answer later today, we'll get back to you by that  
19 time.

20 MEMBER STETKAR: I thought you were  
21 going to have to do that. I just wanted to get it  
22 on the record so you knew next time we need a list  
23 to come back with.

24 MR. SISK: We have it noted, and thank  
25 you.

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1 MEMBER STETKAR: Thank you.

2 MR. BROWN: Maitri and I will track that  
3 as an action item.

4 MR. D. LEE: Let me start. The  
5 atmospheric dispersion factors were determined for  
6 the dose recovery during normal operation, and for  
7 the radiological consequence analysis for  
8 (inaudible) conditions. And on-site atmospheric  
9 dispersion factors are used for the MCR/TSC  
10 habitability analysis. The regulatory basis are as  
11 follows.

12 In DCD 202, Table 20-1, Bounding  
13 Atmospheric Dispersion Factors and Dispersion  
14 Factors are presented. Once the on-site atmospheric  
15 dispersion factors for MCR/TSC habitability  
16 analysis are present in DCD Table 23-2 through 23-  
17 12, and the input variables including post  
18 (inaudible) and intake locations used for the on-  
19 site (inaudible) are shown in the Table 23-13 and  
20 Figure 23-1. Let's move on to the next page.

21 In the next page this slide shows the  
22 design features for the atmospheric dispersion  
23 factors. The long-term factors (inaudible) were  
24 selected to bound the most (inaudible) site, and  
25 the short-term atmospheric dispersion factor at EAB

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1 was obtained from EPRI-URD. For the on-site  
2 atmospheric dispersion factors have been calculated  
3 based on the selected materials (inaudible) to  
4 limit among six U.S. sites. And the two enveloped  
5 most on-site (inaudible) U.S. sites, the sufficient  
6 margin was applied. Lastly, ARCON96 code was used.

7 MEMBER SKILLMAN: Let me ask this  
8 question, please. As I understand it, the site that  
9 you chose is Prairie Island. Is that the most  
10 limiting meteorological site?

11 MR. D. LEE: I will give you answer for  
12 you. To address the essence of the single sites  
13 providing limiting (inaudible) values for the  
14 APR1400 (inaudible) geometrics. The onsite  $\chi/Q$   
15 values are analyzed using 5-year Prairie Island  
16 (inaudible) data as you mentioned, and the  
17 resulting  $\chi/Q$  values are increased by 50 percent  
18 such that more onsite  $\chi/Q$  values become  
19 bounding for the U.S. site meteorological data.

20 MEMBER SKILLMAN: Thank you.

21 MR. D. LEE: On the next page, this  
22 slide shows the (inaudible) set perimeter values  
23 for APR1400 compared to the corresponding site  
24 characteristics, and at the other design site  
25 perimeter values. It is shown in this table

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1 atmospheric dispersion factor and (inaudible)  
2 factor taken into account for the APR1400 could  
3 bound other sites in U.S. Therefore, these sites  
4 perimeters values are reasonable for use in off-  
5 site dose assessment.

6 MEMBER REMPE: Before you leave this  
7 topic, I would normally ask this question of the  
8 Staff if they were going to discuss Section 2.3  
9 today, but they're not here to discuss that today,  
10 so I'm going to try and phrase it as a question to  
11 you, and I'm hoping the Staff will speak up and  
12 clarify. But in their Draft SER on page 245 they  
13 said, sometimes Chapter 2 references the site  
14 boundary when they mean the EAB. Are you aware of  
15 the Staff's comment in their Draft SER on page 245?  
16 And do you know why the Staff provided that comment  
17 in the Draft SER on that page, because I'm  
18 wondering if this comment means that they had a  
19 concern with Section 2.3, because they kind of  
20 imply that the way that Section 2 was written, that  
21 there might be an error. And I just want to know  
22 what was going on. And so could somebody clarify  
23 that statement and what it means, and did they  
24 discuss that with you?

25 MR. CIOCCO: I don't think we have our

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1 meteorologist here.

2 MEMBER REMPE: Well, again, are you  
3 aware of that statement in the Staff's --

4 MR. CIOCCO: Excuse me. We do have  
5 somebody here.

6 MEMBER REMPE: Okay, good.

7 MR. MAZAIKA: This is Mike Mazaika from  
8 the Hydrology-Meteorology Branch.

9 There's sometimes a terminology issue  
10 that we were questioning where the site boundary  
11 and the EAB are co-located, and in some cases that  
12 they are separate, and they're used for two  
13 different analyses. The site boundary is often used  
14 for the long-term  $\chi/Q$  (inaudible) impact analyses,  
15 the EAB is used for design-basis accidents.

16  
17 MEMBER REMPE: Was this discussed with  
18 KHNP, and was it clarified so that you feel  
19 comfortable that things are correct now?

20 MR. MAZAIKA: I would have to go back  
21 and look at the RAI response. I don't have that  
22 answer right now.

23 MEMBER REMPE: Okay. Yes, we'd like to -  
24 - I would -- the sentence didn't reference an RAI,  
25 and so I just would like some clarification of that

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1 sentence, and to understand that things are okay  
2 now.

3 MR. MAZAIKA: Okay. We'll look at that.

4 MEMBER REMPE: Thank you.

5 CHAIRMAN BALLINGER: It's on the Action  
6 Item list.

7 MR. KOH: Section 2.4 describes  
8 hydraulic engineering. Groundwater and flood  
9 elevation (inaudible). Groundwater elevation is two  
10 feet below plant grade, maximum level for flood is  
11 one feet below plant grade. These parameters are  
12 based on EPRI, URD, ARWR, maximum rainfall  
13 precipitation rate (inaudible) hourly, 90 for each  
14 hour, and the short term 3.2 inches in (inaudible).  
15 These parameters are based on hydro meteorological  
16 report and the EPRI value.

17 MEMBER STETKAR: Mr. Koh, before we  
18 leave that slide, in Table 2.0-1, it's -- I'm  
19 confused about the words that are used throughout  
20 the DCD. So, for example, in Table 2.0-1, it  
21 actually says maximum elevation of groundwater 0.61  
22 meters, 2 feet below plant grade in the vicinity of  
23 the SSCs important to safety. In other places I  
24 read, safety-related elevations, and you have in  
25 Chapter 19 and Chapter 17 a list of SSCs that are

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1 risk-significant. So what are the buildings that  
2 have SSCs important to safety? Are they only  
3 safety-related? Are they risk-significant SSCs?  
4 What are those buildings, because it's really  
5 important for me to understand that?

6 MR. KOH: The building -- the SSC  
7 important to safety building partially it is we  
8 think that the(inaudible) and the related --  
9 safety-related buildings, and also some buildings  
10 under -- around the -- the buildings around the  
11 safety-related building potentially also are  
12 including.

13 MEMBER STETKAR: I didn't quite fully  
14 understand that, because you said safety-related  
15 buildings and other buildings around there. I'm  
16 really interested to understand if I'm going to  
17 build this plant what buildings do I need to assure  
18 that the groundwater is more than two feet below  
19 grade and the flood is more than one foot below  
20 grade?

21 For example, turbine generator  
22 building, is that yes or no? A simple question, yes  
23 or no? I will tell you that the turbine generator  
24 building does contain SSCs that are risk-  
25 significant according to Chapter 19 and Chapter 17,

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1 which you're well aware of, as do many other  
2 structures. You can answer at a later date, but I  
3 want to be very, very clear on this so that there's  
4 no question.

5 MR. KOH: Okay.

6 MEMBER STETKAR: Don't change the -- oh,  
7 unless you have an answer.

8 MR. KOH: I will provide the information  
9 later.

10 MEMBER STETKAR: Okay. Then on the topic  
11 of -- because this is all hydrology. In Section  
12 2.4.4.2 you make a statement that says site-  
13 specific information related to the effect of dam  
14 failures on the site includes how the analytical  
15 methods that are presented are applicable to  
16 artificially large floods with appropriately  
17 acceptable coefficients and flood waves through  
18 reservoirs downstream of failures. What do you mean  
19 by artificially large floods?

20 MR. SISK: You're talking now about  
21 temporary flooding of the site?

22 MEMBER STETKAR: It's on the record.

23 MR. SISK: Thank you.

24 MEMBER STETKAR: The -- in Section  
25 2.4.11 where you discuss low water considerations,

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1 you specifically mention "site-specific information  
2 related to low water considerations includes low  
3 flow in rivers and streams, low water resulting  
4 from surges, seiches, or tsunamis, historical low  
5 water, future controls, plant requirements, and  
6 heat sink dependability requirements." You don't  
7 mention explicitly the fact that as a COL  
8 applicant, I should also evaluate failures of  
9 downstream or other impoundments for my essential  
10 cooling water supply, or my ultimate heat sink, if  
11 I so desire, decide to construct my plant that way,  
12 because part of the ultimate heat sink is my  
13 responsibility as a COL applicant. So I was curious  
14 why you didn't provide any notion of evaluating  
15 failures of water impoundments or downstream dams  
16 if I'm on a river, but it could be an impoundment  
17 of a cooling water reservoir, for example. We have  
18 reviewed one site in the United States that has a  
19 very, very large cooling water reservoir with an  
20 earthen dyke around it. You might call it a dam,  
21 it's a dyke, whatever. And failures of that  
22 structure can cause problems for them. So I'll put  
23 that on the record just to see what your response  
24 would be.

25 And in Section 2.4.12 regarding

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1 groundwater, the discussion in that section relates  
2 to hydrostatic loading on structures, and I  
3 understand that. But I couldn't find anything in  
4 the DCD, at least quickly, that relates to  
5 groundwater chemistry. In other words, do you have  
6 limits on the chemistry of the groundwater in terms  
7 of aggressiveness, chlorides, for example, because  
8 those may compromise below-grade structures. And,  
9 obviously, since the groundwater can be only two  
10 feet below grade, a substantial portion of the  
11 subsurface structures could be exposed to the  
12 groundwater. So I was curious, if you do specify  
13 some sort of chemistry when it's for the  
14 groundwater where are they specified in the DCD?

15 MR. KOH: I think that you groundwater  
16 chemical problem related to problems ---  
17 (inaudible) different from site to site, so --

18 MEMBER STETKAR: That's absolutely --

19 MR. KOH: --- (inaudible).

20 MEMBER STETKAR: Absolutely true but if,  
21 for example, depending on your specifications for  
22 the type of concrete that you're going to use in  
23 your buildings it may be more or less susceptible  
24 to groundwater chemistry. So as a COL applicant, if  
25 there are specific limits on the groundwater

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1 chemistry that I need to be aware of, I would think  
2 that they should be specified in the DCD. If  
3 there's no limits, you know, I could probably put  
4 it in an acid bath. So where do you specify those  
5 limits?

6 MR. SISK: We have it --

7 MEMBER STETKAR: If you do have limits,  
8 they should be specified such that the COL  
9 applicant must confirm that their groundwater  
10 chemistry, you know, is better than those limits.  
11 If there are no limits, that's fine, but it's rare  
12 that that's actually the case.

13 MR. SISK: Thank you for the question.  
14 This is Rob Sisk, Westinghouse. Thank you for the  
15 question. We will -- we have noted the question  
16 down. I will need to evaluate it and get back.

17 MEMBER STETKAR: Thank you.

18 (Off record comments)

19 MR. KOH: Can I start again? Okay.  
20 Section 2.5 describes geology, seismology, and  
21 geotechnical engineering. SSE CSDRS and the  
22 HCRHRFSO are used for seismic design of structural  
23 and for (inaudible). SSE is based on 0.3g peak  
24 ground acceleration, and the SSE based on also CSDRS  
25 of 45 (inaudible) spectra. The (inaudible) backdrop

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1 for SSE are (inaudible) HRHFRS is hard rock high  
2 frequency response spectra, and the peak ground  
3 acceleration is 2.2 (inaudible).

4 This figure shows you margin to CSDRS.  
5 Features for the CSDRS as follows. The margin to  
6 CSDRS are developed from the Reg. Guide 1.50  
7 shifted the(inaudible) spectra, basically, and the  
8 (inaudible) value is 0.3g. Below 9 hertz,  
9 (inaudible) Reg. Guide 1.50 spectra, and at the  
10 frequency of 25 hertz the spectra values of Reg.  
11 Guide Spectra are increased by 30 percent, and for  
12 considering high frequency motion at (inaudible)  
13 site is standard from 33 hertz to 50 hertz. DC CSDRS  
14 will be discussed in detail in Chapter 3.

15 CHAIRMAN BALLINGER: With respect to  
16 this Figure 2.0.1 and 2, by the way, in the DCD  
17 nothing is labeled. This figure is clearer but --  
18 and I guess we can guess what damping 2, 3, 4, 5,  
19 7, and 10 percent are, but in the DCD there's no  
20 labels at all that tells you anything. So you  
21 probably ought to think about fixing that.

22 MR. KOH: I see. We will.

23 MR. Y. KIM: Yes, we will incorporate  
24 logistics in our DCD.

25 CHAIRMAN BALLINGER: Not only that, but

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1 in terms of --

2 MR. KOH: You mean label the damping --

3 CHAIRMAN BALLINGER: All blue lines, we  
4 know -- we can guess what the damping factors --

5 MR. KOH: Yes, okay.

6 CHAIRMAN BALLINGER: Yes.

7 MR. KOH: Okay.

8 CHAIRMAN BALLINGER: Thank you.

9 MR. KOH: Damping labels will be added  
10 to here.

11 CHAIRMAN BALLINGER: Okay, thank you.

12 MR. KOH: This figure shows data for  
13 CSDRS. (inaudible) value is 0.3g. This figure shows  
14 you high response spectra, HRHF high response  
15 spectra. Even though the CSDRS amounts to high  
16 frequency application in the high frequency range  
17 between 9 and 50 hertz, those CSDRS are not  
18 anticipated to cover ground motion response spectra  
19 for all potential Central Eastern United States  
20 sites. Therefore, this HRHFOSO is used for covering  
21 high frequency ranging. The PGOHRF response spectra  
22 is 0.2 (inaudible), and this response spectra will  
23 be discussed in detail in Chapter 3.

24 This figure shows you what HRHF  
25 response spectra. (inaudible) deformation is a COL

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1 item. The COL applicant recheck the deformation  
2 potentials and come from the (inaudible) within the  
3 design basis of the facility. For uniformity of  
4 soil, (inaudible) angle is limited to 20 degrees.  
5 (inaudible) static bearing capacity is 50,000 PSF  
6 minimal allowable, dynamic bearing capacity for  
7 normal conditions, dynamic bearing capacity is  
8 50,000 PSF (inaudible) of soil is 1,000 feet per  
9 second, and the liquefaction potential is none for  
10 (inaudible). Minimum soil angle of internal  
11 friction is 35 degrees below the seismic  
12 (inaudible) structure. Allowable settlement of  
13 structures are as follows. Maximum allowable  
14 different set point inside the building is in  
15 principle 50 feet in any direction for the seismic  
16 (inaudible) structures. Minimal allowable different  
17 settlement between buildings which is three inch  
18 between (inaudible) basement and the EDG building,  
19 and half inch between other buildings.

20 MEMBER STETKAR: Let it be on the record  
21 that I have permanent nerve damage in the tips of  
22 my fingers, and sometimes my tactile sense is not  
23 necessarily what it should be. It is now on the  
24 record.

25 A couple of questions on this. First of

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1 all, I -- what particular buildings are in the  
2 scope of the certified design? You mentioned the  
3 nuclear island, you mentioned the emergency diesel  
4 generator building, and the diesel fuel oil tank  
5 building. If I look at the figure, and I have to be  
6 careful because this figure is marked security-  
7 related, so I have to be a bit careful when I refer  
8 to it. Figure 1.2-1 in the DCD shows a plan of the  
9 site, and it has marked several buildings with  
10 shading that says, scope of design certification.  
11 And all of the buildings that are listed here are  
12 in the scope, as is the turbine generator building,  
13 and the compound building. But in particular, also  
14 shown in the scope are the essential service water  
15 component cooling water heat exchanger buildings on  
16 that figure. Are they in the scope of the design  
17 certification, or not? They are certainly safety-  
18 related buildings, but are they in the scope of the  
19 design certification, or not? It's a yes or no  
20 answer. Somebody here should know that. We have a  
21 lot of people.

22 MR. KOH: Mr. Oh, please.

23 MR. OH: This is Andy Oh from KHNP. And  
24 as you asked for the scope of the building as in  
25 scope for the APR1400 design certification is ESW

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1 and CCW heat exchanger building is in scope.

2 MEMBER STETKAR: In scope. Okay.

3 MR. ROCHE-RIVERA: If I could -- good  
4 morning. My name is Robert Roche-Rivera. I'm a  
5 structural engineer, Office of New Reactors with  
6 the EIA. We actually asked the same question you  
7 have, and this will be covered during our Chapter 3  
8 meetings. The response, the clarification we got  
9 from the applicant is that those buildings that you  
10 have indicated are -- with regards to the seismic  
11 analysis and structural design aspects they are not  
12 part of the scope of the certified design. They are  
13 not.

14 MEMBER STETKAR: Thank you.

15 MR. ROCHE-RIVERA: And in addition to  
16 that, actually, the DCD does include COL items that  
17 address that aspect and are left to the COL  
18 applicant.

19 MEMBER STETKAR: Thank you. So I'm now  
20 left with answers on the record that leave me  
21 equally confused as before I answered the question.  
22 So they're either in the scope or not in the scope.  
23 If they are in the scope, it strikes me that the  
24 specifications for foundation and subsurface  
25 materials should apply to them. If they are not in

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1 the scope, it strikes me that it should be very  
2 clear that the COL applicant must be responsible  
3 for them. And I will add not only those buildings,  
4 but also the essential service water cooling tower  
5 structures because they are certainly safety-  
6 related, and I will add the component cooling water  
7 supply and return piping tunnels that go from the  
8 auxiliary building where the component cooling  
9 water pumps are out to the heat exchanger buildings  
10 because those are also certainly safety-related  
11 structures. They happen to be underground piping  
12 ducts but they're safety-related. So I think that  
13 the DCD and the Staff's review of the DCD in all  
14 areas, not just seismic, but also any  
15 specifications for subsurface materials should be  
16 consistent about what is inside the scope, and what  
17 is not inside the scope of what's being proposed  
18 here.

19 MR. SISK: So this is Rob Sisk,  
20 Westinghouse. And to answer that question, clearly  
21 there needs to be some reconciliation of what  
22 Robert had to say and Dr. Oh. What we will do is  
23 cover this in more detail during the Chapter 3  
24 review. This will be specifically covered in  
25 detail, particularly on the seismology, Section

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1 3.7 and 3.8, and we will have that clarity made  
2 at that time.

3 MEMBER STETKAR: But, Rob, it also,  
4 obviously, has -- you know, depending on the  
5 answers there it has trickle down or tentacles that  
6 reach into Chapter 2 here, also, and perhaps COL  
7 information items related to Chapter 2. That's --  
8 if they're out of scope, I'm more concerned about  
9 making sure that the COL information items in  
10 Chapter 2 make it very clear that the COL applicant  
11 must meet some specific criteria for the  
12 foundations and subsurface materials for those  
13 safety-related buildings, because they are safety-  
14 related.

15 MR. SISK: I understand, and we will --  
16 as Robert indicated, as well, there are some COL  
17 information items we will need to look to see if  
18 they're fully addressed, all of the concerns you've  
19 raised today.

20 MEMBER STETKAR: Okay. As I said, not  
21 just Chapter 3, Chapter 2.

22 The second question that I had relates  
23 to your Item 7B here that says, the maximum  
24 allowable differential settlement between buildings  
25 is 3-inches between the nuclear island base mat and

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1 the emergency diesel generator building, and the  
2 diesel fuel oil tank building. Three inches doesn't  
3 sound like a lot until I start to think about  
4 piping, and cable, and vent -- I don't know if  
5 there are any ventilation penetrations, but there's  
6 certainly piping and cable penetrations that go  
7 between those buildings. How do you justify 3-  
8 inches differential settlement between those  
9 buildings?

10 MR. KOH: We check all the settlement of  
11 buildings, NI buildings, and other buildings. As  
12 you know, building, NI building and EDG building,  
13 in between buildings is the only electrical lines  
14 there, so that shows that 3-inch is almost --

15 MEMBER STETKAR: Okay. Are there only  
16 electrical lines, or are there cooling water lines  
17 for the DC generators?

18 MR. KOH: It is, between NI building and  
19 the EDG building, there is only electrical lines,  
20 but between and NI buildings, and other buildings,  
21 there are major steam lines and other piping. So  
22 the between NI building to EDG building amount of  
23 settlement is although with different amount to  
24 each, quite large, 3-inches, but within NI  
25 building, other buildings here, amount of

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1 settlement is only half inch because considering  
2 the piping, venting, piping --

3 MEMBER STETKAR: I'm sorry. That says  
4 inside the building. That's something like --

5 MR. KOH: No, no, no. Here, please,  
6 here.

7 MEMBER STETKAR: Oh, between other  
8 adjacent buildings.

9 MR. KOH: Therefore, half inch between  
10 other buildings.

11 MEMBER STETKAR: Okay.

12 MR. KOH: And NI and the other  
13 buildings, (inaudible) EDG and the other buildings.

14 MEMBER STETKAR: So the 3-inch only  
15 applies to the EDG building.

16 MR. KOH: Yes.

17 MEMBER STETKAR: And that's because the  
18 only connections are electrical cables.

19 MR. KOH: Yes.

20 MEMBER STETKAR: Okay, thank you. That  
21 helps.

22 MR. KOH: Thank you.

23 MEMBER POWERS: And, John, we've  
24 routinely approved 3-inches. This is not an  
25 uncommon number.

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1                   MEMBER STETKAR: It's actually an  
2 uncommon number. Most of the ones we've seen is  
3 half an inch.

4                   MEMBER POWERS: No, just last month we  
5 wrote off on 3-inches.

6                   MEMBER STETKAR: Okay.

7                   MR. KOH: Backfill (inaudible)  
8 properties are as follows. Density, (inaudible)  
9 ratio, and (inaudible) small strain less than 0.001  
10 percent(inaudible) also shows (inaudible), and  
11 the damping of soil (inaudible). This figure shows  
12 you (inaudible) and damping values for the  
13 (inaudible) according to the shear strain  
14 variations as presented in the previous table. This  
15 figure is based on locally, (inaudible) Research  
16 Center report. (inaudible) research.

17                   NRC requested many RAIs for checking  
18 APR1400 DC Chapter 2 to represent the table RAI  
19 (inaudible). This table also shows the RAIs  
20 (inaudible). This table also shows the reference  
21 (inaudible). All RAIs were addressed during the NRC  
22 Staff review and the open items were identified.  
23 (Inaudible.)

24                   CHAIRMAN BALLINGER: I'm not sure  
25 whether this is the right point to ask this

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1 question, but we're going in sort of order. On the  
2 DCD, Chapter 2.1 -- Section 2.1.1, talks about the  
3 exclusion area, and it talks about authority and  
4 control. And there's a statement in there that's, a  
5 highway, railroad, or waterway may traverse the  
6 exclusion area but not close enough to the facility  
7 to interfere with normal operations. What does not  
8 close enough mean? I don't know how to interpret  
9 that. I mean, a railroad track can be closer than a  
10 highway?

11 MR. SISK: This is Rob Sisk,  
12 Westinghouse, again. Thank you for the question.  
13 I'll need to talk with the team to give you a  
14 clearer answer.

15 CHAIRMAN BALLINGER: Thank you.

16 MR. D. LEE: This slide show the key  
17 review items for RAI Number 8012 division number  
18 231-3. As he discussed earlier, NRC Staff note that  
19 almost all COL and ESP applicants previously  
20 reviewed identified zero percent incidence  
21 temperature greater than the corresponding site  
22 parameters for APR1400. For these RAI issues, KHNP  
23 pointed out with the temperature used by previous  
24 certified reactor which used 81 Fahrenheit degree,  
25 identified that those exceedance parameters are

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1 same as those specified in EPRI-URD, thereby  
2 concluding that APR1400 repair temperature is  
3 reasonable and value for use. The answer for your  
4 questions will be provided for you.

5 MEMBER STETKAR: Thank you. And what I'd  
6 like -- I don't know whether the Staff is not going  
7 to discuss Section 2.3 today, and this is part of  
8 2.3, but I'd like if the Staff has, or if you do,  
9 information about what fraction of the United  
10 States would not meet this criterion. We know that  
11 21 percent will not meet 86 percent, 86 degrees.  
12 What fraction will not meet 81 degrees? And I'm not  
13 talking about land area, necessarily, because  
14 Alaska is awfully big.

15 MR. D. LEE: In this city, this phase is  
16 not designed yet, but the cooling tower temperature  
17 and with the others --

18 MEMBER STETKAR: Well, that's why I was  
19 asking about the design because that 81 degrees  
20 must be limited by some feature of the plant  
21 design. And I'd like to understand, you know, what  
22 feature of the plant design limits it to that. In  
23 other words, why cannot you -- why can you not  
24 specify a higher temperature, something like 86 to  
25 88 degrees, which would allow you a much larger

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1 area in Central, and Southern, and perhaps East  
2 Coast U.S.

3 MR. SISK: This is Rob Sisk,  
4 Westinghouse. Again, we'll need to --

5 MEMBER STETKAR: Yes.

6 MR. SISK: -- confer, as we talked about  
7 earlier, John. But I will say that, don't  
8 necessarily presume that that's a design limit as  
9 much as a calculation limit that was done at the  
10 time based on the URDs and based on the analysis of  
11 record.

12 MEMBER STETKAR: Yes, I understand that,  
13 but if I look at -- that one was in the ABWR  
14 certified design, and we haven't built any ABWRs  
15 except South Texas, which is kind of the ABWR  
16 modified a bit. But at South Texas they had to  
17 increase that temperature, in particular, to 88  
18 point some odd degrees.

19 I think that in your slide here you  
20 also say it was U.S. EPR proposed a temperature of,  
21 I have that in my records here, actually 80 degrees  
22 as a 1 percent exceedance value. I could not find a  
23 zero percent exceedance value in the EPR DCD. It's  
24 a 1 percent exceedance value of 80 degrees, so the  
25 zero percent exceedance value would be somewhat

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1 higher than that. How much higher, I don't know.  
2 And I'll remind everyone that the NRC has not yet  
3 certified the US EPR, so that temperature is  
4 somewhat -- could be subject to change if it's ever  
5 certified. The next lowest temperature I could  
6 find, in fact, was 86.1 -- or 86 degrees for the US  
7 APWR, and that was the one where the Staff cited 21  
8 percent of the stations could not meet that. And  
9 then AP1000 is 86.1, the ESBWR is 88, so you could  
10 get the notion. From KHNP, in particular, I'm  
11 interested in understanding what features of the  
12 design limit that temperature. From the Staff, I'll  
13 be more interested in terms of what fraction of the  
14 United States could the plant be built given this  
15 limit.

16 MR. D. LEE: Next, I can make the number  
17 --- RAI number 7912, and the question number 234-1.  
18 Through this RAI, NRC Staff raised the issue as  
19 follows. Since both, the 3 and 4 -- the 3 and 4 and  
20 in the same wind friction window from the thirty  
21 point seven. As you could see, 3 and 4 is located  
22 within this same window friction. At the time the  
23 Reg. Guide 1.194, the criteria is not met, so  
24 cannot be used the reduction factor of 2.  
25 Therefore, KHNP found the fares which have same

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1 application with the example in this RAI and update  
2 all of the analysis without credit of the reduction  
3 factor of 2.

4 Let me introduce summary. Chapter 2  
5 defines site parameters of APR1400 standard plants  
6 and also identified all important site parameters.  
7 The COLA is to come from the DCD site parameters  
8 envelop site specific parameters. Table 20-1  
9 identifies the site parameters for the APR1400  
10 design. Thank you for your attention.

11 CHAIRMAN BALLINGER: Questions from  
12 Members? Thank you. I think we are now, if I even  
13 account for my dyslexia, we're actually ahead of  
14 schedule. We're scheduled for a break at 10:30. I  
15 would propose that we break from now until 20  
16 minutes after and then pick up. Is that agreeable  
17 for everybody? Okay, let's take a break for 15  
18 minutes.

19 (Whereupon, the above-entitled matter  
20 went off the record at 10:04 a.m. and resumed at  
21 10:19 a.m.)

22 CHAIRMAN BALLINGER: And I believe KHNP  
23 wants to clarify one question.

24 MR. OH: Yes. Mr. Speaker, I'd like to  
25 clarify --

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1                   CHAIRMAN BALLINGER:    Can you identify  
2 yourself please?

3                   MR. OH:    Yes.    Andy Oh, KHNP Washington  
4 office.    I would like to clarify my answer again  
5 for the scope of ESW and CCW.    Actually, the ESW  
6 and CCW systems is in scope for the APR 1400  
7 design.

8                   However, the building regarding the  
9 first seismic analysis and instructional analysis  
10 is out of scope.

11                  MEMBER STETKAR:    Is out of scope.  
12 Thank you.    That clarifies that and I'll keep it on  
13 the record then that I want to be sure -- I would  
14 like to have assurance that indeed in Chapter 2,  
15 which is what we are discussing today, there is --  
16 it's adequately clear such that the combined  
17 licensed applicant understands what limitations  
18 they must meet in terms of sub-surface soil  
19 structure, foundation design and things like that  
20 for those structures -- the cooling tower  
21 structure, if they are to use a cooling tower, and  
22 for the piping tunnels that connect the complement  
23 cooling water system and the service water piping  
24 to those buildings.

25                  MR. OH:    However, steel systems design

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1 is in scope.

2 MEMBER STETKAR: The system -- I  
3 understand the system in terms of flow rates and  
4 piping sizes and things like that. But I am  
5 talking about structures here.

6 MR. SISK: This is Rob Sisk  
7 Westinghouse, John. John, just to communicate  
8 clearly so we capture the idea correctly for  
9 Chapter 2, you're referring to the tunnels in the  
10 building. You just want to note that they are --  
11 need to be addressed?

12 MEMBER STETKAR: I want to make sure  
13 that the COL applicant understands what they need  
14 to meet in terms of settlement requirements,  
15 differential settlement requirements, subsurface  
16 soil requirements for those structures because they  
17 are indeed all safe -- those -- the tunnels -- the  
18 CCW heat exchanger and ESW pump building buildings  
19 and the cooling tower buildings, if they are going  
20 to -- if they are going to use cooling towers.

21 MR. SISK: Okay. Let's continue. Turn  
22 on the microphone. Either that or speak more  
23 loudly.

24 MR. ROY: My name is Tarun Roy. I am  
25 the NRO project manager responsible for

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1 coordinating staff review of APR 1400 Chapter 2 of  
2 the design certification application. The NRC  
3 technical staff involved with the safety review of  
4 the APR 1400 FSAR Chapter 2 RS are as follows. We  
5 have Seshagiri Tammara, then Mike Lee on the end,  
6 and Ricardo Rodriguez. We will not be presenting  
7 2.3 today. It will be on October 4th of 2016.

8 During this briefing, the staff will  
9 present the Chapter 2 site characteristics with  
10 open items although there are no open items. The  
11 staff issued the 33 questions to the applicant,  
12 requesting additional information. All questions  
13 are either confirmative action or closed.

14 However, the last -- late last week in  
15 Chapter 3 a draft -- Chapter 3 a draft RAI response  
16 was issued from the applicant, RAI Number 8299,  
17 question 3.7.2.9. The resolution of this response  
18 may affect the DCD section 2.5.4.5 and COL item  
19 2.5.8. RAI response will be discussed during the  
20 presentation of section 2.5. Ricardo will do that.

21 With that, now I turn the presentation  
22 over to the technical reviewer, Rao Tammara, for  
23 the Section 2.1 and 2.2 of the radiation protection  
24 accidental consequence branch.

25 MR. TAMMARA: My name is Tammara Rao.

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1 MALE SPEAKER: Is the button pushed?

2 MR. TAMMARA: I am with NRO. My  
3 responsibility is to review the FSR Sections 2.1  
4 and 2.2. 2.1 entails the geography and demography.  
5 It's the subsections covering the site, location  
6 and description, exclusion area authority and  
7 control and operation distribution.

8 These -- this information mainly  
9 pertains to site specific and not design specific,  
10 therefore the information is to be addressed by the  
11 COL applicant who references this design.

12 Therefore, COL applicant will address  
13 this information as a part of COL information 2.1  
14 in the COL application.

15 Next slide, please. Section 2.2 deals  
16 with the nearby industrial transportation and the  
17 military facilities. This review also has three  
18 subsections which covers the locations and the  
19 routes nearby the site and the description of all  
20 the facilities or with the processes, follow-ups  
21 and the operations and the actions and the other  
22 section where they devaluate the potential impacts  
23 of those facilities on the safe operational plant  
24 whether there are any potential impacts. These are  
25 also, again, site specific. They are not design

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1 specific. There are no site parameters or  
2 characteristics defined in 2.0 table by the design.  
3 Therefore, COL applicant to -- who addresses ---  
4 who references this design is to be providing this  
5 information as a part of COL item 2.2-1 and also  
6 2.2-2 and staff will -- finds this acceptable  
7 because it is site-specific information.

8 MEMBER STETKAR: I have a standard  
9 question that I ask of every new plant so I have to  
10 ask it on this one to get it on the record.

11 In the SER you note that the following  
12 principal types of hazards will be considered with  
13 respect to each of the above areas of review. We  
14 are talking about these nearby hazards.

15 If they have a probability of occurrence  
16 greater than 1 times 10 to the minus seven per year  
17 and in the DCD the applicant uses that 10 to the  
18 minus seven value and said well, if we can't do a  
19 very detailed analysis we will use a ten to the  
20 minus six screening value. Revision 2 of regulatory  
21 guide 1.200 notes that it is recognized for those  
22 new reactor designs with substantially lower risk  
23 profiles, EG internal events, CDF below ten to the  
24 minus six per year, that the quantitative screening  
25 value should be adjusted according to the

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1 corresponding baseline risk value.

2 So I'll ask you in that context why  
3 does the staff accept a ten to the minus seven  
4 absolute screening value for the APR 1400 design or  
5 if a -- an approximate analysis is used -- the ten  
6 to the minus six screening value?

7 MR. TAMMARA: In the evaluation  
8 generally we screen -- I mean, the SRP guidance is  
9 also the design basis accident is defined as the --  
10 those events which have the probability of greater  
11 than ten to the four minus seven having a dose  
12 greater in excess of 10 CFR 100. That is the --  
13 that is the definition of the design basis  
14 accident.

15 So whenever we are looking at the  
16 evaluation of the facilities, which have the  
17 potential to impact the plant, we are screening out  
18 on that basis first.

19 But however, if you have a detailed or  
20 more statistical data available, the subset of that  
21 definition says you can go as low or as high as ten  
22 to the four minus six on this screening. So that  
23 is the rare -- the design basis accident is defined  
24 so that is the criterion that is being used.

25 Therefore, when they are saying that

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1 they will meet ten to the four minus seven, we are  
2 accepting that one. But however in the COL phase  
3 we are evaluating whether they are meeting that ten  
4 to the four minus seven. If they are not, if they  
5 are meeting the ten to the four minus six, if they  
6 are not then we have to delay the NPRA or some  
7 other mitigating measures or something else. So  
8 that -- those are the steps which are being  
9 evaluated in the review.

10 MEMBER STETKAR: And that's -- and I  
11 understand that and I understand why you're  
12 constrained by what's written in the SRP.

13 We have seen plants and we have not yet  
14 reviewed Chapter 19 of the APR1400 design  
15 certification so I have no idea what their core  
16 damage frequency is or what the basis for that is.

17 Recognizing that in many cases they  
18 cannot evaluate external hazards like seismic or  
19 flooding or high winds or those things until they  
20 actually have a site in the PRA.

21 We have reviewed new reactor designs  
22 where -- who profess that their entire core damage  
23 frequency is less than ten to the minus seven per  
24 year. So therefore screening out something at ten  
25 to the minus seven per year would be equivalent of

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1 screening out something that's equal to everything  
2 else -- everything else that could possibly  
3 contribute to core damage or releases.

4 And what I am questioning is is that  
5 appropriate. I understand what the SRP says.

6 MR. TAMMARA: But that is present  
7 guidance available. That's how we rely on the  
8 regularity requirement.

9 MEMBER STETKAR: And that's why I asked  
10 the question to get it on the -- to get it on the  
11 record.

12 In Section 2.2.3.3 -- this is a  
13 question about a particular analysis -- it said the  
14 following principal types of hazards will be  
15 considered with respect to each of the above areas  
16 review. If they have a probability of occurrence  
17 of greater than 10 to the minus seven per year,  
18 which I just -- and two of them are missiles more  
19 energetic than the tornado missile spectra and  
20 pressure effects in excess of the design basis  
21 tornado and what I am curious about is, is it  
22 intentional for the staff to limit those missiles  
23 and the pressure effects -- the wind loving  
24 pressure effects to tornadoes because we know that  
25 in the United States there are some locations in

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1 particular -- southeastern United States and along  
2 the Gulf Coast were in fact hurricane missiles and  
3 perhaps hurricane wind blowing are more limiting  
4 than tornado missiles. So was limitation in the  
5 SER to tornado missiles intentional?

6 MR. TAMMARA: I think that is covered  
7 under Section 2.3 meteorology and hydrology. But  
8 2.1 and 2.2 are typically manmade hazards, not  
9 natural hazards. Natural external.

10 MEMBER STETKAR: Yes. I got it.

11 MR. TAMMARA: So therefore I cannot  
12 probably answer your question precisely. We might  
13 have to rely on --

14 MEMBER STETKAR: Well, but in 2.2,  
15 because that's your area, you're saying that if I  
16 have a manmade hazard and I don't want to be  
17 dramatic, but a local hazard that can -- manmade  
18 hazard now that can generate a missile, point it at  
19 the plant, that as long as that missile is less  
20 energetic than a tornado missile I am okay.

21 And I am saying that may I should be  
22 using tornado or hurricane because the hurricane  
23 missiles may be more limiting. I don't know.

24 I am trying to understand why you  
25 limited those manmade hazard missiles to comparing

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1       them with tornado missiles rather than any external  
2       hazard generated missile which could be a tornado  
3       or a hurricane.

4               MR. TAMMARA:  No, the first step is to  
5       find out that the accident probability has ten to  
6       the four minus seven it is -- if it is screened out  
7       there is no question of evaluating the --

8               MEMBER STETKAR:  Okay.  So I got ten to  
9       the minus five event that throw -- hurls a missile  
10       at the plant.  So I can't screen it out.  It's less  
11       than ten to the minus.  It's ten to the minus five.  
12       It hurls a missile at the plant.  Do I compare that  
13       missile to a tornado generated missile or to a  
14       hurricane generated missile?

15              MR. TAMMARA:  We'd probably we'd have  
16       to evaluate the energy and see and compare.  That  
17       is the -- that is the part of the analysis.  We  
18       cannot throw it away but we are to -- we are to  
19       evaluate that situation and the energy of that  
20       missile.  But so far that hasn't arised in our  
21       evaluations thus far.  But it may.  I do not know.

22              MEMBER STETKAR:  That's right, because  
23       I don't know where they are going to put this plant  
24       and I have no idea what manmade missile hazards  
25       this plant might be exposed to, neither the

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1 frequency nor the size nor the energy of those  
2 missiles. We don't know.

3 MR. TAMMARA: But that will be the --  
4 that will be the case when the COL applicant has to  
5 address in the evaluate.

6 MEMBER STETKAR: We are not  
7 communicating here. I am questioning whether the  
8 comparison -- the energy comparison of those  
9 missiles that I am hurling at the plant now ten to  
10 the minus five per year so I can't screen them out  
11 on frequency, whether that energy comparison should  
12 be made against tornado missiles, which is  
13 specified in the SER or against any externally-  
14 generated missile which would include hurricane  
15 missiles.

16 MR. TAMMARA: Why are you are comparing  
17 that kind if you have -- if you have calculated the  
18 missile you will have the missile and its impact.  
19 We are not comparing and throwing away based upon  
20 the other missiles.

21 MEMBER STETKAR: This says that I can  
22 screen it out. If it's ten to the minus five I can  
23 screen it out if it's less energetic than a tornado  
24 missile.

25 MR. TAMMARA: If we -- if you can

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1 demonstrate, yes.

2 MEMBER STETKAR: Doesn't say anything  
3 about hurricane missiles.

4 MR. WARD: Excuse me. I want to be  
5 clear just so we can answer the question properly.  
6 But were you saying that you think hurricane  
7 missiles may be more energetic?

8 MEMBER STETKAR: Oh, I know hurricane  
9 missiles may be more energetic because that's why  
10 we revised the high wind criteria.

11 MR. WARD: So it doesn't exceed a  
12 tornado, which you think is less energetic.

13 MEMBER STETKAR: That may be the  
14 rationale. But I am trying to get the staff to  
15 answer why this is specifically focused on tornado  
16 missiles.

17 MR. WARD: The other question I will  
18 have to check will Chapter 3 is if it's a tornado  
19 missile that was analyzed in Chapter 3 then that's  
20 what they would look to as being the limiting case  
21 an perhaps it is Chapter 3 that needs to consider  
22 that.

23 MEMBER STETKAR: It may be. Again, we  
24 are going chapter by chapter here.

25 MR. WARD: Right.

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1 MEMBER STETKAR: And I am sensitive to  
2 this because there have been COL applicants who  
3 have had to change things because they're more  
4 limited by hurricanes in particular South Texas but  
5 and I think Turkey Point was more limited -- Turkey  
6 Point was more limited by hurricanes.

7 So it's an issue that's come up that  
8 the staff and us, you know, traditionally through  
9 most of the United States looks only at tornado  
10 missiles because you very quickly get past the  
11 areas that are limited by hurricanes.

12 There may be a rationale. There  
13 actually may be a rationale, Bill, about why  
14 tornadoes --

15 MR. WARD: Well, I know recently they  
16 upgraded the highest tornado wind speeds. I don't  
17 know the details but that may be the reason.

18 MEMBER STETKAR: Anyway, that's --

19 MR. WARD: We will look it up.

20 MEMBER STETKAR: Yes, take a look at  
21 it.

22 MR. TAMMARA: Thank you. That's all my  
23 presentation.

24 CHAIRMAN BALLINGER: So who's next?

25 MR. LEE: I am.

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1 CHAIRMAN BALLINGER: So who's next?  
2 You are. Okay.

3 MR. LEE: So if we can go to slide ten.  
4 Hi. My name is Mike Lee. Good morning. I was  
5 given the hydraulic engineering section to review.

6 As you can see, this list of items that  
7 the COL applicant must address in their application  
8 is not unlike what you might find in NUREG 0800.

9 All these areas rely on-site-specific  
10 information or scenarios that the applicant, the  
11 COL applicant, would collect and present at the  
12 time of the -- of an application.

13 Upon inspection, you'll see though that  
14 geochemistry groundwater -- geochemistry is not one  
15 of these items that's come up in an earlier  
16 discussion and we'd be happy to take that question  
17 back and get back to you on that at the next time  
18 we come before you, if that --

19 MEMBER STETKAR: I didn't -- you know,  
20 I understand it's on the record. I didn't want to  
21 repeat it here.

22 MR. LEE: We will have an answer  
23 because when Chapter 3 kind of shows up there may  
24 be some open items. So we will review with the  
25 subcommittee so we'd be happy to go ahead and do

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1 our homework on that.

2 So if we can go to slide 11. Thank  
3 you. All right. So as I said, the information on  
4 the previous slide is what the -- it's site  
5 specific and was provided by the COL applicant and  
6 there is guidance out there on how to do those  
7 reviews. For example, you have Reg Guide 1.206 and  
8 more recently you have JLD ISG 2012.06 which the  
9 staff is currently using to review the  
10 50.54 evaluations from the existing fleet.

11 As was mentioned earlier this morning,  
12 there is a number of parameters that have already  
13 been reviewed and commented on by this or an  
14 earlier subcommittee related to groundwater levels  
15 tsunami and precipitation rates relative to  
16 rainfall. So in addition to collecting  
17 information about the site that's based on geology  
18 and meteorology and climatology and the like, the  
19 COL applicant will have to also meet these -- this  
20 design envelope. So if we can go to slide 11 or  
21 12.

22 MEMBER STETKAR: I hate to do this to  
23 you. Let me -- let me just make sure it's clear  
24 because the applicant about this notion of what do  
25 they mean in the vicinity of SSCs that are

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1 important to safety that's sort of a different  
2 philosophical question.

3 Let's get back to kind of a more  
4 traditional question. Are we confident that the  
5 COL applicant, if for example, the service --  
6 central service water complement -- cooling water  
7 heat exchanger building's cooling towers, if they  
8 use them, or however they -- wherever they get  
9 their water from and those underground safety  
10 related piping tunnels.

11 Are we confident that the COL applicant  
12 knows that they need to meet the two feet and one  
13 feet criteria for those safety-related structures  
14 also or do they apply or do they not apply?  
15 Because everything I see is indexed to the nuclear  
16 island. Put that up on a hill.

17 MR. LEE: Yes. No, that's a good  
18 question and I think within the nuclear -- the  
19 power bloc there is going to be a designation of  
20 what structure systems are important to safety and  
21 also assessment.

22 MEMBER STETKAR: But here in particular  
23 for a COL applicant do I know that if I put the  
24 nuclear island up on top of a hill and satisfy  
25 everything in terms of flooding groundwater and

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1 down at the base of the hill, and the hill might be  
2 pretty big, I have my service water building and  
3 tunnels that go from the stuff up on the hill to  
4 down below, do I need to meet the same flood and  
5 ground water levels for those service water  
6 buildings because they are safety related.

7 MR. LEE: In my judgement, the short  
8 answer is yes. I mean --

9 MEMBER STETKAR: In my judgement that  
10 is too. I want to make sure -- that's my own  
11 judgement. This is a subcommittee meeting. It's  
12 not an ACRS meeting.

13 MR. LEE: And I can tell you from our  
14 experience in the 5054 review that issue hasn't  
15 been ambiguous.

16 MEMBER STETKAR: Yes. Well, I just  
17 want to make sure that I couldn't necessarily find  
18 -- because I couldn't determine what was in scope  
19 and out of scope I couldn't necessarily find COL  
20 information items in Chapter 2. Not Chapter 3 but  
21 Chapter 2 that alert the COL applicant to the fact  
22 that they need to meet these things. And, you  
23 know, it might be obvious to a lot of people but a  
24 COL applicant might say well, it wasn't in the DCD,  
25 I don't need to necessarily meet it because it

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1 wasn't in the certified design. So staff, you  
2 can't ask me about it.

3 MR. LEE: I think the COL applicant will  
4 be hard pressed to argue that some off -- you know,  
5 just some structured system component that was  
6 important to safety that wasn't necessarily in the  
7 power bloc physically like a service water intake  
8 structure or something like that wouldn't be  
9 subject to these criteria.

10 MEMBER STETKAR: I think they would be  
11 hard pressed. It's just that we are reviewing the  
12 design certification and making sure that it  
13 specifies clearly what is in the certified design  
14 and what is the responsibility of the COL  
15 applicant. Essentially no surprises because of the  
16 COL applicant.

17 MR. LEE: Let's hope not.

18 MEMBER STETKAR: Okay. Thanks.

19 MEMBER SKILLMAN: Mike, I'd like to  
20 build on John's earlier comment relative to the  
21 limitation that KHNP put on maximum ground water  
22 and flood.

23 The additional phrase for the SS or for  
24 the areas close to SSCs or the buildings close to  
25 the SSCs is an add on from the design cert from

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1 combustion.

2 And so at least in my view that little  
3 phrase carries an immense burden and it would be  
4 prudent if that phrase was not there.

5 What is near to me or near to you or  
6 what's near to one of my colleagues might be very  
7 different than what our colleagues from KHNP think  
8 is near and I can just imagine the torture that we  
9 would go through to determine what the rate of  
10 ingress is of ground water for something that's 100  
11 yards away or 200 yards away or 500 meters away.  
12 It just seems like it poses a question that does  
13 not need to be addressed.

14 MR. LEE: Enters as an ambiguity.

15 MEMBER SKILLMAN: It does. So I just  
16 want to reinforce John's earlier comment on that.

17 CHAIRMAN BALLINGER: I think that's a  
18 question that we can take back with us. Thank you.

19 MR. LEE: All right. I am on slide 12. All right.

20 So there is one COL information item  
21 which is information item 2.4.1 and it stipulates  
22 that the applicant is to provide -- the COL  
23 applicant is to provide sufficient information to  
24 verify that the hydraulic related events will not  
25 adversely affect the safety basis for the APR1400

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1 design.

2 The COL applicant is to characterize  
3 the potential flooding hazards that may affect the  
4 proposed reactor site and the COL applicant decides  
5 on what combination of design features and that  
6 could be elevation of door openings, the addition  
7 of field to raise the power block raid, passive  
8 transit system berms or administrative procedures  
9 which will be used to mitigate the effects of any  
10 potential flood hazard at the proposed site.

11 So the items that are identified here  
12 are not unlike what we are currently seeing in our  
13 reviews of the 50.54 flood hazard evaluation.  
14 So there is nothing new here.

15 So in closing, if we can turn to slide  
16 13, the DCD applicant has provided plant-specific  
17 hydrologic site parameters the staff finds as  
18 acceptable, as I mentioned earlier. Those have  
19 already been reviewed by this committee or an  
20 earlier -- or this subcommittee on an earlier.

21 The applicant -- the DC applicant has  
22 properly identified the site-specific information  
23 be provided as part of any future COL application  
24 and the applicant has -- the DCD applicant has  
25 satisfactorily answered all earlier RAIs and there

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1 are no open items. So be happy to answer any  
2 questions you might have at this point. Thank you  
3 for your time.

4 MEMBER STETKAR: No questions?

5 MR. RODRIGUEZ: So hi. My name is  
6 Ricardo Rodriguez. I am a geotechnical engineer  
7 NRO DSEA. I am presenting Section 2.5. Just a  
8 little caveat. A team of people is actually  
9 working 2.5. Stephanie Devlin-Gill, David  
10 Heestel, Luisette Candelario, they are both  
11 seismologists and geothermical engineers as well.  
12 So if there are any questions I might rely on them  
13 for the response.

14 So slide 14 talks about essentially  
15 what we cover in our review. Range is basic  
16 geologic and seismic information, background  
17 information, surface deformation, stability of  
18 subsurface materials and foundation, and stability  
19 of slopes. Essentially what we did here is as a  
20 caveat for the next slide please -- so what we are  
21 looking at this -- at this -- for this section what  
22 we our focus wants frank parameters that are  
23 representative of a potential COL or ESP site. So  
24 the applicant had to demonstrate that the  
25 parameters as they described in the section in

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1 Table 2.01 were representative of a reasonable  
2 number of sites that they were included as part of  
3 tier one.

4 There was a summary table included and  
5 also not all the focus of the RAIs where the  
6 applicant needed to provide the basis for those  
7 parameters. As you can see here, some of the  
8 parameters that we are -- we look at are that first  
9 line should actually read allowable bearing  
10 capacity not demand. Minimum shear wave velocity  
11 allowable level of settlement as the  
12 applicant discussed this morning. No liquefaction  
13 potential for seismic category one  
14 structures. The potential for surface deformation  
15 as I said earlier this parameter is expected to be  
16 representative of a potential COL or ESP site.

17 Next slide. So I'll talk about the  
18 findings we have for the first three sections. We  
19 found that DC required the site specific geology  
20 considerations are addressed by COL applicants in  
21 accordance with the regulations.

22 Also, the DC requires COL requirements  
23 to conduct site specific PSHA and site response  
24 analysis in accordance with relevant regulations  
25 We had a number arise from this

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1 issue but it was the result at the end. The site  
2 specific sub-surface profiles need to be compared  
3 to the profiles in the DCD to ensure that the  
4 parameters in Chapter 3.7 are relevant to COL  
5 sites.

6 For finding the DCD required the COL  
7 applicants show no potential for tectonic  
8 or nontectonic surface deformation. Any  
9 questions? Next slide. So the two more  
10 geotechnical engineer related sections are 2.4 and  
11 2.5. We as a number of RAIs -- the majority of  
12 them were related to soil or rock informing the  
13 requirements. The applicability of static  
14 parameters especially related to the structure of  
15 fill, complications regarding the calculation of  
16 carrying capacity in sediment.

17 We wanted to make sure that the  
18 protection are adjacent to and under seismic  
19 categories was addressed and also for 2.5 we asked  
20 and RAI providing asking the static events the  
21 stability of all natural manmade slopes.

22 In summary, the applicant adequately  
23 addressed RAIs in many instances. They created COL  
24 -- new COL information items tasking the future COL  
25 applicant to authorize the issues at hand.

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1           And on a related note, as we talked  
2 about earlier, we were aware that the essentials of  
3 this water building were out of scope. We had  
4 that very same question at the very beginning. We  
5 had -- we had a real issue with the SED people so  
6 we were aware of that. And so we reviewed this  
7 section with the understanding that there will be  
8 signed by the COL.

9           MEMBER STETKAR: That's -- yes, and I  
10 got that. I was fairly confident in that answer  
11 when I asked the question. But I wanted to make  
12 sure that the applicant was on record clearly  
13 because, as I said, the first thing that I look to  
14 -- because essentially a lot of the stuff in  
15 Chapter 2 was silent on those buildings.

16           Paid a lot of attention to the nuclear  
17 island in particular and the diesel generator  
18 building. And said, well, what about those  
19 buildings.

20           So the first thing I looked at was the  
21 figure that I referred to in Chapter 1, which to me  
22 said they are part of the certified design because  
23 they are buildings. It wasn't flow diagrams. And  
24 my bigger concern now is to make sure that it's  
25 really clear in the COL information items in both

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1 Chapter 2 and Chapter 3 what the COL applicant  
2 needs to assure regarding those buildings and the  
3 connecting tunnels.

4 MR. RODRIGUEZ: Right. Right.

5 So I know for a fact there is -- I  
6 can't remember the name of the COL item number but  
7 there's a COL item that's state -- that the COL  
8 began has a responsibility essentially to decide  
9 those two other buildings.

10 MEMBER STETKAR: Well, we -- I didn't  
11 look at Chapter 3 because I ran out of gas. But,  
12 again, Chapter 3 may be just structural design --  
13 structural and seismic design. It doesn't  
14 necessarily address subsurface soils and fill and  
15 ground water and flooding levels and all of that  
16 kind of stuff which are Chapter 2 types of things  
17 and wind blowing and all of that kind of stuff.  
18 Well, wind level is probably Chapter 3.

19 MR. RODRIGUEZ: Yes. So next slide.  
20 So these are the completion that RDS staff came up  
21 with. So there are new open items that are part of  
22 the Chapter 2 review.

23 There are 15 information items out the  
24 five -- Chapter 2.5 that adequately represent  
25 the actions needed to be taken by the potential COL

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1 applicants and the applicant identified --  
2 appropriately identified appropriate geologic,  
3 seismologic, and geotechnical site parameters and  
4 site specific formation to be provided as part of  
5 any future COL application.

6 And the staff is currently tracking  
7 confirmatory items. Also as I mentioned at the  
8 beginning, we recently were made aware last week  
9 actually there was a direct response of an RAI --  
10 subject RAI that may have some impact into Section  
11 2.5 and we are currently tracking the resolution of  
12 that RAI. So I have no other details than that  
13 because it's still draft. But it's a note for the  
14 committee. That is -- do you have any questions?

15 CHAIRMAN BALLINGER: We are remarkably  
16 ahead of schedule by an hour. And so we have, I  
17 think, two choices. We can go to lunch now and  
18 come back at noon or we can pick up and begin  
19 Chapter 5 assuming that KHNP and everybody can do  
20 that. I'd ask people's advice what do we think we  
21 should do.

22 MEMBER STETKAR: Oh, some of us have --  
23 some of us have a meeting at 12:00 so --

24 CHAIRMAN BALLINGER: Including myself.  
25 Including myself. Okay.

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1                   MEMBER STETKAR: But you don't need to  
2 be there.

3                   CHAIRMAN BALLINGER: So that reduces the  
4 number of options to one, which is we start. So  
5 can the KHNP people -- can you shift out? Is that  
6 going to work?

7                   MR. SISK: What's the final plan?

8                   CHAIRMAN BALLINGER: Oh, the plan is to  
9 push forward. Very good. Thank you.

10                  MR. WARD: Excuse me, can we have five  
11 minutes to get Chapter 5 down from NRC here?

12                  CHAIRMAN BALLINGER: We'll take a five  
13 minute hiatus.

14                  (Whereupon, the above-entitled matter  
15 went off the record at 10:57 a.m. and resumed at  
16 11:05 a.m.)

17                  CHAIRMAN BALLINGER: Okay. It's yours.

18                  MR. SISK: Okay, Dr. Ballinger. Thank  
19 you. Rob Sisk with Westinghouse again. We are  
20 ready to go with Chapter 5. I think given the time  
21 allotment; and hopefully have a good discussion for  
22 this section, we think we can get through 5.2  
23 before lunch. I understand you have a noon  
24 deadline, so we will try to cover 5.2 this morning  
25 and then we'll cover the rest after lunch or at the

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1 next available timing as it works out. So if  
2 that's acceptable to the ACRS, I'll turn it over to  
3 Minseok Kim and he will lead us through Section  
4 5.2, or Chapter 5.2.

5 MR. MINSEOK KIM: Okay. Good morning.  
6 My name is Minseok Kim. I'm one of the Chapter 5  
7 engineer. I really appreciate the opportunity to  
8 participate this meeting and present Chapter 5.

9 Let me start. The contents of today's  
10 presentation for Chapter 5 is on the screen.  
11 Firstly, the overview of Chapter 5. And then the  
12 reactor coolant system and also safety connected  
13 systems section by section will be presented,  
14 including the open items. Finally, I will  
15 summarize. And that's the end of the presentation.

16 This slide shows the list of submitted  
17 documents. Presented here for Chapter 5 itself and  
18 Tier 1, there are four technical reports. There  
19 have been 77 questions and all of the questions  
20 were responded by KHNP. There are six questions  
21 for RCP were submitted after the issue of the SCE.

22 Chapter 5 section overview. Section  
23 5.1, Summary Description, describes the design  
24 features of the reactor coolant system. 5.2,  
25 Integrity of RCPB, describes the measures that

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1 provide and maintain the integrity of the RCPB  
2 throughout the facility's design life. 5.3,  
3 Reactor Vessel, describes the reactor vessel  
4 material issues. Finally, 5.4, RCS Components and  
5 Subsistent Design, describes the reactor system  
6 components.

7 Okay. Here are three of today's  
8 presenters shared 5.1, Summary Description. The  
9 RCS and the components are shown in the figure. On  
10 the left of the slide the design features of  
11 APR1400 are listed. It includes 60 years design  
12 life and primary and secondary operating  
13 conditions. APR1400 is a pressurized water reactor  
14 with two closed loops. The major components are  
15 the reactor vessel, two parallel heat transfer  
16 loops each containing one steam generator and two  
17 RCPs, a pressurizer connected to the hot leg on  
18 loop No. 2. All components are located inside the  
19 containment building.

20 MEMBER SKILLMAN: Before you proceed to  
21 that slide --

22 MR. MINSEOK KIM: Okay.

23 MEMBER SKILLMAN: -- let me ask you to  
24 go back the slide 2, please. One more. Which  
25 document provides the accounting for the

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1 transients, the number of heat-ups, cool-downs,  
2 LOCAs, main steam safety valve openings of 150-100  
3 or 190-100 or 50-90-50 load swings? Where are the  
4 transients accounted for for the reactor coolant  
5 system pressure boundary? I do not see them in  
6 Tier 1 or Tier 2.

7 MR. MINSEOK KIM: Is that question for  
8 THE -- THEN occurrences? Is it?

9 MEMBER SKILLMAN: Rob, what I'm really  
10 asking for is your reactor coolant system  
11 functional specification bases.

12 MR. SISK: You understand? We'll take  
13 that as a note. We'll get back to you after lunch.

14 MEMBER SKILLMAN: Let me tell you why  
15 I'm asking. This plant does not have isolation  
16 valves. This plant can run backwards in several  
17 loops depending on what the pump configuration is.  
18 And I'm particularly interested in the reverse flow  
19 delta T versus time for if you drop a pump, four  
20 pumps, you drop one pump, your now idle pump runs  
21 backwards. You go back up on your anti-rotation  
22 device, but that loop is now flowing backwards.  
23 And if you are operating one pump in each loop, the  
24 idle loop in -- the idle pump in that loop is  
25 running backwards.

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1           So I'm curious where that is addressed  
2           in your thermal hydraulic cycles as the basis for  
3           your ASME Section III, Class 1 analysis.

4           MR. SISK: I understand the question.

5           MEMBER SKILLMAN: Thank you.

6           MR. SISK: We have -- please.

7           MR. ROE: Good morning. My name is Tae  
8           Sun Roe working for KEPCO E&C.

9           That kind of information is included in  
10          the ----- transient document. It's not  
11          listed in this list of submitted documents. But  
12          that document includes the transient including the  
13          one pump down and it contains the flow variation,  
14          temperature variation and pressure variation and  
15          number of occurrence for the transient.

16          And the question you said regarding the  
17          reverse flow, I think the Dr. -- Mr. Choi will  
18          answer on that question, right?

19          CHAIRMAN BALLINGER: You said that  
20          there was a document. Which --

21          MEMBER SKILLMAN: I would like -- if we  
22          may see that document, that would help me. That  
23          way I will understand the transient count, or the  
24          number of transients that are included for a 60-  
25          year design life for this reactor coolant system

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1 pressure boundary. So if we could see that  
2 document, I would appreciate it.

3 MR. MINSEOK KIM: As I understand the  
4 description for the transients and occurrences are  
5 listed in Chapter 3, Section 3.9. Is that right?

6 MEMBER SKILLMAN: For the reactor  
7 coolant system?

8 MR. TAE HAN KIM: This is Tae Han Kim  
9 from KEPCO E&C. 3.391.

10 MR. MINSEOK KIM: 391?

11 MEMBER SKILLMAN: Thank you. I will  
12 look there. I would have thought they were in  
13 Chapter 5 for the reactor coolant system.

14 MR. SISK: So Rob Sisk, Westinghouse  
15 again. So please refer to Chapter 3. And there  
16 was a question still left on the table about the  
17 reverse flow that you were going to address? Okay.  
18 So I wanted to make sure we got that part of the  
19 question resolved. And then we're going to have a  
20 -- just a brief response on the reverse flow.

21 MEMBER SKILLMAN: Thank you. I'd like  
22 to hear that. Thank you.

23 MR. CHOI: Good morning. My name is  
24 Seognam Choi. I'm senior engineer of the Component  
25 Design and Mechanical Groups. And we have two

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1 questions in April meetings.

2 MEMBER SKILLMAN: Yes.

3 MR. CHOI: Yes. And the first one is  
4 the momentum and the flow load changes in reactor  
5 coolant system. And second is the reverse flow  
6 through the RCS loop. It's accounting for the RCS  
7 loading analysis? Yes. And then we try to the  
8 analysis in progress and not -- I'm sorry is not  
9 finished yet, but in about one or two month we try  
10 to finish the report. And then we consider  
11 the full load, the mechanical hydraulic force  
12 because it by the equivalent and it's calculated  
13 and applied to the RCS coolant and some other. And  
14 then the hydraulic forces are due to the frictions  
15 and the momentum changes are caused by reactor  
16 coolant flows. And we tried to -- the in progress.  
17 I'm not telled about the district, but later then I  
18 will try to the answer that you are questions.

19 MEMBER SKILLMAN: In the future will be  
20 fine.

21 MR. CHOI: Yes.

22 MEMBER SKILLMAN: Thank you.

23 Rob, thank you.

24 MR. SISK: Okay.

25 MR. MINSEOK KIM: If I may resume on

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1 the presentation, the slide on the functions of  
2 reactor coolant system. First one is energy  
3 transfer from the core to the steam generator to  
4 produce steam for the turbine generator. Secondary  
5 barrier to the list of fission products. And there  
6 are several more functions listed.

7 The principle parameters of the reactor  
8 coolant system can be found in Table 5.1.1-1.

9 MEMBER SKILLMAN: Could we back up one  
10 slide, please? Back one more.

11 Your last bullet, venting of steam and  
12 non-condensable gases. I read in the description  
13 that there's the vent from the pressurizer and  
14 there's the vent from the reactor vessel head.

15 MR. MINSEOK KIM: Yes.

16 MEMBER SKILLMAN: What is the sizing  
17 basis of the vent from the reactor vessel head? Is  
18 that intended to ensure that you do not have a gas  
19 bubble on the reactor vessel head after an  
20 accident?

21 MR. TAE HAN KIM: This is Tae Han Kim  
22 from KEPCO E&C. RCG, reactor core gas venting  
23 system including pressurizer venting and reactor  
24 header venting is based on the --

25 MEMBER STETKAR: Can you please speak

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1 up a little bit so that --

2 MR. TAE HAN KIM: Yes, they have  
3 natural circulation analysis. NCC. Recall, NCC.

4 MEMBER SKILLMAN: Oh, natural  
5 circulation analysis?

6 MR. TAE HAN KIM: Yes.

7 MEMBER SKILLMAN: What consideration is  
8 given in that analysis to elimination of loops  
9 seals in the cold legs?

10 MR. TAE HAN KIM: I'm afraid that that  
11 is little bit different perspective of -- regarding  
12 the loop --

13 (Simultaneous speaking.)

14 MEMBER STETKAR: Will you please speak  
15 up so that we have you on the record? You have to  
16 speak into the microphone.

17 MR. TAE HAN KIM: Yes. Thank you. I  
18 think that is a little bit different design feature  
19 of loop seal. Venting of steam and condensable gas  
20 is venting from the head of pressurizer and head of  
21 RCC base, not in the reactor -- I mean, loop pipe.

22 MEMBER SKILLMAN: I understand that.  
23 I'm placing that question on the record for future  
24 action, please. Thank you.

25 MR. MINSEOK KIM: 5.2.1, Conformance

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1 with Codes and Code Cases. The classification of  
2 RCPB conforms with the requirements of 10 CFR  
3 Appendix A Division 1. A quality group ABC in  
4 accordance with Reg Guide 1.26, and are designed  
5 and fabricated with ASME Section III for in-service  
6 -- service inspection to RCPB. 5.2.4 and 6.6  
7 provide the description of the application of ASME  
8 Section XI.

9 For the in-service testing to RCPB  
10 application of ASME Code for Operation and  
11 Maintenance of NPP can be found in Section 3.9.6.  
12 Reg Guide 1.84, 147, 192 are used in determining  
13 the applicable ASME Code cases.

14 5.2.2, Overpressure Protection.

15 MEMBER STETKAR: Before you start on  
16 this, I have a general question, because you're --  
17 no, you can keep on slide 8 -- because you're going  
18 to start talking about valves here. But I want to  
19 talk about configuration.

20 In Section 5.1.2 there's a general  
21 statement that says overpressure protection for the  
22 RCS is provided by four POSRVs connected to the top  
23 of the pressurizer. These valves discharge to the  
24 in-containment refueling water storage tank where  
25 steam is released underwater to be condensed and

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1       cooled. Good.

2                   If the steam discharge exceeds the  
3       capacity of the in-containment refueling water  
4       storage tank, it is vented to the containment  
5       atmosphere. I found that strange. That's unusual.  
6       So I looked at your Figure 5.1.2-3 in the DCD where  
7       I see that in each of the two lines from the POSRVs  
8       to the IRWST there are motor-operated three-way  
9       valves. That to me is a very unusual design. I  
10      don't think I've seen that.

11                   So I have two questions. First of all,  
12      under what conditions is the IRWST not capable of  
13      handling a discharge from the POSRVs? In other  
14      words, what conditions would require me as an  
15      operator to vent directly to the containment?

16                   That's the first question. Do you have  
17      an answer to that? Or if not, we can do it after  
18      lunch.

19                   MR. ROE: My name is Tae Sun Roe from  
20      KEPCO E&C. During the design-basis instance we did  
21      not discharge to the containment atmosphere or the  
22      discharge from the POSRV goes to the IRWST. But in  
23      case of the beyond-design-basis such as a severe  
24      accident, then the IRWST cannot cool all discharge  
25      from the POSRV condensing the steam. So in that

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1 case the operator open the survey valves and the --  
2 discharge to the containment atmosphere. So is not  
3 within the design-base. It's beyond-design-basis  
4 such as a severe accident.

5 MEMBER STETKAR: Well, okay. I'm not a  
6 severe accident person. Dr. Rempe and the good Dr.  
7 Powers, as opposed to the bad Dr. Powers, are more  
8 severe accident.

9 When you say "severe accident," what in  
10 particular do you mean by that? Because if you're  
11 relieving the energy into the containment, I still  
12 have to remove the energy from the containment. So  
13 I don't understand why it makes a difference  
14 whether I'm blowing it into the containment or  
15 whether I'm blowing it into the IRWST.

16 MEMBER POWERS: The containment  
17 pressure goes up.

18 MEMBER STETKAR: Because the  
19 containment pressure would go up either way,  
20 wouldn't it?

21 MR. OH: This is Andy Oh, KHNP  
22 Washington Office. And during the severe accident  
23 lot of hydrogen can be generated from the melted  
24 down core, so if that hydrogen is inputted in the  
25 IRWST and IRWST is -- lot of hydrogen can be

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1 accumulated in a small amount of the volume. So in  
2 order to prevent that event we have use three-way  
3 belt to vent it out to the containment to  
4 atmosphere to the preventing some of the high  
5 accumulation of the hydrogen inside the IRWST.

6 MEMBER STETKAR: Thank you. So it's  
7 basically a hydrogen vent?

8 MR. OH: Yes. Three belt is major role  
9 is venting for hydrogen, the preventing of the  
10 accumulation of hydrogen inside the IRWST.

11 MEMBER STETKAR: Okay. Thank you. I  
12 don't know whether anyone else has any questions on  
13 that, because I have a separate question.

14 Because it's very unusual to have  
15 motor-operated valves in the discharge flow path  
16 from the primary safety valves, I'm curious whether  
17 it is physically possible for those valves to block  
18 flow. And I don't want a licensing answer. I  
19 don't want an electrical answer. I want to  
20 understand how those valves are configured  
21 internally such that I have assurance that  
22 regardless of how they may fail internally I can  
23 still have a discharge from the POSRVs to some  
24 place.

25 Because if I can't, I don't have

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1 pressure relief from my primary system. And if one  
2 of them is blocked, I don't have half of the  
3 pressure relief from my primary system. So I  
4 really want to understand how those valves are  
5 configured internally and how you have assurance  
6 that indeed they are always open to someplace.

7 MR. TAE HAN KIM: This is Tae Han Kim,  
8 KEPCO E&C. I think you questioning the three-way  
9 valve blocking case. Any possibility -- is that  
10 right, your concern? Any possibility of  
11 blocking the three-way valve?

12 MEMBER STETKAR: I'm interested in the  
13 possibility of a three-way valve being positioned  
14 such that it can block or severely restrict flow.

15 MR. TAE HAN KIM: We design and -- for  
16 procurement we gave it some kind of requirement not  
17 to have --

18 (Simultaneous speaking.)

19 MEMBER STETKAR: I didn't see any  
20 discussion of these valves whatsoever in the DCD,  
21 nor did I see any discussion of these valves in the  
22 SER. And that's why I'm really curious about these  
23 valves, because I haven't seen any valves like this  
24 in any other design that I've ever looked at.

25 MR. MINSEOK KIM: Minseok Kim speaking.

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1 In Chapter 6.8 is there any description for three-  
2 way valve there? Please somebody check this.

3 MR. SISK: This is Rob Sisk, and for  
4 the sake of time we're going to take a look and get  
5 back to you after lunch.

6 MEMBER STETKAR: Yes, if you can.

7 MR. SISK: We'll continue on.

8 MEMBER STETKAR: I searched a few  
9 places and I did some word searches. I think I  
10 looked at Chapter 6, but I may not have done the  
11 right word searches.

12 MEMBER SKILLMAN: I would like to build  
13 on John Stetkar's question, please. I'm in your  
14 Tier 1 document at Figure 2.4.1-2. It's on page  
15 2.418. And this image shows the four POSRVs  
16 relieving to the IRWST but also relief to the RDT,  
17 the reactor drain tank. And I searched on reactor  
18 drain tank and I do not find the reactor drain tank  
19 described anywhere in the document. So I'm  
20 curious, what is the RDT versus the IRWST?

21 Furthermore, as I read the  
22 documentation, the piping from the POSRVs to the  
23 IRWST is not seismic. And I'm curious why that  
24 piping is not seismic. Two questions.

25 MR. MINSEOK KIM: The drain tank is --

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1 I think it's -- it can be found in Chapter 9. The  
2 drain tank is -- it belong to chemical and volume  
3 control system. And --

4 MEMBER SKILLMAN: I'll be happy to  
5 look, but I don't think it's mentioned in the SER.  
6 Now maybe in the SER for Chapter 9, but it's  
7 certainly not in the SER for Chapter 5, even though  
8 it's identified as part of your relief system off  
9 the reactor coolant system.

10 MR. TAE HAN KIM: This is Tae Han Kim  
11 from KEPCO E&C again. This (inaudible) line into  
12 the Tier 1 is showing the -- just a kind of a  
13 leakage indicates of line we have leakage. Then we  
14 flowing down to the RDT. This not the main purpose  
15 of discharge to POSRV.

16 MEMBER SKILLMAN: But it's described in  
17 Chapter 9, you say, Auxiliary Systems?

18 MR. TAE HAN KIM: I think so, but I  
19 have to confirm that.

20 MEMBER SKILLMAN: Let me leave those  
21 questions on the record, please. Thank you.

22 MR. OH: This is Andy Oh, KHNP again.  
23 For -- in terms of three-way valve, that  
24 classification is described in Chapter 3, and also  
25 the function is described in Chapter 19.

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1 CHAIRMAN BALLINGER: So I'm also  
2 assuming that the issue related to severe accidents  
3 and power to these valves is discussed in one of  
4 those chapters. Is that correct?

5 MR. OH: Yes. Andy Oh again. I think  
6 so, yes.

7 MEMBER STETKAR: I'll look at Chapter 3  
8 and Chapter 19 over lunch to see what they say  
9 about those valves, but my suspicion is given  
10 what's typically in those chapters they're not  
11 going to describe what the valves look like. I  
12 want to understand can those valves block or  
13 severely restrict flow? Is there any way that they  
14 can block or severely restrict flow?

15 CHAIRMAN BALLINGER: Regarding the  
16 seismic qualification I was trying to search  
17 through that, and there's a difference between  
18 Seismic Category 1 and Seismic Category 2 for that  
19 piping that's in one of the documents somewhere,  
20 but it's unclear.

21 MR. SISK: And just -- this is Rob  
22 Sisk, Westinghouse. Just to address Gordon's  
23 comment, if you take a look at Section 9.3.3.2.4,  
24 Component Descriptions, it does go a little bit  
25 into RDT. I don't know whether it would address

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1 all your concerns, but there is a bit of a  
2 discussion.

3 MEMBER SKILLMAN: Yes, I'm there now.  
4 I can see it.

5 MR. SISK: Okay.

6 MEMBER SKILLMAN: I was anticipating,  
7 but since it's credited out of Chapter 5, it would  
8 show up somewhere in 5, but particularly because  
9 it's in Tier 1 and shown on that image, there would  
10 have been a description of it as part of the relief  
11 system or drain system. So thank you.

12 MR. MINSEOK KIM: Okay. Overpressure  
13 protection of the RCS and steam generator is  
14 precluded by operation of the pressurizer POSRVs,  
15 MSSVs and by the RPS. Pressure lift capacity is  
16 conservatively sized to satisfy the overpressure  
17 requirements of ASME Section III, Division 1, NB  
18 7000. They are designed to maintain below 110  
19 percent of design pressure during the worst case  
20 loss-of-load event with (inaudible) reactor trip.  
21 SSE suction relief valve provides sufficient  
22 pressure relief capacity to mitigate the most  
23 limiting LTOP events during low-temperature  
24 conditions.

25 MEMBER STETKAR: Are you going to

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1 discuss the LTOP protection in other slides, or is  
2 this the only slide that mentions it?

3 MR. MINSEOK KIM: For the design  
4 feature this is the only slides --

5 MEMBER STETKAR: Okay.

6 MR. MINSEOK KIM: -- and there are open  
7 items regarding LTOP.

8 MEMBER STETKAR: That's okay. Then let  
9 me ask my questions about LTOP here. I understand  
10 the design, first of all. My question is, first  
11 question is do I have assurance that both SCS  
12 suction lines will be open to those relief valves  
13 at any time that LTOP protection is required? In  
14 other words, there's a relief valve in each suction  
15 line. And to have that relief valve provide  
16 protection I need both of the motor-operated valves  
17 from the hot leg to that relief valve -- they must  
18 be open, right?

19 (No audible response.)

20 MEMBER STETKAR: Say, yes, that's  
21 correct. I didn't find anything that specifically  
22 told me as a plant operator that I must have those  
23 motor-operated valves open. I can find things that  
24 are written in the draft technical specifications  
25 that say the relief valves must be operable. And

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1 they give me an opening set point -- opening  
2 pressure set point. I can find things in the  
3 technical specifications that says I must have at  
4 least one shutdown cooling system in operation  
5 during modes 4, 5 and 6. I cannot find anything  
6 that actually tells me I need to have both of those  
7 lines open.

8 So if you can tell me where in some  
9 sort of guidance the COL applicant knows that he  
10 needs to write his procedures such that below the -  
11 - are the temperatures proprietary or are they not  
12 proprietary? The LTOP enable and disable  
13 temperatures, are they proprietary or not?

14 MR. TAE HAN KIM: This is Tae Han Kim  
15 from KEPCO E&C again. The LTOP valve is -- as you  
16 explained to us, it is told in the (inaudible)  
17 shutdown cooling system, and the shutdown cooling  
18 system is manually put in the operation when there  
19 is -- the RCS decrease down to the mode, low mode.  
20 So at that time the LTOP valve is automatically  
21 connected when we open the isolation valve to the  
22 RCS.

23 MEMBER STETKAR: Correct. I understand  
24 that, but if I can cool down using only one SCS  
25 train, I will only have one valve connected to the

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1 system. Now I know one valve has adequate  
2 relieving pressure, but many of the discussions in  
3 the DCD seem to indicate that I have two relief  
4 valves available.

5 MR. TAE HAN KIM: Yes, we have two  
6 relief valves, but capacity is based on the -- how  
7 can I say? The -- two each one have a full  
8 capacity for our evaluation for LTOP relieving.

9 MEMBER STETKAR: Okay.

10 MR. TAE HAN KIM: In the case of we  
11 have only one shutdown cooling pump line available,  
12 we can have a full capacity of LTOP.

13 MEMBER STETKAR: I think what I'm  
14 trying to understand is is it possible, is it  
15 allowed for me as a COL applicant -- am I allowed  
16 to go into the LTOP regime if -- and I won't  
17 specify the temperature, but if I'm below the  
18 enable temperature am I allowed to have only one  
19 SCS cooling train allowed, or am I supposed to have  
20 both of them aligned?

21 MR. TAE HAN KIM: For normal shutdown  
22 cooling to the refueling operation we need two  
23 shutdown cooling operation for normally pre-down  
24 and maintain the refueling state. But we also have  
25 a -- based on the SRP, we -- one shutdown cooling

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1 pump can also maintain into the shutdown state even  
2 though the little bit longer time is needed.

3 So for the case of two operation we  
4 have a full capacity of LTOP. And even though we  
5 have one line of SSCS, we have a -- what can I say,  
6 full capacity of LTOP by each.

7 MEMBER SKILLMAN: The limiting  
8 condition for operation is 3.4.11, Chapter 16, and  
9 it says two operable LTOP systems shall be operable  
10 as follows: Two operable. It then gives  
11 conditions if a valve is not operable. But it  
12 appears as though the answer to John's question is  
13 two.

14 MEMBER STETKAR: Well, I used to run a  
15 plant and I will tell you that if the operability  
16 requirement is that the pressure set point must be  
17 greater than 530 psig, I will say that valve is  
18 operable even though it's isolated from the reactor  
19 coolant system. It's still operable in the same  
20 way that a standby pump is still operable despite  
21 the fact that it's not running. Unless something  
22 tells me that I need by law to open the motor-  
23 operated valves, I'm not going to do that unless I  
24 physically need to do that somehow. And that's  
25 what I'm trying to establish, whether or not --

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1                   MEMBER SKILLMAN:        There's something  
2                   that --

3                                   (Simultaneous speaking.)

4                   MEMBER STETKAR:        -- there's something  
5                   that tells me that whenever I go below that enable  
6                   temperature I must open all four of those motor-  
7                   operated valves.

8                   MEMBER SKILLMAN:        I see what you're  
9                   saying. Okay. I got it.

10                   MEMBER STETKAR:        And I don't -- I can  
11                   find things actually in the DCD and in the SER that  
12                   lead me to believe that the intent is that I should  
13                   open all four, but I want to have confidence that  
14                   if indeed that's what's intended that the people  
15                   who operate the plant know clearly that that's  
16                   what's intended. Because they're going to write  
17                   the procedures. And if they call cool down using  
18                   only one train because they're component cooling  
19                   water temperature is 47 degrees --

20                   MEMBER SKILLMAN:        Thirty-six degrees,  
21                   yes.

22                   MEMBER STETKAR:        -- they're going to do  
23                   that. They're going to cool down like a rock.

24                   MR. ROE:        Yes, Tae Sun Roe from KEPCO  
25                   E&C. I'm going to add some statement regarding

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1 your question or concern.

2 As you know, the Chapter 5.4.7 shutdown  
3 cooling system describes the -- such kind of case  
4 when you mention. When the LTOP alarms occurs,  
5 then the operator should open the suction line  
6 isolation valves if it's closed. So the overflow  
7 valves should be open in that case. I'm not sure  
8 that that helps.

9 MEMBER STETKAR: And I -- yes. And  
10 that might be it. And that alarm comes in at the  
11 LTOP enable temperature?

12 MR. ROE: Yes, right.

13 MEMBER STETKAR: Okay.

14 MR. ROE: If the temperature is below  
15 the enable temperature, then -- the isolation  
16 valves is not open yet, then --

17 MEMBER STETKAR: The operator will  
18 receive an alarm.

19 MR. ROE: -- operator should open the  
20 (inaudible) valves.

21 MEMBER STETKAR: Good. I read about  
22 those alarms, but I wasn't quite sure exactly what  
23 temperature they -- okay. That probably answers it  
24 well enough for me. Thank you.

25 I mean, I had a couple of other

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1 questions if you can bear with me, Ron, on LTOP.  
2 I'll wait until we get to SCS for the other  
3 questions. I don't know if anyone else has LTOP  
4 questions.

5 MR. MINSEOK KIM: Continue. The figure  
6 shows the pressurizer POSRV. Main valve is here.  
7 Two spring-loaded pilot valves. And here the  
8 motor-operated pilot valves. The blue scale shows  
9 the automatic actuation for the RCS overpressure  
10 protection. Red shows the RCS rapid  
11 depressurization, bimanual actuation.

12 In the April meeting there was a  
13 question regarding the ASME quality requirement.  
14 POSRV can be valid committed by ASME Section III as  
15 the overpressure protection device. Regarding the  
16 capacity, according to ASME Section III POSRV has  
17 ASME capacity. Here is the example for the  
18 certification number.

19 MEMBER SKILLMAN: Yes, that was my  
20 question, and I appreciate the citation to the ASME  
21 Code. And I think Dr. Riccardella reinforced that,  
22 that there is an allowance for a pilot valve versus  
23 a spring valve. And that was the thrust of the  
24 question back in April. Thank you for answering  
25 that. Excuse me, John.

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1 CHAIRMAN BALLINGER: Before we go to  
2 the next slide, you have a question?

3 MEMBER STETKAR: Oh, no. You said  
4 before we go -- I do before we go to the next  
5 slide, once we get back to the slide we were on.

6 CHAIRMAN BALLINGER: Oh, okay. Back to  
7 slide 9. A materials question: I was going  
8 through the list of materials that are used and  
9 everything. And as far as I can tell this is the  
10 only place where Alloy X750 is used, which is a  
11 super alloy. And I think that's true, but what I'd  
12 like to know is if that's true, what is the heat  
13 treatment used for that alloy, for that X750?

14 MR. TAE HAN KIM: Pardon me, sir. This  
15 is Tae Han Kim from KEPCO E&C. We didn't catch  
16 your question.

17 CHAIRMAN BALLINGER: The spring there,  
18 as far as I could read that spring material is  
19 Alloy X750, which is a high-strength nickel-based  
20 alloy. And my question is assuming that's true --  
21 I guess confirm that it's true. And if it is,  
22 what's the heat treatment for that material? What  
23 condition is it in? Because certain heat  
24 treatments for that material are very susceptible  
25 to cracking. So I'm just curious as to whether

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1 it's got just a standard spring temper, double  
2 aging, or what's the heat treatment for that  
3 material? Because there's a history in our  
4 industry where Alloy X750 has not reacted very well  
5 in some cases.

6 MR. JONGSOO KIM: Jongsoo Kim for KEPCO  
7 E&C. I think the Alloy X750 is usually in other  
8 increment. For example, a CDM. And that describe  
9 the heat treatment condition. And you can -- and  
10 let me check that section. There's another  
11 section, Section 4.

12 PARTICIPANT: Chapter 4.

13 MR. JONGSOO KIM: I'm sorry. Chapter  
14 4.

15 CHAIRMAN BALLINGER: Chapter 4?

16 MR. JONGSOO KIM: Yes.

17 CHAIRMAN BALLINGER: Chapter 4. Okay.

18 MR. JONGSOO KIM: But that section is  
19 for the other components, but I think the same  
20 materials.

21 MEMBER STETKAR: Maybe same material,  
22 but maybe different heat treatment?

23 MR. TAE HAN KIM: Yes, sir. This is  
24 Tae Han Kim again. This is the kind of better  
25 specific material, so supplied by vendor. So we

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1 will check it, what kind of material heat treatment  
2 is done. So we would get back to you.

3 CHAIRMAN BALLINGER: Thank you.

4 MEMBER STETKAR: Don't change. My  
5 first question on this slide is if I look at the  
6 blue box I see motor-operated valves on the inlet  
7 to the pilot and on the outlet from the pilot on  
8 this slide. If you can point to them with the --  
9 if I look at DCD Figure 5.1.14-1, I see a motor-  
10 operated valve on the inlet and I see a manual  
11 valve on the outlet. So which is it?

12 CHAIRMAN BALLINGER: It's a  
13 magnification problem.

14 MEMBER STETKAR: Huh?

15 CHAIRMAN BALLINGER: The outlets are  
16 not motorized.

17 MEMBER STETKAR: Oh, those are manual  
18 valves on the outlet?

19 CHAIRMAN BALLINGER: Yes, It's just a  
20 number --

21 (Simultaneous speaking.)

22 MEMBER STETKAR: Oh, okay. I didn't --  
23 it's just a valve?

24 CHAIRMAN BALLINGER: Yes.

25 MEMBER STETKAR: Okay. Good. Thanks.

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1 I didn't --

2 MR. MINSEOK KIM: I think this one is  
3 motor-operated.

4 MEMBER STETKAR: Is motor-operated and  
5 the upper one is manual. Okay. Good.

6 My question about those was if I'm an  
7 operator, if there are four combinations of two  
8 valves being closed that will prevent the POSRV  
9 from operating in either the pilot-operated or the  
10 spring-loaded mode, how do I as an operator know  
11 that those four valves are open?

12 MR. YUNE: I'm Mr. Yune from KEPCO E&C.  
13 Let me explain the protocol with spring-loaded  
14 pilot valve, what are the variable. What are  
15 variable used in three quantity? If spring-loaded  
16 pilot valve open but pressure decrease, that should  
17 be shut down. But if not fail, then maintain open,  
18 the operator open -- close the motor-operated  
19 valve.

20 The other manual valve, we can check  
21 every (inaudible) the spring-loaded pilot valve set  
22 point. Then we close the manual valve. If not  
23 open, then manual open. So we do not want the main  
24 valve open. So that case we close the manual  
25 valve. Then operator can check the motor

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1 (inaudible) valves. In MCR there's two  
2 pairs position indicated in the MCR and motor  
3 operated power removed during power operation.

4 MEMBER STETKAR: Okay. Power is  
5 removed from the motor-operated valves during --

6 MR. YUNE: Yes, during power operation.

7 MEMBER STETKAR: Well, if I'm an  
8 operator and during power operation my valve sticks  
9 open, then I have to go re-energize the motor to  
10 close the valve?

11 MR. YUNE: Yes, during -- infrequently  
12 fail close and power and close the motor valve.

13 MEMBER STETKAR: That's interesting.  
14 So I get to blow-down my system for a while while I  
15 go re-energize power.

16 Did I hear you -- do I have valve  
17 position indication in the main control room on  
18 both the motor-operated valve and the manual valve?

19 MR. YUNE: Yes.

20 MEMBER STETKAR: And the manual valve  
21 also?

22 MR. YUNE: Yes.

23 MEMBER STETKAR: Thank you.

24 MR. MINSEOK KIM: Before going further  
25 I'm afraid that the slide is not the final. Please

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1 give time to change the slide. We have some  
2 modification on the slide, but we did not --

3 MEMBER REMPE: Mr. Chairman, why don't  
4 we use this as an opportunity for a break?

5 CHAIRMAN BALLINGER: Yes, I didn't  
6 understand the question. You say the next slide,  
7 which is slide 10 -- whoops, that's not the slide  
8 that I got here. Okay.

9 MR. MINSEOK KIM: Yes.

10 CHAIRMAN BALLINGER: I understand.

11 MEMBER SKILLMAN: I believe the  
12 gentleman said that there needs to be a correction  
13 to the --

14 CHAIRMAN BALLINGER: Yes.

15 MEMBER SKILLMAN: -- image on this  
16 slide.

17 MR. SISK: We need to caucus a little  
18 bit on this particular question and topic and get  
19 back. And I'm looking at time and the schedule.  
20 We could do that right after lunch, but I think  
21 we'll need to have a time to talk.

22 CHAIRMAN BALLINGER: In that case, I  
23 think it's a good time to adjourn until --

24 MEMBER SKILLMAN: Recess.

25 CHAIRMAN BALLINGER: -- recess, excuse

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1 me, until 1:00.

2 (Whereupon, the above-entitled matter  
3 went off the record at 11:52 a.m. and resumed at  
4 1:01 p.m.)

5 CHAIRMAN BALLINGER: Okay. We're back  
6 in session.

7 MEMBER POWERS: Is that like back in  
8 the saddle?

9 CHAIRMAN BALLINGER: Yes.

10 MEMBER POWERS: Back in the saddle  
11 again.

12 CHAIRMAN BALLINGER: You better keep  
13 going before this gets out of control here. More  
14 out of control.

15 (Laughter.)

16 CHAIRMAN BALLINGER: We're losing  
17 something in the translation.

18 Okay. Let's continue.

19 MR. MINSEOK KIM: For this section  
20 there are three open items in SER. Question 5.2.2  
21 there were four sub-items, among them sub-item No.  
22 B and C regarding the LTOP. It was requested to  
23 provide the description of the LTOP analysis and  
24 provide (inaudible) result including the maximum  
25 (inaudible). KHNP responded on this date, but the

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1 follow-up RAI was issued. The number was --  
2 question number was 5.2.2-7. Provide the  
3 description about LTOP analysis methodology in  
4 parameters and solutions. KHNP responded that  
5 describe description about detailed methodology in  
6 parameters and solutions. And why these include  
7 (inaudible) solution are suitability conservative.

8 CHAIRMAN BALLINGER: We have a question  
9 that's from a member that's not here, Dr. Corradini  
10 on this topic. And he was -- I have his written  
11 comment. It says regarding the over-pressure  
12 protection relief during the LTOP transient. This  
13 on the open item. With regard to the energy input  
14 assumptions the staff issued this RAI, and the  
15 question, to address whether the energy inputs were  
16 conservative and how the RCS conditions for this  
17 transient were calculated.

18 He said please ask the staff or the  
19 applicant to explain what is uncertain about the  
20 energy input that is missing in the application.  
21 That's a question from him. Apparently there was  
22 some writing about the uncertainty in the relief  
23 valve setting and the energy input.

24 MR. SISK: This is Rob Sisk,  
25 Westinghouse. I think we -- Tae Han?

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1 MR. TAE HAN KIM: This is Tae Han Kim  
2 from KEPCO E&C. The LTOP valve were basically  
3 evaluated for worst case, this addition and energy  
4 addition, so we calculated addition from the  
5 (inaudible) different temperature from primary to  
6 secondary side. But I'm not fully understand  
7 what's the uncertainty question.

8 CHAIRMAN BALLINGER: I think Member  
9 Skillman would know this better, but during that  
10 transient you're very close to solid. And so a  
11 very small change in input can make a very large  
12 change in pressure. And so the question was how is  
13 the uncertainty in that addition calculated?

14 MEMBER STETKAR: Ron, why don't we wait  
15 until the staff comes up?

16 CHAIRMAN BALLINGER: Okay.

17 MEMBER STETKAR: Because I have a  
18 question --

19 CHAIRMAN BALLINGER: You had a question  
20 about that, too?

21 MEMBER STETKAR: -- about that also.

22 CHAIRMAN BALLINGER: Okay. All right.

23 MEMBER STETKAR: And I wanted to --

24 (Simultaneous speaking.)

25 CHAIRMAN BALLINGER: All right. We'll

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1 wait for the staff.

2 MEMBER STETKAR: I think it's better  
3 for the staff.

4 CHAIRMAN BALLINGER: Okay.

5 MR. MINSEOK KIM: Go on? The third  
6 item was to address the difference between the pre-  
7 service testing in DCD Section 5.2 and Chapter 14  
8 test for pressurizer POSRVs. KHNP revised test  
9 plans in Section 14.2 to describe the complete pre-  
10 service testing for pressurizer POSRVs.

11 Okay. I'll turn over to Mr. --

12 MEMBER STETKAR: Let me ask you one  
13 question about the POSRVs. Are the APR1400 POSRVs  
14 rated for water relief? In other words, if they  
15 open under water relief, will they reseal?

16 MR. MINSEOK KIM: Both water and steam?

17 MEMBER STETKAR: Sub-cooled. I'm  
18 talking about sub-cooled water relief, so that if I  
19 fill the pressurizer full of water during a  
20 transient will they reseal or will they stick open?  
21 When I say "stick open," I don't necessarily mean  
22 stick fully open. I mean chatter or --

23 MR. TAE HAN KIM: Tae Han Kim again.  
24 With POSRV when we gave our procurement spec, we  
25 are required to qualify for both steam and hot

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1 water.

2 MEMBER STETKAR: You will require steam  
3 and water?

4 MR. TAE HAN KIM: Yes.

5 MEMBER STETKAR: Thank you. Is that --  
6 while I have you here, is that -- does that also  
7 apply for the main steam safety valves? Are they  
8 qualified for water relief or only steam?

9 (No audible response.)

10 MEMBER STETKAR: I see shaking of  
11 heads.

12 MR. TAE HAN KIM: I think this is  
13 different.

14 MEMBER STETKAR: So are main steam  
15 safety valves only steam relief?

16 MR. TAE HAN KIM: Yes.

17 MEMBER STETKAR: Thank you. That helps  
18 me later on when I review PRA things. It doesn't  
19 have to do anything with what we're talking about  
20 today. Thank you.

21 MR. MINSEOK KIM: Can you move onto  
22 third (inaudible)?

23 MR. JONGSOO KIM: Good afternoon,  
24 ladies and gentlemen. My name is Jongsoo Kim,  
25 KHNP.

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1                   This is Section 5.2.3, Reactor Coolant  
2 Pressure Boundary Materials. All the reactor --  
3 RCPB material specification and selections complied  
4 with ASME Section III NB requirements and Reg Guide  
5 1.84.

6                   Low-alloy steel and carbon-steel. RCS  
7 main components fabricates the low-alloy steel or  
8 carbon-steel or austenitic stainless steel  
9 cladding. Cladding is in accordance with Reg Guide  
10 1.43 and fracture toughness properties also meet 10  
11 CFR 50 requirements. And  $RT_{NDT}$  is 10 degree  
12 Fahrenheit maximum for RCPB and minus 10 degree  
13 maximum for (inaudible) belt line materials. To  
14 reduce the neutron embrittlement effects of  
15 (inaudible) materials the chemical elements are  
16 controlled. The major structural materials are SA-  
17 508 Grade 3 Class 1, or 508 Grade 1A.

18                   MEMBER POWERS: May I ask what steps  
19 you will take to ensure you don't run into the  
20 kinds of problems they had with the Doral pressure  
21 vessel?

22                   MR. TAE HAN KIM: I'm sorry. I --

23                   MEMBER POWERS: On the Doral pressure  
24 vessel with hydrogen blisters in it.

25                   MR. MICHAEL LEE: I'm sorry, Dana. Can

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1 you ask the question --

2 MEMBER POWERS: Well, what steps will  
3 you take to assure that the forgings don't suffer  
4 from the same problems of the pressure vessel at  
5 the Doral Plant in Belgium? It seems we have to do  
6 a little more than just specify the chemical  
7 composition.

8 MR. JONGSOO KIM: Well, as far as I  
9 know, the (inaudible) pressure (inaudible) in Korea  
10 made from the ring forging and with the  
11 requirements of ASME III requirements and with  
12 additional and examination. Yes, which is only  
13 examination with more, yes, method.

14 MEMBER POWERS: Well, of course that's  
15 exactly what the people at Doral did and  
16 subsequently found out with better ultrasonics that  
17 they had these quarter-sized flaws throughout their  
18 vessel. And one particular one of the rings, they  
19 go to make up the overall forging. And so it  
20 appears they're just saying good forging practices  
21 is not good enough now.

22 MR. SISK: Yes, Rob Sisk, Westinghouse.  
23 I will say that; as you know I'll make the generic  
24 statement because I think it's important, we do the  
25 -- monitor the operating experiences that we're

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1 seeing across the fleet and the Doral experience  
2 and how that applies to experience in Korea, but  
3 now we're looking at a certified design, how we're  
4 assuring that that's not into a -- something that  
5 is --

6 MEMBER POWERS: Well, as far as we know  
7 --

8 MR. SISK: -- acceptable.

9 MEMBER POWERS: -- it seems to be a  
10 peculiarity of the Rotterdam forging practices, but  
11 it's not the only one. We had a problem with a  
12 French steam generator. Same thing. And what it  
13 says -- I mean, this is all hydrogen dissolution  
14 into the steel and an insufficient annealing time  
15 somehow. And so what do you do to make sure you  
16 don't get that problem?

17 MR. SISK: We're going to have to look  
18 into that in more detail.

19 MEMBER POWERS: I mean, I think my  
20 point is it's not evident to me that a chemical  
21 control is sufficient anymore for specifying  
22 forgings with low-alloy steels.

23 CHAIRMAN BALLINGER: To make it clear,  
24 it's possible to meet the toughness specifications,  
25 impact specifications and have this problem.

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1 MR. MICHAEL LEE: I think we understand  
2 the comment and we will be looking to make sure  
3 that is addressed in our operating experience  
4 evaluations to make sure that if there is something  
5 that we can learn from that to enhance APR1400 --

6 (Simultaneous speaking.)

7 MEMBER POWERS: Yes, well, I mean, I  
8 think it's combatable because this problem of  
9 hydrogen was recognized back in the '50s and  
10 protocols were arranged to -- on the annealing to  
11 get rid of it, but manifestly they didn't work all  
12 the time. And I don't know whether it's just a  
13 failing at adherence or it's -- something more  
14 needs to be done, obviously.

15 MEMBER RICCARDELLA: I would suggest  
16 that a big part of that problem was the change in  
17 the ultrasonic techniques that we used way back in  
18 those days when those were built versus the  
19 ultrasonic techniques now. And I'm assuming that  
20 you guys would be using the state-of-the-art  
21 ultrasonic inspection --

22 (Simultaneous speaking.)

23 MEMBER POWERS: Well, I wouldn't assume  
24 anything.

25 MEMBER RICCARDELLA: No.

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1 MR. MICHAEL LEE: We're doing it. I  
2 think it's again something we need to be tracking,  
3 and appreciate the comment.

4 MEMBER POWERS: Yes, somebody's going  
5 to ask you if I don't.

6 MR. JONGSOO KIM: Austenitic stainless  
7 steel. Austenitic stainless steel is controlled  
8 not to use to -- of sensitized stainless steel. So  
9 solution annealed condition and just carbon  
10 contents are applied. Cold worked and cobalt  
11 contents also controlled.

12 Nickel-chromium-iron alloys. Only  
13 Alloy 690 is used for nickel-based alloy. In  
14 addition to ASME Code requirements we incorporate  
15 the state-of-art industry requirements of EPRI  
16 document.

17 CHAIRMAN BALLINGER: I have a question.  
18 Back up to austenitic stainless steel. It just  
19 dawned on me -- yes, less than 0.065 percent or L-  
20 grade. Those are two different things. The  
21 specification on L-grade is less than 0.04. So L-  
22 grade would be 0.04 or less carbon. 0.065 is not  
23 L-grade. It's much higher. And so the welding  
24 procedures for something that uses 0.065 for the  
25 carbon filler metal would be different, way

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1 different than using L-grade with respect to  
2 sensitization. So those two numbers to me are not  
3 -- I don't know. They don't make any sense  
4 together. Am I making myself clear?

5 (No audible response.)

6 CHAIRMAN BALLINGER: So reduce carbon  
7 content of base metals. Okay. To me that says  
8 maybe L-grade. I don't know. And weld materials.  
9 So less than 0.065 is standard stainless steel  
10 grade because that's from 0.04 to -- 0.08 is the  
11 maximum number down to 0.04, which is the L-grade.  
12 And then it says or L-grade, which would be 0.04 or  
13 less.

14 MR. JONGSOO KIM: Yes, we use L-grade  
15 for welding materials, austenitic stainless steel  
16 welding material. However, for the base material  
17 we applied maximum carbon content of 0.065 percent.  
18 That's not L-grade. But in some components I will  
19 talk later, but in this slide the surge lines were  
20 safe and we used L-grade. And for the surge line  
21 we use (inaudible) stabilized stainless steel. And  
22 we -- for the -- yes.

23 CHAIRMAN BALLINGER: Okay. And again,  
24 for weld materials L-grade -- since you're using a  
25 filler metal that's a duplex, I'm not sure the L-

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1 grade means much. In other words, if you have a  
2 ferrite number that has to be within -- above five,  
3 or I forget. Pete would know the number better  
4 than I. I think it's greater than five or seven  
5 for a ferrite number of something.

6 PARTICIPANT: I'm not a metallurgist.

7 CHAIRMAN BALLINGER: Okay. Take my  
8 word for it. It's above five, right?

9 MR. JONGSOO KIM: Yes.

10 CHAIRMAN BALLINGER: So you're using a  
11 duplex material, so L -- there's no L-grade,  
12 there's no 308L, I don't think. So it's just  
13 confusing. It's just -- I understand a little bit  
14 better now, but low -- reduced carbon would be --  
15 0.065 would be reduced carbon from the standard  
16 grade.

17 MR. JONGSOO KIM: Yes.

18 CHAIRMAN BALLINGER: But it wouldn't be  
19 L-grade.

20 MEMBER RICCARDELLA: I think the  
21 operative phrase here is the first bullet under  
22 nickel-chrome-iron, "control on chemistry and  
23 mechanical properties consistent with state-of-the-  
24 art industrial requirements," or "state-of-the-art  
25 industry -- nuclear industry requirements." And I

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1 think that would apply to all your materials.

2 CHAIRMAN BALLINGER: Well, but that's  
3 for -- okay.

4 MEMBER RICCARDELLA: Yes, but I mean, I  
5 think that would apply -- I mean --

6 CHAIRMAN BALLINGER: In fact nowadays  
7 it's very difficult to actually buy 300-series  
8 stainless steel that's not already L. Okay. Thank  
9 you.

10 MR. JONGSOO KIM: Yes. Okay.  
11 Castings. And identify the contents is limited to  
12 prevent similar aging. For examples, 14 percent  
13 maximum for CF8M. Comparability with reactor  
14 coolant. RCS water chemistry of APR1400 complied  
15 with up-to-date EPRI primary water chemistry  
16 guidelines. And the impurity control of chloride  
17 and fluoride in non-metallic insulation complied  
18 with Reg Guide 1.36.

19 Fabrication and processing of ferritic  
20 materials.

21 MEMBER STETKAR: Can I ask you; I read  
22 that, where in the APR1400 inside the containment  
23 do you use non-metallic insulation?

24 MR. JONGSOO KIM: The insulation is  
25 used at the outside of the component, not inside --

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1 MEMBER STETKAR: Inside the reactor  
2 containment you have pumps and pipes and valves and  
3 vessels.

4 MR. JONGSOO KIM: Yes.

5 MEMBER STETKAR: On the exterior of  
6 many of the pumps and pipes and valves and vessels  
7 you have insulation. On the exterior of some of  
8 that you apparently have reflective metal  
9 insulation. I know what that is. And apparently  
10 some places you have non-metallic insulation. I'm  
11 asking you where inside the containment you use  
12 non-metallic insulation. Because this seems to  
13 tell me that you use non-metallic insulation in  
14 there. Otherwise, why does it say it complies with  
15 Regulatory Guide? So I'm just curious where you  
16 use it.

17 MR. MINSEOK KIM: The reactor --  
18 Minseok Kim speaking. The reactor vessel  
19 insulation uses reflective metal insulation.

20 MEMBER STETKAR: Good.

21 MR. MINSEOK KIM: But the -- for the  
22 other components say inside the containment there -  
23 - they can use non-metallic insulation.

24 MEMBER STETKAR: That includes the  
25 reactor coolant loops?

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1 MR. TAE HAN KIM: Sorry, sir. This is  
2 Tae Han Kim from KEPCO E&C.

3 MEMBER STETKAR: Yes.

4 MR. TAE HAN KIM: We applied Korean  
5 containment, so we tried the metallic insulation  
6 inside the containment. But I will check again and  
7 get back to you.

8 MEMBER STETKAR: I didn't catch the  
9 last. What did you say at the end there?

10 MR. TAE HAN KIM: We use the metallic  
11 insulation --

12 MEMBER STETKAR: Yes.

13 MR. TAE HAN KIM: -- inside the  
14 containment.

15 MEMBER STETKAR: And is that for  
16 everything? Does that include main steam lines and  
17 main feedwater lines and --

18 MR. TAE HAN KIM: Yes.

19 MEMBER STETKAR: -- all of the reactor  
20 coolant system?

21 MR. TAE HAN KIM: Yes, inside the  
22 containment.

23 MEMBER STETKAR: Inside the  
24 containment?

25 MR. TAE HAN KIM: Yes.

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1                   MEMBER STETKAR:    Okay.    That's what I  
2                   was trying to establish.    Thank you very much.

3                   MR. JONGSOO KIM:    So fabrication and  
4                   processing of metallic materials.    Ferritic  
5                   materials are controlled in fabrication and process  
6                   with ASME Code Rules and Regulatory Guides as  
7                   applicable.    ASME Section III and IX are used for  
8                   qualification of welding procedure and personnel.  
9                   Pre-heat control for Reg Guide 1.50 and cladding  
10                  procedure qualification for Reg Guide 1.43 and  
11                  welder qualification or limited (inaudible) for Reg  
12                  Guide 1.71 are also applied.

13                  And fabrication and processing of  
14                  austenitic stainless steel.    Austenitic stainless  
15                  steel also controlled in fabrication and processes  
16                  in order to avoid cracking or sensitizing.    To  
17                  avoid stress corrosion cracking austenitic  
18                  stainless steel is supplied in solution and  
19                  (inaudible) condition and (inaudible) through a  
20                  specific temperature range.    Cold working is  
21                  prohibited and on non-sensitization is conformed by  
22                  ASTM A262 Practice A or E corrosion test.

23                  Welding of austenitic stainless steel  
24                  we comply with Reg Guide 1.44.

25                  CHAIRMAN BALLINGER:    Go back.    A262

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1 Practice A or E, these are immersion corrosion  
2 tests. There's a whole list of them. I can see  
3 using 262 for qualifying material used as received,  
4 but I don't understand how you use 262 for an as-  
5 welded structure. So I'd be curious to know a  
6 little bit more information about how you use 262  
7 for something that's welded already --

8 MR. JONGSOO KIM: Yes.

9 CHAIRMAN BALLINGER: -- to verify the  
10 sensitization --

11 MR. JONGSOO KIM: Yes.

12 CHAIRMAN BALLINGER: -- non-  
13 sensitization things. So that's a question that I  
14 have.

15 MR. JONGSOO KIM: Yes, I will explain  
16 using this the next parameter, using next  
17 parameter. And welding of austenitic  
18 stainless steel will comply with Reg Guide 1.44.  
19 And delta ferrite contains in welding materials,  
20 welding heat input and interpass temperature, and  
21 carbon content are controlled for ensuring  
22 integrity of weld heat affected zone and  
23 (inaudible).

24 And finally, ASTM A262 Practice A or E  
25 is used for ensuring non-sensitization. That means

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1 the welding material is ensured by welding  
2 qualification. During the welding qualification  
3 process we complied  
4 -- we tested the ASTM A262 practice. So we qualify  
5 that -- that the welding material used in those  
6 welding procedure would not be sensitized.

7 CHAIRMAN BALLINGER: Okay. But I'm  
8 cautioning -- you're limiting your carbon to 0.065  
9 or lower. Between 0.065 and 0.4 the response to  
10 the same heat input to an A262 test will be  
11 different, quite a bit different. So if you have  
12 piping that varies in carbon content within your  
13 specification, the response to the heat input that  
14 -- above which you get sensitization is going to be  
15 different. So it's -- I'm curious as when we talk  
16 about quality control how that's going to be  
17 assured.

18 MR. JONGSOO KIM: Yes, when we test the  
19 (inaudible), for example, welding material, we do  
20 sensitizing heat treatment. That means it's a  
21 little bit different, the low-alloy -- low-carbon  
22 stainless steel between the -- with the other --  
23 the standard austenitic stainless steel. So we  
24 first sensitized (inaudible) welding and then we  
25 test the Practice A or E test.

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1 MEMBER STETKAR: So is this a test  
2 program prior to doing the actual welding? Am I  
3 missing something?

4 MEMBER RICCARDELLA: I think he says  
5 it's part of the welding procedure qualification.

6 CHAIRMAN BALLINGER: Okay. So they do  
7 some --

8 MEMBER RICCARDELLA: Yes, the procedure  
9 qualification, you run the test and you cover your  
10 -- if the tests cover the range of possible carbon  
11 contents in the materials, then those procedures --

12 CHAIRMAN BALLINGER: Yes. Yes. Okay.

13 MEMBER RICCARDELLA: -- will work in  
14 the field.

15 CHAIRMAN BALLINGER: Thank you.

16 MR. JONGSOO KIM: Contamination control  
17 is applied during the fabrication process. NQA-1  
18 requirements are applied for cleanliness and clean  
19 procedures. And cleaning water chemistry is also  
20 controlled.

21 MEMBER POWERS: I'm not sure what it  
22 means when you say "maintain cleanliness according  
23 to NQA-1." NQA-1, as far as I know, doesn't say  
24 anything about cleanliness.

25 MR. JONGSOO KIM: We (inaudible) by the

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1 classification of the (inaudible) and there is a  
2 requirement for the -- the (inaudible) requirements  
3 applicable to the classification of cleanliness.  
4 Yes.

5 MEMBER POWERS: So what is the  
6 cleanliness requirement? I mean, you're using NQA-  
7 1 to make sure that you're staying within your  
8 specification, but I still don't know what the  
9 cleanliness specification is.

10 MR. JONGSOO KIM: Yes, the cleanliness  
11 specification is Class 1 (inaudible) 3, and those  
12 requirements are in NQA-1, Subsection 3.2. There  
13 should be -- there is applicable requirements how  
14 to classify the cleanliness. And there is also  
15 various requirements to that applicable requirement  
16 of cleanliness.

17 MEMBER POWERS: Okay. So you specify  
18 Cleanliness Category 1 and then you use NQA-1  
19 processes to make sure that you're in compliance  
20 with that specification is what you're saying?

21 MR. JONGSOO KIM: Yes.

22 MEMBER POWERS: Thank you.

23 MR. JONGSOO KIM: And there is one open  
24 item in this section regarding DCD classification.  
25 NRC concerns the integrity of welding material --

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1 fabricated using control parameters specified in  
2 DCD. The welding procedure specification of  
3 austenitic stainless steel qualified with ASME  
4 Section III and IX using those parameters specified  
5 in the DCD such as maximum heat input, interpass  
6 temperature and reduced carbon contents. In the  
7 weld qualification process ASTM 262 Practice A or E  
8 test is performed to issue the non-sensitization of  
9 welding material and weld heat-affected-zone.

10 Since the product welding is to be  
11 performed under a weld input, interpass temperature  
12 and carbon content is less than the value allowed  
13 by the qualified WPS, the weld metal and weld heat-  
14 affected-zone will not be sensitized severely. And  
15 we submitted RA response to NRC to resolve this  
16 concern. The Section 5.2.4 describes  
17 the in-service inspection and testing. ASME  
18 Section XI and 10 CFR 50.55(a) are applied for pre-  
19 service inspection and in-service inspection of  
20 APR1400.

21 ISI program of 10-year interval will be  
22 implemented. We prepare the PSI and ISI program  
23 and submit through licensing body prior to  
24 implementation of the code required examination.  
25 And code case is complied with Reg Guide 1.147.

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1           Inspectability.       The components of  
2       APR1400 will be designed to allow sufficient spaces  
3       for examination with ASME Code Section XI IWA-1500.

4           And qualification.

5           MEMBER STETKAR:    I have a question  
6       about inspectability.  In two places in the DCD you  
7       indicate that the bottom head of the reactor vessel  
8       is examined manually by removing insulation and  
9       that you have an access tunnel down where it comes  
10      in so that people can get down there to do those  
11      inspections.  Is it actually feasible for people to  
12      go down there and perform those inspections  
13      manually?

14           But I recall when I was at Zion; this  
15      is many, many, many years ago, that the dose rates  
16      were typically so high down there that people  
17      essentially could not go there.  So I was curious  
18      of all of your inspection descriptions that one  
19      raised a question with me in terms of how those  
20      inspections would actually be performed.  Because  
21      everything else is underwater.

22           MR. JONGSOO KIM:  We can go there.

23           MEMBER STETKAR:  You can go there?

24           MR. JONGSOO KIM:  Yes, we do.

25           MEMBER STETKAR:  And you do that in

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1 Korea? You actually go under and remove insulation  
2 and inspect the exterior of the bottom heads?

3 MR. JONGSOO KIM: Yes, we design the  
4 insulation with removable insulation.

5 MEMBER STETKAR: Yes, I understand it  
6 can be removed, but the dose rates are low enough  
7 that people can actually do that?

8 MR. JONGSOO KIM: Yes.

9 MEMBER STETKAR: Okay. Good. Okay.  
10 That's --

11 MR. JONGSOO KIM: And qualification.  
12 The qualifications of examination personnel, we  
13 comply with ASME Section XI, double A, 2300 and  
14 Appendix 7. Performance demonstration we -- with  
15 comply with ASME Section XI Appendix VIII,  
16 respectively. And the reactor pressure vessel head  
17 will be examined in accordance with Code Case N-  
18 729-1, modified with 10 CFR 50.55(a). And Boric  
19 Acid Corrosion Program will be also implemented in  
20 APR1400.

21 And now I will turn over to --

22 MR. MINSEOK KIM: 5.2.5, Reactor  
23 Coolant Pressure Boundary Leakage Detection. The  
24 RCPB leakage detection systems are designed in  
25 accordance with Regulatory Guide 1.29 and conforms

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1 to 1.45. The sensitivity for unidentified leakage  
2 can be discussed like this: 0.5 gpm can be  
3 detected less than one hour. And the methods are  
4 inventory, sump level and flow, containment air  
5 particulate radioactivity monitoring, and an  
6 acoustic leak monitoring system.

7 The definition of identified leakage is  
8 accordance with the Reg Guide 1.45 captured/flow-  
9 metered/conducted to collection, or collection  
10 system, or leakage into the containment atmosphere  
11 from a known source and the leakage instrumentation  
12 in the -- provided in the main control room.

13 No questions?

14 MR. JONGSOO KIM: Yes, Jongsoo Kim  
15 again. Reactor vessel materials. This slide  
16 describes the reactor vessel materials. This  
17 figures show the reactor vessel of APR1400  
18 schematically. And it will be fabricated in  
19 accordance with ASME Section III basically, and  
20 Section II for materials and Section V for NDE and  
21 Section IX for welding will be applied. In various  
22 records will also be met during the verifications.

23 And the reactor vessel consists of low-  
24 allow steel or SA-508 Grade 3 Class 1 with  
25 austenitic stainless steel cladding. And fraction

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1 mechanics -- provisions of minus 10 degree  
2 Fahrenheit or 10 degrees Fahrenheit of  $RT_{NDT}$  values  
3 are implemented to certify ASME Code and 10 CFR 50  
4 Appendix G requirements. And CEDM nozzles and ICI  
5 nozzles are main components of Alloy 690 materials  
6 in reactor vessels. Reactor vessel material  
7 program are provided with ASTM E 185 and 10 CFR 50  
8 Appendix H.

9 MR. CHOI: Seognam Choi speaking.  
10 Section 5.3.2.1, Pressure-Temperature Limits. The  
11 purpose of the making pressure-temperature limits  
12 and of operating the plant following it is to  
13 prevent the reactor vessel pressure boundary  
14 materials from the non-ductile fracture during  
15 heat-up and cool-down transients. This is based on  
16 the requirement of Appendix G of 10 CFR 50 and  
17 Appendix G of ASME Section XI. This P-T limit  
18 curves are conservatively based on the end of life  
19 of 60 years and the critical limiting sections such  
20 as reactor vessel beltline, reactor vessel flange  
21 and inlet, outlet nozzles.

22 This slide shows the typical P-T limit  
23 curves for the end of life of 60 years. This curve  
24 we made provide an acceptable range of operating  
25 temperatures and pressure for heat-up, cool-down,

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1 low-temperature overpressurizations and core  
2 criticals and in-service leak and hydrostatic test  
3 conditions. This these P-T limits curves are  
4 adjusted periodically if necessary to stay within  
5 the allowable stress limit during operation. The  
6 detail informations and explanation of APR1400 is  
7 reported to NRC. And these P-T limit curves is  
8 also combined license items. It can be developed  
9 based on the plant-specific data.

10 Pressurizer thermal shocks.  
11 Pressurizer thermal shock events happened to the  
12 pressurizer water reactor. That is the overcooling  
13 of the reactor vessel will followed by the  
14 immediately pressurization.  $RT_{PTS}$  for evaluating  
15 beltline values at the end of life are evaluated  
16 and satisfy the screening criteria of 10 CFR 50.61.

17 On this slide each  $RT_{PTS}$  values are well  
18 below the screening criteria. Also this detail  
19 information go to NRC. And then PTS is also core  
20 items. It can be developed later based on the  
21 plant-specific data.

22 Next. Upper-self energy. Upper-shelf  
23 energy is also another requirement to have more  
24 safety margin against non-ductile fracture by the  
25 irradiation. And this is also regulated by the

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1 Appendix G of 10 CFR 50 and (BTP) 5-3 of NRC  
2 Standard Review Plans. And the change of the USE  
3 can be predicated by the NRC Reg Guide 1.99. With  
4 the initial limiting values of 75 foot-pounds the  
5 estimated value of end-of-life USE for APR1400 is  
6 to be about 51 foot-pounds, which is greater than  
7 the limiting end-of-life values. It can be  
8 developed later based on the plant-specific data.

9 MR. J. KIM: The Section 5.3.3 reactor  
10 vessel integrity. This slide then with the vessel  
11 of APR1400.

12 Then into which of this vessel is  
13 ensured by using techniques, proven techniques and  
14 well characterized materials by planned  
15 experiences.

16 The structure into which the reactor  
17 vessel is ensured by ASME Section 3 MB, material  
18 certification vessels examination, the handling of  
19 the reactor vessel comply with ASME codes and 10  
20 CFR 50.

21 And, after initiation of power  
22 operation, the reactor vessel into which it will be  
23 issued by ISI program and the reactor vessel  
24 surveillance program respectively.

25 MEMBER STETKAR: I have a question, you

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1 didn't cover it here, but your Table 5.3-7  
2 specifies a schedule for removal of the  
3 surveillance capsules.

4 And, I was curious why the surveillance  
5 capsules are not removed from symmetric locations  
6 around the reactor vessel? In particular, why do  
7 you remove capsules at locations 217 degrees and  
8 224 degrees ANC rather than in the four removals,  
9 have them symmetrically located around the vessel?

10 So, that must have been intentional,  
11 so, why do you do that?

12 MR. J. KIM: The location is determined  
13 high level of neutron fluence and those four --  
14 those locations are the same -- but the same 40  
15 degrees -- 45 degrees, it is the same, 45 degrees  
16 is the same. So --

17 MEMBER STETKAR: I'm sorry, but they're  
18 not. 217 degrees and 224 degrees, to me, are 7  
19 degrees apart.

20 MR. J. KIM: Yes, they are symmetrical.

21 MEMBER STETKAR: If you look at Table  
22 5.3-7, just look at Table 5.3-7. You are not  
23 removing the four capsules from four symmetric  
24 locations around the vessel. Just look at the  
25 table and you see 217 degrees and 224 degrees which

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1 are right next to one another.

2 So, my question is, if that's  
3 intentional, why are you doing that? Your two  
4 spares are not located 180 degrees apart around the  
5 vessel as I would expect them to be. They're  
6 located about a 100 degree apart.

7 So, my question is, if that is  
8 intention? It that is what you are specifying for  
9 the certified design, why, as a combined license  
10 applicant must I follow this schedule? There must  
11 be an intention. So, why is it?

12 MR. J. KIM: Yes, this --

13 MEMBER STETKAR: If it's an error, then  
14 it's an error. But, if it's intentional, I want to  
15 understand why it's intentional?

16 MR. J. KIM: Yes, this is no error and  
17 this --

18 MEMBER STETKAR: It is not? Okay.  
19 Why, then, do you have this particular removal  
20 schedule?

21 MR. J. KIM: This location is, first  
22 is, highest location is first.

23 MEMBER STETKAR: Let me try this again.

24 Do you expect the highest fluence to be  
25 in the northeast corner of the plan view of the

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1 reactor vessel shown in Figure 5.3-5? And, if so,  
2 why is it there? As opposed to anywhere else  
3 symmetrically around the reactor vessel?

4 MR. J. KIM: Basically, at this  
5 location is symmetrical. We -- from the vertical  
6 access, this is the 37 and 40, yes, 44 is -- those  
7 locations are all symmetrical from here from here.

8 So, from (inaudible) from 35, 44 and  
9 35, 44. And, this is minus 35 and 44.

10 MEMBER STETKAR: I'm not understanding  
11 you. If I look at Figure 5.3-7, I'm sorry, Figure  
12 5.3.-5, Figure 5.3-5, on the PDF files, it's page  
13 149 on the PDF file or in the DCD, it's page 5.3-  
14 54.

15 If I look at that picture, I see that  
16 you are removing two of the four capsules at 217  
17 and 224 degrees in the, what I would call, the  
18 northeast corner of that picture.

19 And, I'm curious about why two of the  
20 four are removed from there rather than removing  
21 them symmetrically around the vessel of the four?

22 MEMBER REMPE: But, the table has like  
23 six months, 18 months and so they're going --

24 MEMBER STETKAR: The table says I  
25 remove four. I remove them from 217, 37, 224 and

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1 323.

2 MR. J. KIM: How many places do you  
3 have the highest fluence points.

4 MEMBER STETKAR: And, if you expect the  
5 highest fluence to be in that northeast corner of  
6 the vessel, why do you expect it be?

7 I can understand if you expect the  
8 highest fluence to be there that you would  
9 selectively sample from that location. Why do you  
10 expect the highest fluence to be in that 217 to 224  
11 degree area?

12 MR. J. KIM: From our -- this -- my  
13 understanding is that basically those areas are the  
14 highest point and specifically the sequence and I  
15 will check and the --

16 MEMBER STETKAR: Okay, I'd appreciate  
17 it if you'd check because I don't know what there  
18 is about the core that would indicate why I would  
19 selectively have two samples from that location out  
20 of the four over the whole life of the plant.

21 MR. J. KIM: Yes.

22 MEMBER STETKAR: In other words, why I  
23 would not symmetric -- over the life of the plant,  
24 why would not select samples from each of the four  
25 quadrants?

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1 MR. J. KIM: Yes, yes, I will.

2 MEMBER STETKAR: Okay.

3 MR. J. KIM: Thank you.

4 MEMBER STETKAR: I'm not a materials  
5 guy. I just would have expected that there would  
6 be, over the life, you would have gone around the  
7 vessel.

8 MR. SISK: Rob Sisk. What --

9 MEMBER STETKAR: Unless there's  
10 something unique that would give me an indication  
11 that I would expect to have higher fluence in that  
12 particular area.

13 MR. SISK: So, just for clarification,  
14 your expectation is that there would be samples  
15 around or --

16 MEMBER STETKAR: My expectation would  
17 be that there were samples that I would sample  
18 from, I don't care about the sequence at the  
19 moment, but 217, 323, 37 and 143, that would give  
20 me samples in all four quadrants.

21 MR. SISK: Or are you looking for where  
22 you get the highest radiation and, therefore,  
23 you'll get the most conservative answer coming out  
24 in sequence over time.

25 MEMBER STETKAR: And, if there's a

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1 reason why you expect the highest fluence or the  
2 highest --

3 MR. SISK: So, that's what you're  
4 looking for?

5 MEMBER STETKAR: -- degradation at --  
6 because, see, you're sampling from two that are  
7 very close to one another.

8 MR. SISK: Yes, two here and two here  
9 at different times.

10 MEMBER STETKAR: No, not just -- look  
11 at the picture and look at the table. You can't  
12 pull them up at the same time.

13 The sequence specifies that I remove  
14 capsules, the sequence, at 217, 37, 224 and 323.

15 MR. SISK: That's correct.

16 MEMBER STETKAR: So, remover two  
17 capsules that are located very close to one another  
18 --

19 MR. SISK: and, close in time.

20 MEMBER STETKAR: -- and, well, I mean  
21 not close in time, but --

22 MR. SISK: But, I mean --

23 MEMBER STETKAR: You, it's number one  
24 is at 227, number two -- I'm sorry, number one is  
25 at 217, number two is at 37, number three is at

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1 224, which is close to number one and, number four  
2 is at 323, which is roughly 90 degrees away from  
3 number one and three.

4 So, I only get one sample kind of in  
5 the other two-thirds of the entire vessel over the  
6 four years.

7 MR. SISK: I understand your --

8 MEMBER STETKAR: And, I don't -- it's  
9 fine if I expect the highest fluence to be in that  
10 area, I have it. But, I -- and, if it's  
11 intentional, I'm just curious why the highest  
12 fluence would be expected to be in that area?

13 CHAIRMAN BALLINGER: I mean, I'm  
14 looking at Table 5.3.7 here.

15 MEMBER STETKAR: Yes.

16 CHAIRMAN BALLINGER: And, there's --  
17 when it says target fluence, there's only one  
18 capsule, D, which is the 323 at end of life which  
19 would be probably 40 or 50 EFPH.

20 MEMBER STETKAR: That's their nominal  
21 maximum targets.

22 CHAIRMAN BALLINGER: The EOL, right?

23 MEMBER STETKAR: Right.

24 CHAIRMAN BALLINGER: And, that's 6.44  
25 times  $10^{19}$ . And, so, that's the end of life target

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1 fluence. Maybe that's the highest fluence at the  
2 end of the life.

3 MEMBER RICCARDELLA: As I look at it,  
4 all six of the capsules are in the regions of high  
5 fluence.

6 CHAIRMAN BALLINGER: Yes, oh, yes.

7 MEMBER RICCARDELLA: They're all in the  
8 peak area.

9 CHAIRMAN BALLINGER: Yes.

10 MEMBER RICCARDELLA: And, I think it's  
11 somewhat random whether you pick them. They might  
12 be trying to duplicate --

13 MEMBER STETKAR: It was just curious to  
14 me why, if I was going to sample four, I wouldn't  
15 sample them from axis symmetric locations around  
16 the vessel. You know, why --

17 MR. Y. KIM: Yes, this is Yunho Kim.

18 MEMBER STETKAR: You have to -- if  
19 you're going to answer, you have to come up to the  
20 microphone.

21 MR. Y. KIM: This is Yunho Kim.

22 Usually, we have a loading pattern,  
23 impure loading pattern. We designed that, for each  
24 quadrant at the same angle, they have the same  
25 fluence. Right?

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1                   MEMBER STETKAR:     Should be, I would  
2 think so.

3                   MR. Y. KIM:     Yes, so, for, I think that  
4 the lesser fluence should add to it.   The highest  
5 fluence point from each quadrant.

6                   But, we don't have to select for each  
7 quadrant in sequence, you don't have to because in  
8 -- for each quadrant, you have the symmetrical --

9                   MEMBER RICCARDELLA:   Are you using it?  
10 Are you using low leakage core design?

11                  MR. Y. KIM:     Yes.     We have a low  
12 leakage loading pattern.

13                  Did that help you?

14                  MEMBER STETKAR:   I mean, in principle,  
15 it shouldn't make any difference.   In principle, it  
16 shouldn't make any difference.     It's just a  
17 curiosity, if it doesn't make any difference, why  
18 don't you pull samples from symmetric locations to  
19 confirm that it didn't make any difference?

20                  MEMBER RICCARDELLA:   In three of the  
21 four.   Three of the four in symmetric locations.

22                  MEMBER STETKAR:   No, three of the --  
23 I'm sorry, three of the four are within roughly a  
24 one-third of the vessel, 217, 224 and 323 on your  
25 figure is where three of the four come from.

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1 MEMBER RICCARDELLA: But, they're also  
2 pulling 37, right?

3 MEMBER STETKAR: They are pulling --

4 MEMBER RICCARDELLA: Yes, 37 is --

5 MEMBER STETKAR: Yes, they're pulling  
6 37, but three of the four -- they're not pulling  
7 anything from the --

8 MEMBER RICCARDELLA: The upper left  
9 quadrant.

10 MEMBER STETKAR: -- the upper left.

11 MEMBER RICCARDELLA: There might be a -  
12 - we need to -- this is --

13 MEMBER STETKAR: That's why I asked if  
14 there a particular reason --

15 MEMBER RICCARDELLA: Yes.

16 MEMBER STETKAR: -- why they're  
17 focusing on that area. If there isn't then, then  
18 okay.

19 MEMBER REMPE: Have you seen other ones  
20 and do they always -- for other plants, have they  
21 rotated around or do they use the data from the  
22 second one because they're doing calculation and  
23 they're trying to say, well, I want a nearby  
24 location to see how good my model is predicting?

25 I don't know how --

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1 MEMBER STETKAR: I don't know.

2 MEMBER REMPE: -- that's what I was --

3 MEMBER STETKAR: I don't know. I don't  
4 know, it's just -- I'm sorry. I'm almost sorry I  
5 brought it up, but I was just really curious.

6 MR. M. KIM: Can I proceed?

7 There's a list of parameters of  
8 the coolant pump. Before, I indicated RCPs  
9 are vertical single stage bottom suction  
10 horizontal discharge.

11 This is on the motor shaft provides  
12 rotating the shaft for cooldown.

13 This figure shows the pump and the  
14 rotating parts.

15 It is supplied and lock to its shaft,  
16 pump alignment is maintained by a water lubricated  
17 bearing. These other bearings is water lubricated  
18 and the radial thrust bearings in the motor shaft,  
19 these are oil lubricated.

20 Pump and motor is collected by a  
21 coupling.

22 And, in the April meeting, there was a  
23 question about the inspections, motor inspections.  
24 For the rotor inspections, the motor has to be  
25 removed and the thrust bearing has to be removed,

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1 motor stand also removed.

2 For seal changes, remove the coupling  
3 and the reason the coupling is on, and thrust  
4 bearing is slightly lifted and then some space is  
5 here around the rigid coupling. And, the seal  
6 assembly can be -- can put outside for inspection  
7 or change.

8 There was another question for high  
9 pressure cooler. They are normally cooled by two  
10 ways in the system. One is the seal injection from  
11 CVCS and number two is the high pressure cooler.

12 The seal injection water is combined  
13 with a recirculation flow at the jet pump and is  
14 injected to the seals through the high pressure  
15 cooler.

16 Note that the recirculation flow, not  
17 only the emergency condition when injection is  
18 lost, but during normal operation, the  
19 recirculation of flow is required. And, the CCW  
20 cools the separation flow.

21 Another question was the seal -- seal  
22 design is different from the existing plant. The  
23 function and geometry is the same but the motors  
24 are improved.

25 For the long-term exposure up to high

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1 temperature and pressure environment for the -- I'm  
2 saying the difference is more clear. The  
3 difference between the previous plants and the  
4 APR1400 and this application design.

5 And, a test was done and the test  
6 results demonstrated the ability of the seal to  
7 survive an extended SEVU event.

8 There is an open item for the seal --  
9 regarding injection and seals.

10 Section Number 5.4, two, Part I was to  
11 clarify regarding what condition during a 30 minute  
12 period. Thirty minutes in low flow CCW.

13 ICP seal injection is supplied by one  
14 of the two charging pumps and when the charging  
15 pumps are not available, the auxiliary charging  
16 pump can supply the steam injection to the ICPs.

17 And, in the response KHMP provided a  
18 description that the charging pumps and the  
19 auxiliary charging pumps are not directly impacted  
20 by a low flow CCW because the charging pump motor  
21 is air cooled.

22 MEMBER STETKAR: I'm sorry, the  
23 auxiliary charging pump motor is air cooled, is  
24 that correct?

25 MR. M. KIM: That is correct.

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1 MEMBER STETKAR: Does the centrifugal  
2 charging pump require component cooling water?

3 MR. M. KIM: In this design, ARP1400  
4 DCD application and air cooled motor is supplied  
5 and the charging pump has -- the charging pump  
6 mini-flow heat exchanger and the CCW is required.

7 But, the (inaudible) is served, it was  
8 not affected by the loss of CCW. The effects of  
9 the low CCW is not directly affected to the pump  
10 operation.

11 MEMBER STETKAR: So, you will have, if  
12 I lose all CCW the centrifugal charging pumps will  
13 continue to operate with no problem forever, is  
14 that true?

15 MR. M. KIM: The point is --

16 MEMBER STETKAR: No, I'm asking you a  
17 specific question. If I lose CCW, will the  
18 centrifugal charging pumps continue to operate with  
19 no problem forever? And, what I mean forever, I  
20 mean at least 24 hours.

21 MR. T. KIM: Yes, this is Tea Han Kim  
22 from KEPCO E&C.

23 Yes, we can run --

24 MEMBER STETKAR: Thank you.

25 MR. T. KIM: -- charging pump.

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1 MEMBER STETKAR: We have that on the  
2 record.

3 Now, so, I understand if I lose CCW, I  
4 still have seal injection flow from the centrifugal  
5 charging pumps. So, I do not interrupt seal  
6 injection flow.

7 You now say that the reactor coolant  
8 pump can continue to run for at least 30 minutes  
9 with no damage.

10 MR. M. KIM: Ten minutes.

11 MEMBER STETKAR: I'm sorry, this says  
12 30 minutes.

13 MR. M. KIM: Thirty minutes means the  
14 no impact.

15 MEMBER STETKAR: Well, okay. Then,  
16 where's the ten minutes? The ten minutes --

17 MR. M. KIM: It's not in the DCD --

18 MEMBER STETKAR: It's not in the DCD,  
19 is it? Where is -- what does -- you said ten  
20 minutes, so I want to understand what the ten  
21 minutes is.

22 MR. M. KIM: The difference is --

23 MEMBER STETKAR: If I -- so, let's now  
24 talk -- I lose all component cooling water, seal  
25 injection remains available because it stays

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1 available. How much time do the operators have  
2 before they must trip the reactor coolant pump  
3 before I have damage to either the pump or its  
4 seals?

5 MR. M. KIM: The seal is okay. The  
6 bearing -- the pump and motor are oil bearing.

7 MEMBER STETKAR: Okay.

8 MR. M. KIM: Yes, it's limited, it has  
9 a limit of 30 minutes to affect.

10 MEMBER STETKAR: Okay.

11 MR. M. KIM: It is described in Section  
12 5.012.

13 MEMBER STETKAR: Yes, yes, I read that.

14 So, that's 30 minutes. So, before it  
15 basically seizes. But, you said something about  
16 ten minutes just now, so what's the ten minutes?

17 MR. M. KIM: Ten minutes means if --  
18 before ten minutes, the CCW is restored, there is  
19 any -- there is no damage to --

20 MEMBER STETKAR: Right, okay. But, I  
21 don't restore CCW in ten minutes. CCW never comes  
22 back, it's gone forever, what's the ten minutes  
23 then? What happens after ten minutes?

24 MR. M. KIM: The bearing may be  
25 damaged, but there is no effect to on the crossed

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1 down characteristic.

2 MEMBER STETKAR: What about the seals?

3 MR. M. KIM: The seal is okay. The  
4 seal is okay for indefinite time, forever.

5 MEMBER STETKAR: Okay. I've asked many  
6 pump manufacturers this question and they always  
7 have told me they do not know how long the seals  
8 will last once the pump starts to vibrate  
9 significantly. And, I'm talking now about  
10 mechanical damage to the seals because the  
11 clearances are typically not very large.

12 So, as I start to get shaft vibrations,  
13 I can get rubbing on those intermediate seals and  
14 they can start to leak.

15 MR. M. KIM: What is the exact  
16 conditions? Seal injection is available or not?

17 MEMBER STETKAR: Seal -- even with seal  
18 injection available, I've asked other pump  
19 manufacturers this question and they can never give  
20 me an answer to what -- some of them say maybe five  
21 minutes, some of them say maybe ten minutes.

22 But, they've never been able to tell me  
23 much longer than that period that they will assert,  
24 I don't want to use guarantee because they never  
25 use that word. But, they will say that I will not

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1 have seal damage.

2 And, I'm talking now mechanical damage,  
3 not hydraulic or thermal damage.

4 MR. M. KIM: So, if I just mentioned it  
5 contained in the DCD, 30 minutes is -- operational,  
6 30 minutes is possible if the seal injection is  
7 available.

8 MEMBER STETKAR: Okay, let me --

9 CHAIRMAN BALLINGER: I think what he's  
10 saying is, let me -- the pump is running.

11 MEMBER STETKAR: Yes.

12 CHAIRMAN BALLINGER: Something happens  
13 to the pump.

14 MEMBER STETKAR: Nope.

15 CHAIRMAN BALLINGER: Which causes the  
16 imbalance of some kind.

17 MEMBER STETKAR: Nope.

18 CHAIRMAN BALLINGER: No?

19 MEMBER STETKAR: The component cooling  
20 water goes away. I stop cooling every single  
21 bearing on that pump. I've stopped cooling the oil  
22 --

23 CHAIRMAN BALLINGER: Right.

24 MEMBER STETKAR: -- I've stopped --  
25 okay.

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1 CHAIRMAN BALLINGER: So, the bearing  
2 dies.

3 MEMBER STETKAR: The bearing starts to  
4 -- the oil starts to heat up for the bearing.

5 MR. M. KIM: The temperature bearing  
6 and recoil is increasing.

7 MEMBER STETKAR: But, now, on most  
8 things, before the bearings actually fail, I have  
9 experience from this on a main turbine, you start  
10 to get very increased vibrations because of the  
11 viscosity of the oil gets pretty thing.

12 And, as the vibrations increase, there  
13 may be a chance that you can have mechanical damage  
14 to the seals.

15 MR. M. KIM: The APR1400 ICP has its  
16 reference, the -- we have the OPR1000 plans  
17 experience. And, the OPR1000 has referenced the  
18 system. And, they conducted an analysis and tests  
19 and three and four, conducted the full scale test.

20 MEMBER STETKAR: Okay. Well, when you  
21 say test, did they actually cut off all cooling  
22 water with a pump operating at rated reactor  
23 coolant system temperature and pressure with seal  
24 injection available to the seals and let the pump  
25 run for 30 minutes and confirm that there was no

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1 damage? Did they do that? Was that the test?

2 MR. M. KIM: Yes, that is discussed in  
3 DCD 5412.

4 MEMBER STETKAR: I'm sorry, I read the  
5 DCD and the DCD is very careful to say that the  
6 bearing damage after 30 minutes would not be so bad  
7 that you would seize the pump shaft.

8 MR. M. KIM: Yes, that's right.

9 MEMBER STETKAR: Before the pump shaft  
10 seizes, I'm going to have very high pump shaft  
11 vibration at some time before the pump shaft  
12 seizes, right? Or no? You have no pump shaft  
13 vibration?

14 MR. M. KIM: I didn't bring the test  
15 results here, but as I know, as far as I know, the  
16 limit is the bearing temperature, not the vibration  
17 for this test.

18 MEMBER STETKAR: I'm asking -- you  
19 know, we may be talking about different criteria  
20 here. I'm talking about how long can I let that  
21 pump run with no component cooling water with seal  
22 injection available before the operators must trip  
23 the pump because the seals can be damaged. And, if  
24 that's 30 minutes, that's fine, I understand that,  
25 but I would like to know what test has been

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1 performed to confirm that.

2 Because I have asked that same question  
3 to several different other pump manufacturers over  
4 the last 25 years of my life and none of them know  
5 the answer to that question.

6 MR. M. KIM: Yes, and I should check  
7 the test results available and then --

8 MEMBER STETKAR: Yes.

9 MR. M. KIM: I hope then, tomorrow  
10 morning, I --

11 MEMBER STETKAR: That would be great.  
12 I mean, if you -- because that was my second  
13 question. If you actually have run tests on this  
14 pump to confirm that, that would be very, very,  
15 very useful.

16 CHAIRMAN BALLINGER: That's an action  
17 item.

18 MEMBER STETKAR: But, it has to be a  
19 test at rated system temperature and pressure to  
20 ensure -- because I'm looking for seal damage. I'm  
21 not looking for seizure of the shaft. I'm not  
22 looking for bearing damage that's so bad that the  
23 pump -- the reactor coolant pump is somehow other  
24 damaged. I'm strictly looking at possible  
25 mechanical damage to the seals.

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1 MR. SISK: So, Rob Sisk, Westinghouse.

2 Just, again, clarification on what you  
3 just said. You're not raising a safety concern,  
4 you're looking at it from more of equipment  
5 reliability or equipment --

6 MEMBER STETKAR: No, heck, I'm raising  
7 a reactor coolant pump seal LOCA concern and what  
8 is the time window available for the operators to  
9 manually trip the reactor coolant pumps after loss  
10 of component cooling water which is a risk  
11 assessment question and it's also a potential seal  
12 LOCA question. So, that's what I'm asking about.

13 Because there's a time window and any  
14 other pump manufacturer I've ever asked the  
15 question has come up with maybe ten minutes which  
16 was why I was curious about when you said ten  
17 minutes.

18 Some other pump manufacturers wouldn't  
19 tell me any more than five minutes.

20 MR. M. KIM: I believe that the --  
21 during the 30 minutes, the temperature limit was  
22 not -- the test is under the limit and there was no  
23 --

24 MEMBER STETKAR: I mean, that would be  
25 -- in principle, you could do that. If you have a

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1 huge oil reservoir with really good heat transfer,  
2 I can see how it can be done. I've just never seen  
3 it yet, so that's why I'm asking you if you have  
4 test available, it'd be great.

5 MR. M. KIM: I cannot show the test  
6 results here.

7 MEMBER STETKAR: Yes, I mean I  
8 understand, everything is proprietary, but, just  
9 make sure that we get the relevant information.

10 MR. M. KIM: I check and make an answer  
11 tomorrow.

12 MEMBER STETKAR: Thank you, thank you,  
13 thank you.

14 MEMBER SUNSERI: I have a question on  
15 this slide regarding the auxiliary charging pump.  
16 And, the experience in the U.S. with positive  
17 displacement charging pumps is that they are not  
18 very reliable, seal failures, high vibration.

19 And, as a consequence of that, many  
20 plants in the United States have either eliminated  
21 the use of positive displacement charging pumps or  
22 significantly restrict their usage time so that  
23 they can be available, you know, at the moment  
24 they're absolutely needed.

25 So, my question for you is, what is the

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1 basis for having a positive displacement auxiliary  
2 charging pump and what benefit do you expect to  
3 gain from that?

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

6 The first, we use the is put in the  
7 auxiliary charging pump, the main purpose of that  
8 one is the we have to utilize that one for hydro  
9 test for that is a very high pressure. So, that  
10 kind of high pressure can be obtain easily from  
11 that kind of pump.

12 MEMBER SUNSERI: Right.

13 MR. T. KIM: So, that is one of the  
14 main purpose we're using that. And, also, we're  
15 using the charging -- main charging pump as a  
16 centrifuge, so there's another type.

17 And, also, this -- the auxiliary  
18 charging pumps, so it's not already running so it  
19 is for emergency case also we can use some limited  
20 time for operation.

21 MEMBER SUNSERI: Okay. So, I  
22 understand you said two basic reasons.

23 One is, it provides the head necessary  
24 to do the hydro which I understand that. U.S.  
25 plants bring in a temporary pump to do that since

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1 it's done only once every ten years or so.

2 And, then, the other reason is because  
3 of diversity. You want something different than a  
4 charging -- a centrifugal charging pump.

5 Is that -- did I understand that  
6 correctly?

7 MR. T. KIM: Yes.

8 MEMBER SUNSERI: Okay, thank you.

9 MEMBER STETKAR: There are plants, I  
10 was surprise when I started working in Switzerland,  
11 this was, again, one plant that I've worked at uses  
12 only centrifugal, or I'm sorry, only positive  
13 displacement charging pumps and they don't -- they  
14 haven't had any problems with them.

15 I mean, it's a different -- apparently,  
16 some people make really good positive displacement  
17 pumps.

18 MEMBER SUNSERI: They're probably built  
19 like a Swiss watch.

20 MEMBER STETKAR: Yes, they --

21 MEMBER SUNSERI: We can make it work,  
22 but the effort it took to do that was not worth the  
23 benefit.

24 MEMBER STETKAR: No, it's -- but, I  
25 know that there are plants who routinely do use

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1 positive displacement, you know, 24/7, 365 days a  
2 year for charging and, you know, haven't had the  
3 problems that we've had at some plants in the U.S.  
4 with them.

5 MR. M. KIM: Okay, the second part was  
6 regarding the seal test results discussed in the  
7 previous slide.

8 In the response, the seal test  
9 available to staff audit and the general summary of  
10 the test is incorporated into DCD Section 5.4.12.

11 Finally, on the chapter of motor and,  
12 as you can see in the figure, it has cylindrical  
13 shrink feet of the outer to the hull and then  
14 cortical shrink feet between the hull and the  
15 shaft.

16 The fly motor is 26 meter chrome  
17 molybdenum vanadium 14-5, a German motor. And, the  
18 first toughness K1c value is higher than 165  
19 nanopascal to meter or 150 KSI or two-inch.

20 The technical report fly integrity  
21 provides a description for the flywheel design.

22 There are six open items for flywheel  
23 and these are follow up questions for the question  
24 number one through six.

25 The open items are question number 7

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1 through 12.

2 To describe objectable approaching for  
3 determining fracture toughness of the fly motor in  
4 the response to this question, we specified the  
5 directness of determining fracture toughness in  
6 the test is being done and the test report  
7 will be available by November.

8 Question number eight is to clarify  
9 operating experience table. In the previous  
10 response to the previous question, there were some  
11 extra items.

12 For example, there was some spells not  
13 relevant to the operating experience. So, KHMP  
14 revised the operating experience table with the  
15 same tier and used the Korean and German plants  
16 and, of course, including other countries.

17 Question number nine, to apply ACP  
18 fly's test limit or one sort of the yield strength  
19 of the motor will provide technical  
20 justification for use of one-third of ultimate  
21 strength. In the response, the ACP fly stress  
22 limit of one-third of the yield strength of the  
23 material according to the SRP and the -- it depends  
24 on the test result of both the yield strength value  
25 and the fracture toughness data.

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1           Question number ten, to revise the  
2           technical report include on analysis of hub and  
3           provide appropriate fatigue crack growth rates.

4           The technical report will be revised to  
5           add a separate stress probe of the hub.

6           Question number 11, to specify maximum  
7           flaw size as the acceptance criteria. So, in the  
8           response to this question, revised DCD subsystem to  
9           include the inspection as criteria.

10          Number 12, test and inspection proposed  
11          for the fly also applies to the hub.

12          In the picture, the hub has oil  
13          channels that will make it difficult to preform  
14          ultrasonic inspection flaw, but flaw propagation  
15          will be show as negligible.

16          As addition defense in depth notation,  
17          on PT or NT is proposed in the response. PT or  
18          OMT on the hub.

19          If you don't have questions --

20          MEMBER RICCARDELLA: Yes, I actually  
21          have a question. I've actually done some flywheel  
22          burst analyses in my career.

23          One of the things that made it  
24          difficult to address in U.S. plants was the  
25          flywheel was keyed onto the shaft and the key

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1 weight presented a stress concentration.

2 This figure that you showed doesn't  
3 show a key. Is there a key way in the flywheel?

4 MR. M. KIM: That was one of the  
5 questions in the previous RAI and there is no key  
6 in the actual design.

7 MEMBER RICCARDELLA: Good, thank you.

8 MR. M. KIM: I turn it over Mr. Choi.

9 MR. CHOI: Seognam Choi speaking.

10 This is a stream generators.

11 Two steam generators are designed into  
12 APR1400. This steam generator is a vertical U2  
13 lead circulation type of heat exchanger with 13,102  
14 tubes of alloy 690 thermal ETTD materials. And,  
15 with the integral economizer and 10 percent  
16 marginal, the heat transfer area for tube  
17 pluggings.

18 This has also three types of tube  
19 support such as horizontal grade, vertical and  
20 diagonal support.

21 And, this slide shows the steam  
22 generators of APR1400 shippings with Barca of  
23 United Arab Emirates.

24 We have only one obstacle remaining  
25 related to the steam generator program. The

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1 question is the leakage, first, to change  
2 the operating number.

3 And, second, is the clarifications of  
4 inconsistencies of the proposed leakage barrier  
5 within technical specifications and Chapter 15 of  
6 DCD.

7 We submit the answer at June 16th this  
8 year and we believe this RAI will be acceptable  
9 because we correct the inconsistencies as  
10 requested.

11 MEMBER REMPE: So, just to make clear,  
12 if I read this new graph, it implies to me that, in  
13 Chapter 15, you did use .6 gallons per minute in  
14 your Chapter 15 analysis?

15 MR. CHOI: Yes.

16 MEMBER REMPE: Okay, good. Thank you.

17 CHAIRMAN BALLINGER: I have a sort of  
18 general question about the steam generator,  
19 especially the tubing.

20 I'm sure you're aware of what happened  
21 at San Onofre, their large steam generators like  
22 these, 690 tubing and they had a case where one  
23 plant had excessive wear and leakage eventually.

24 And, the other plant had the same  
25 tubing with nominally the same exact construction,

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1 but didn't.

2 And, they traced that, at least if my  
3 memory serves, to slight differences in the way the  
4 surfaces were treated on the tubes and the  
5 clearance between the AVBs in the upper part of the  
6 section.

7 And, so, those steam generators were  
8 nominally manufactured in exactly the same way, but  
9 yet, that small difference made a huge -- had a  
10 huge effect.

11 Now, you -- in the DCD and everything,  
12 there's a fairly large discussion of that issue.  
13 But, I still come down to asking the question of,  
14 given the fact that -- how are we going to -- how  
15 are you going to be sure that that problem with  
16 that similar that happened to the San Onofre steam  
17 generators doesn't happen here, given the fact that  
18 just the small difference within a specification  
19 for fabricating the steam generators made a huge  
20 difference?

21 In other words, what --

22 MR. CHOI: I'm not sure the differences  
23 of San Onofre or our APR1400. And, then, the --  
24 San Onofre manufacture ways that same manufacturer  
25 of the APR1400.

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1                   MEMBER BALLINGER:   No, no, that's for  
2                   sure.  That's not the point.  The point is, is that  
3                   in spite of the fact that whoever manufactured the  
4                   steam generators, we know who they were, they were  
5                   manufactured to the same specifications, I presume.

6                   And, yet, they had excessive wear in  
7                   one and not excessive wear in the other.  And, so,  
8                   my question is -- and, these are in the upper  
9                   bundle where the AVBs are, irrespective of what's  
10                  down below with the egg crates and things like  
11                  that.  So, that's different.

12                  But, how are we -- how are you going to  
13                  assure that that problem doesn't -- is not -- well,  
14                  very unlikely to exist in these steam generators?  
15                  Because they are roughly the same size, same  
16                  tubing.

17                  I don't know what the ABV material is,  
18                  the egg crate material is a 409 or something  
19                  stainless steel.  But, I don't know what the -- I  
20                  forget what the AVB material is.

21                  MEMBER RICCARDELLA:   Let me just, I  
22                  mean, the problem was fluid elastic instability.

23                  CHAIRMAN BALLINGER:   Yes.

24                  MEMBER RICCARDELLA:   And, what could  
25                  you tell us to give us some confidence that we

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1 don't have a fluid elastic instability problem in  
2 these steam generators which are of --

3 I mean, I know there's a couple of  
4 paragraphs in the DCD about it, but, in terms of  
5 testing and experience, I mean, are these similar  
6 to the OPR1000 steam generators? Are they larger?  
7 Just some discussion of that would be helpful.

8 MR. CHOI: Yes, there is a two  
9 improvement of the steam generator design.

10 The first one is that we designed it  
11 going central regions and there's high flow regions  
12 and we blocked in the flow.

13 The egg crate flow, this plate is added  
14 center of regions.

15 And, the second one is the vertical  
16 horizontal central lines have the one more -- or  
17 one or two more vertical supports added. And, that  
18 is the main improvement of the APR1000.

19 CHAIRMAN BALLINGER: That's right.

20 MR. CHOI: Yes.

21 CHAIRMAN BALLINGER: But, according --  
22 the analysis that you're doing is a computer  
23 analysis to predict fluid elastic instability.  
24 They did the same thing, I think, for the other  
25 steam generators and the CFD people will claim that

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1 they can cure pattern baldness with their CFD code,  
2 but, the fact of the matter is, they can't.

3 MEMBER RICCARDELLA: Well, but, I mean  
4 there are successful steam generators of this size  
5 operating. Palo Verde's a case in point.

6 I think, you know, it comes down to  
7 operating experience and test data.

8 CHAIRMAN BALLINGER: So, again, it's  
9 back to the test data. So, the design code, the  
10 rules will say that if you suspect that you're  
11 going to have an issue, you need to confirm that  
12 you don't.

13 So, my question is, how are you going  
14 to confirm that you don't?

15 MR. CHOI: As I said before, that  
16 there's two improvement of the support and control  
17 the chemicals and then I think so.

18 CHAIRMAN BALLINGER: Okay. So, you're  
19 saying that those improvements are going to fix --

20 MR. CHOI: Yes.

21 CHAIRMAN BALLINGER: -- they're going  
22 to ensure against the problem?

23 MEMBER SUNSERI: Let me ask the  
24 question a little differently.

25 The codes you're using to design the

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1 parameters inside the steam generators, the flows,  
2 the thermal hydraulic characteristics, do you have  
3 sufficient operating experience with those codes or  
4 are any of the codes new and unique to this design  
5 and being used for the first time?

6 MR. CHOI: Yes, and we use the same  
7 EPRI code at those three.

8 MEMBER SUNSERI: You said EPRI codes?

9 MR. CHOI: Yes.

10 MEMBER SUNSERI: Okay.

11 CHAIRMAN BALLINGER: Thank you.

12 MEMBER RICCARDELLA: How much different  
13 are these steam generators from the OPR1000 steam  
14 generators?

15 MR. CHOI: Size?

16 MEMBER RICCARDELLA: Size, yes.

17 MR. CHOI: Yes, well, OPR is about --  
18 total is 821 inches high and then this APR1400 is  
19 905 inches tall.

20 MEMBER RICCARDELLA: A 100 inches  
21 taller?

22 MR. CHOI: Yes. And, it's a bigger --

23 MEMBER RICCARDELLA: Bigger diameter?

24 MR. CHOI: Yes, the diameter is.

25 MEMBER RICCARDELLA: Yes, you mentioned

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1 -- you didn't mention in the DCD that the tube  
2 support structure, the egg crate structure is the  
3 same?

4 MR. CHOI: Yes.

5 MEMBER REMPE: I'm sorry, maybe -- I  
6 know you asked about APR, but Shin-Kori's steam  
7 generators, are they the same as this plant's?

8 MR. CHOI: I'm sorry. Yes, there is  
9 increase the tube support over three maybe.

10 MEMBER RICCARDELLA: Okay, so --

11 MR. CHOI: It goes with these allow the  
12 tube size.

13 MEMBER REMPE: Okay. So, this will be  
14 different than Shin-Kori?

15 MR. CHOI: Yes.

16 MEMBER RICCARDELLA: Than Shin-Kori 3?

17 MR. CHOI: It's the same.

18 MEMBER RICCARDELLA: This is Shin-Kori  
19 3?

20 MEMBER REMPE: It's the same as Shin-  
21 Kori 3, that's what I meant to say, the newer  
22 plants, so it's the same. And, you've manufactured  
23 those with Doosan --

24 MR. CHOI: Yes.

25 MEMBER REMPE: -- manufactures them?

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1 MR. CHOI: Yes.

2 MEMBER REMPE: Okay.

3 MEMBER RICCARDELLA: So, if there's a  
4 problem like San Onofre, we'll see it before --  
5 right?

6 MEMBER SUNSERI: So (inaudible) three  
7 back around.

8 CHAIRMAN BALLINGER: It's all the fault  
9 of the metallurgist.

10 MEMBER RICCARDELLA: It's what?

11 CHAIRMAN BALLINGER: It's all the  
12 metallurgist's fault.

13 MEMBER RICCARDELLA: Well, I mean, you  
14 know, if you're operating close to an instability  
15 point, you can see those kind of differences. If  
16 you're operating, you know, well below the  
17 instability point, then the small differences  
18 probably won't make that much of a difference.

19 CHAIRMAN BALLINGER: But, if you don't  
20 know that's you're close to the instability point -  
21 -

22 MEMBER RICCARDELLA: Well, but I mean  
23 they've done analysis and testing to say that  
24 they're not close -- that they're well below the  
25 instability point.

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1 CHAIRMAN BALLINGER: I thought they  
2 said they've done analysis, but I didn't read that  
3 they'd done testing. Okay.

4 MR. T. KIM: Yes, 5.4.7 shutdown  
5 cooling system. Shutdown cooling system is used to  
6 reduce the temperature of the ICS from a hot  
7 shutdown condition to refueling condition.

8 One of the design features of the  
9 APR1400 is the shutdown cooling pumps and the  
10 containment spray pumps are identical and  
11 functionally interchangeable.

12 MEMBER STETKAR: Let me ask you a  
13 couple of questions about this system before you go  
14 to the RAI.

15 If I look at the drawings in the DCD,  
16 in particular, Figures 5.4.7-3 which shows the  
17 shutdown cooling system as shown here, or Figure  
18 6.3.2-1 which shows more detail of safety injection  
19 and shutdown cooling and Figure 6.2.2-1 which shows  
20 the containment spray system, I do not see any  
21 manual isolation valve on the suction side of the  
22 containment spray valve.

23 And, your drawings are pretty good  
24 about showing valves and flanges and reducers.

25 So, if I must remove a containment

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1 spray pump from service, it seems to me that I must  
2 close the suction valve from the IRWST for that  
3 pump which prevents me from using the shutdown  
4 cooling pump in that train.

5 So, I'm curious about how do I align a  
6 shutdown cooling pump to replace a containment  
7 spray pump? What valves -- what particular valves  
8 are open to do that? Or is a manual valve missing  
9 from your drawings?

10 MR. T. KIM: This is Tae Han Kim from  
11 KEPCO E&C again.

12 Actually, we have a cross connector  
13 line between the shutdown cooling system and the  
14 shutdown containment spray system. But, the DCD  
15 drawing is not showing everything in details, but  
16 we have some connecting lines.

17 MEMBER STETKAR: Well, it's -- I, you  
18 know, I see the connecting line. I understand how  
19 the pipes are connected. And, your drawing, in  
20 particular, for the containment spray system and  
21 the safety injection shutdown cooling system are  
22 rather detailed.

23 They're so detailed for the spray  
24 system is you show a 12-inch to 14-inch piping  
25 reducer. It shows a locked open manual valve V1003

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1 on the discharge side of the pump.

2 I see no manual valve on the suction  
3 side of the containment spray pump. And, I cannot  
4 find one in any drawing.

5 So, if there's no valve there, if  
6 that's the certified design with no valve there,  
7 then, if I must remove a containment spray pump  
8 from service to repair it for whatever reason, it  
9 seems that I must close the containment spray pump  
10 suction valve from the IRWST because that is the  
11 only isolation valve that I have for the pump.

12 If I close the spray pump suction valve  
13 from the IRWST, that is the same suction supply to  
14 the SCS pump, meaning, I cannot use the SCS pump.

15 Do you understand what I'm saying?

16 MR. T. KIM: The first question, the  
17 cross connecting -- one of the cross connecting  
18 valve is 340 --

19 MEMBER STETKAR: Let me give specific  
20 valve numbers.

21 MR. T. KIM: Three hundred and forty.

22 MEMBER STETKAR: Three forty, yes, 340  
23 is --

24 MR. T. KIM: Is the correct one of --

25 MEMBER STETKAR: Right.

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1 MR. T. KIM: -- the connecting valves.

2 MEMBER STETKAR: Right. But, if you  
3 look at the flow diagram, I must close 347, 3-4-7,  
4 to isolate the suction of the spray pump because  
5 there is no manual valve between the junction to  
6 340 and the suction of the spray pump. I cannot  
7 find a manual valve in your certified design.

8 So, to isolate a spray pump, it seems I  
9 must close 347. If I close 347, that isolates 340  
10 and the shutdown cooling pump cannot take a suction  
11 from the IRWST.

12 MR. T. KIM: Actually, right now, we  
13 didn't bring the whole detail P&ID here so --

14 MEMBER STETKAR: Okay. So, maybe  
15 something is missing from the certified -- the  
16 drawings and the certified design. But, I get  
17 really upset when things are missing from the  
18 drawings and the certified design because they are  
19 the certified design.

20 And, indeed, the drawings do show a  
21 large number of manual valves.

22 So, I'll ask you to check to see, is  
23 there a manual valve in the line between the  
24 junction of valve 340 and the suction of the  
25 containment spray pump, please?

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1           And, if there is, I'm good. I  
2 understand how it works. I can get water there a  
3 different way, but your whole discussion says that  
4 I use that cross connect with 347 and whatever the  
5 other one is there that I can't read, 341, I think.

6           So, that's a question I have about that  
7 valve.

8           There is one, you can see, in the  
9 suction line of the shutdown cooling pump going the  
10 other way, it's V-1-0, my eyes are not very good,  
11 it's 5 or 6.

12           Different, but related topic, you said  
13 that, if I use a shutdown cooling pump to replace  
14 the spray pump for the containment spray function,  
15 I line it up so I have suction discharge. And, it  
16 says that the -- in that condition, the shutdown  
17 cooling pump is capable of being automatically  
18 started by a safety injection signal or a  
19 containment spray signal.

20           Do the operators make that transfer?  
21 In other words, how do the shutdown cooling pumps  
22 receive the automatic start signal from containment  
23 spray or safety injection? How is that automatic  
24 and a start signal enabled?

25           MR. T. KIM: When the operator line up

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1 the SCP, is there a CSP with the manual valve in  
2 the cross align, the interlock for this valve  
3 enable the SIS and the CSA containment spray  
4 injection system go the pump.

5 MEMBER STETKAR: It's interlocked with  
6 the valve?

7 MR. T. KIM: Yes.

8 MEMBER STETKAR: That's exactly what I  
9 was looking for. Thank you, thank you on that one.  
10 Thank you. I was worried about starting the pump  
11 without the valves open and, if it's interlocked  
12 with the valve, that's great. Thank you. But,  
13 still look for that manual valve on the suction of  
14 the spray pump.

15 MR. T. KIM: Actually, this drawing, I  
16 might can explain, but, you know, I have to define  
17 each bandwidth here, so I will have another chance  
18 to talk with this drawing.

19 MEMBER STETKAR: Okay, thank you.

20 MR. M. KIM: Go to the next slide.

21 The SCS has one open item. Question  
22 number four, to revise the ITAAC for gas operation  
23 addressing those things related to shutdown cooling  
24 system, safety injection system, containment spray  
25 system.

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1 In the response, KHMP revised the ITAAC  
2 to include the as-built evaluation for gas  
3 containment.

4 MEMBER STETKAR: Before we go to the  
5 pressurizer, where -- there is the suction line,  
6 the SCS suction line from the hot leg located? Is  
7 it at the bottom of the hot leg or is it up --  
8 where relative to the mid plain of the hot leg is  
9 the actual suction line located?

10 MR. T. KIM: This is Te Ha Kim, again,  
11 KEPCO E&C.

12 It's the bottom line.

13 MEMBER STETKAR: It's directly from the  
14 bottom?

15 MR. T. KIM: Yes.

16 MEMBER STETKAR: Thank you. Good.

17 MR. CHOI: Pressurizer, Seognam Choi  
18 speaking.

19 The function of the pressurizer is to  
20 control the rate of coolant system pressure and the  
21 volumes by the operational transient without  
22 opening the safety valve which the over  
23 pressurization arises is protected by the full  
24 pilot operating safety relief valve is on the top  
25 of the pressurizers.

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1           The inside volume of the pressurizer is  
2           2400 cubic feet and this is connected to the third  
3           line at the bottom.

4           This is the design parameters of  
5           pressurizer for APR1400 and the shapes.

6           And, this figure is APR1400 pressurizer  
7           related to the hydrostatic testing at the shafts.

8           MEMBER STETKAR: I have -- I'm sorry, I  
9           have one more question on shutdown cooling system,  
10          and you don't need to go back on slides.

11          In Section 5.4.7.2.2 of the DCD,  
12          there's a statement that said the failure position  
13          of each valve on loss of actuating signal or power  
14          supply is selected to provide reasonable assurance  
15          of safe operation.

16          System redundancy is considered one  
17          defining the failure position of any given valve.

18          In Section 5.7.2.5, you note that the  
19          SCS does not utilize any pneumatically operated  
20          valves. So, the only valves that I could see on  
21          your flow diagrams are either manual valves or  
22          motor operated valves.

23          In my experience, most motor operated  
24          valves, if I do not have any power to them, they  
25          fail, so-called, as-is. If it's closed, it remains

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1 closed. If it's open, it remains open. And,  
2 that's also typically the case if I don't have any  
3 signal for it.

4 So, I'm curious about this statement  
5 that you have selected, fail positions for the  
6 valves in the SCS and that those failed positions  
7 have been defined based on some consideration of  
8 redundancy of the system.

9 Are there -- let me ask the question  
10 more simply, are there any valves in that system  
11 that do not fail as I would call it, as-is. If  
12 it's closed, it remains closed. If it's open, it  
13 remains open.

14 MR. T. KIM: Yes, this is Hae Han Kim  
15 again.

16 As you explained, sir, MOVs fail as-  
17 is, but some of the SOV is.

18 MEMBER STETKAR: But, I didn't see any  
19 SOVs in the SCS. I saw them in other systems. Are  
20 there SOVs in the shutdown cooling system?

21 MR. T. KIM: Sorry, I misunderstood  
22 with that.

23 MEMBER STETKAR: Oh, are there or are  
24 there not in -- this is the only place that I found  
25 in Chapter 5 where it discussed failure positions

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1 where I did not see any SOVs.

2 So, I was curious why this statement  
3 applies to the shutdown cooling system?

4 MR. T. KIM: I'm sorry, actually, I  
5 misunderstand the Chapter 6 from --

6 MEMBER STETKAR: Oh, okay.

7 MR. T. KIM: -- so, that's the one, I  
8 think.

9 MEMBER STETKAR: Let me just put it on  
10 the record, I -- if it's only motor operated valves  
11 and they fail as-is, I understand how the system  
12 works, I just don't know what, in particular, that  
13 statement that I quoted means in the context of the  
14 certified design.

15 Because, to me, it implies that there's  
16 something active that was done to perhaps determine  
17 that a valve would reposition itself.

18 MR. SISK: Okay, Rob Sisk,  
19 Westinghouse.

20 I understand the comment. I think  
21 you're looking for automatic adjustments for  
22 repositioning. But, it may be simply that the  
23 system is aligned for this safe performance --

24 MEMBER STETKAR: And, I --

25 MR. SISK: -- if the valves do not

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1 operate.

2 MEMBER STETKAR: I'm pretty happy with  
3 that statement, Rob. I trip over things where you  
4 talk about failure positions being selected as if -  
5 -

6 I've seen people do things, for  
7 example, if a signal is not available, but power is  
8 available, they'll reposition a valve to what its  
9 so-called failure, you know, best guess in terms of  
10 the right position should be.

11 So, I've seen people get pretty  
12 creative with those types of things. You can't do  
13 much for a motor if there's no power to it. But,  
14 if power is to it and you don't have a signal,  
15 there might be something smart that says, oh, go  
16 open that valve that used to be closed because  
17 that's where I'd like it.

18 MR. SISK: I understand the comment.  
19 We'll have to discuss that internally.

20 MEMBER STETKAR: Yes. I doubt that  
21 that's the case, but I just stumbled over that and  
22 it gave me a lot of pause.

23 MR. SISK: Understood.

24 MR. M. KIM: 5.4.12, reactor coolant  
25 system high point vents.

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1           Reactor coolant gas vent system, the  
2 function is to discharge non-condensable gases and  
3 steam from the high points of the RCS for venting  
4 or pressure controlled during post-accident  
5 conditions.

6           The IRWST collects the -- collects and  
7 condenses the steam discharge from the coolant gas  
8 vent system.

9           MEMBER STETKAR: Okay. I had a really  
10 difficult time looking at the DCD, several sections  
11 of the DCD to understand what the real connections  
12 are to the IRWST.

13           There are different simplified drawings  
14 in the DCD that show different connections and  
15 they're all very simplified. Is there any drawing  
16 anywhere in DCD Tier 1 or Tier 2 that unambiguously  
17 shows every flow path into the IRWST, out of the  
18 IRWST and things like the locations of spargers  
19 within the IRWST?

20           I couldn't find one, but I admit, I did  
21 not read all -- every page of the DCD.

22           MR. SISK: So, again, Rob Sisk,  
23 Westinghouse.

24           For clarification, you're looking for  
25 all of -- a drawing that shows all of the lines

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1 into the IRWST and the spargers?

2 MEMBER STETKAR: Yes. It's, in  
3 simplified, in a way that is unambiguous. Because,  
4 for example, in one drawing, I'm led to believe  
5 that the POSRVs -- let me use RCGVS as an example.

6 In one drawing, I'm led to believe that  
7 RCGVS discharges through its own line. In another  
8 drawing, it seems to discharge in a line that comes  
9 from the containment purge system.

10 So, I don't know how many discharge  
11 lines are, I don't know how they're oriented. And,  
12 because I can't see anything, I don't know if there  
13 are any valves in those lines that can be left  
14 closed.

15 In particular, other than the one  
16 drawing that I mentioned earlier this afternoon, or  
17 this morning, no other drawing show those two motor  
18 operated three-way valves in the POSRV lines.

19 So, without kind of an unambiguous  
20 complete drawing, it's really difficult to see how  
21 the thing is piped up.

22 MR. SISK: But, it sounds like you're  
23 looking -- Rob Sisk, Westinghouse again.

24 It sounds like you're looking for  
25 basically the system drawing. Because, if you're

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1 looking just at the IRWST, you're not going to see  
2 the --

3 MEMBER STETKAR: No, that's right.  
4 But, I've looked at the system drawings and the  
5 system drawings tend to just show arrows. And, I  
6 went to the IRWST drawing in Chapter 6 and, in  
7 particular, that drawing doesn't even show the  
8 POSRVs coming into to the IRWST. It just shows  
9 some other lines.

10 So, in Chapter 6, the one that  
11 ostensibly shows the IRWST, and I think there was a  
12 -- I think there was an RAI about that and the  
13 response to that RAI said, well, yes, in Chapter 6,  
14 we just showed the IRWST. It doesn't necessarily  
15 show every line going into it.

16 I couldn't find one drawing anywhere  
17 that showed everything.

18 MR. SISK: It would be complicated  
19 drawing. But, I -- we understand what you -- your  
20 comment.

21 MEMBER STETKAR: Well, it -- and, in  
22 terms of complexity, I'm more concerned about how  
23 lines are plumbed together, piped together and if  
24 there might be valves in those lines and things --

25 People typically will show the location

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1 of the spargers. For example, I don't know, are  
2 the spargers relatively high in the IRWST? Are  
3 they low? Where are the spargers in relation to the  
4 suction lines for the SI pumps and the spray pumps?

5 MR. SISK: Let me ask Mr. Tae Han Kim  
6 if he'd like to comment.

7 MR. T. KIM: I believe if you check the  
8 Figure 6.8-3.

9 MEMBER STETKAR: 6.8-3? Yes.

10 MR. T. KIM: Yes.

11 MEMBER STETKAR: Yes.

12 MR. T. KIM: You checked already?

13 MEMBER STETKAR: It doesn't -- that  
14 one, in particular, does not show the discharge  
15 lines from the POSRVs or the RCGVS which is what  
16 started me on my hunt.

17 Figure 2.4.1-2 in DCD Tier 1, now, is a  
18 very, very simplified drawing. And, that leads me  
19 to believe that lines are connected together.

20 All the other system drawings just kind  
21 of show arrows going out to the IRWST.

22 MR. SISK: John, we're taking down the  
23 comment and we'll look into that.

24 MEMBER STETKAR: Thanks.

25 MR. M. KIM: Have you mentioned the

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1 Figure 2.4.5-1 of Tier 1? The --

2 MEMBER STETKAR: I looked at 2.4.1-2.

3 Which one did you say?

4 MR. M. KIM: 2.4.5-1 Tier 1 is this  
5 diagram is for RCGVS.

6 MEMBER STETKAR: 2.4.5-1? I did not  
7 look at that. I'll look at that later.

8 MR. SISK: Figure 6.8-3.

9 MEMBER STETKAR: Figure 6.8-3 does not  
10 show the POSRVs or RCGVS, does it?

11 MR. SISK: It's got a lot of stuff on  
12 it.

13 MEMBER STETKAR: It's got a lot of  
14 stuff on it, it doesn't have that. It's got more  
15 stuff than any other drawing I could find.

16 MR. M. KIM: Yes, every diagram is  
17 simplified.

18 MEMBER STETKAR: Every diagram is  
19 simplified and several are somewhat different.

20 MR. M. KIM: The figure in the response  
21 to RAI question 82, RAI 82-44 --

22 MEMBER STETKAR: Yes.

23 MR. M. KIM: -- question number 5.2.2-2

24 --

25 MEMBER STETKAR: That refers --

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1 MR. M. KIM: -- the figure shows the  
2 IRWST and three-way valves and POSRV, but it is  
3 also a simplified one.

4 MEMBER STETKAR: Yes, it is. I looked  
5 at that one, too. Okay.

6 You only have this one slide on RCGVS,  
7 right? Okay.

8 MR. M. KIM: Yes, it is.

9 MEMBER STETKAR: Let me ask you a  
10 couple of questions about that.

11 In -- let me get my figure here first -  
12 - give me a second because we're -- you're ahead of  
13 me here.

14 If I look at Figure 5.4.12-1 which  
15 shows the RCGVS flow diagram, there are manual  
16 valves, V212, V2300 and V1430 that -- well, let me  
17 be very clear here because we're on the record.

18 Figure 5.4.12-1 shows V1430 in the  
19 discharge line from RCGVS to the IRWST. So, if  
20 that valve is closed, if that valve 1430 is closed,  
21 I cannot vent from the pressurizer or from the  
22 reactor vessel head to the IRWST, which is part of  
23 my question about understanding how things are  
24 plumbed together.

25 I had to go look in other places, if I

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1 look at Figure 5.1.2-1, that shows the connection  
2 from the reactor vessel head to the RCGVS and it  
3 shows a manual valve, V212 in that line.

4 So, if that valve is closed, I cannot  
5 vent the head.

6 If I look at Figure 5.1.2-3, that shows  
7 the connection from the pressurizer to RCGVS and  
8 that drawing shows valve V2300 manual valve. And,  
9 if that valve is closed, I cannot vent the  
10 pressurizer.

11 So, I have a manual valve from the  
12 reactor vessel head. I have a manual valve from  
13 the pressurizer. And, then, I have a manual valve  
14 in the discharge line to the IRWST.

15 My first question is, do those valves  
16 have position indication in the main control room?  
17 And, you may not have that. I mean, you know, yes.

18 MR. SISK: We've taken a note down.

19 MEMBER STETKAR: Yes, okay. My follow  
20 up question on that was, if they don't have  
21 position indication in the main control room, when  
22 are those valves closed during normal plant  
23 shutdown and refueling operations? You know, when  
24 are they repositioned?

25 Because they had position indication

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1 and, you know, the operators know that they're  
2 open, then I'm okay.

3 I just want to make sure that I  
4 understand the solenoid valves in the RCGVS,  
5 according to Table 5.4.12-1, those are DC powered  
6 valves, is that correct?

7 MR. OH: This is Andy Oh, KHMP,  
8 Washington Office.

9 You are asking about RCGVS solenoid  
10 valve power source?

11 MEMBER STETKAR: Yes, yes, there's a  
12 table, I think I know the answer, I'm just trying  
13 to confirm it.

14 MR. OH: Yes, they are DC power.

15 MEMBER STETKAR: They are DC power?

16 MR. OH: Mm-hm.

17 MEMBER STETKAR: Thank you.

18 Because, it was a bit confusing when I  
19 read it. I think I know the philosophy. The text  
20 in the DCD emphasizes the fact that RCGVS can  
21 receive power from the alternate AC generator.  
22 That's not quite accurate.

23 The alternate AC generator can provide  
24 power to either the battery charger in Division A  
25 or the battery charger in Division B. Those

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1 batteries are rated for eight hours.

2 The Division C and Division D batteries  
3 are rated for 16 hours.

4 So, I need the AAC generator to be able  
5 to operate RCGVS for 16 hours. And, I kind of get  
6 that.

7 Now, my question is, and this is for  
8 the PRA people, you will not be able to answer it  
9 today, I just want to put it on the record.

10 According to the plant design, after 16  
11 hours, I cannot operate RCGVS because the solenoid  
12 valves will fail closed. Even if I had the  
13 alternate AC generator, because that can only  
14 supply one division.

15 So, is there any part of the PRA, in  
16 particular, the Level 2 PRA, where you take credit  
17 for venting the pressurizer, in particular, through  
18 the RCGVS to keep pressure low in the Level 2 PRA  
19 after 16 hours?

20 Typically, in a Level 2 PRA, you'll ask  
21 a question of, is reactor coolant system pressure  
22 high or low and is it maintained low?

23 And, I don't know -- I didn't go look  
24 at the PRA to examine how they answered that  
25 question. I didn't have time. And, I don't know

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1 what the timing is in the PRA.

2 So, this is more of a PRA question.  
3 I'll bring it up again in the PRA, but this is kind  
4 of a warning shot before we get to Chapter 19.

5 I just want to, first of all, I wanted  
6 to make sure that they were at DC power and you've  
7 answered that question. So, thank you.

8 How big is the pressurizer vent piping?  
9 The drawing, this Figure 5.4.12-1 indicates that  
10 the piping from the reactor vessel head is three-  
11 quarter inch diameter. And, there was a question  
12 about, I know that the staff asked the question  
13 about a LOCA in that line.

14 I couldn't find a size on the line from  
15 the pressurizer. Do you know how large that is?

16 I mean I can speculate, but I don't  
17 want to do that.

18 MR. J. KIM: Which line?

19 MEMBER STETKAR: It's the line -- it's  
20 the vent line from the pressurizer to RCGVS. So,  
21 it's that common vent line that comes off the four  
22 POSRV head. It's the line that goes over to the  
23 solenoid valves that are shown on Figure 5.4.12-1.

24 MR. OH: This is Andy Oh, KHMP  
25 Washington Office again.

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1                   And, from the pressurizer to the RCGVS,  
2                   the size of pipe is two inch.

3                   MEMBER STETKAR:       Two inch?       Okay,  
4                   thanks.    That's -- I know it was -- it's shown,  
5                   it's two inches through the solenoid valves, but I  
6                   didn't know if it was larger or smaller than two  
7                   inches coming out.    So, it's a two inch line?  
8                   Thank you.

9                   Okay, you're going to get to take a  
10                  break, so I only have one more question here.  
11                  Maybe two more.

12                  In the DCD, there's a discussion about  
13                  leak detection for RCGVS and I know how the system  
14                  is configured.

15                  It says the RCGVS is designed not to be  
16                  used during normal operation.    The piping is  
17                  designed to slope downward to drain to the reactor  
18                  drain tank and the IRWST.

19                  The potential for leakage is very low  
20                  and a leak detection system is not required.

21                  I always get concerned when people say  
22                  the potential is very low.    I understand that the  
23                  desire, in fact, is to open these lines.    But, my  
24                  concern is, if those solenoid -- if two of the  
25                  solenoid valves are leaking or for some reason are

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1 stuck open and the operators want to control a  
2 depressurization, they may not have the control  
3 that they want.

4 The system actually is configured for  
5 leakage detection in the same way that other  
6 systems that you discuss in the plant can discover  
7 leakage.

8 And, I was curious why you specifically  
9 say you don't need leakage detection on this system  
10 when you have the capability of detecting leakage  
11 by pressure transmitter PT-106, in particular, and  
12 the ability of the operators to open the valve to  
13 the reactor drain tank to check for amount of  
14 leakage flow if you detect high pressure.

15 So, it's -- personally, it's not a big  
16 concern from my perspective. This, again, is a  
17 subcommittee meeting, so I can say that.

18 But, I'm always curious about people  
19 saying I don't need something because something is  
20 very unlikely.

21 Typically, our experience then shows  
22 when that unlikely thing happens, people are very  
23 concerned.

24 So, I'd ask you to recheck that  
25 statement about why you don't need leakage

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1 detection. Because you may have it already.

2 Now, the last question that I have --  
3 actually, I'll wait and I'll ask the last -- I'll  
4 ask the staff my last question because it's more  
5 relevant to them.

6 So, I'm sorry, I'm done now.

7 MR. CHOI: Seognam Choi speaking.

8 Yes, these components support it.

9 This slide shows the schematic view of  
10 the APR1400 or main component in the support. The  
11 reactor vessel have the full operator columns and  
12 that is connected to the bottom of the floor in  
13 others.

14 The steam generator has a sliding base  
15 and sliding base is connected to the bottom and two  
16 keys are located at the upper shelf of steam  
17 generators.

18 Pressurizer support is integral support  
19 and this is at the bottom is connected to AE  
20 building. And, with coolant components four  
21 breaker columns at the bottom and two upper and  
22 lower rated columns and two reactor snivels at the  
23 bottom of ICD motor stem.

24 MR. M. KIM: Minseok Kim is presenting.

25 In summary, Chapter 5 describes the

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1 design features of the coolant system of APR1400.  
2 All the ICS components are located inside the  
3 containment building.

4 The table shows the pre-installed  
5 parameters for the system. ICPD components are  
6 considered with the 10 CFR 50.2 as the depiction of  
7 the ICPD and 10 CFR 50.55(a) the code and  
8 standards.

9 The applicable code and standards of  
10 the components are listed in Chapter 3, Table 3.2-  
11 1.

12 Chapter 5 is on a success path for  
13 completion on schedule. An SER with open items was  
14 issued. A path for closing each open item has been  
15 discussed with the NRC staff and is being  
16 implemented.

17 KHMP believes that the open items,  
18 except for flywheel, which is in progress, have  
19 been addressed.

20 Chapter 5 as reviewed and marked up in  
21 response to NRC's RAI will be incorporated into the  
22 next revision of the DCD.

23 Monitoring of changes to other chapters  
24 for impacts on this chapter is conducted to  
25 maintain consistency.

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1           This is all of our presentation we  
2 prepared. I thank you for your attention.

3           CHAIRMAN BALLINGER: Thank you.

4           Now, we have an option, we can --

5           MEMBER STETKAR: No, you're going to  
6 ask does anybody have any more questions first.

7           CHAIRMAN BALLINGER: Okay. That's all  
8 I was going to say, but it is what I'm going to say  
9 now. I was going to offer a break and then talk.

10          MEMBER STETKAR: All right. Because,  
11 the staff's going to come up, right?

12          CHAIRMAN BALLINGER: No.

13          MEMBER STETKAR: Oh.

14          CHAIRMAN BALLINGER: We've now  
15 succeeded in getting ourselves right back on  
16 schedule.

17          MEMBER STETKAR: Okay.

18          CHAIRMAN BALLINGER: A little late,  
19 actually.

20          MEMBER STETKAR: Let me, you know, let  
21 me cut to the chase.

22                 Appendix 5A discusses interfacing  
23 system LOCA analyses. And, first of all, let me  
24 say that this is the first DCD where I've seen such  
25 a comprehensive assessment of interfacing system

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1 LOCA pathway as I think that it was really -- I was  
2 really pleased to see that. I've not seen anybody  
3 address that issue in this level of completeness  
4 before. So, let me preface any comments that I  
5 have with that.

6 I did have a couple of questions  
7 related to those analyses.

8 The first question I had is simply one  
9 of completeness that you did a very comprehensive  
10 evaluation of every system connected to the reactor  
11 coolant system to identify the flow paths,  
12 isolation valves and so forth, except for one.

13 And, that is the auxiliary pressurizer  
14 spray line. Why did you not include that? Your  
15 conclusion, I'll tell you, I think, would be the  
16 same for the charging line as the auxiliary  
17 pressurizer spray line. But, you didn't include  
18 it.

19 So, when I went, conceptually, around  
20 the reactor coolant system and looked for piping,  
21 that one seemed to be missing.

22 So, that's just a comment. It's --  
23 everything else seemed so complete that I didn't  
24 know why it wasn't there. I mean, you even went  
25 down the sample lines.

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1                   MR. SISK: We're going to have to take  
2 a look at that to see if there's a particular  
3 reason or if it's --

4                   MEMBER STETKAR: Well, I don't know  
5 whether there's a reason or not.

6                   MR. SISK: Yes, we'll --

7                   MEMBER STETKAR: I'm not -- it was --  
8 everything else was so complete that I was looking  
9 for something that was missing and I thought I  
10 found something.

11                   A couple of questions, and I understand  
12 the analyses, I think they're really good. There  
13 are a couple of places where you take credit for  
14 manual operator actions to isolate systems before  
15 other systems become over pressurized.

16                   And, in particular, I'm looking at the  
17 let down and charging lines where you say, well,  
18 the operators have pressure indications. There are  
19 relief valves to the reactor drain tank.

20                   How large is -- and Dick Skillman asked  
21 this morning for a different reason -- what is the  
22 capacity of the reactor drain tank in terms of  
23 volume and what is its pressure rating?

24                   Because, essentially, your analysis  
25 says I can blow to the reactor drain tank for long

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1 enough so that the operators recognize the need to  
2 isolate the let down or charging line and stop the  
3 release. I mean, that's basically the philosophy  
4 for those two pathways.

5 So, if the -- for example, if the  
6 reactor drain tank could hold two liters and failed  
7 at a pressure of, you know, two pounds, that would  
8 not provide very much time for the operators to  
9 isolate the lines.

10 If it's a relatively large tank, that  
11 provides much more time. So, that's why I'm asking  
12 about that particular question.

13 MR. M. KIM: The internal volume of the  
14 reactor drain tank is specified in the Table 934-2.

15 MEMBER STETKAR: 93 --

16 MR. M. KIM: A thousand gallons and the  
17 minimum is added.

18 MEMBER STETKAR: I can look it up.  
19 It's 934-2, you said, the table number?

20 MR. M. KIM: The table number is 934-2.

21 MEMBER STETKAR: 934-2, I will look  
22 that up in the interest of time. Thank you.

23 CHAIRMAN BALLINGER: Now, I'm confused.

24 MEMBER STETKAR: Why?

25 CHAIRMAN BALLINGER: It's -- we're

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1 finished in effect.

2 MEMBER STETKAR: No, we're not. I have  
3 one more question.

4 CHAIRMAN BALLINGER: Okay.

5 MEMBER STETKAR: As best as I can --  
6 this, again, is just so I understand the integrated  
7 plant. As best as I can tell, each main steam  
8 safety valve has a rated capacity of slightly more  
9 than five percent rated power. Is that --

10 I think I found -- I did some  
11 calculations and I came out with each main steam  
12 safety valve having a rating capacity of about 5.3  
13 percent full power.

14 And, that seems to be consistent with  
15 statements that all 20 MSSVs can relieve full  
16 power. Each POSRV, my guess is, can relieve about  
17 3.5 percent full power. And, I'd like to confirm  
18 that my estimates are correct or, they don't have  
19 to be precise, but approximately correct.

20 The reason is, not for anything in  
21 Chapter 5, I'm looking out at Chapter 19 and the  
22 success criteria for the PRA. So, I want to make  
23 sure that I understand what those relief capacities  
24 are.

25 So, if you can confirm that. As I

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1 said, I did a couple of back of the envelopes and I  
2 think I'm close, but I'm not sure.

3 MR. SISK: Again, we've got the  
4 comment, we'll take a look at that.

5 MEMBER STETKAR: Thanks.

6 And, now, I'm done. I'm finished, no  
7 more.

8 CHAIRMAN BALLINGER: I think I'll wait  
9 a few seconds just to see.

10 Thank you.

11 Okay, so, now we're, again, we have an  
12 option of taking a break and then coming back to  
13 have any further discussion or having discussion  
14 now.

15 So, my vote is, since we're already  
16 half an hour late, we might just as well go around  
17 the table and ask about questions.

18 MEMBER MARCH-LEUBA: I'll second that  
19 one.

20 CHAIRMAN BALLINGER: Soft vote.

21 Okay, any questions around -- from  
22 members? I think we have to open the line, right?

23 In the meantime, are there any  
24 questions from the audience? Any people want to  
25 make a statement or anything?

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1                   Hearing none, hopefully the line will  
2 be open.

3                   Okay, I think -- okay, I think the line  
4 is open. Just to be sure, is anybody out there,  
5 can you make a human noise so that we can verify  
6 that?

7                   MS. BANERJEE: Yes, Maitri's out there.

8                   CHAIRMAN BALLINGER: Great, that's a  
9 human.

10                  MEMBER POWERS: You're very generous in  
11 your appraisals here.

12                  CHAIRMAN BALLINGER: Okay, is there  
13 anybody out there that would like to -- any member  
14 of the public out there that would like to make a  
15 statement?

16                   Going once, going twice, closed.

17                   Okay, so there are no comments. Can we  
18 close the line?

19                   Okay, I think that pretty much  
20 concludes today's -- we did -- oh, now we can go  
21 around the table.

22                   Joy?

23                   MEMBER REMPE: I don't have any  
24 additional comments. Thanks for all your  
25 presentations.

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1                   MEMBER BROWN:     Thank you very much.  
2     Charlie Brown.     Thank you very much and who can  
3     compete with John.     So, I give up.

4                   MEMBER MARCH-LEUBA:     I have no further  
5     comments.

6                   MEMBER STETKAR:     I'd like to thank  
7     you.     You covered a lot of material today.  
8     I'm obviously a detail oriented person, but one  
9     of the roles that the ACRS provides that is to  
10    look at integrated plant safety.

11                   So, a lot of the things that I ask, I'm  
12    trying to understand system interactions.     I'm  
13    trying to understand how the design relates to  
14    success criteria and the risk assessment.

15                   I'm trying to understand how the risk  
16    assessment results feed back into the design and so  
17    forth.

18                   So, many of my questions come from that  
19    direction.

20                   In the future, I'll just make this  
21    statement on the record, less emphasis on open RAIs  
22    and more emphasis on technical information from the  
23    design would be appreciated.     We can read RAIs and  
24    things like that from the staff.     So, from your  
25    perspective, keep it more technical.

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1                   But, again, thank you.

2                   MEMBER SUNSERI:     Thank you for your  
3 presentations.     I enjoyed them and I have no  
4 further questions.

5                   CHAIRMAN BALLINGER:   Dr. Powers?

6                   MEMBER POWERS:     Nothing.

7                   CHAIRMAN BALLINGER:   Pete?

8                   MEMBER RICCARDELLA:   I'm impressed by  
9 the level of detail that you've gone into and  
10 particularly by how much you've recognized the  
11 lessons learned with existing plants and the  
12 problems with existing plants and how to avoid  
13 those, particularly in the materials area.

14                   CHAIRMAN BALLINGER:   And, I would like  
15 to thank you for a great -- a very good  
16 presentation.

17                   I have in front of me from Maitri a set  
18 of action items and I would propose that tomorrow  
19 near the end of our talk those -- we should go  
20 through those action items to make sure everybody's  
21 on the same wave length.   Because, we could do it  
22 now, but it would take a long time.

23                   So, with that being said, I think we  
24 are adjourned until tomorrow morning at 8:30.

25                   (Whereupon, the above-entitled matter

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1           went off the record at 3:27 pm.)  
2  
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**Official Transcript of Proceedings**  
**NUCLEAR REGULATORY COMMISSION**

Title:                   Advisory Committee on Reactor Safeguards  
                              APR 1400 Subcommittee Meeting

Docket Number:     (n/a)

Location:             Rockville, Maryland

Date:                  Thursday, September 22, 2016

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

APR1400 SUBCOMMITTEE

+ + + + +

THURSDAY

SEPTEMBER 22, 2016

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

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

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## COMMITTEE MEMBERS:

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CHARLES H. BROWN, JR., Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER C. RICCARDELLA, Member

JOHN W. STETKAR, Chairman

MATTHEW W. SUNSERI, Member

## DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER L. BROWN

## ALSO PRESENT:

TONY AHN, KHNP

MAITRI BANNERJEE, NRR\*

JOHN BUDZYNSKI, NRO

BOB CALDWELL, NRO

SEOG NAM CHOI, KHNP

WOOCHONG CHON, KEPCO NF

JEFF CIOCCO, NRO

TIM DRZEWIECKI, NRO

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REBECCA KARAS, NRO  
JONG SOO KIM, KHNP  
JUNGHO KIM, KHNP  
MINSEOK KIM, KHNP  
YUN HO KIM, KHNP  
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ROB SISK, Westinghouse  
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ANGELO STUBBS, NRO  
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\* Present via telephone

A G E N D A

Opening Remarks..... 4

Staff Opening Remarks..... 5

Chapter 5..... 9

Public Comment..... 43

Adjourn..... 45

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

8:35 a.m.

1  
2  
3 CHAIRMAN BALLINGER: This meeting will  
4 come to order. This is a meeting of the -- a  
5 renewed meeting of the APR1400 Committee of Advisory  
6 Committee of Reactor Safeguards. I'm Ron Ballinger,  
7 Chairman of the Committee. Members in attendance  
8 are Joy Rempe, Charlie Brown, Jose March-Leuba, John  
9 Stetkar, Matt Sunseri, Dana Powers and Peter  
10 Riccardella.

11 The purpose of today's meeting is an  
12 extension of yesterday's meeting to receive  
13 briefings from KHNP regarding -- and the staff  
14 regarding the design certification for the APR1400.  
15 The rules for today's meeting again were published  
16 in the *Federal Register* on September 7, 2016. The  
17 meeting was announced as an open and closed meeting,  
18 so if we have questions that turn out to be  
19 proprietary, you need to let us know so we can close  
20 the meeting.

21 A transcript is being kept and made  
22 available in the *Federal Register*, as stated in the  
23 *Federal Register* notice. We would request that  
24 people shut off or disable chicken sounds and stuff  
25 like that various cell phones and other items that

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1 we've heard already this morning.

2 Participants should first identify  
3 themselves when they have comments, and speak with  
4 sufficient clarity and volume so that they can be  
5 readily heard. We have a bridge line open I think  
6 again, and before we get started, I want to make  
7 some clarifications of yesterday.

8 This is a subcommittee meeting, which  
9 means that questions from members are questions from  
10 the subcommittee members themselves. They're not  
11 questions from the ACRS. The ACRS communicates  
12 through its letters only.

13 So while we have kept a list of  
14 questions and we've gotten asked questions where the  
15 applicant or the staff may say we'll get back to you  
16 because we need to get an answer, that is not an RAI  
17 all right, definitely.

18 Not an RAI, and so we'll adjudicate  
19 those questions amongst the staff and things like  
20 that. So that's to be very, very clear about that  
21 and I think that's clear under Member Stetkar wants  
22 to say something in addition.

23 MEMBER STETKAR: No, that's pretty  
24 clear.

25 CHAIRMAN BALLINGER: So with that, does

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1 -- you want to say something Bill or Jeff?

2 MR. CIOCCO: Jeff Ciocco. I'm the  
3 lead project manager for the APR1400 design  
4 certification project. Thank you for having us back  
5 this morning. We look forward to giving you our  
6 staff presentation on Chapter 5. We have everybody  
7 assembled up here at the table. Over here, we had  
8 good representation by our technical staff in the  
9 audience, as well as our technical branch chiefs,  
10 and we have a division director with us as well  
11 today from the Division of Engineering, Bob  
12 Caldwell.

13 So we look forward to giving you our  
14 presentation, any questions that you have, thank  
15 you.

16 CHAIRMAN BALLINGER: And so who's up?  
17 Jessica.

18 MS. UMANA: Okay. Good morning. I'm  
19 Jessica Umana. I'm the Chapter 5 Project Manager  
20 for APR1400. Today, you will hear the staff's  
21 presentation to ACRS on reactor, I'm sorry, reactor  
22 coolant system and related systems. Specifically,  
23 the staff will cover technical topics and open items  
24 that came up fast in our review, which was captured  
25 in the safety evaluation which you received some

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1 time prior to this meeting.

2 I'd like to take this opportunity today  
3 to just present the presenters. We have John  
4 Budzynski, Dan Widrevitz, John Honcharik and Greg  
5 Makar. Let me move on through the slides. While  
6 you see the presenters up here, I do want to take a  
7 moment to appreciate this item. The next is the  
8 entire staff that worked on Chapter 5.

9 On this slide, we have it over on this  
10 one and I believe the next two slides we an overview  
11 of the SRP sections that were reviewed and the  
12 number of questions that were generated from each  
13 section with open items. There is one correction  
14 I'd like to make, and that's on this slide.

15 This one shows that we have one open  
16 item in 5.4, but that open item is actually in  
17 Section 5.4.1.2. The confusion was on my part based  
18 on the numbering scheme that was produced when the  
19 RAI went out. But I do want to make that  
20 clarification. It's not in 5.4. It's 5.4.1.2.

21 I believe here we have a summary.  
22 Overall, 77 questions were generated in Chapter 5,  
23 and we have 13 open items. I think maybe one or two  
24 may have been brought to resolution since this  
25 presentation was prepared by the -- I'll let the

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1 staff cover that.

2 So as you can see here, go back a few  
3 slides. A number of questions were generated in  
4 5.4.1.1, which is the Reactor Coolant Pump Flywheel,  
5 and then we had a few questions come from 5.2.3.  
6 So now we'll turn it over to John Budzynski. He's  
7 going to be presenting in 5.2.2, which is  
8 Overpressure Protection, 5.4.1.2, Reactor Coolant  
9 Pumps, 5.4.7, Shutdown Cooling, 5.4.12, Reactor  
10 Coolant System High-Point Vents.

11 MR. BUDZYNSKI: Okay. The first  
12 section we're going to hear is Section 5.2.2,  
13 Overpressure Protection System. The main primary  
14 reason for the overprotection is to protect the  
15 reactor cooling system, connecting systems and  
16 secondary sides of steam generators.

17 The reactor cooling of the pressure  
18 boundary is consistent with four POSRVs, two  
19 shutdown cooling relief valves and 20 main steam  
20 safety valves, five per steam line and the shutdown  
21 cooling suction line relief valve provides  
22 sufficient pressure, relief capacity to indicate the  
23 most, the main low pressure overprotection event.

24 Let's go on to the next slide. In the  
25 there open items, two have been since closed. The

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1 only remaining open item is the second one, 5.2.2.7  
2 and we requested additional information on how they  
3 determine the methodology in what computer codes  
4 they used, and then put parameters in the  
5 assumptions being made in the analysis for a  
6 limiting LTOP event.

7 MEMBER STETKAR: John, I had a question  
8 about that, juts for my edification. When I read  
9 through that section of SER, I know you're concerned  
10 about energy input from the secondary to the primary  
11 system. Is that what --

12 MR. BUDZYNSKI: Yes.

13 MEMBER STETKAR: It's noted. It says  
14 "The applicant did provide information on the  
15 secondary to primary heat transfer using the  
16 secondary temperature 230 degrees Fahrenheit, 110  
17 degrees C greater than the RCS, which the staff  
18 concludes is substantially more conservative than  
19 the 100 degrees Fahrenheit, 37 degrees C difference  
20 allowed by the technical specifications, and is  
21 therefore acceptably conservative."

22 How come we have a situation where the  
23 secondary temperature is at 230 degrees Fahrenheit  
24 higher than the primary temperature under conditions  
25 when LTOP is required, and I don't -- because

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1 yesterday I couldn't ascertain whether or not the  
2 actual enable temperature was proprietary. So we  
3 all know what it is but --

4 MR. BUDZYNSKI: I would have to say  
5 that the gentleman that wrote this RAI is not  
6 present, and he is the gentleman that's familiar  
7 with this RAI. I would have to go back and discuss  
8 it with him --

9 MEMBER STETKAR: Because that -- see,  
10 that's a really big delta T --

11 MR. BUDZYNSKI: Yes, it is.

12 MEMBER STETKAR: And I'm not a thermal  
13 hydraulics guy, but I sort of know where water boils  
14 under what different pressures and how heat transfer  
15 normally works.

16 So it's really hard for me -- when you  
17 say it's acceptably conservative, if it's -- if it's  
18 absurd, that isn't what we ought to be doing either.  
19 So if you could help me with that somehow, you know,  
20 just put it on -- it's on the transcript and as Ron  
21 said it's just a question.

22 MR. BUDZYNSKI: Okay.

23 MS. KARAS: This is Becky Karas.

24 MEMBER STETKAR: It's only -- I'd hate  
25 to see applicants doing analyses with just

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1 artificial conditions, and then somebody saying well  
2 that's acceptably conservative.

3 MS. KARAS: This is Becky Karas, chief  
4 of Reactor Systems. I can try and get the reviewer  
5 down here.

6 MEMBER STETKAR: Oh, it would help if  
7 it's a quick answer, you know. If it isn't, then  
8 we're going to be meeting on these things.

9 MS. KARAS: Okay, okay, all right.

10 MEMBER STETKAR: It isn't -- it doesn't  
11 necessarily have to be answered, you know,  
12 immediately if the cognizant person isn't here.

13 MS. KARAS: Yeah. I can try and get him  
14 down here during this meeting, okay.

15 MEMBER STETKAR: Thank you.

16 MS. KARAS: Okay.

17 MR. BUDZYNSKI: The next section  
18 5.4.1.2, Reactor Coolant Pumps. The pump design is  
19 -- the reactor coolant pump is a vertical shaft,  
20 single stage centrifugal pump. Loss of cooling  
21 water event is the most serious one. CCW flows to  
22 the pump motor bearing old cores, motor air coolers,  
23 high pressure seal water coolers pump and the CVCS  
24 continues to provide sealed water injection flow to  
25 the RCP pump by seals.

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1 Pump and motor bearings designed to  
2 withstand the loss of CCW for 30 minutes. CCW,  
3 that's Division 1, supports charging pump new flow  
4 heat exchanger and CVCS and all coolers under RCPS.  
5 The seal design is improved to have low seal leakage  
6 rates during a station blackout event.

7 Two open items that have since been  
8 closed and resolved so we won't discuss it here.

9 MEMBER STETKAR: I had, John, a question  
10 on the overspeed for the flywheel, and I hit you  
11 with it because I beat up the applicant enough  
12 yesterday. When I read their section of the DCD,  
13 they're very, very, very careful in the DCD to say  
14 that the highest anticipated overspeed is predicted  
15 for a loss of coolant accident, with the largest  
16 break size remaining after the application of leak  
17 before break.

18 That break size is apparently four  
19 inches, okay. There's a lot of much bigger piping  
20 connections to the reactor coolant system than four  
21 inches. How do I treat -- I mean does the staff  
22 accept leak before break arguments in terms of LOCA  
23 sizes for this type of analysis? What happens if I  
24 get like a 12 inch break? Does the flywheel come  
25 apart? That's my concern.

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1 (Off mic comments.)

2 MR. HONCHARIK: I guess this is John  
3 Honcharik. So I guess the question is whether or  
4 not that four inch line is the limiting line?

5 MEMBER STETKAR: They claim it's the  
6 limiting line after they apply all of their leak  
7 before break stuff. In other words, whatever -- I  
8 haven't read Chapters 3.6.3, nor am I a specialist  
9 in leak before break analyses because that's always  
10 mystified me. But apparently after you do your leak  
11 before analyses, they conclude that the largest  
12 break equivalent size that they can get after all of  
13 that is four inches, and they did their overspeed  
14 analysis based on a four inch break is my  
15 understanding.

16 It said based on that four inch break, I  
17 won't exceed my design overspeed of the pump, and my  
18 question is well, you know, the loops themselves are  
19 really big and I don't want to get into the double  
20 ambiguity and sheer of the loop, and there's  
21 pressurize the surge line it's 12 inches.

22 The direct vessel injection lines are  
23 like eight or eight and a half inches. Couldn't  
24 find the charging and letdown lines sizes, but  
25 they're probably, you know, in the four inch or so

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1 range. What happens if they get a bigger break, you  
2 know? Essentially you've accepted their overspeed  
3 analysis as being acceptable.

4 What I don't know is if they have a  
5 bigger break, can they get a larger overspeed and  
6 have the flywheel come apart?

7 MR. HONCHARIK: Yeah, because I looked  
8 at the flywheel and I know, I mean I know they -- I  
9 think they -- I'm sure they did leak before break as  
10 you stated, and basically there, instead of having a  
11 break you'll have a leak. So more than likely  
12 those, what they're saying then is that those larger  
13 pipe sizes more than likely will have a leak, not a  
14 break.

15 So some of the limiting ones would be  
16 the other ones, and I think the largest that they  
17 specified was four inches. But I'd have to consult  
18 with someone for the leak before break.

19 MEMBER STETKAR: Yeah, and indeed that's  
20 what they say they did. But what I'm curious about  
21 -- and I don't know how that factors into design  
22 basis LOCA analyses. That's a different topic. I'm  
23 just saying for the purposes of evaluating the  
24 integrity of the flywheel or an overspeed is does  
25 the staff typically accept those types of leak

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1 before break arguments.

2 I'm not sure that I've seen that before  
3 in other applications, but I must admit that I  
4 didn't go back and try to do a thorough search of  
5 Chapter 5 to see how people did those overspeed  
6 analyses.

7 MR. MITCHELL: Yeah, and this -- if I  
8 could interject. This is Matthew Mitchell, Chief of  
9 the Materials and Chemical Engineering Branch in  
10 NRO. I believe the characterization with respect to  
11 the span of systems which on occasion be applied a  
12 leak before Break 2 is accurate and that they did  
13 eliminate from a leak before break analysis  
14 perspective lines down to -- essentially into the  
15 forward trench.

16 I think you will find that in 363 when  
17 we get to covering that. From a philosophical  
18 standpoint, in terms of the application of leak  
19 before break technology, I think the staff should  
20 probably take this back and discuss this.

21 MEMBER STETKAR: I was more -- the  
22 reason I asked you rather than KHNP is that they  
23 have used the leak before break argument in a few  
24 places throughout the DCD, and to me this is, you  
25 know, it's partly technical, it's partly

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1 philosophical. Because you've -- this is first place  
2 where I could hang my hat on something that  
3 the applicant has explicitly said they've accounted  
4 for, it's why I'm kind of raising it now in terms of  
5 what's the staff's philosophy in accounting for  
6 those arguments.

7 MR. MITCHELL: And I completely  
8 understand the question. I'm sure, as you will  
9 recollect, leak before break has inherently been  
10 tied to general design criterion 4, and the  
11 elimination of the dynamic effects of pipe rupture.

12 MEMBER STETKAR: Exactly.

13 MR. MITCHELL: And that has since the  
14 initiation of the leak before break concept been a  
15 rather well-defined regulatory box in terms of the  
16 type of effects, jet impingement, pipe whip, that  
17 could be essentially excluded from the design basis  
18 based upon the demonstration of leak before break.

19 MEMBER STETKAR: Yes.

20 MR. MITCHELL: Having done leak before  
21 break analyses myself for many, many years, back  
22 when I was in the other office and then my branch  
23 deals with LBB now, I will say that I'm not familiar  
24 with a prior application that I can recall where it  
25 would have been associated with flywheel overspeed.

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1 I'd need to go back and research that a bit more to  
2 see whether or not that was ever established by  
3 precedent. But that would be within the scope of  
4 dynamic effects of pipe rupture.

5 MEMBER STETKAR: Yeah. I didn't, as I  
6 said, I didn't try to go back to the other DCDs  
7 that I have and track it, only because I ran out of  
8 time. But I didn't recall hearing it and I've sat  
9 in on several of the design certifications over the  
10 last seven-eight years or so, and I didn't recall  
11 hearing that type of argument before.

12 MR. MITCHELL: And I think I would agree  
13 that we probably want to go back and discuss it  
14 amongst ourselves a little bit more because I,  
15 likewise I'm not sure whether I've run across that.

16 MEMBER STETKAR: Yeah. Okay, thank you.

17 MS. KARAS: Dr. Stetkar, at whatever  
18 point you want to return to your prior question, we  
19 have the reviewer here for that.

20 MEMBER STETKAR: I'm pretty thrilled  
21 right now before I forget what it was.

22 MS. KARAS: If you could possibly  
23 restate your question, it would be helpful.

24 MEMBER STETKAR: Oh gee. Well, now  
25 we're really pressing. Let me go back to where the

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1       heck it was.

2                   CHAIRMAN BALLINGER:  Oh, the temperature  
3       on the --

4                   MEMBER    STETKAR:        No.        In    all  
5       seriousness, the concern as I understand it for the  
6       energy and for the low temperature overpressure  
7       protection analysis was concerning with heat  
8       transfer from the secondary side to the primary  
9       side, energy transfer from the secondary side --  
10      there you are -- to the primary side.

11                   In the SER, there's a statement that  
12      said you're still tracking that as an open item.  We  
13      know that.  So the applicant did provide information  
14      on the secondary to primary heat transfer using the  
15      secondary temperature of 230 degrees Fahrenheit, 110  
16      degrees C greater than the RCS, which the staff  
17      concludes is substantially more conservative than  
18      the 100 degrees Fahrenheit, 37 degrees C difference  
19      allowed by the technical specifications, and is  
20      therefore acceptable and conservative.

21                   My question was for your benefit,  
22      because you may not have been here, I don't know  
23      whether the LTOP enable and disable temperatures  
24      are proprietary information, so I didn't cite those  
25      temperatures.  We all know what they are.  But given

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1 the enable temperature, is it feasible at all to have  
2 a secondary temperature 230 degrees higher than  
3 that temperature? In other words, how does thermal  
4 dynamics work in this situation?

5 MR. DRZEWIECKI: So there's another  
6 event, I'm sorry. Is this in?

7 MEMBER STETKAR: Well, I think so, yeah.

8 MR. DRZEWIECKI: It's on, okay. I'm Tim  
9 Drzewiecki. I'm from the Systems Branch. We also  
10 looked at this in an event in Chapter 15 as well, in  
11 which we were looking at some of the overpressure  
12 events there. As far as that specific answer to  
13 your question, I don't it my fingertips. I can  
14 follow up on that.

15 It was addressed in an RAI because  
16 actually the event that I'm thinking of is a  
17 startup. It's a startup of an RCP in a random loop.  
18 So we asked an RAI on that, trying to get the basis  
19 for where those values are from. I can follow up  
20 with that RAI value there, but it's addressed as  
21 well in Chapter 15. I forget the event number.

22 However, as far as the tracking of this  
23 RAI and why it's an open item, it is that we were  
24 not clear on how the calculation was actually done,  
25 some of the other inputs and things like that.

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1 That's why it's being tracked as an open item.

2 MEMBER STETKAR: My question when I  
3 stumbled across the actual temperature was, you  
4 know, I understand having confidence that you, that  
5 the staff must understand how the applicant did  
6 their analyses. That's clear. There's no question  
7 about that, and it's also clear that the analysis  
8 should be appropriately conservative.

9 But it shouldn't necessarily be  
10 unrealistic in the sense of you can't achieve these  
11 conditions. In other words, just saying that, you  
12 know, I could pick a 1,000 degree temperature  
13 difference and that would be even more conservative,  
14 but we all know that's physically impossible.

15 So I was just questioning, you know,  
16 what basis. Are there conditions where you could  
17 get that type of delta T in that direction at the  
18 time when you need LTOP. It's clear there are other  
19 conditions where maybe you could get that type of  
20 delta T during a cooldown, while the secondary and  
21 the primary system is still intact, but now when  
22 you're below the -- as cold as you are when you get  
23 the LTOP enable or even the disable temperature.

24 MR. DRZEWIECKI: Yes, I understand that.

25 MEMBER STETKAR: Because you're talking

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1 about a few hundred degrees on the secondary side.

2 MR. DRZEWIECKI: Yeah, yeah. So as far  
3 as the details, I'm sorry, I don't have it at my  
4 fingertips.

5 MEMBER STETKAR: No, that's fine.

6 MR. DRZEWIECKI: But it was definitely  
7 addressed in the section that's within 15 on the  
8 startup --

9 MEMBER STETKAR: On the startup of the  
10 pump.

11 MR. DRZEWIECKI: Yeah.

12 MEMBER STETKAR: Okay, because that  
13 again, that might have been. I don't want to  
14 speculate. I didn't go over in Chapter 15 and try  
15 to draw this. I just found it Chapter 5.

16 MR. DRZEWIECKI: Yeah, okay.

17 MEMBER STETKAR: Okay.

18 MR. DRZEWIECKI: Thank you.

19 MEMBER STETKAR: Thank you.

20 MEMBER REMPE: Excuse me while you're  
21 still there. I'm a little confused on what it is  
22 you're still investigating, because what's in the  
23 draft DIC says well, the inputs are conservative and  
24 I thought I heard today that it's not the inputs  
25 anymore; it's just the methodology you're concerned

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1 about at this point or what is it?

2 MR. DRZEWIECKI: So as far as the  
3 language that the inputs, we found them to be --  
4 conservative and acceptable. I really can't speak  
5 to that. I don't know if Gordon wrote that.  
6 However, the one thing that I will say is as far as  
7 the methods and the actual calculation that was  
8 done, that's what we have questions on.

9 MEMBER REMPE: So this is that it was  
10 the code. It starts with an O, OBERP, O-B-E-R-P is  
11 the name of the code that was used, right?

12 MR. DRZEWIECKI: It could be.

13 MEMBER REMPE: Okay, but that -- okay.  
14 So I was just looking at the RAI and the response  
15 back, and I was just kind of curious on what was the  
16 problem. But I guess we'll hear about it later.

17 MR. DRZEWIECKI: Okay. Just their  
18 response to that was the 5.2.2.7 follow-up, because  
19 that would be the one that's still on the  
20 evaluation.

21 MEMBER REMPE: Right.

22 MR. DRZEWIECKI: Okay.

23 MEMBER REMPE: But there's two parts to  
24 it, and I assume that the hand calculations aren't  
25 causing the problems when you're talking about the

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1 methods, because that usually isn't a problem with a  
2 hand calculation. But the energy, the second one  
3 talks about the method of analysis. But anyway, I  
4 just am curious about it. But I guess we'll get an  
5 update and we'll hear about it later is the answer  
6 to the question at this point.

7 MR. DRZEWIECKI: Yes.

8 MEMBER REMPE: Thank you.

9 MR. BUDZYNSKI: Okay. We're on 5.4.7,  
10 Shutdown Cooling. Configuration similar to most  
11 current PWR designs. Two independent trains.  
12 Shutdown cooling pumps are interchangeable with the  
13 containment spray pumps. So this is used during  
14 shutdown, refueling, startup and it's used in the  
15 range of approximately below 450 psig and 350  
16 degrees Fahrenheit.

17 When we did the evaluation of gas  
18 accumulation, we used Generic Letter 2008, RIS 2013-  
19 09 and we evaluated it also against NEI 09-10. We  
20 have one open item. We accepted the ITAAC that they  
21 wrote, but the only problem we have is that the NEI  
22 09-10 was not referenced in the DCD, and we wanted  
23 it to be referenced in the DCD because it -- more or  
24 less it's the most current gas management procedure  
25 we have, guidance we have.

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1           It takes into consideration void testing  
2           and it takes into consideration of a gas  
3           accumulation high point sections of the piping  
4           configuration, and it's all put together one piece  
5           and we wanted that to be referenced. As far as the  
6           ITAAC, it was acceptable and we can close that out  
7           within -- once we get together with the applicant.

8           MEMBER REMPE:     So I have a question  
9           about the section with an RAI that was closed out.  
10          It's RAI 384-8100 about natural circulation.

11          MR. BUDZYNSKI:    Yes.

12          MEMBER REMPE:     And the response back  
13          from the staff. The reason I'm interested in this  
14          is just for future evaluations when we look at  
15          accident analysis and natural circulation in a CE  
16          plant, and I guess they're basing things on some  
17          Palo Verde data and in some startup testing and I  
18          just was curious. Are you the person who evaluated  
19          that?

20          MR. BUDZYNSKI:    Yes, yes.

21          MEMBER REMPE:     Okay. So could you  
22          elaborate a little bit more about why you find that  
23          acceptable?

24          MR. BUDZYNSKI:     Okay. What we  
25          initially looked at, there was a decay heat ratio of

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1 less than .87 I believe it was, and when we have some  
2 hazard they come up with that number. We could find  
3 it anywhere. If they said it was less than that,  
4 then it's acceptable. There would be no problem in  
5 natural flow conditions, okay.

6 They responded and when they responded  
7 they showed that it would demonstrate that at full  
8 power, the amount of heat being produced for -- I'm  
9 trying to -- I don't have the question in front of  
10 me, so I'm trying to think of the response.

11 MEMBER REMPE: It's okay. A good  
12 approximation.

13 (Simultaneous speaking.)

14 MR. BUDZYNSKI: --heat produced at full  
15 power versus the amount of heat produced at the  
16 natural flow conditions, recirculation conditions  
17 would be less. So therefore you're not exceeding  
18 any type of thermal limits at that condition.  
19 Basically, that's what they're saying.

20 And to me, that made sense, but I don't  
21 have my notes in front of me to go into detail on  
22 that, yeah.

23 MEMBER REMPE: Well, I pulled the NUREG  
24 from the email that did the calculations for this or  
25 the testing and the results, and so I guess we'll be

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1 discussing this a little bit more as we go further  
2 into the DCD in other sections.

3 MR. BUDZYNSKI: Yeah. I can get better  
4 information that I have on my desk on that.

5 MEMBER REMPE: Okay, thank you.

6 MR. BUDZYNSKI: Okay. RCS high point  
7 vents. There's no open items here. This is just a  
8 description of the technical topics that were  
9 covered during evaluation. Do you want me to go  
10 over those, or they're just listed with it.

11 MEMBER STETKAR: I have a question, but  
12 it doesn't pertain to any of the bullets here but it  
13 does pertain to the vents so --

14 MR. BUDZYNSKI: Okay, go ahead then.

15 MEMBER STETKAR: In the SES, this is --  
16 I need to pretty much understand what you thought  
17 about it. In the SER, you start off saying the  
18 staff reviewed Section 5.4.12 in accordance with the  
19 standard review plan. To ensure the adequacy of the  
20 RCGVS, to remove from high points in the RCS non-  
21 condensible gases that could hinder natural  
22 circulation and core cooling after a design basis  
23 event.

24 Later on in that discussion, it says "To  
25 address potential gas accumulation in the steam

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1 generator tubes, the applicant described a procedure  
2 to operate the reactor coolant pump for short periods  
3 of time to transfer non-condensable gases from the  
4 tubes to the other RCS high points for venting,  
5 therefore in accordance with 10 CFR 50.34(f)(2)(vi)  
6 and 10 CFR 50.46(a). Vents are provided for the RCS  
7 high points for the APR1400.

8 I went back and I read the DCD pretty  
9 carefully, because I stumbled over that discussion  
10 in the DCD when I first read it, and I later  
11 concluded that their discussion of using the reactor  
12 coolant pumps was completely unrelated to a natural  
13 circulation event, which to me makes a lot of sense  
14 because, you know, I kind of have natural  
15 circulations when I don't have the reactor coolant  
16 pumps.

17 MR. BUDZYNSKI: Right.

18 MEMBER STETKAR: So I can't bump the  
19 reactor coolant pumps to take non-condensibles out  
20 of the steam generators during a natural circulation  
21 event. You may want to go back and look carefully  
22 at the way the SER is written, because I came away  
23 from the SER with the conclusion that natural  
24 circulation cooling is fine, and the vents are fine  
25 because they can bump the reactor coolant pumps to

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1 take gas out of the U tubes during a natural  
2 circulation event.

3 MR. BUDZYNSKI: Okay. I'll take a look  
4 at that.

5 MEMBER STETKAR: And if that -- if that  
6 was your intent, I'm very curious about how one can  
7 actually do that. As I've said, when I read the  
8 DCD, the way the DCD is organized they're really  
9 careful to say that they can open the vents to  
10 remove non-condensibles from the pressurizer and in  
11 particular from the reactor vessel head I think is  
12 the only time that they used the words natural  
13 circulation.

14 They talk about bumping the reactor  
15 coolant pumps as a way of degassing the system in  
16 another part of the discussion, which is more  
17 oriented toward normal operation, normal venting of  
18 the system, for example, for cooldown or heat up or  
19 things like that. So I'm hoping it's just my  
20 reading the SER wrong, and that you're not actually  
21 taking credit for that process, to facilitate  
22 natural circulation cooling.

23 MR. BUDZYNSKI: Okay. I'll make that  
24 an item to go back and talk to the engineer that did  
25 the review.

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1           MEMBER STETKAR: It could be a wording  
2 situation in the SER, or if it's actually a  
3 technical conclusion, I'd like to understand how  
4 they came to that.

5           MR. BUDZYNSKI: Okay.

6           MS. UMANA: Okay. We have Darren  
7 Widrevitz up to present reactor coolant pressure  
8 boundary materials.

9           MR. WIDREVITZ: So in terms of this  
10 slide, I take the open item was an editorial concern  
11 that we were looking at a little bit later in the  
12 game. I think there really is no technical  
13 significance to it. So unless you had questions  
14 about it, I'd like to entertain questions about the  
15 section in general. Does that make sense?

16                   There was -- the text of the DCD implied  
17 a particular -- some welding parameters were  
18 sufficient to demonstrate non-sensitization, when in  
19 fact it was a coupling with the ACM and A262 A or E,  
20 and using these parameters that they felt was  
21 sufficient to produce non-sensitized product.

22

23           CHAIRMAN BALLINGER: I think we went  
24 through that to some extent with the applicant  
25 yesterday on this A262 and where it's used and I

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1 think we concluded, at least I did, that Practice  
2 A262 A and E are -- would never be used on an actual  
3 weld.

4 They might be used as part of weld  
5 qualification as a Member Riccardella mentioned, but  
6 not as part of any kind of QA on an actual weld on a  
7 pipe, since Practice E requires a U bend sample to  
8 be taken out of -- to be taken out in Practice A  
9 would require basically inducing IGA in the weld  
10 itself.

11 MS. UMANA: Okay, all right. We'll move  
12 on. We have Section 5.2.5 on Reactor Coolant  
13 Pressure Boundary Leakage Detection, and I'll be  
14 covering this slide. Developing requirements of  
15 this area are found in GDC 30 and GDC 20, with the  
16 acceptance criteria outlined in Reg Guide 1.45 for  
17 GDC 30 and Reg Guide 1.29 and 1.45 for GDC 2 (sic).

18 The staff conducted its review against  
19 SRP Section 5.2.5. I'm sorry, the following review  
20 -- the review areas are listed here for you. I'll  
21 spare you reading all of those. This one was pretty  
22 straightforward. There were three RAIs, most  
23 requesting clarification and resolution of some  
24 inconsistency, and all were stasured as confirmatory  
25 items. I'm hoping to see those changes in the next

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1 revision to the DCD.

2 Now there was one COL information item  
3 and the staff found it acceptable, because it's  
4 consistent with the Reg Guide which is referenced in  
5 the COL information item. Do you have -- if you  
6 have any questions, I'll defer to the technical  
7 reviewer in the audience.

8 CHAIRMAN BALLINGER: Maybe this is a  
9 time to ask a question which I wanted to ask  
10 yesterday, and it's related to this but unrelated to  
11 this. I searched for, because I'm sensitized, if  
12 you will, to steam generator tube leaks. So I'm  
13 always after looking to see what is the allowable,  
14 unidentified and identified leakage.

15 And so that number is bandied about in  
16 the DCD and in one place it says .5 gallons per  
17 minute is unidentified leakage is allowed, and then  
18 ten gallons per minute identified leakage. Is that  
19 correct?

20 MS. UMANA: Chang Li?

21 CHAIRMAN BALLINGER: Because I've seen  
22 other numbers in the document and I'm thinking --

23 MS. UMANA: I have the technical  
24 reviewer here. He'll be able to answer that.

25 CHAIRMAN BALLINGER: And then 150

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1 gallons per minute through one steam generator.

2 MEMBER STETKAR: That's a typo.

3 CHAIRMAN BALLINGER: That's a typo?  
4 That has to be a typo, okay. I was going to say  
5 that.

6 MR. LI: I am the reviewer for this  
7 sections. What you said is correct for unidentified  
8 leakage, the limit specified in the tech spec is .5  
9 gallons per minute. For identified leakage is 10  
10 gallons per minute, and there's an interface between  
11 steam generator. In steam generator leakage, I  
12 think you quote 150 gallons per minute?

13 CHAIRMAN BALLINGER: Yes.

14 MR. BUDZYNSKI: That's per day in the  
15 tech specs.

16 CHAIRMAN BALLINGER: Per day.

17 MR. BUDZYNSKI: There's a typo in the  
18 SER.

19 MR. LI: The typo, yeah.

20 CHAIRMAN BALLINGER: Okay, thank you.

21 MS. UMANA: If there are more questions,  
22 we're going to move onto -- I think this is a topic  
23 that you enjoy very much, the flywheel integrity and  
24 I'm going to hand it over to John, and then he can  
25 go through his --

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1                   MEMBER STETKAR: I apologize for that.  
2 I just somehow associate the flywheel with the  
3 reactor coolant pump. I didn't look far enough in  
4 your presentation, so sorry.

5                   MR. HONCHARIK: Hi, good morning. I  
6 reviewed the reactor coolant pump flywheel  
7 integrity, and basically the KHNP provided some  
8 areas in accordance with the Reg Guide, and that  
9 included material selection and fabrication  
10 technique for the flywheel, and any pre-service  
11 inspection that will be done and also in-service  
12 inspections, and also the overspeed testing per the  
13 SRP.

14                   Also they provided the flywheel analysis  
15 for the Reg Guide, and that basically looked for the  
16 critical speed for the ductile and non-ductile  
17 fracture mechanisms, and also it included a fatigue  
18 crack growth rates for the flywheel.

19                   Next slide. As everyone stated, there  
20 were six open items for this area. The first one  
21 was basically they didn't specify what method  
22 they're going to determine the fracture toughness of  
23 the material in question. So basically we asked  
24 that. I think they -- per yesterday, they responded  
25 about I think a week ago. So we're still evaluating

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1 that, but I think they mentioned something that  
2 they're going to use the direct method basically to do  
3 testing for it.

4 The next item was the operating  
5 experience. We have some operating experience for  
6 the material that they were using. Mostly it was  
7 clarifications or what actual operating experience  
8 was applicable to this material and situation. So I  
9 think they also provided that.

10 Next was the -- right now the applicant  
11 provided an analysis using one-third ultimate  
12 strength. However, the SRP specified that they used  
13 a one-third yield strength. So basically we asked a  
14 question okay, if you're going to use one-third of  
15 the ultimate, provide justification why that's  
16 acceptable. If not, use the one-third yield per the  
17 SRP.

18 I think they responded, I think they're  
19 probably going to use the one-third yield. They're  
20 going to --

21 MEMBER STETKAR: There wasn't a big  
22 difference if I recall, was there?

23 MR. HONCHARIK: Huh?

24 MEMBER STETKAR: There wasn't a very big  
25 difference between those two values, was there?

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1 MR. HONCHARIK: Probably not, yeah.

2 MEMBER STETKAR: Yeah.

3 MR. HONCHARIK: So they're going to do  
4 that and I think November they're supposed to  
5 provide that revised analysis. The other thing that  
6 they did was this flywheel is pretty much similar  
7 to all the other ones, except this one has hub, some  
8 place for a key. They have that hub that attaches  
9 it to the rotor.

10 So basically we're asking that they also  
11 do an analysis of that hub, you know, because if  
12 that fails, it could potentially release the  
13 flywheel. So I think they responded and they're  
14 going to do analysis and I think basically they're  
15 basing a lot of it on all that's going to be  
16 compression. So that will be coming in November  
17 along with the other analysis.

18 And also any inspections that you're  
19 going to be doing on that hub should be the same as  
20 the flywheel. So they're also responding to that.

21 The next was the -- this was just a  
22 minor one. Basically, they needed to specify what  
23 the acceptance criteria for the NDE methods, so that  
24 the acceptance criteria for flaw size, it will be  
25 bounded by the analysis. So we're just looking to

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1 make sure that that was consistent and they respond  
2 to that. I think they're going to put that in the  
3 DCD.

4 Next slide, and the last one was  
5 basically to put in the DCD, because they didn't  
6 mention anything about annual inspections of the  
7 hub. So we asked them that they would need to put  
8 some inspection criteria for the hub. Basically,  
9 that was our review for the flywheel. Any  
10 questions?

11 (No response.)

12 MR. HONCHARIK: Thank you.

13 MS. UMANA: Okay. We're going to move  
14 on to Greg Makar. He's going to present on the  
15 steam generator program.

16 MR. MAKAR: The review in Sections  
17 5.4.2.1 and 5.4.2.2 address a variety of materials  
18 and design and inspection topics. Our slide here  
19 just refers to the one open item that we had, and  
20 that is a -- the accident induced leakage  
21 performance criterion in the tech specs, which was  
22 the value proposed is an acceptable value, but  
23 that's also described in a number of places in the  
24 tech spec bases.

25 We found some potential inconsistencies

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1 and weren't certain that it, that the value that  
2 we're using was consistent with the accident  
3 analyses in Chapter 15. So after discussing that  
4 with them in our radiation protection and accident  
5 consequences branch, we found that it was really an  
6 administrative issue, that there just needed to be  
7 some, some edits in the tech spec bases to --

8 MEMBER STETKAR: That's what I wanted to  
9 make sure. I thought that -- I'm glad you clarified  
10 that. So it's simply making sure that the citations  
11 of things like .3 GPM and .6 GPM in the tech spec  
12 bases align with the values that were used for  
13 transients and steam line breaks respectively in the  
14 Chapter 15 analyses, right. You're not questioning  
15 it all, the 150 gallons per day.

16 MR. MAKAR: Operationally.

17 MEMBER STETKAR: Operational limit at  
18 all. Okay, thanks. Thank you.

19 MR. MAKAR: So the applicant has since  
20 responded to that and clarified that. So we are --  
21 we'll be closing that open item and tracking it as  
22 confirmatory.

23 MS. UMANA: Okay, and just to top off  
24 the presentation I provided.

25 MEMBER STETKAR: Don't go too far yet.

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1 MS. UMANA: Oh.

2 MEMBER STETKAR: Chris, no Chris.

3 MS. UMANA: Oh.

4 MEMBER STETKAR: I know where he's  
5 going. I'm trying to turn him off for a second.

6 MS. UMANA: This is just a courtesy list  
7 of the acronyms used throughout Chapter 5 and some  
8 that you probably heard in the presentation, if you  
9 are interested in referencing it.

10 MEMBER STETKAR: As usual, they can't  
11 shut me up. They try.

12 CHAIRMAN BALLINGER: We don't want to.

13 MEMBER STETKAR: Yes, you do but --

14 CHAIRMAN BALLINGER: Okay, we do.

15 MEMBER STETKAR: And I'm okay with that.  
16 Yesterday, I noted that the applicant has included  
17 this Appendix 5A specifically addressing the inter-  
18 system LOCA evaluations, and I had not seen in other  
19 design certifications such an extensive evaluation  
20 of that topic, and I'd like --

21 Again, I think that's very, very good.  
22 It shows a lot of thoughtfulness. I had a question  
23 for the staff, and this is -- I saved it for you  
24 because it's I think more pertinent for you.

25 In their evaluations, in particular of

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1 the shutdown cooling system, the safety injection  
2 system and containment spray system, they rely  
3 substantially, I don't think entirely but  
4 substantially, at least in the DCD, on the fact that  
5 they designed those piping systems outside the  
6 containment to a pressure of 900 pounds, 900 psig,  
7 which they say is 40 percent of the normal reactor  
8 coolant system operating pressure of 2,250 psi.

9 I think that's a good idea, you know.  
10 They've in fact enhanced the design of those  
11 systems. The reason I have a question for the  
12 staff, and that I'd like to have a little discussion  
13 about this is that they repeatedly refer to things  
14 like this is in accordance with the NRC's position  
15 presented in the NRC Letter Reference 2.

16 And the Letter Reference 2 is the NRC  
17 letter preliminary evaluation of the resolution of  
18 the inter-system loss of coolant accident issue for  
19 the Advanced Boiling Water Reactor design pressure  
20 for low pressure systems, Docket No. 52-001. So  
21 we've got that on the record.

22 The staff's SER says well, you looked at  
23 that 900 pounds and you concluded that it's  
24 consistent with past applicant practices that you  
25 found acceptable, and you have reasonable assurance

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1 that at this design pressure, the integrity of the  
2 RCS will be maintained.

3 My question is I haven't seen that  
4 argument used in any other design certification, and  
5 this seems to be establishing a precedent, such that  
6 if I just come in and claim that my shutdown cooling  
7 system, residual heat removal system or any other  
8 low pressure system at 40 percent of my reactor  
9 coolant system operating pressure, I get carte  
10 blanche. I can't have an interfacing system LOCA,  
11 because that is NRC's position.

12 And in this particular application, I  
13 can personally point to other things that provide  
14 additional protection in those systems against  
15 interfacing system LOCAs, and therefore draw my own  
16 conclusion about the susceptibility of those systems  
17 to breaks or the likelihood of their being  
18 overpressurized and then failing.

19 But what I'm asking the staff is is this  
20 an NRC regulatory position, because as we are all  
21 painfully aware, that once this is written in a  
22 safety evaluation report for this applicant, it  
23 will become regulatory precedent. I think there's a  
24 danger in doing that. I think that use of enhanced  
25 piping system design is part of the -- part of the

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1 solution.

2 I think that judicious locations of  
3 pressure relief valves, temperature indications,  
4 pressure indications, automatic or manual isolation  
5 release flow paths and those types of things are all  
6 -- testing. For example, how frequently do you go  
7 in and test interstitial spaces, to make sure that  
8 they're not overpressurized, that you don't have  
9 leakage that you perhaps couldn't monitor.

10 They're all part of the solution of  
11 this, not just simply saying well I've designed my  
12 piping to greater than 40 percent of reactor coolant  
13 system pressure. So I'd ask you to take that and  
14 come back and say is that a formal NRC regulatory  
15 position regarding interfacing system LOCAs.

16 The reason I'm concerned about that is  
17 twofold. Number one, from just a regulatory  
18 footprint, and number two, I certainly don't want to  
19 in the future go fighting battles with people doing  
20 risk assessments, saying that we don't need to  
21 consider thinking about interfacing system LOCA  
22 because the NRC staff has told us that we are  
23 absolutely safe because our piping is designed to 40  
24 percent of reactor coolant system pressure. We've  
25 faced those battles in the past.

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1           So the other thing I'll bring up is that  
2           the -- in research, they're currently working on the  
3           Level 3 PRA project, and as part of that project,  
4           they've had rather extensive work done on  
5           interfacing system LOCAs. I don't know what the  
6           current status of that is. We had a briefing some  
7           time recently, which might have been several months  
8           ago.

9           As part of that process, there was a  
10          report produced out at PNNL, and I'll give you the  
11          citation. It's PNNL 24783, Expert Elicitation to  
12          Support Interfacing System Loss of Coolant Accident  
13          Modeling, and the Level 3 PRA project is not using  
14          that report verbatim, but they're using information  
15          from that report to inform their treatment of  
16          interfacing system LOCAs.

17          I'm curious whether this old letter  
18          report, and I trace back a little bit on the history  
19          of the thing with NUREG/CRs, not NUREGs. NUREG/CRs,  
20          some of which I can't even find in ADAMS because  
21          they're so old, whether that is still consistent  
22          with the NRC regulatory position, research position  
23          and so forth on susceptibility to interfacing system  
24          LOCAs.

25          So if you can kind of take that kind of

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1 long rambling approach. I'm not necessarily -- I'm  
2 not right now, because this is a subcommittee  
3 meeting, I personally am not questioning the  
4 applicant's conclusions regarding interfacing system  
5 LOCA.

6 But I base my conclusion not only on  
7 that 900 pounds. I base it on other features of the  
8 system's designs that I've looked at and what they  
9 claim they will be doing in terms of monitoring and  
10 testing and inspection and so forth.

11 So and I, you know, it's just I had to  
12 bring it up as I did yesterday because neither the  
13 applicant nor the staff made any mention in their  
14 presentations about, you know, Appendix 5A, about  
15 this analysis. Yet in the SER, you've addressed it  
16 and the applicant obviously has done quite a bit of  
17 work, time working on this.

18 If we're design certification, they're  
19 beyond design basis events. I will admit that.  
20 They can be really, really important if not  
21 addressed sufficiently in the world of risk  
22 assessment, as you're well aware, and now I'm done  
23 sir.

24 CHAIRMAN BALLINGER: Thank you. Other  
25 questions from members at this point? We're getting

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1 the phone line open. We should hear the eruption of  
2 crackles shortly. While we're doing that, are there  
3 any folks in the audience that would like to make a  
4 comment or a statement?

5 (No response.)

6 CHAIRMAN BALLINGER: Yes, it is. It's  
7 open. Is there anybody out there on the line? Can  
8 you identify yourself or make yourself known so we  
9 can verify that this line is open? Maitri's not  
10 even up.

11 MS. BANNERJEE: Yeah. This is Maitri.

12 CHAIRMAN BALLINGER: She is up. Thank  
13 you. Now is there anybody else out there that would  
14 like to make a statement?

15 (No response.)

16 CHAIRMAN BALLINGER: Hearing none, I  
17 think we're done there. Okay. Now in closing, can  
18 we go -- we'll go around the table, start with Pete  
19 this time.

20 MEMBER RICCARDELLA: I have no comments.

21 CHAIRMAN BALLINGER: Dana?

22 MEMBER POWERS: (No audible response.)

23 CHAIRMAN BALLINGER: Matt?

24 MEMBER SUNSERI: No comments, thanks.

25 MEMBER STETKAR: Nothing more, other

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1 than to say I was pretty impressed with the staff's  
2 review of Chapter 5 in particular. Did a pretty, a  
3 pretty doggone thorough review. So good job.

4 CHAIRMAN BALLINGER: Jose?

5 MEMBER MARCH-LEUBA: No comment.

6 CHAIRMAN BALLINGER: Charles, Charlie?

7 MEMBER BROWN: No more comments.

8 CHAIRMAN BALLINGER: You're not even  
9 here. Oh, there you are over there.

10 MEMBER BROWN: I am.

11 CHAIRMAN BALLINGER: Joy, I don't know  
12 where her name tag is.

13 MEMBER REMPE: It's hiding among the  
14 electrical cords. But I have no additional  
15 comments. Thanks for your efforts and your  
16 presentations today. Thank you for your time.

17 CHAIRMAN BALLINGER: Well, we thank you  
18 very much. Again, I would like to express my  
19 gratitude for the time and effort and the  
20 thoroughness of your presentations, both the  
21 applicant and the staff, and with that, we are  
22 adjourned.

23 (Whereupon, the above-entitled matter  
24 went off the record at 9:31 a.m.)

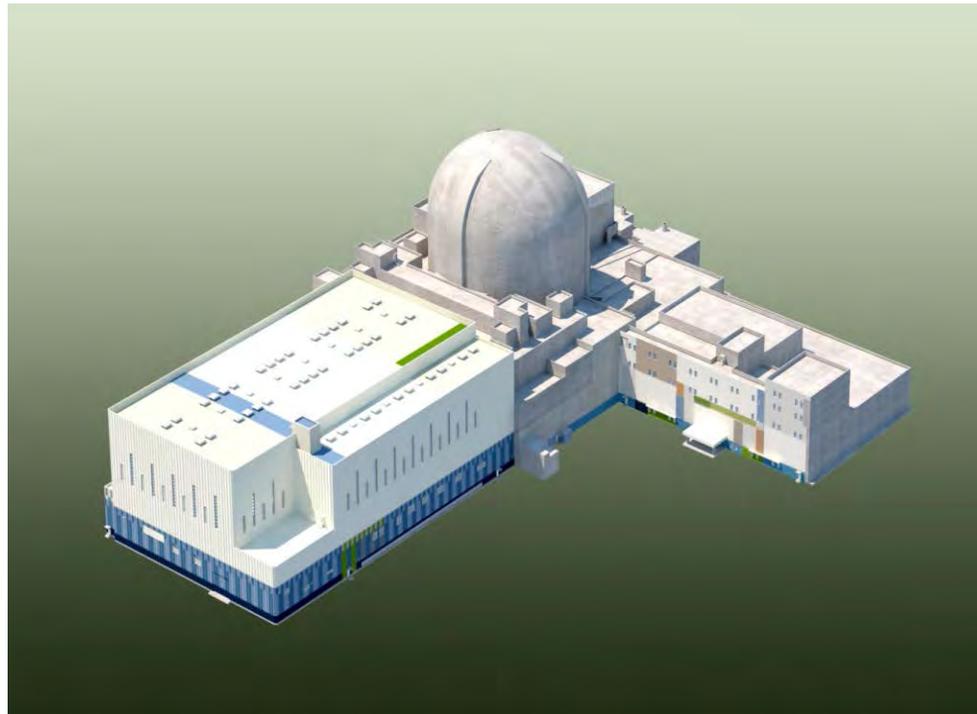
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# Overview of the APR1400 DC Project



**KEPCO/KHNP**  
**Sep. 21~22, 2016**

# Contents

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- **Introduction**
  - **References for design overview of the APR1400**
  - **NPPs in Korea**
  - **Project History**
- **Design Features and General Arrangement**
- **Design Review Status**
- **Summary**

# References for design overview of the APR1400

## List of Presentations to the ACRS in April 20-21, 2016

Document No.	Title
APR1400-Z-M-EC-16002-NP	APR1400 system design (Nuclear steam supply system)
APR1400-F-M-EC-16002-NP	APR1400 system design (Fuel design)
APR1400-E-N-EC-16001-NP	APR1400 system design (Containment system)
APR1400-E-C-EC-16001-P/NP	Seismic design analysis
APR1400-Z-M-EC-16001-P/NP	Structural analysis for reactor coolant system
APR1400-E-B-EC-16001-P/NP	Piping design (Piping stress analysis)
APR1400-E-N-EC-16003-P/NP	Piping design (Hazard analysis)
APR1400-E-N-EC-16002-P/NP	Radioactive waste management and radiation protection
APR1400-E-E-EC-16001-P/NP	Electrical system design
APR1400-Z-J-EC-16001-P/NP	Instrumentation & control system
APR1400-K-I-EC-16001-P/NP	Man-machine interface system
APR1400-E-N-EC-16004-P/NP	Plant security design (Aircraft impact analysis)
APR1400-E-N-EC-16005-P/NP	Plant security design (Loss of large area analysis)
APR1400-F-A-EC-16001-P/NP	Safety analysis
APR1400-E-P-EC-16001-P/NP	Probabilistic risk assessment
APR1400-K-X-EC-16002-P/NP	Mitigation strategies for beyond design basis event

# Nuclear Power Plants in Korea

In Operation	24 Units	21,716 MW
Commissioning (Reference Plant)	1 Unit	1,400 MW
Under Construction	3 Units	4,200 MW
Planning	6 Units	8,600 MW



Hanul 1,2,3,4,5,6



Shin-Hanul 1,2  
Shin-Hanul 3,4



Wolsong 1,2,3,4  
(PHWR)



Shin -Wolsong 1,2



Kori 1,2,3,4  
Shin-Kori 1,2



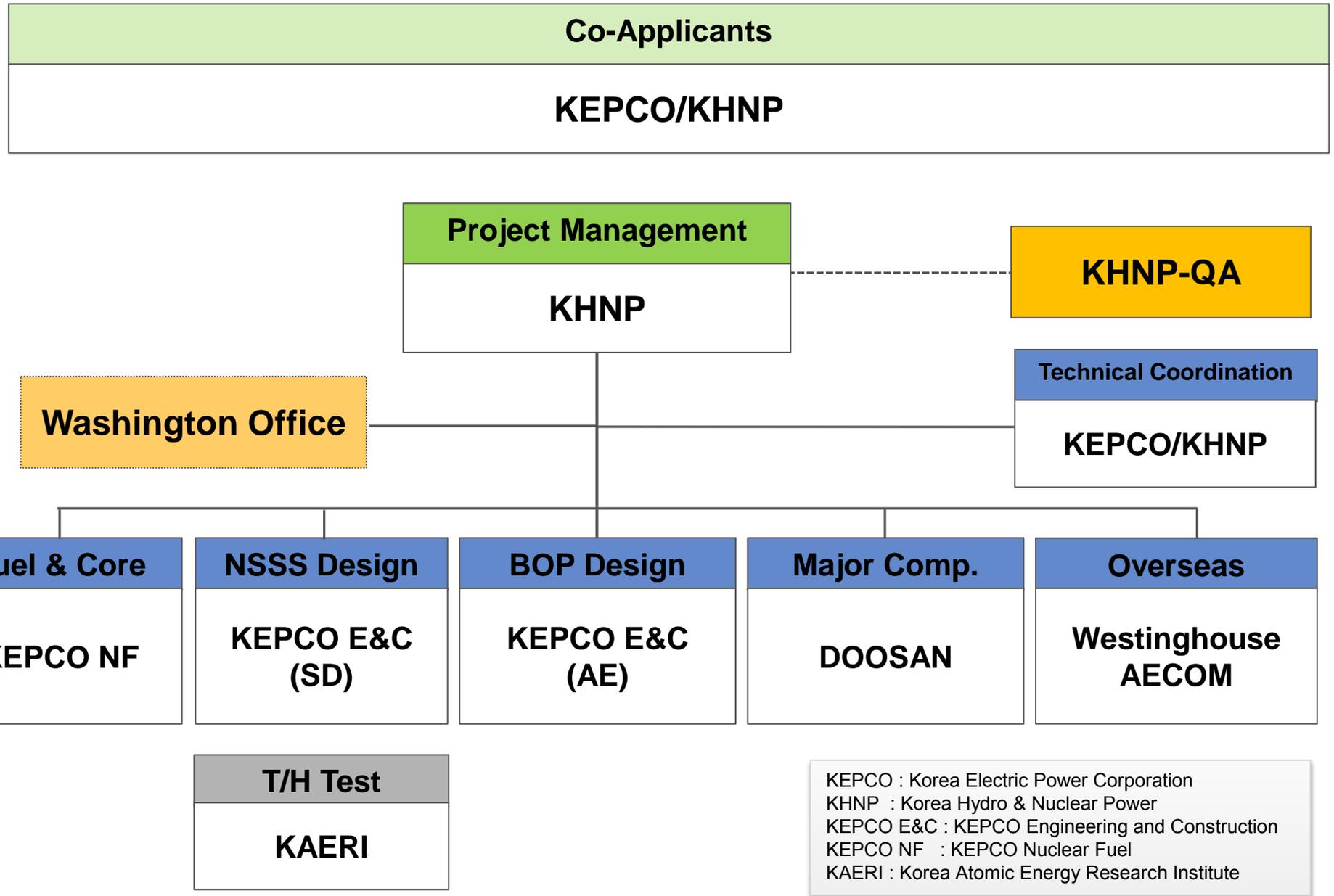
Shin-Kori 3,4  
Shin-Kori 5,6



Hanbit 1,2,3,4,5,6

ACRS Meeting (Sep.21-22. 2016)

# Project Organization



ACRS Meeting (Sep. 21-22, 2016)

KEPCO : Korea Electric Power Corporation  
 KHNP : Korea Hydro & Nuclear Power  
 KEPCO E&C : KEPCO Engineering and Construction  
 KEPCO NF : KEPCO Nuclear Fuel  
 KAERI : Korea Atomic Energy Research Institute

# Project History and Progress

- [Mar. 2009] Submittal of the Intent of APR1400 DCA to the U.S.NRC
- [Apr. 2010~Oct. 2014] Performed total 18 PARMs
- [Sep. 2013] First Submittal of the APR1400 DCA to the U.S.NRC
- [Dec. 2013] Non-accept of the APR1400 DC application
- [Dec. 2014] Resubmittal of the APR1400 DCA to the U.S.NRC
- [Mar. 2015] Receive the Docketing letter of APR1400 DC application
- [Apr. 2015] Receive the First RAIs[Ch. 2 & 3]
- [Jan. 2016] Finished Phase I Review

21-22. 2016)



## NRC NEWS

Office of Public Affairs, Headquarters

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www.nrc.gov ■ opa.resource@nrc.gov

No: 15-012  
CONTACT: Scott Burnell, 301-415-8200

March 4, 2015

### NRC To Begin Full Certification Review of APR1400 Reactor

The Nuclear Regulatory Commission has [docketed for review](#) Korea Electric Power Corp. and Korea Hydro and Nuclear Power's application to certify the APR1400 reactor design for use in the United States.



# Development history of APR1400

- Development of Advanced Power Reactor 1400 (1992~2002)
- Licensing agreement with ABB-CE

EPRI URD/EURD  
Sys. 80+  
(CE, 1300MWe)



Latest Codes &  
Standards

## Improved OPR 1000

- In Operation - SKN 1/2, SWN 1/2

## OPR 1000

- In Operation - Hanbit 3/4 ('95/'96) - Hanul 3/4 ('98/'99)
- Hanbit 5/6 ('02/'02) - Hanul 5/6 ('04/'05)

## NSSS Design

Palo Verde #2 (CE, 1300MWe)

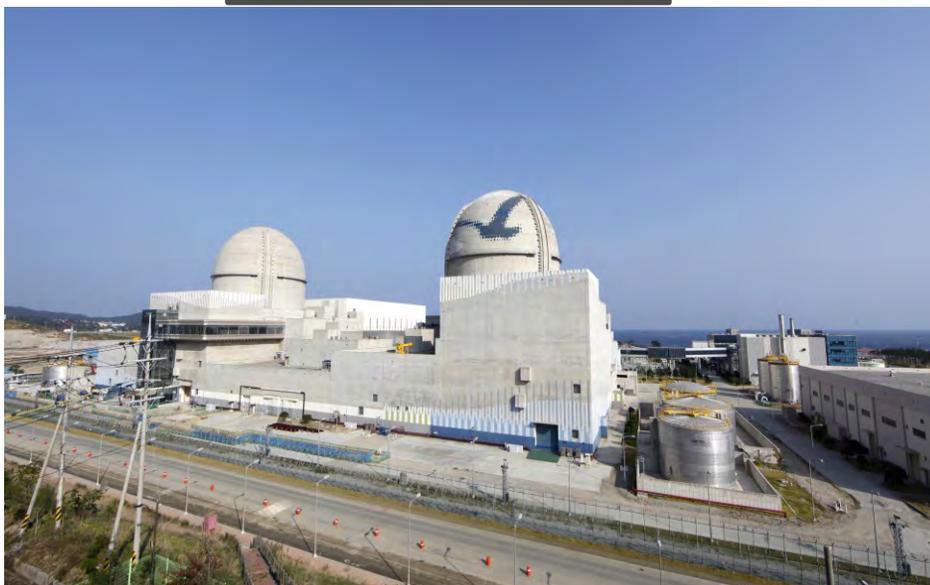
## Core Design

ANO #2 (CE, 1000MWe)

# APR1400 Design Features

- APR1400 referenced Shin Kori units 3&4.
- APR1400 is an essentially complete design
  - Construction completed in Korea (Shin Kori Units 3 & 4)
    - OL for Shin Kori Unit 3 issued on October 2015
    - Criticality reached on December 2015
    - Commercial operation scheduled on October 2016
  - Under-construction in UAE (Barakah Units 1 - 4)

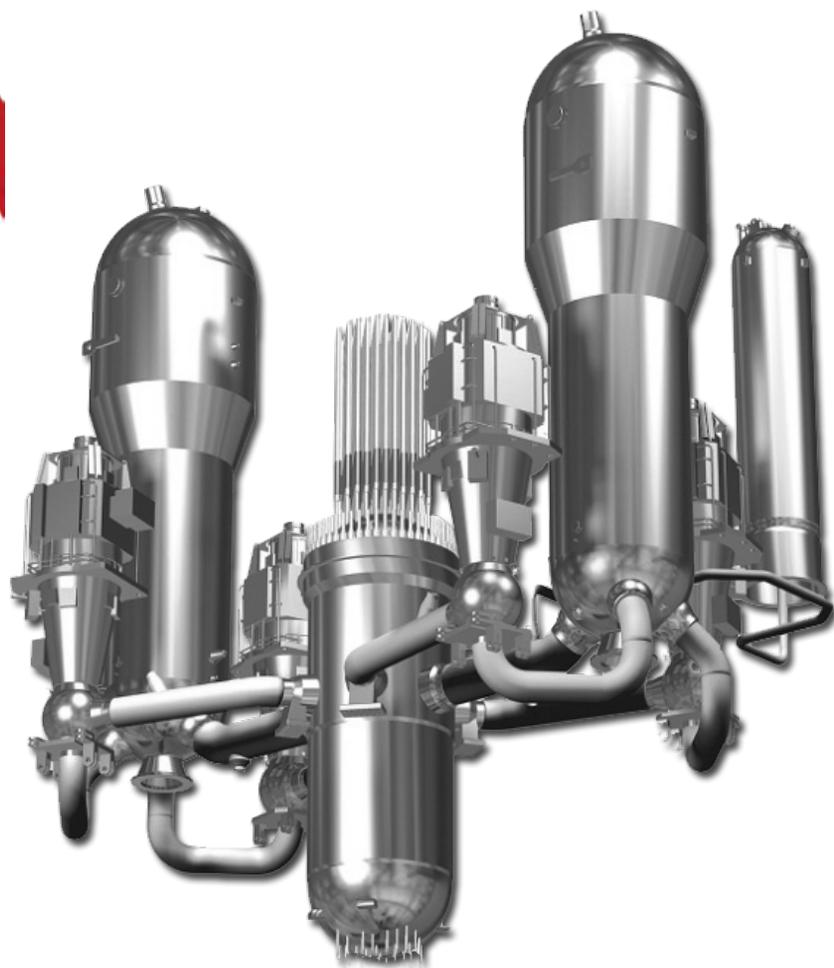
SKN 3&4, Korea



Barakah, UAE



# Design Features of the APR1400



- **Design Life Time : 60 Years for Class 1 Major Equipment**
- **Power : 4000MWth / 1400MWe**
- **Two-Loop : 2 HLs, 2 SGs, 4 RCPs, 4 CLs, 1 Pzr**
- **Primary Operating condition:**
  - **Pressure : 2250psia**
  - **HL/CL Temp. : 615/555 °F**
- **Secondary Operating condition:**
  - **Pressure : 1000psia**
  - **MF/MS Temp. : 450/545 °F**
- **Pzr Free volume : 2400 ft<sup>3</sup>**
- **SG U-tube : 13102/SG, Alloy 690TT**

# APR1400 for NRC DC(1/2)

## Basic approach of design change for NRC DC

- **Retain reference plant design (SKN 3&4)**
  - To take advantage of proven safety and performance
- **Meet US NRC Regulation Guidance effective on Aug. 2014**
  - Six month before the target docketing date

# APR1400 for NRC DC(2/2)

## Special Design Considerations for NRC DC

### ■ Enhance SBO coping capability

- Gas turbine generator for AAC source, 16 hr battery, FLEX implementation

### ■ Improve the tolerance to the beyond design basis

- Analysis of aircraft impact by 10CFR50.150
- Application of LOLA (loss of large area) design requirement
- Application of physical security requirement

### ■ Robust design for the design base accidents

- GSI-191 for LBLOCA
- Diverse reactor protection systems for common cause failures
- Application of FEM model to seismic design

# Design Differences between APR1400 and System 80+

## Containment

- System80+ : Spherical Steel
- APR1400 : Cylindrical PS Concrete

## Thermal Power

- System80+ : 3,931 MWt
- APR1400 : 4,000 MWt

## Hot-leg Temp.

- System80+ : 621F
- APR1400 : 615F

SIS: safe injection system  
 DVI: direct vessel injection  
 POSRV: pilot operated safety relief valve  
 IHA: integrated head assembly  
 CFS: core flooding system  
 PAR: passive autocatalytic recombiner  
 IVR: in-vessel retention  
 ERVC: external reactor vessel cooling

## RCS OPP / RD System

- System80+ : 4 PSV + 2 SDS
- APR1400 : 4 POSRV

## RV Upper Structure

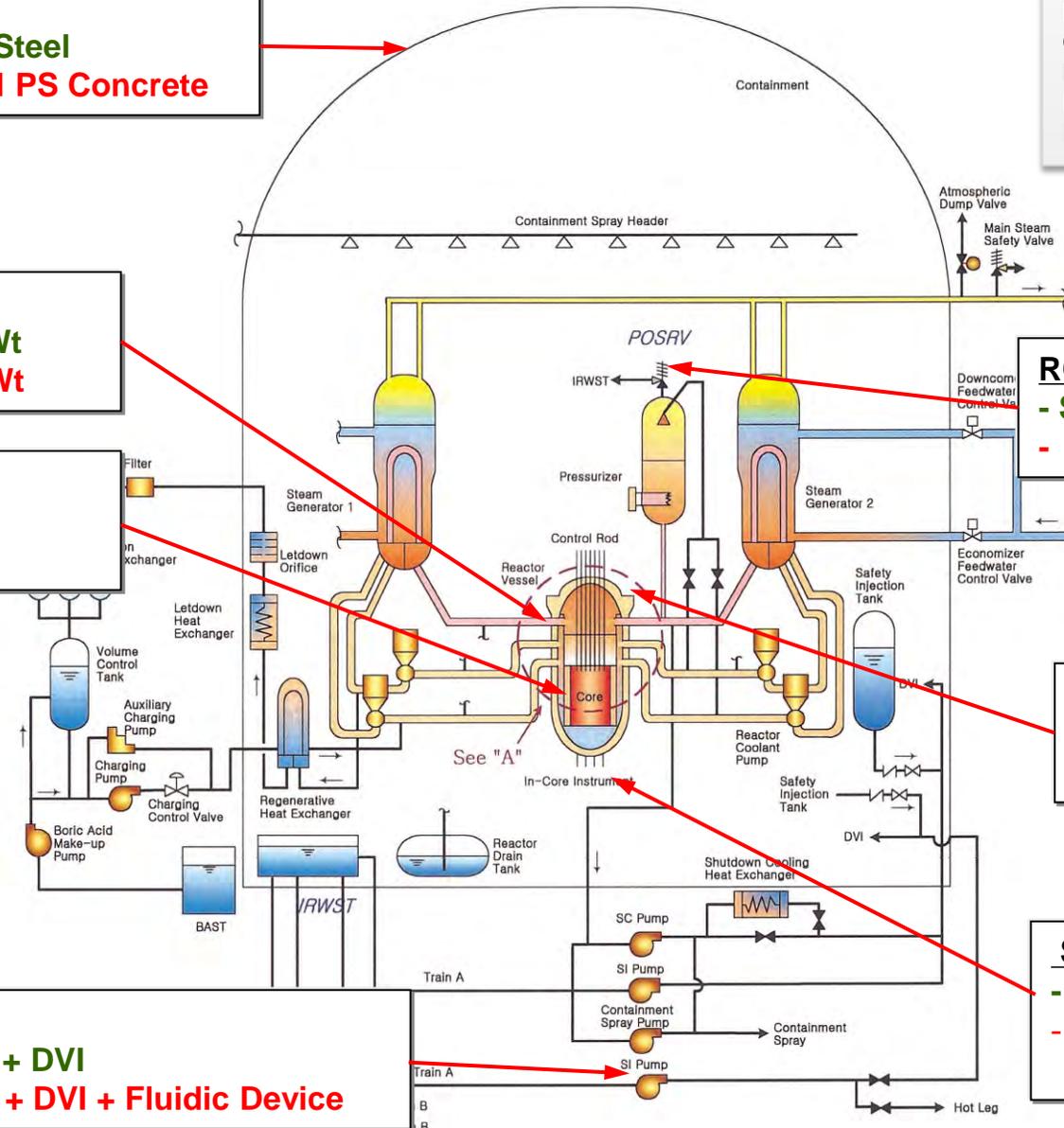
- System80+ : Conventional
- APR1400 : IHA

## Severe Accident

- System80+ : CFS
- APR1400 : CFS + PAR, IVR/ERVC

## Safety Injection System

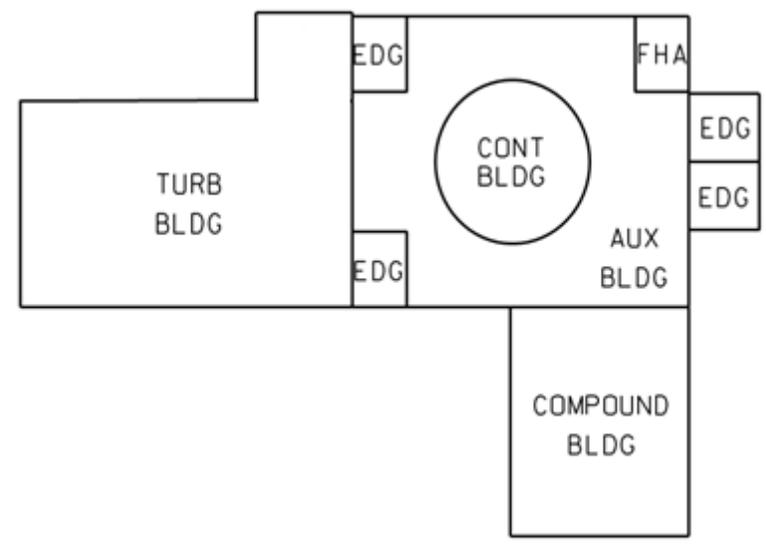
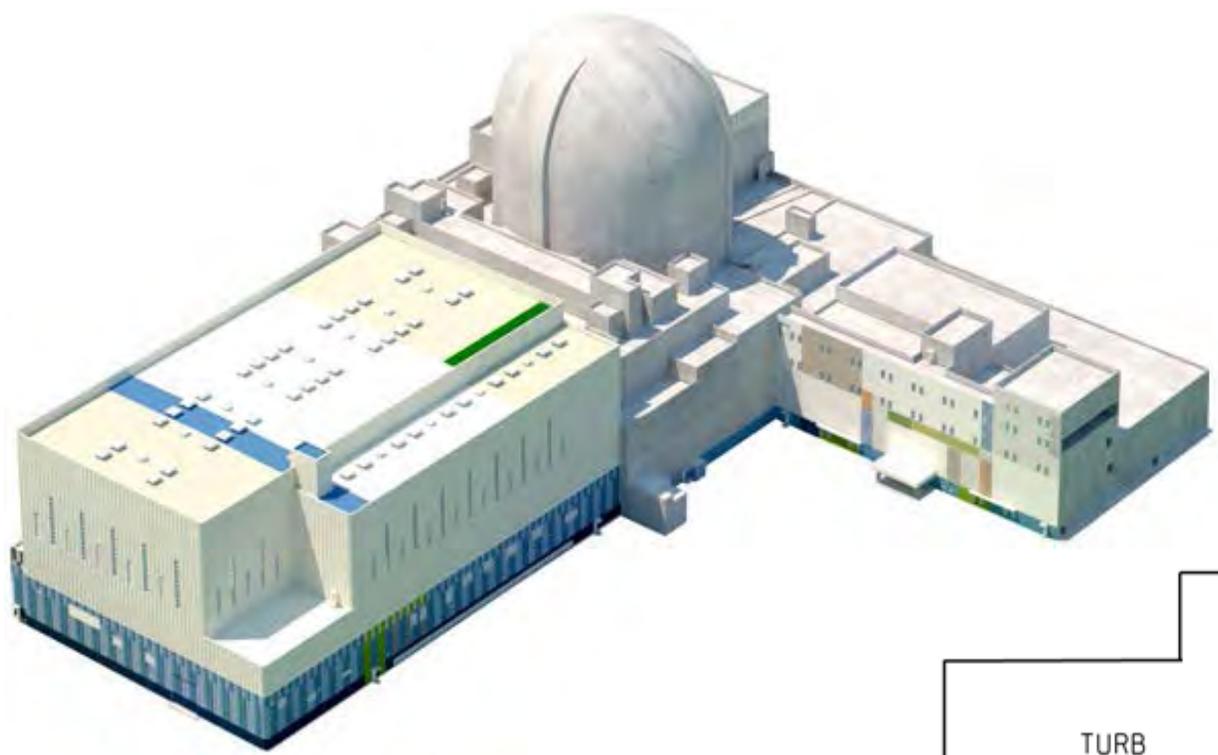
- System80+ : 4 train SIS + DVI
- APR1400 : 4 train SIS + DVI + Fluidic Device



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# General Arrangement (1/3)

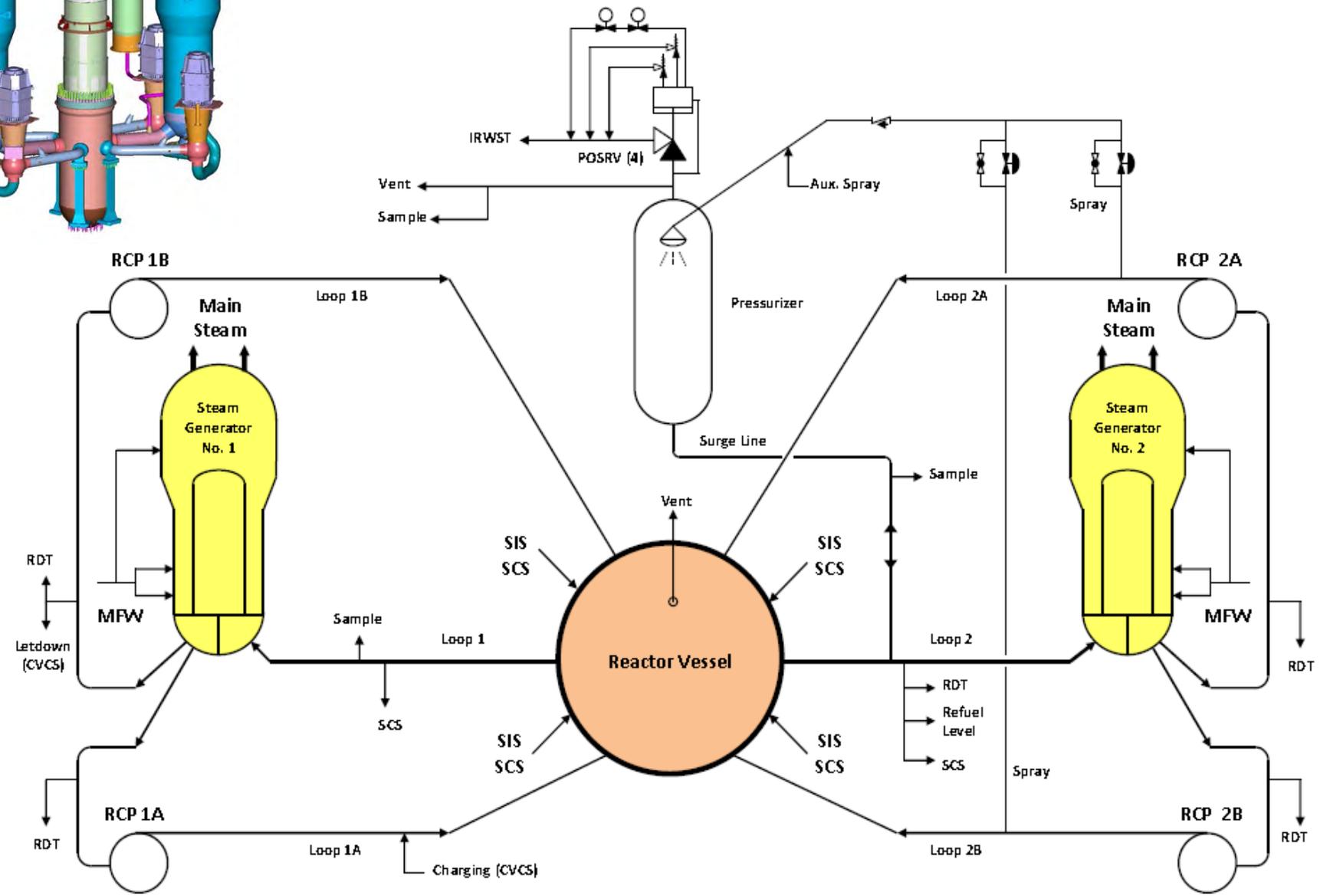
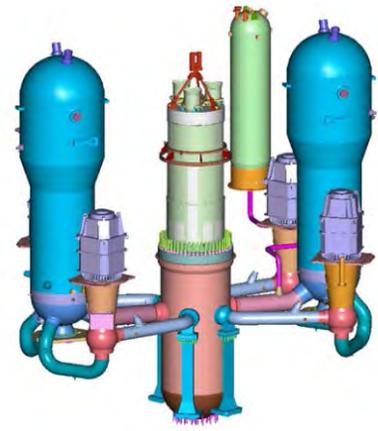
## Plant General Arrangement



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# General Arrangement (2/3)

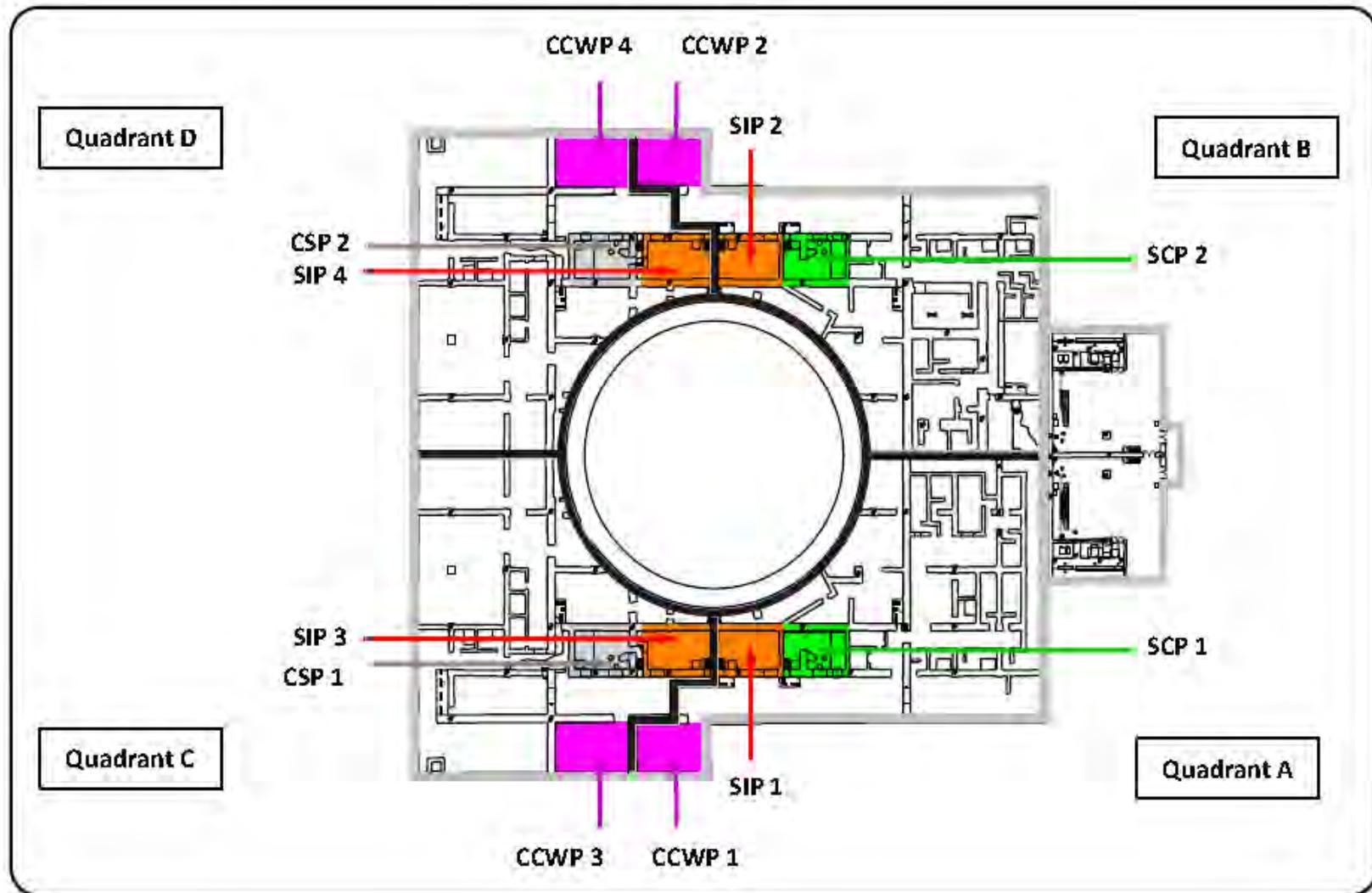
## RCS Arrangement Plane



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# General Arrangement (3/3)

## Quadrant Arrangement of Aux. Building



SIP : Safety Injection Pump  
 SCP : Shutdown Cooling Pump  
 CSP : Containment Spray Pump  
 CCWP : Component Cooling Water Pump

# Design Review Status

Task	Description	Target Date
Phase I	PSER and RAI <b>Completed</b>	Feb. 2016 <b>Jan. 29 2016</b>
Phase II	SER with Open Items <b>(Underway)</b>	Nov. 2016
Phase III	ACRS Review of SER with Open Items <b>(Underway)</b>	Jun. 2017
Phase IV	Advanced SER with No Open Items <b>(Underway)</b>	Dec. 2017
Phase V	ACRS Review of Advanced SER with No Open Items	Jun. 2018
Phase VI	Final SER with No Open Items	Sep. 2018

# Summary

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- **The APR1400 adopted proven technologies from the operation of OPR1000.**
- **The APR1400 used safety analysis codes and methodologies of the certified System 80+.**
- **The APR1400 standard design approval was issued by Korean regulatory authority in 2002.**
  - The first unit of the APR1400, Shin-Kori Unit 3, has been constructed and its commercial operation is scheduled on October 2016.
- **The APR1400 is an essentially complete design.**



Thank you

# APR 1400 DCA

## Chapter 2: Site Characteristics



**KEPCO/KHNP**  
**Sep. 21~22. 2016**

**Presented by: Kwang-Hoon Koh, Dong-Su Lee**

# Contents

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- **Overview of Chapter 2**
  - **List of Submitted Documents**
  - **RAI Summary**
  - **Scope**
- **Site Characteristics**
  - **Subsection Outline**
  - **List of RAIs**
- **Key Review Items**
- **Summary**
- **Attachments**

# Overview of Chapter 2

## ➤ List of Submitted Documents

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002 -P & NP	APR1400 Design Control Document Tier 2: Chapter 2 Site Characteristics	0	DCD	ML15006A041
APR1400-K-X-IT-14001 -P & NP	APR1400 Design Control Document Tier 1	0	DCD	ML15006A039

## ➤ RAI Summary

No. of Questions	No. of Responses	Not Responded	No. of OI
33	33	0	0

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# Overview of Chapter 2

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## ➤ Scope

This chapter provides the site interface requirements for the APR1400 Design including geological, seismological, hydrological and meteorological characteristics.

The COLA is to confirm site characteristics are bounded, or provide site specific qualification.

# Site Characteristics

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- The APR1400 is designed on the basis of a set of assumed site-related parameters.
- The parameters were selected to include a range of potential nuclear power plant sites in the United States.
- Table 2.0-1 is a summary identifying specific site parameters for the APR1400 design. (Table provided attachment)

# Site Characteristics (cont.)

## ➤ Subsection Outline

Section	Title	Description
2.1	Geography and Demography	<b>Site Specific Characteristics</b>  The COL applicant will provide site-specific Information * on the site location and a description of the site, exclusion authority and control, and population distribution, as stated in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.206
2.2	Nearby Industrial, Transportation, and Military Facilities	<b>Site Specific Characteristics</b> See above

\* Complete list of COL Information Items for Chapter 2 is provided at end of presentation

# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.3	Meteorology	<p>1. Snow (winter precipitation)</p> <ul style="list-style-type: none"><li>a. 100 year snowpack roof load(normal) : 2.873 kPa (60 psf)</li><li>b. Extreme winter precipitation roof load : 5.985 kPa (125 psf)</li><li>c. Depth of 48-hr probable maximum winter precipitation (PMWP) : 914.4 mm (36 inch)</li><li>d. Basis : HMR (NOAA), ASCE/SEI 7, EPRI URD</li></ul>

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# Site Characteristics (cont.)

➤ Subsection Outline (cont.)

Section	Title	Description
2.3 (cont'd)	Meteorology	<p>2. Extreme wind</p> <ul style="list-style-type: none"> <li>a. 50 year 3-second wind gust speed : 64.8 m/s (145 mph), exposure category C</li> <li>b. Importance factor : 1.15 for seismic category I/II structures</li> <li>c. Basis : ASCE/SEI 7</li> </ul> <p>3. Tornado</p> <ul style="list-style-type: none"> <li>a. Maximum tornado wind speed : 102.8 m/s (230 mph)</li> <li>b. Maximum translational speed : 20.6 m/s (46 mph)</li> <li>c. Maximum rotational speed : 82.2 m/s (184 mph)</li> <li>d. Radius of maximum rotational speed : 45.7 m (150 ft)</li> <li>e. Maximum pressure differential : 8.274 kPa (1.2 psi)</li> <li>f. Rate of pressure drop : 3.447 kPa/s (0.5 psi/s)</li> <li>g. Basis : RG 1.76</li> </ul> <p>4. Hurricane</p> <ul style="list-style-type: none"> <li>a. Maximum 3-second wind gust speed : 116 m/s (260 mph)</li> <li>b. Basis : RG 1.221</li> </ul>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.3 (cont'd)	Meteorology	<p><b>5. HVAC outdoor design temperature</b></p> <p><b>a. 5% exceedance values :</b></p> <ul style="list-style-type: none"><li>• maximum : 35.0°C (95°F) dry bulb, 25.0°C (77°F) coincident wet bulb</li><li>• minimum : -20.6°C (-5°F) dry bulb</li></ul> <p><b>b. 1% exceedance values :</b></p> <ul style="list-style-type: none"><li>• maximum : 37.8°C (100°F) dry bulb, 25.0°C (77°F) coincident wet bulb</li><li>• minimum : -23.3°C (-10°F) dry bulb</li></ul> <p><b>c. 0% exceedance values (historical limit excluding peak &lt; 2 hours) :</b></p> <ul style="list-style-type: none"><li>• maximum : 46.1°C (115°F) dry bulb, 26.7°C (80°F) coincident wet bulb</li><li>• minimum : -40.0°C (-40°F) dry bulb</li></ul>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.3 (cont'd)	Meteorology	<b>6. Ambient design temperature for cooling tower</b>  a. <b>5% exceedance values for circulating water system</b> <ul style="list-style-type: none"><li>• maximum : 26.1°C (79°F) non-coincident wet bulb,</li><li>• minimum : -20.6°C (-5°F) dry bulb</li></ul> b. <b>0% exceedance values for essential service water system (historical limit excluding peak &lt; 2 hours)</b> <ul style="list-style-type: none"><li>• maximum : 27.2°C (81°F) non-coincident wet bulb</li><li>• minimum : -40.0°C(-40°F) dry bulb</li></ul>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.3 (cont'd)	Meteorology	<p><b>7. Atmospheric dispersion factors</b></p> <p><b>a. Purpose</b></p> <ul style="list-style-type: none"> <li>• Dose to the public during normal operation</li> <li>• Radiological consequence analyses for DBAs</li> <li>• MCR/TSC habitability analysis</li> </ul> <p><b>b. Regulatory Basis</b></p> <ul style="list-style-type: none"> <li>• SRP 2.3.4 – 2.3.5 (Rev.3)</li> <li>• RG 1.23 (Rev.1), 1.111 (Rev.1), 1.145 (Rev.1), 1.194</li> </ul> <p><b>c. Bounding atmospheric dispersion factors and deposition factors at the offsite locations are presented in Table 2.0-1.</b></p> <p><b>d. The 95<sup>th</sup> percentile on-site atmospheric dispersion factors for the MCR/TSC habitability analysis are presented in Table 2.3-2 through 2.3-12.</b></p> <p><b>e. The input variables including post-accident gaseous vent and intake locations used for on-site <math>\chi/Qs</math> are shown in Table 2.3-13 and Figure 2.3-1.</b></p>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.3 (cont'd)	Meteorology	<p>7. Atmospheric dispersion factors (cont'd)</p> <p>f. Design features</p> <ul style="list-style-type: none"> <li>• Long-term <math>\chi/Q</math> &amp; <math>D/Q</math> :                             <ul style="list-style-type: none"> <li>- Used the bounding values of <math>2.0E-05 \text{ s/m}^3</math> for <math>\chi/Q</math> and <math>2.0E-07 \text{ m}^{-2}</math> for <math>D/Q</math> at EAB to bound most US sites</li> </ul> </li> <li>• Short-term <math>\chi/Q</math> :                             <ul style="list-style-type: none"> <li>- Used <math>1.0E-03 \text{ s/m}^3</math> at EAB based on EPRI-URD</li> </ul> </li> <li>• On-site <math>\chi/Q</math> :                             <ul style="list-style-type: none"> <li>- Selected the most limiting meteorological condition among 6 U.S. NPP sites</li> <li>- Added sufficient margin to envelope most of U.S. sites</li> <li>- ARCON96 code is used</li> </ul> </li> </ul>

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# Site Characteristics (cont.)

Postulated Site Parameter Values for APR1400 Compared to Corresponding Site Characteristics and Other Design Site Parameter Values

Site / Design	Site Boundary Annual Average X/Q (s/m <sup>3</sup> ) (No Decay/Undepleted)	Site Boundary Annual Average X/Q (s/m <sup>3</sup> ) (2.26-Day Decay/Undepleted)	Site Boundary Annual Average X/Q (s/m <sup>3</sup> ) (8.00-Day Decay/Depleted)	Site Boundary Annual Average D/Q (1/m <sup>2</sup> ) (Relative Deposition)
APR1400	2.00E-05	1.99E-05	1.84E-05	2.00E-07
	805 m	805 m	805 m	805 m
Fermi (RWB Vent Stack)	1.10E-05	1.10E-05	1.00E-05	4.60E-08
	981 m	981 m	981 m	772 m
South Texas Project	8.10E-06	8.10E-06	7.30E-06	6.40E-08
	1,115 m	1,115 m	1,115 m	1,115 m
V.C. Summer	5.80E-06	5.80E-06	5.30E-06	1.60E-08
	805 m	805 m	805 m	805 m
Vogtle	5.50E-06	5.50E-06	5.00E-06	1.70E-08
	800 m	800 m	800 m	800 m
Clinton ESP	2.04E-06	2.04E-06	1.84E-06	1.46E-08
	1,025 m	1,025 m	1,025 m	1,025 m
Grand Gulf ESP	8.80E-06	-----	-----	1.20E-08
	1,368 m	-----	-----	933 m
North Anna ESP	3.70E-06	3.70E-06	3.30E-06	1.20E-08
	1,416 m	1,416 m	1,416 m	998m
PSEG Nuclear ESP	1.00E-05	1.00E-05	9.50E-06	4.10E-08
	386 m	386 m	386 m	386 m
AP1000 DCD	<= 2.00E-05	-----	-----	-----
	805	-----	-----	-----

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.4	Hydrologic Engineering	<p>1. Groundwater and Flood elevation</p> <ul style="list-style-type: none"><li>a. Groundwater elevation : 0.61m (2 ft) below plant grade</li><li>b. Maximum level for flood : 0.3 m (1 ft) below plant grade</li><li>c. Basis : EPRI URD</li></ul> <p>2. Maximum rainfall precipitation rate (1 mi<sup>2</sup>) :</p> <ul style="list-style-type: none"><li>a. hourly 492.7 mm (19.4 inch) per hour</li><li>b. short-term of 157.5 mm (6.2 inch) in 5 minutes</li><li>c. Basis : HMR (NOAA), EPRI URD</li></ul>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.5	Geology, Seismology, and Geotechnical Engineering	<ol style="list-style-type: none"><li>1. SSE : 0.3g peak ground acceleration</li><li>2. CSDRS (Certified Seismic Design Response Spectra) :<ol style="list-style-type: none"><li>a. SSE is based on CSDRS.</li><li>b. Enhanced spectra in high frequency range of RG 1.60 : Figure 2.0-1 and 2.0-2<ul style="list-style-type: none"><li>• Frequency at the PGA is changed from 33 Hz to 50 Hz.</li><li>• Spectral amplitude at 25 Hz are set to RG 1.60 response spectra at 25 Hz scaled by factor 1.30</li></ul></li></ol></li><li>3. HRHF (Hard Rock High Frequency) RS:<ol style="list-style-type: none"><li>a. Peak ground acceleration : 0.46g</li><li>b. Response spectra : Figure 2.0-3 and 2.0-4</li></ol></li></ol>

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# Site Characteristics (cont.)

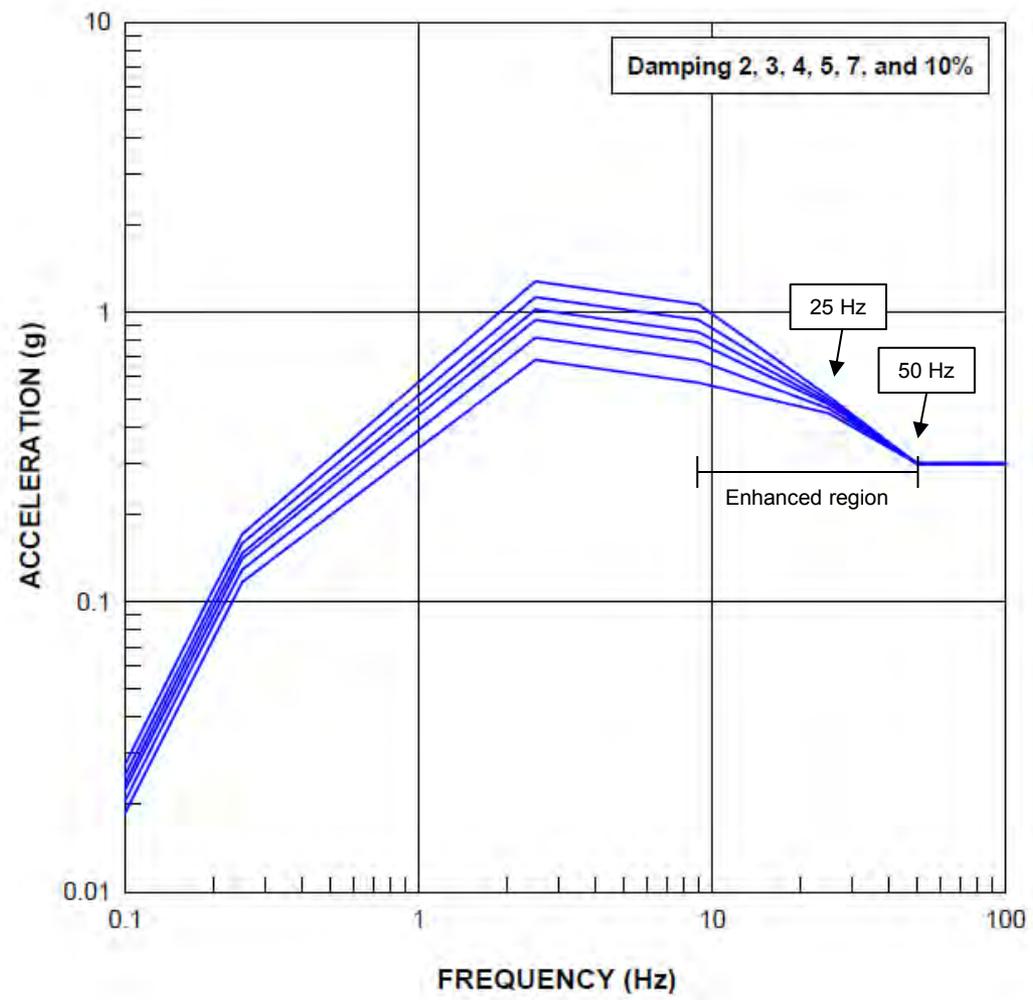


Figure 2.0-1 Horizontal Certified Seismic Design Response Spectra

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# Site Characteristics (cont.)

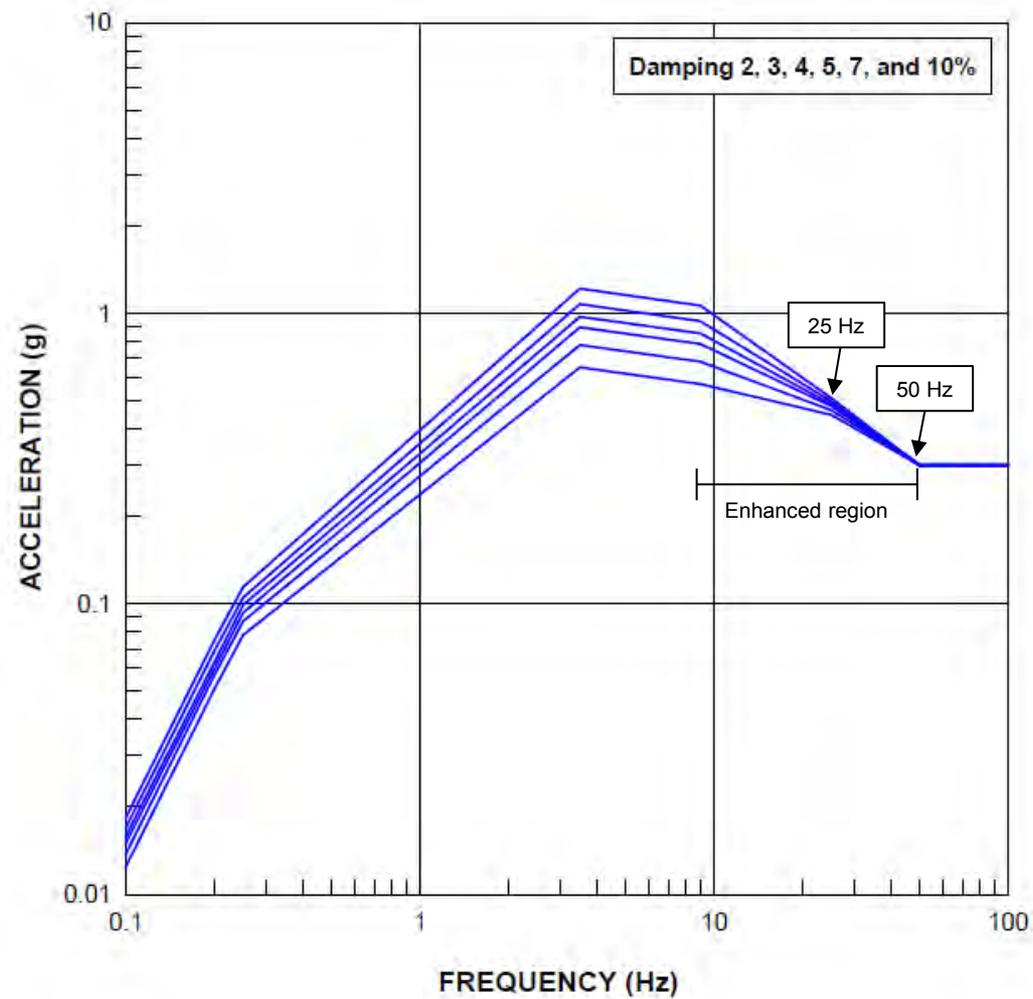


Figure 2.0-2 Vertical Certified Seismic Design Response Spectra

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# Site Characteristics (cont.)

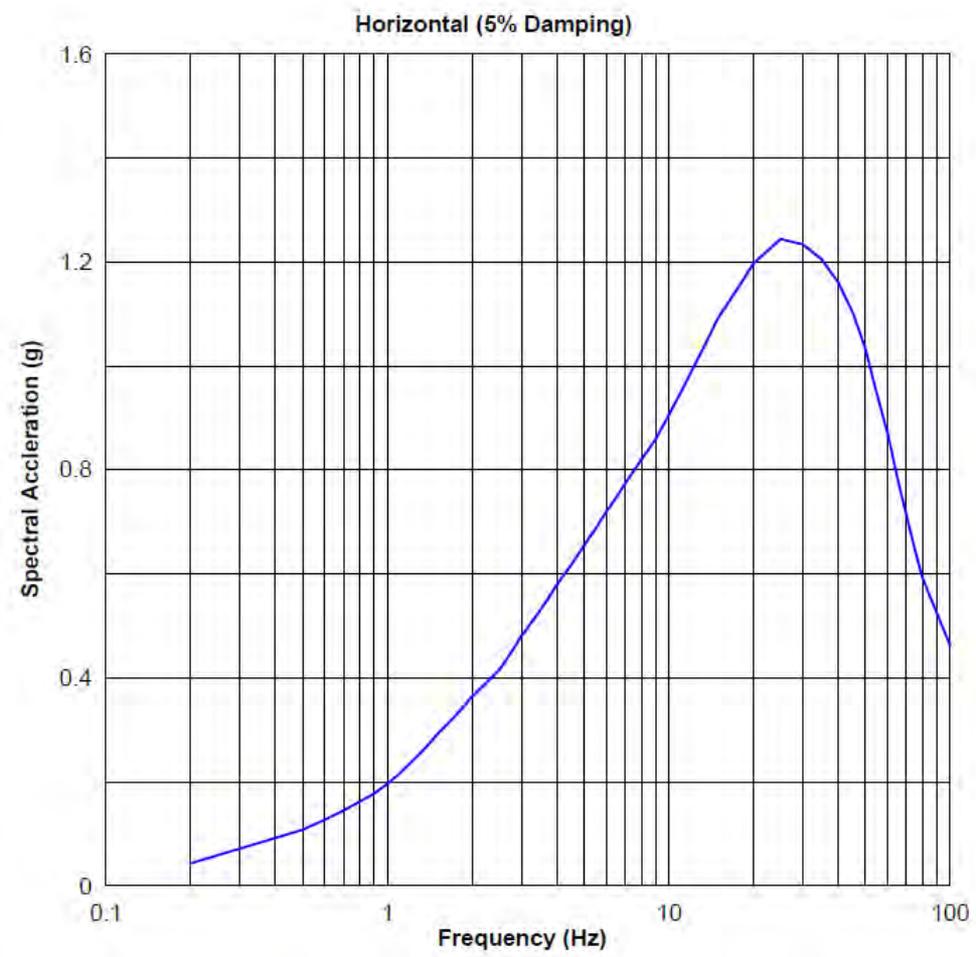


Figure 2.0-3 Horizontal HRHF Response Spectra

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# Site Characteristics (cont.)

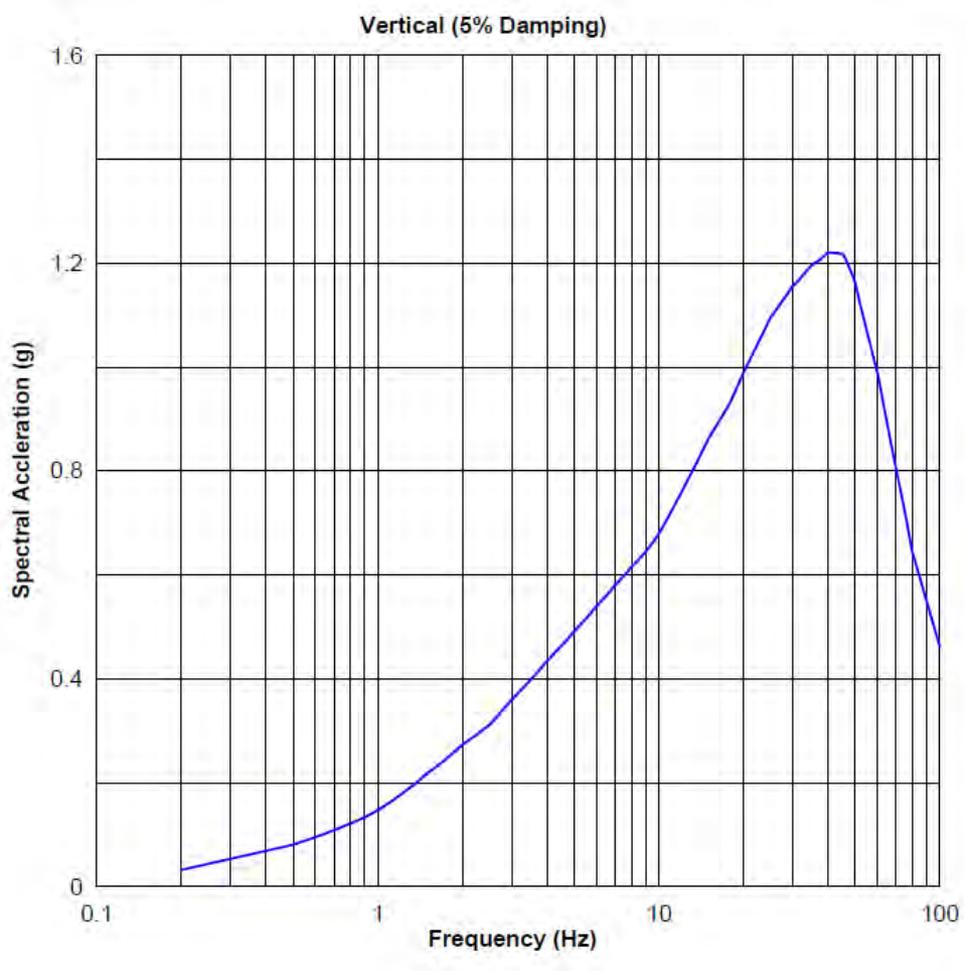


Figure 2.0-4 Vertical HRHF Response Spectra

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# Site Characteristics (cont.)

➤ Subsection Outline (cont.)

Section	Title	Description
2.5 (cont'd)	Geology, Seismology, and Geotechnical Engineering	<p>4. Surface tectonic and nontectonic deformation at site :</p> <p>a. The COL applicant will check the deformation potentials and confirm that the effects are within the design basis of the facility.</p> <p>5. Maximum dip angle for soil uniformity : 20 deg.</p> <p>6. Subsurface stability:</p> <p>a. Minimum allowable static bearing capacity : 712 kPa (15,000 psf)</p> <p>b. Minimum allowable dynamic bearing capacity, normal conditions plus SSE : 2872.8 kPa (60,000 psf)</p> <p>c. Minimum shear wave velocity at SSE input at ground surface : 1,000 ft/s</p> <p>d. Liquefaction potential : None (for Seismic Category I structures)</p> <p>e. Minimum soil angle of internal friction : 35 degrees below the footprint of the Seismic Category I structures at their excavation depth</p>

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# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.5 (cont'd)	Geology, Seismology, and Geotechnical Engineering	<b>7. Allowable settlement</b>  <b>a. Maximum allowable differential settlement inside building :</b> <b>12.7 mm (0.5 inch) per 15.24 m (50 ft) in any direction for the Seismic Category I structures</b>  <b>b. Maximum allowable differential settlement between buildings :</b> <b>76.2mm (3.0 inch) between NI Common Basemat and EDG Building &amp; DFOT Building, 12.7 mm (0.5 inch) between other adjacent buildings</b>

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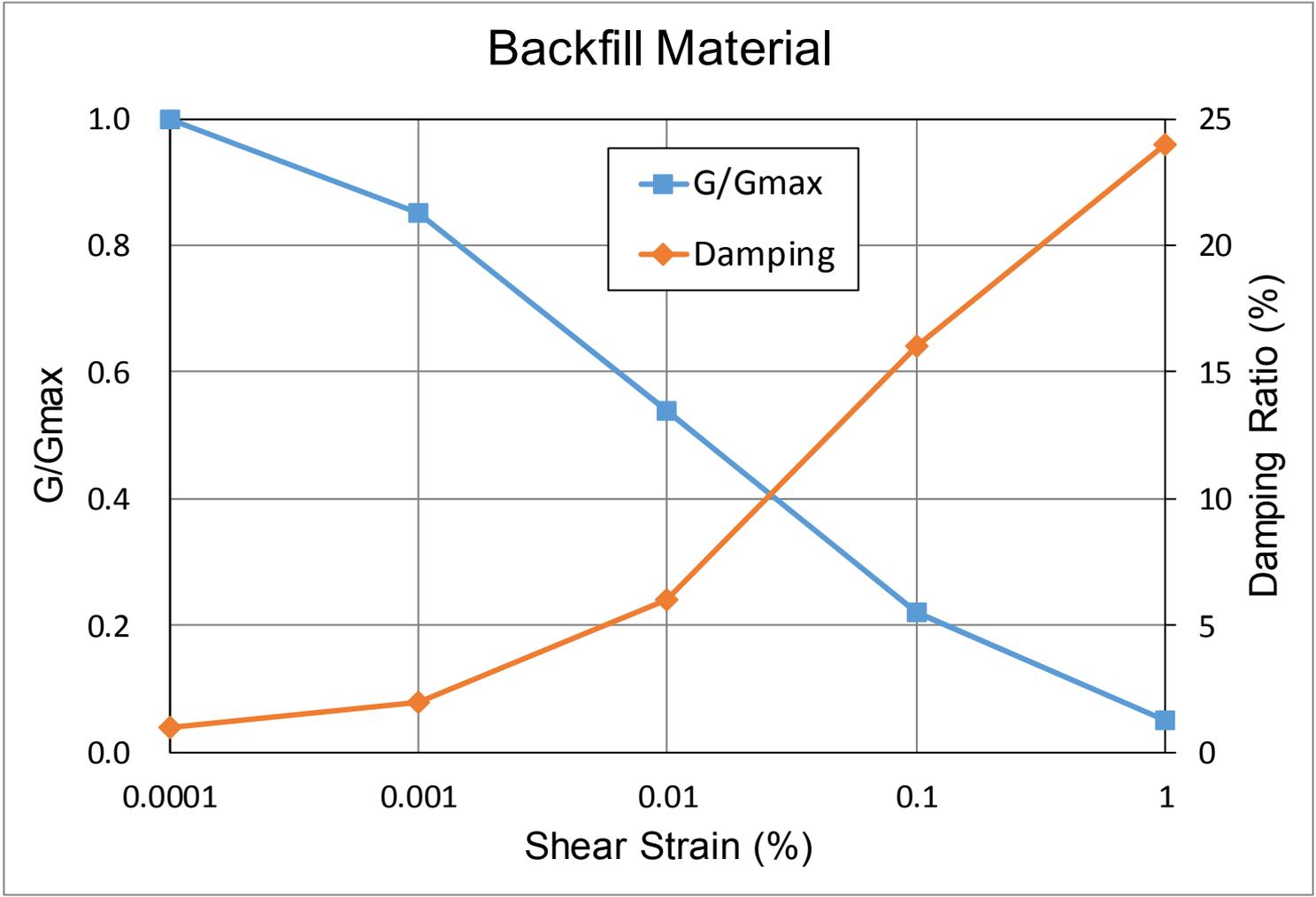
# Site Characteristics (cont.)

## ➤ Subsection Outline (cont.)

Section	Title	Description
2.5 (cont'd)	Geology, Seismology, and Geotechnical Engineering	<b>8. Backfill material</b>
		a. Density : 2.2 g/cm <sup>3</sup> (137 pcf)
		b. Dynamic Poisson's ratio : 0.33
		c. G/G <sub>max</sub> vs shear strain relation
		d. Damping vs shear strain relation
		Shear Strain(%)    G/G <sub>max</sub> Damping (%)
		-----
1.0	0.05	24.0
0.1	0.22	16.0
0.01	0.54	6.0
0.001	0.85	2.0
0.0001	1.00	1.0

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# Site Characteristics (cont.)



<G/G<sub>max</sub> vs Shear Strain & Damping vs Shear Strain for Backfill>

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# Site Characteristics (cont.)

## ➤ List of RAIs

RAI No.	Question No.	Description
8012	02.03.01-1&2	Update the parameter table
8012	02.03.01-3	HVAC design temperature in Table 2.0-1
8211	02.03.04-4	MCR and TSC Location
7912	02.03.04-3	Offsite $\chi/Q$ Values
CQ*	02.03.04-1	Adding onsite $\chi/Q$ into Table 2.0-1
7912	02.03.04-2	Request Met. Data
CQ*	02.03.04-3	Explanation of the Met. Data in Table 2.3-13
8211	02.03.04-5	The source – receptor pairs and The most limiting Met. Data of 6 US sites.
7912	02.03.04-1	Revision of the all calculation without reduction factor of 2
7913	02.03.05-1	Confirmation of the $\chi/Q$ and D/Q

\* CQ : Clarification Question

# Site Characteristics (cont.)

## ➤ List of RAIs (cont.)

RAI No.	Question No.	Description
8012	02.03.01-4	Extreme winter precipitation roof load
7827	02.05.04-1	Soil Uniformity Requirement
7827	02.05.04-2	Dynamic bearing capacity
7828	02.05.02-1	Applicable NRC Reg. Guides
7829	02.05.03-1	Tectonic surface deformation
7847	02.05.04-3	Minimum soil angle of internal friction
7847	02.05.04-4	Minimum dynamic properties requirements for Structural Fill Granular
7847	02.05.04-5	Lean concrete backfill
7847	02.05.04-6	Minimum dynamic shear modulus
7847	02.05.04-7	Potential for Liquefaction

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# Site Characteristics (cont.)

## ➤ List of RAIs (cont.)

RAI No.	Question No.	Description
7847	02.05.04-8	Static and dynamic parameter for EDG and DFOT
7847	02.05.04-9	Static and dynamic bearing demand and capacity
7847	02.05.04-10	Maximum differential settlement
7848	02.05.02-3	Soil profiles
8018	02.05.05-1	Stability of slope

✓ All RAIs were address during the NRC Staff's review and no open items were identified .

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# Key Review Items

## ➤ RAI NO. 8012 Question 02.03.01-3a, NRC provided 8/4/15, KHNP addressed 11/4/15

- **Description of Issue** : NRC staff noted that almost all the COL and ESP applications previously reviewed identified 0-percent exceedance non-coincident wet-bulb temperatures greater than the corresponding site parameter value (81 °F) for APR1400.
- **Resolution** : NRC had certified the U.S. Advanced Boiling-Water Reactor design in May 1997 and had recently performed a detailed review of the U.S. Evolutionary Power Reactor (EPR) design, in which plants, 81 °F for the non-coincident wet-bulb temperature site parameter was used as part of the US ABWR certified design and as part of the US EPR review. KHNP stated that APR1400 design ambient temperature site parameters and values for all percent exceedance levels are the same as those specified in EPRI URD for Advanced Light Water Reactors. Therefore, the 0 percent exceedance wet bulb temperature of 27.2 °C (81 °F) used in the APR1400 DCD FSAR is reasonable and valid for use today.

# Key Review Items (cont.)

➤ RAI NO. 7912 Question 02.03.04-1 Rev. 2, NRC provided 6/1/15, KHNP addressed 6/1/16

- **Description of Issue** : Since both the air intakes of the Aux. Building (No. 3 & 4 in the figure) are in the same wind direction window (i.e., within 90°) from the release point 7, the two intakes do not meet the criteria in RG 1.194 for a reduction factor of 2.
- **Resolution** : KHNP updated the  $\chi/Q$  calculation without credit of the reduction. The resultant MCR/TSC doses for all DBAs are within the acceptance criteria.

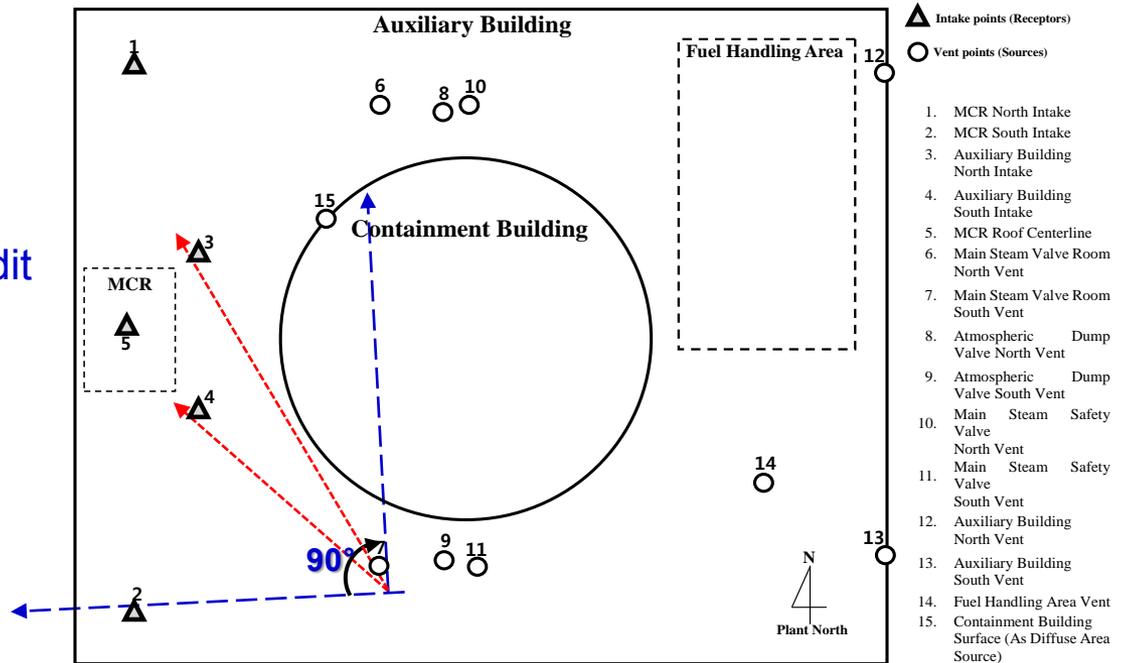


Figure 2.3-1 Locations of Post-accident Gaseous Vents and Intakes

# Summary

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- Chapter 2 defines site parameters of the APR1400 standard plant and also identifies important site parameters.
- The COLA is to confirm that DCD site parameters envelope site-specific parameters.
- Table 2.0-1 identifies the site parameters for the APR1400 Design.

# Acronyms

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- **KHNP: Korea Hydro & Nuclear Power**
- **COL / COLA: Combined License / Combined License Applicant**
- **PMWP: Probable Maximum Winter Precipitation**
- **HMR: Hydrometeorological Report**
- **NOAA: National Oceanic and Atmospheric Administration**
- **ASCE: American Society of Civil engineers**
- **SEI: Structural Engineering Institute**
- **HVAC: Heating, Ventilation, and Air Conditioning**
- **MCR / TSC: Main Control Room / Technical Support Center**
- **DBA: Design Basis Accident**
- **SRP: Standard Review Plan**
- **RG: Regulatory Guide**
- **EAB: Exclusion Area Boundary**
- **SSE: Safe Shutdown Earthquake**
- **PGA: Peak Ground Accelaration**
- **G/Gmax: Shear Modulus of Soil/Maximum Shear Modulus of Soil**

# Attachment

## ➤ Table 2.0-1 Site Parameters (1/4)

Parameter Description	Parameter Value
Maximum Elevation of Groundwater	0.61 m (2 ft) below plant grade <sup>(1)</sup> in the vicinity of the SSCs important to safety
Maximum Flood Elevation	0.30 m (1 ft) below plant grade in the vicinity of the SSCs important to safety
Precipitation	
- Maximum precipitation rate (1 mi <sup>2</sup> )	492.7 mm (19.4 in.) over 1 hour 157.5 mm (6.2 in.) in 5 minutes
- 100-year snowpack roof load	2.873 kPa (60 lbf/ft <sup>2</sup> )
- Extreme winter precipitation roof load	5.985 kPa (125 lbf/ft <sup>2</sup> )
- Depth of 48-hour probable maximum winter precipitation (PMWP)	914.4 mm (36 in.)
HVAC Outdoor Design Temperature <sup>(5)</sup>	
- 5 % exceedance values	
· Maximum	35.0 °C (95 °F) dry bulb and 25.0 °C (77 °F) coincident wet bulb
· Minimum	-20.6 °C (-5 °F) dry bulb
- 1 % exceedance values	
· Maximum	37.8 °C (100 °F) dry bulb and 25.0 °C (77 °F) coincident wet bulb
· Minimum	-23.3 °C (-10 °F) dry bulb
- 0 % exceedance values (historical limit excluding peaks < 2 hours)	
· Maximum	46.1 °C (115 °F) dry bulb and 26.7 °C (80 °F) coincident wet bulb
· Minimum	-40.0 °C (-40 °F) dry bulb
Ambient Design Temperature for Cooling Tower	
- Ambient 5 % exceedance values for circulating water system (CWS)	
· Maximum	26.1 °C (79 °F) non-coincident wet bulb
· Minimum	-20.6 °C (-5 °F) dry bulb
- Ambient 0 % exceedance values for essential service water system (ESWS) <sup>(5)</sup> (historical limit excluding peaks < 2 hours)	
· Maximum	27.2 °C (81 °F) non-coincident wet bulb
· Minimum	-40.0 °C (-40 °F) dry bulb

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ Table 2.0-1 Site Parameters (2/4)

Parameter Description	Parameter Value
Extreme Wind - 50-year 3-second wind gust speed - Importance factor	64.8 m/s (145 mph) 1.15 <sup>(2)</sup>
Tornado Parameters - Maximum horizontal wind speed - Translational speed - Rotational speed - Radius of maximum rotational speed - Maximum pressure differential - Rate of pressure drop - Missile spectra	102.8 m/s (230 mph) 20.6 m/s (46 mph) 82.2 m/s (184 mph) 45.7 m (150 ft) 8.274 kPa (1.2 psi) 3.447 kPa/s (0.5 psi/s) Table 2 (Region I) of NRC RG 1.76 (Reference 1)
Hurricane Parameters - Maximum 3-second wind gust speed - Missile spectra	116 m/s (260 mph) Table 1 of NRC RG 1.221 (Reference 2)
Accident Release $\chi/Q$ Values at exclusion area boundary (EAB) · 0-2 hr	$1.00 \times 10^{-3} \text{ s/m}^3$
Accident Release $\chi/Q$ Values at low-population zone (LPZ) · 0-8 hr · 8-24 hr · 24-96 hr · 96-720 hr	$2.20 \times 10^{-4} \text{ s/m}^3$ $1.60 \times 10^{-4} \text{ s/m}^3$ $1.00 \times 10^{-4} \text{ s/m}^3$ $8.00 \times 10^{-5} \text{ s/m}^3$
Annual Average $\chi/Q$ Values at Site Boundary · Undepleted/no decay · Undepleted/2.26-day decay · Depleted/8.00-day decay · Relative deposition factor (D/Q)	$2.00 \times 10^{-5} \text{ s/m}^3$ $1.99 \times 10^{-5} \text{ s/m}^3$ $1.84 \times 10^{-5} \text{ s/m}^3$ $2.00 \times 10^{-7} \text{ 1/m}^2$
Inventory of radionuclides that could seep into the groundwater	See Table 11.2-9
Safe Shutdown Earthquake (SSE)	0.3 g peak ground acceleration

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ Table 2.0-1 Site Parameters (3/4)

Parameter Description	Parameter Value
Certified Seismic Design Response Spectra (CSDRS) Referencing SSE	See Figures 2.0-1 and 2.0-2
Hard Rock High Frequency (HRHF) Response Spectra <sup>(4)</sup>	0.46g peak ground acceleration See Figures 2.0-3 and 2.0-4
Tectonic and Non-tectonic Surface Deformation Potential	See Subsection 2.5.3
Allowable Static Bearing Capacity	The allowable static bearing capacity, including a factor of safety appropriate for the design load combinations, shall be greater than or equal to the maximum static bearing demand of 718.2 kPa (15 ksf). The allowable static bearing capacity is the value of ultimate bearing capacity divided by 3.0.
Allowable Dynamic Bearing Capacity	The allowable dynamic bearing capacity, including a factor of safety appropriate for the design load combinations, shall be greater than or equal to the maximum dynamic bearing demand of 2,872.8 kPa (60 ksf). The allowable dynamic bearing capacity is the value of ultimate bearing capacity divided by 2.0.
Minimum Factor of Safety for Slope on Static condition	1.5
Minimum Factor of Safety for Slope on Dynamic condition (SSE)	1.2
Minimum Shear Wave Velocity	304.8 m/s (1,000 ft/s)
Maximum Dip Angle for Soil Uniformity	20 degrees
Liquefaction Potential	See Subsection 2.5.4.8
Maximum Allowable Differential Settlement inside Building	12.7 mm (0.5 in.) per 15.24 m (50 ft) in any direction for the Seismic Category I structures
Maximum Allowable Differential Settlement between Buildings	76.2 mm (3.0 in.) between NI Common Basemat and EDG Building & DFOT Building 12.7 mm (0.5 in.) between other adjacent buildings
Minimum Soil Angle of Internal Friction	Greater than or equal to 35 degrees below the footprint of the seismic Category I structures at their excavation depth
Slope Failure Potential (yes/no)	No
Backfill Material Density	2.2 g/cm <sup>3</sup> (137 pcf)

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ Table 2.0-1 Site Parameters (4/4)

Parameter Description	Parameter Value		
Backfill Material Dynamic Poisson's Ratio	0.33		
Backfill Material Dynamic Properties (Normalized Shear Moduli & Maximum Damping) <sup>(6)</sup>	Shear Strain(%)	G/G <sub>max</sub>	Damping (%)
	1.0	0.05	24.0
	0.1	0.22	16.0
	0.01	0.54	6.0
	0.001	0.85	2.0
	0.0001	1.00	1.0
Strain-compatible Minimum Shear-wave Velocity of Backfill	155 m/s (510 fps)		

- (1) Plant grade represents the level of ground adjacent to the nuclear island buildings and is established at a plant elevation 98 ft 8 in.
- (2) 100-year recurrence interval: Value to be used for design of seismic Category I and II structures only.
- (3) Bearing capacity is defined at the foundation level of the seismic Category I structures.
- (4) The HRHF response spectra are provided for evaluation of site-specific ground motion response spectra which exceed the CSDRS in the high frequency range at hard rock sites.
- (5) Degrees Fahrenheit (°F) are the main units and temperatures in Celsius (°C) are reference values that are converted from main units.
- (6) The backfill material dynamic properties are used to calculate the shear-straincompatible shear wave velocity profiles for the backfill. The strain-compatible damping values of the backfill cannot be greater than 15%.

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ List of COL Items (1/5)

COL No.	Description
COL 2.0(1)	The COL applicant is to demonstrate that the APR1400 design meets the requirements imposed by the site-specific parameters and conforms with all design commitments and acceptance criteria if the characteristics of the site fall outside the assumed site parameters in Table 2.0-1.
COL 2.1(1)	The COL applicant is to provide site-specific information on the site location and description of the site, exclusion authority and control, and population distribution as stated in NRC RG 1.206.
COL 2.2(1)	The COL applicant is to provide site-specific information on nearby industrial, transportation, and military facilities as required in NRC RG 1.206
COL 2.2(2)	The COL applicant is to identify the DBE caused by nearby industrial, transportation, and military facilities and determine its design parameters.
COL 2.3(1)	The COL applicant is to provide site-specific information on meteorology including regional climatology, local meteorology, onsite meteorological measurement program, estimated short-term atmospheric dispersion for accident release, and long-term atmospheric dispersion estimates for routine release as addressed in NRC RG 1.206.
COL 2.3(2)	The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR 50.34 and GDC 19 are not exceeded, if the site-specific $\chi/Q$ values exceed the bounding values described in Tables 2.3-1 to 2.3-12.
COL 2.4(1)	The COL applicant is to provide the site-specific hydrologic information on probable maximum precipitation (PMP), probable maximum flood (PMF) of streams and rivers, potential dam failures, probable maximum surge and seiche flooding, probable maximum tsunami hazards, ice effects, cooling water canals and reservoirs, channel diversions, flood protection requirements, low water considerations, groundwater, potential accidental release of liquid effluents in ground and surface water, and Technical Specifications and emergency operation requirements in accordance with NRC RG 1.206, NRC RG 1.59, and NRC JLD-ISG-2012-06.

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ List of COL Items (2/5)

COL No.	Description
COL 2.5(1)	The COL applicant is to provide the site-specific information on geology, seismology, and geotechnical engineering as required in NRC RG 1.206. The COL applicant is to conduct the probabilistic seismic hazard analysis (PSHA) and develop the site-specific GMRS using the PSHA results as required in NRC RG 1.208.
COL 2.5(2)	The COL applicant is to confirm that the FIRS of the nuclear island are completely enveloped by the CSDRS-compatible free-field response motions at the bottom elevation of the nuclear island for a site with the low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) at the finished grade in the free field. Alternately, the COL applicant is to confirm that the FIRS of the nuclear island are completely enveloped by the CSDRS for a hard rock site with a low-strain shear wave velocity of supporting medium for the nuclear island greater than 2,804 m/s (9,200 ft/s).
COL 2.5(3)	The COL applicant is to confirm that (i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m <sup>3</sup> (125 lb/ft <sup>3</sup> ) and the site-specific strain-compatible soil hysteresis damping ratio profile is to be equal to or less than that shown in Table 3.7A-1; (ii) the profiles of site-specific soil properties (weight density, strain compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio) are generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11; (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it; and (iv) the site-specific strain-compatible soil shear wave velocity profile, including backfill, is consistent with one of the APR1400 generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11.

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ List of COL Items (3/5)

COL No.	Description
COL 2.5(3) (cont'd)	The site specific upper bound and lower bound low-strain shear wave velocity profiles are to be bounded by the APR1400 generic low-strain shear wave velocity profiles S1 through S9 considered for the standard design. The lower bound and upper bound shear wave velocity profiles correspond to the $G_{max}/1.5$ and $1.5G_{max}$ of the site-specific low-strain soil shear modulus profile where $G_{max}$ is the low-strain maximum shear modulus. The lower bound low-strain shear wave velocity for the site-specific soil profile is not to be less than 304.8 m/s (1,000 ft/s)
COL 2.5(4)	The COL applicant is to confirm that the site-specific profile for a HRHF site is consistent with generic soil profile S9 and the site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra shown in Figures 3.7-12 and 3.7-13. In addition, the COL applicant is to confirm that the FIRS of the seismic Category I structures are completely enveloped by the HRHF-compatible free-field response motions at the bottom elevation of each seismic Category I structure.
COL 2.5(5)	The COL applicant is to perform a site-specific seismic analysis to develop in-structure response spectra at key locations, strain-compatible properties, embedment and extent of backfill using the procedure described in Appendix 3.7A if COL 2.5(2) and COL 2.5(3) above are not met. In addition, the COL applicant is to confirm that the site-specific 5% damped in-structure response spectra so generated are enveloped by the corresponding 5% damped in-structure response spectra provided in Appendix 3.7A.
COL 2.5(6)	The COL applicant is to perform a site-specific seismic response analysis using the procedure described in Appendix 3.7B and the EPRI White Paper "Seismic Screening of Components Sensitive to High Frequency Vibratory Motions" (Reference 6), if COL 2.5(4) is not met.

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ List of COL Items (4/5)

COL No.	Description
COL 2.5(7)	The COL applicant is to perform an evaluation of the subsurface conditions within the standard plant structure footprint based on the geologic investigation in accordance with NRC RG 1.132.
COL 2.5(8)	The COL applicant is to confirm that the dynamic properties of SFG to be used in construction of the APR1400 seismic Category I structures and compressive strength of lean concrete under the nuclear island basemat satisfy the SFG requirements provided in Table 2.0-1 and minimum compressive strength of 140 kg/cm <sup>2</sup> (2,000 psi).
COL 2.5(9)	The COL applicant is to evaluate the potential future surface deformation of tectonic and non-tectonic origin.
COL 2.5(10)	If the potential for future surface deformation exists, the COL applicant needs to demonstrate the potential effects of surface deformation are within the design basis of the facility.
COL 2.5(11)	The COL applicant will evaluate the allowable bearing capacity of the subsurface based on the site-specific properties of the underlying materials, including appropriate laboratory test data to evaluate strength, and considering local site effects, such as fracture spacing, variability in properties, and evidence of shear zones. If the site-specific allowable bearing capacity is less than the maximum bearing demands specified in Table 2.0-1, a site-specific evaluation shall be performed by a COL applicant using the APR1400 basemat model and methodology described in subsection 3.8.5.
COL 2.5(12)	The COL applicant will verify whether the predicted settlement exceeds settlements within each building and between buildings exceed the maximum differential settlement within building specified in Table 2.0-1 or not. If the predicted settlement exceeds the maximum value in Table 2.0-1, a detailed site specific evaluation shall be performed by a COL applicant using the APR1400 basemat model and methodology described in subsection 3.8.5 to demonstrate acceptable.

ACRS Meeting (Sep.21-22. 2016)

# Attachment

## ➤ List of COL Items (5/5)

COL No.	Description
COL 2.5(13)	The COL applicant is to evaluate the potential for liquefaction occurring at the site adjacent to and under seismic Category I structures in accordance with NRC RG 1.198. In addition, the COL applicant is to evaluate the liquefaction potential for those seismic Category II structure foundations that if failed, could degrade the function of a seismic Category I SSC to an unacceptable safety level.
COL 2.5(14)	The COL applicant is to provide site-specific information about the static and dynamic stability of all natural and man-made soil and rock slopes including embankments and dams.
COL 2.5(15)	The COL applicant is to confirm that the soil angle of internal friction below the footprint of the seismic Category I structures at their excavation depth is a minimum of 35 degrees.

ACRS Meeting (Sep.21-22. 2016)



# Presentation to the ACRS Subcommittee

**Korea Hydro Nuclear Power Co., Ltd (KHNP)**

**APR1400 Design Certification Application Review**

**Safety Evaluation Report with open Items**

**Chapter 2: SITE CHARACTERISTICS**

September 21, 2016

# Presentation Contents

- Staff Review Team
- Overview of Design Certification Application
- Technical Areas of Interest
  - ◆ 2.1 Geography and Demography
  - ◆ 2.2 Nearby Industrial, Transportation, and Military Facilities
  - ◆ 2.3 Meteorology ( will be presented on October 4, 2016)
  - ◆ 2.4 Hydrologic Engineering
  - ◆ 2.5 Geology, Seismology, and Geotechnical Engineering

# ACRONYMS

- ADAMS- Agencywide Documents Access & Management System
- CFR- Code of Federal Regulation
- COL- Combined License
- DC - Design Certification
- DBA- Design Basis Accident
- DBE- Design Basis Event
- DCD- Design Control Document
- D/Q- Relative Deposition Factor ( $1/m^2$ )
- EAB – Exclusion Area Boundary
- EPRI- Electric Power Research Institute
- ESP- Early Site Permits
- FSAR- Final Safety Analysis Report
- GDC-General Design Criterion

# ACRONYMS

- ISG- Interim Staff Guidance
- ITAAC- Inspections, tests, analyses, and acceptance criteria
- KHNP- Korea Hydro & Nuclear Power
- LPZ- Low Population Zone
- OI- Open Item
- PMWP- Probable Maximum Winter Precipitation
- RAI- Request for Additional Information
- RG- Regulatory Guide
- SAR- Safety Analysis Report
- SE- Safety Evaluation
- SRP- Standard Review Plan
- SSC- Structures Systems and Components
- URD- Utility Requirements Documents
- $\chi/Q$  – Atmospheric Dispersion Factor ( $\text{sec}/\text{m}^3$ )

- **Technical Staff Presenters**
  - ♦ **Seshagiri Tammara- DCD Section 2.1 and 2.2**  
Radiation Protection and Accident Consequences Branch
  - ♦ **Michael Lee- DCD Section 2.4**  
Hydrology & Meteorology Branch
  - ♦ **Ricardo Rodriguez- DCD Section 2.5**  
Geoscience and Geotechnical Engineering Branch
- **Project Managers**
  - ♦ **Jeff Ciocco – Lead PM**
  - ♦ **Tarun Roy– Chapter PM**

# Staff Review Team



- ♦ **Seshagiri Tammara**  
Radiation Protection and Accident Consequences Branch
- ♦ **Michael Lee**  
Hydrology and Meteorology Branch
- ♦ **Ricardo Rodriguez**  
Geoscience and Geotechnical Branch
- ♦ **Stephanie Devlin-Gill**  
Geoscience and Geotechnical Branch
- ♦ **David Heeszal**  
Geoscience and Geotechnical Branch
- ♦ **Luisette Candelario**  
Geoscience and Geotechnical Branch

# Overview of Design Certification Application

<b>SRP Section/Application Section</b>		<b>Number of RAI Questions</b>	<b>Number of SE Open Items</b>
2.0	Site Characteristics	0	0
2.1	Geography and Demography	0	0
2.2	Nearby Industrial, Transportation, and Military Facilities	0	0
2.3	Meteorology	10	0
2.4	Hydrologic Engineering	0	0
2.5	Geology, Seismology, and Geotechnical Engineering	23	0
<b>Totals</b>		<b>33</b>	<b>0</b>

# Technical Topics of Interest

## Section 2.1 - Geography and Demography



### **Section 2.1 - Geography and Demography**

- The review involves the following sections of the KHNP APR 1400 DCD:
  - ♦ 2.1.1 - Site Location and Description
  - ♦ 2.1.2 - Exclusion Area Authority and Control
  - ♦ 2.1.3 - Population Distribution

The COL applicant is to provide this site specific information as part of COL information Item 2.1(1) in the COL application.

# Technical Topics of Interest

## Section 2.2 - Nearby Industrial, Transportation, and Military Facilities



### **Section 2.2 - Nearby Industrial, Transportation, and Military Facilities**

- The review involves the following sections of the KHNP APR 1400 DCD:
  - ♦ 2.2.1 - Locations and Routes
  - ♦ 2.2.2 - Descriptions
  - ♦ 2.2.3 - Evaluation of Potential Accidents

The COL applicant is to provide this site specific information as part of COL information Item 2.2(1) and COL information Item 2.2(2) in the COL application.

# Technical Topics of Interest

## Section 2.4 -Hydrologic Engineering



### **Section 2.4 – Hydrologic Engineering**

- The review involves the following sections of the APR 1400 DCD:
  - 2.4.1 Hydrologic Description
  - 2.4.2 Floods
  - 2.4.3 Probable Maximum Flood on Streams and Rivers
  - 2.4.4 Potential Dam Failures
  - 2.4.5 Probable Maximum Surge and Seiche Flooding
  - 2.4.6 Probable Maximum Tsunami Hazards
  - 2.4.7 Ice Effects
  - 2.4.8 Cooling Water Canals and Reservoirs
  - 2.4.9 Channel diversion
  - 2.4.10 Flooding Protection Requirements
  - 2.4.11 Low Water Considerations
  - 2.4.12 Groundwater
  - 2.4.13 Accidental Release of Radioactive Liquid Effluents in Ground and Surface Water
  - 2.4.14 Technical Specifications and Emergency Operations Requirements
  - 2.4.15 Combined License Information

# Technical Topics of Interest

## Section 2.4 -Hydrologic Engineering



- Information in all the sections is site specific and will be provided by the COL applicant.
- Hydrologic Parameters
  - ♦ The DCD applicant identified the following hydrologic parameters:
    - Maximum groundwater level ( 2 ft below finished grade)
    - Maximum flood (tsunami) level (1 ft below finished grade)
    - Maximum hourly rainfall rate (19.4 in/hr.)
    - Maximum short-term rainfall rate (6.2 in/5 min.)
- A COL applicant needs to demonstrate that its site characteristics fall within the APR 1400 DCD site parameters
- Staff previously evaluated these parameters to determine the acceptability of the parameter values

# Technical Topics of Interest

## Section 2.4 -Hydrologic Engineering



- COL Information Item 2.4(1)
  - ♦ COL applicant is to provide sufficient information to verify that hydrologic-related events will not affect the safety-basis for the APR 1400
  - ♦ COL applicant is to characterize the potential flooding hazards that may affect proposed reactor site
  - ♦ COL applicant decides on what combination of design features (i.e., elevation of door openings, the addition of fill, passive drainage systems, berms, administrative procedures) will be used to mitigate effects of any potential flooding hazard proposed reactor site.

# Conclusion

## Section 2.4 – Hydrologic Engineering



- The DCD Applicant has provided plant specific hydrological site parameters and the Staff finds those acceptable.
- The DCD Applicant has properly identified the site specific information to be provided as part of any future COL application.
- The Applicant has satisfactorily answered all earlier RAI's and there are no open items.

# Technical Topics of Interest

## Section 2.5 – Geology, Seismology, and Geotechnical Engineering



- The review involved the following sections of the APR 1400 DCD:
  - 2.5.1 Basic Geologic and Seismic Information
  - 2.5.2 Vibratory Ground Motion
  - 2.5.3 Surface Deformation
  - 2.5.4 Stability of Subsurface Materials and Foundations
  - 2.5.5 Stability of Slopes

# Technical Topics of Interest

## Section 2.5 – Geology, Seismology, and Geotechnical Engineering



- Establishes site parameters for a candidate site, including:
  - ♦ Maximum allowable bearing demand
  - ♦ Minimum shear wave velocity
  - ♦ Allowable settlements (total, differential)
  - ♦ No liquefaction potential for seismic category I structures
  - ♦ No surface tectonic deformation potential within the exclusion area boundary
- These parameters are expected to be representative of a potential COL or ESP site.

# Technical Topics of Interest

## Section 2.5 – Geology, Seismology, and Geotechnical Engineering



- Sections 2.5.1, 2.5.2 and 2.5.3 findings:
  - ♦ DCD requires that site specific geology considerations are addressed by COL applicants in accordance with applicable regulations
  - ♦ DCD requires COL applicants to conduct site specific PSHA and site response analysis in accordance with relevant regulations
  - ♦ Site specific subsurface profiles are compared to generic profiles in DCD to ensure that parameters in DCD Chapter 3.7 analyses are relevant to COL sites
  - ♦ DCD requires that COL applicants show no potential for tectonic or non-tectonic surface deformation at the site

# Technical Topics of Interest

## Section 2.5 – Geology, Seismology, and Geotechnical Engineering



- Sections 2.5.4 and 2.5.5 findings:
  - ♦ The majority of staff RAIs focused on:
    - Soil or rock uniformity requirements
    - Applicability of static and dynamic parameters of the subsurface, including the SFG (structural fill granular) and lean concrete backfill
    - Clarifications regarding the calculation of bearing capacity and settlement for safety related structures
    - Liquefaction potential adjacent to and under Seismic Category I structures
    - Static and dynamic stability of all natural and man made slopes
- The applicant adequately addressed all RAIs. In many instances, tasked any future COL applicant to address pertinent issues during the COL application process through Information Items

# Technical Topics of Interest

## Section 2.5 – Geology, Seismology, and Geotechnical Engineering



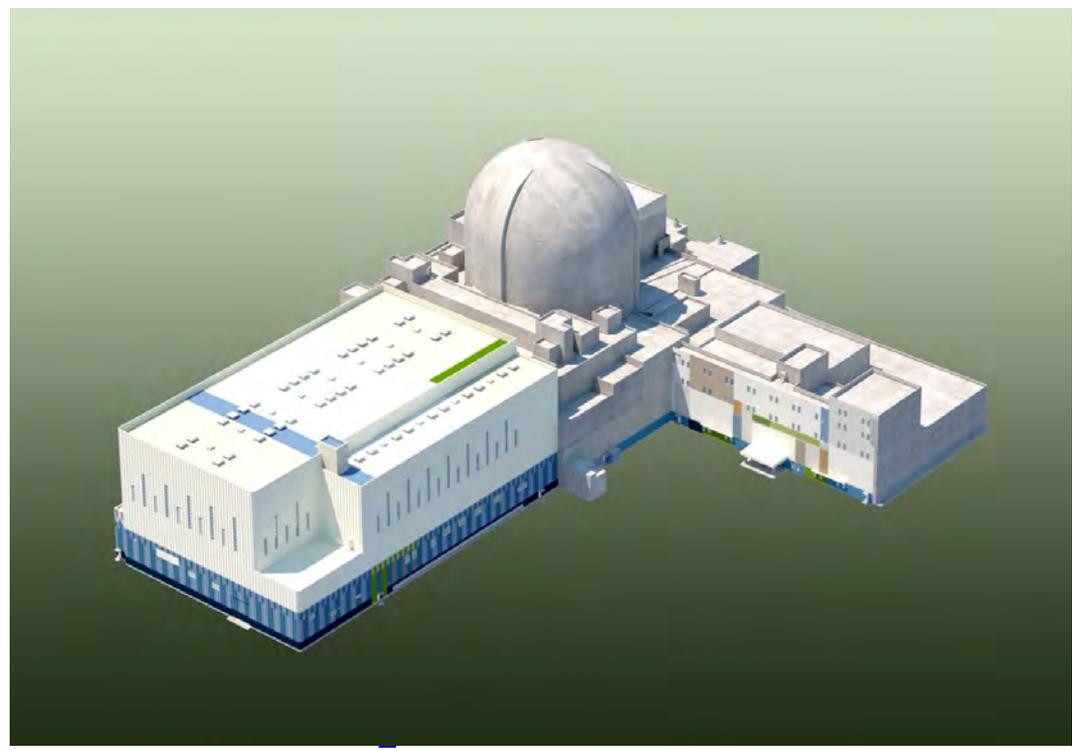
### Staff Conclusions

- ◆ No Open Items identified in Chapter 2.5
- ◆ 15 Information Items identified in Chapter 2.5 adequately represent the actions need to be taken by potential COL applicants
- ◆ The applicant properly identified appropriate geologic, seismologic and geotechnical site parameters and properly identified the site specific information to be provided as part of any future COL application.
- ◆ 10 Confirmatory Items are currently being tracked by the staff

Questions?

# APR1400 DCA

## Chapter 5: Reactor Coolant System and Connecting Systems



**KEPCO/KHNP**  
**September 21~22, 2016**

ACRS Meeting (Sep.21-22. 2016)

# Contents

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- **Overview of Chapter 5**
  - **List of Submitted Documents**
  - **RAI Summary**
  - **Section Overview**
- **Reactor Coolant System and Connecting Systems**
  - **Key Design Features**
  - **Description of Open Item**
- **Summary**
- **Current Status**
- **Attachments**
  - **Acronym**
  - **List of COL Items**

# Overview of Chapter 5

## ● List of Submitted Documents

Document No.	Title	Revision	Type	ADAMS Accession No.
APR1400-K-X-FS-14002 -P & NP	APR1400 Design Control Document Tier 2: Chapter 5 Reactor Coolant System and Connecting Systems	0	DCD	ML15006A044
APR1400-K-X-IT-14001 -P & NP	APR1400 Design Control Document Tier 1	0	DCD	ML15006A039
APR1400-Z-A-NR-14015 -P & NP	Neutron Fluence Calculation Methodology for Reactor Vessel	0	TER*	ML15009A124
APR1400-Z-M-NR-14008 -P & NP	Pressure-Temperature Limits Methodology for RCS Heatup and Cooldown	0	TER (IBR**)	ML15009A125
APR1400-A-M-NR-14001 -P & NP	KHNP APR1400 Flywheel Integrity Report	0	TER	ML15009A126
APR1400-E-N-NR-14005 -P & NP	Shutdown Evaluation Report	0	TER	ML15128A285

\* TER: Technical Report, \*\*IBR: Incorporated by Reference

## ● RAI Summary

No. of Questions	No. of Responses*	Not Responded	No. of Open Items
77	77	0	13

\* The responses to 6 RAIs for RCP flywheel were submitted after the issue of SE (Sep. 12, 2016).

ACRS Meeting (Sep.21-22. 2016)

# Overview of Chapter 5

## ● Section Overview

Section	Major Contents	Presenter
5.1 Summary Description	Design Features of the Reactor Coolant System (RCS)	Minseok KIM
5.2 Integrity of Reactor Coolant Boundary (RCPB)	Describes the measures that provide and maintain the integrity of the RCPB throughout the facilities design life	
5.2.1	Conformance with Codes and Code Cases	Minseok KIM
5.2.2	Overpressure Protection	Minseok KIM
5.2.3	Reactor Coolant Pressure Boundary Materials	Jongsoo KIM
5.2.4	In-service Inspection and Testing	Jongsoo KIM
5.2.5	RCPB Leakage Detection	Minseok KIM
5.3 Reactor Vessel	Describes Reactor Vessel Material Issues	
5.3.1	Reactor Vessel Materials	Jongsoo KIM
5.3.2	P-T limits, Pressurized Thermal Shock, Upper-Shelf Energy	Seognam CHOI
5.3.3	Reactor Vessel Integrity	Jongsoo KIM
5.4 RCS Component and Subsystem Design	Describes the Reactor System Components	
5.4.1	Reactor Coolant Pumps (RCPs)	Minseok KIM
5.4.2	Steam Generators (SGs)	Seognam CHOI
5.4.7	Shutdown Cooling System (SCS)	Minseok KIM
5.4.10	Pressurizer	Seognam CHOI
5.4.12	RCS High Point Vents	Minseok KIM
5.4.15	Component Supports	Seognam CHOI

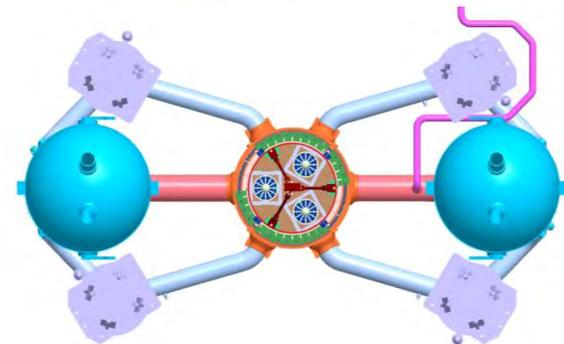
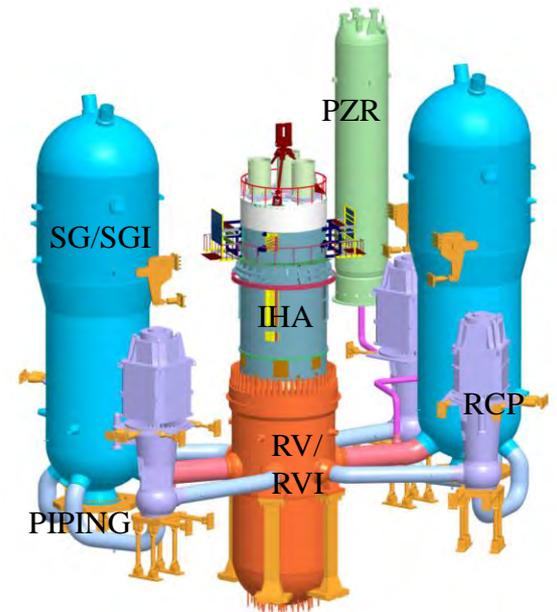
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# Reactor Coolant System and Connecting Systems

## ● 5.1 Summary Description (1/3)

### ➤ Design Features of APR1400

- ◆ **Design Life:** 60 Years
- ◆ **Power:** 4,000 MWth / 1,400 MWe
- ◆ **Two Loops:** Symmetric
  - ✓ 1 RV, 2 SGs, 4 RCPs, 1 Pressurizer
  - ✓ 2 Hot Legs, 4 Cold Legs
- ◆ **Primary Operating Condition:**
  - ✓ Pressure: 2,250 psia
  - ✓ NOP Hot / Cold Temp.: 615 / 555 °F
- ◆ **Secondary Operating Condition:**
  - ✓ Pressure: 1,000 psia
  - ✓ MF/MS Temp.: 450 / 545 °F
- ◆ **SG Tube:** 13,102 /SG, Alloy 690TT
- ◆ **Pressurizer:** 2,400 ft<sup>3</sup>



# Reactor Coolant System and Connecting Systems

## ● 5.1 Summary Description (2/3)

### ➤ RCS Functions

- ◆ Energy transfer from the reactor core to the steam generator
- ◆ Secondary barrier to the release of fission products
- ◆ Sufficient cooling during all normal plant operations and expected transients
- ◆ Reactor coolant circulation with the required chemistry & boron concentration
- ◆ System pressure control to a moderate extent through sprays
- ◆ Rapid depressurization of the RCS by manual operation of POSRVs
- ◆ Venting of steam and non-condensable gases

# Reactor Coolant System and Connecting Systems

## ● 5.1 Summary Description (3/3)

### ➤ Principal Parameters of the RCS (Table 5.1.1-1)

Parameter	Value
Design thermal power, MWt (including net heat addition from pumps)	4,000
Design pressure, kg/cm <sup>2</sup> A (psia)	175.8 (2,500)
Design temperature (except pressurizer), °C (°F)	343.3 (650)
Pressurizer design temperature, °C (°F)	371.1 (700)
Coolant flow rate, kg/hr (lbm/hr)	75.6 × 10 <sup>6</sup> (166.6 × 10 <sup>6</sup> )
Cold leg temperature, operating, °C (°F)	290.6 (555)
Average temperature, operating, °C (°F)	307.2 (585)
Hot leg temperature, operating, °C (°F)	323.9 (615)
Normal operating pressure, kg/cm <sup>2</sup> A (psia)	158.2 (2,250)
System water volume, m <sup>3</sup> (ft <sup>3</sup> ) (with pressurizer)	455.3 (16,079)
Pressurizer water volume, m <sup>3</sup> (ft <sup>3</sup> ) (full power)	33.2 (1,171)
Pressurizer steam volume, m <sup>3</sup> (ft <sup>3</sup> ) (full power)	35.7 (1,260)

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# Reactor Coolant System and Connecting Systems

## ● 5.2.1 Conformance with Codes and Code Cases

### ➤ Conformance with 10 CFR 50.55a

- ◆ Construction: ASME Section III 2007 Edition with 2008 Addenda
  - ✓ RCPB components - Class 1 components
  - ✓ RCPB components that meet the exclusion requirements - Class 2 components
  - ✓ The remaining safety-related components - Class 3 components
- ◆ ISI: ASME Section XI 2007 Edition with 2008 Addenda (Sections 5.2.4 and 6.6)
- ◆ IST: ASME OM Code 2004 Edition with 2005 and 2006 Addenda – Section 3.9.6

### ➤ Compliance with Applicable Code Cases

- ◆ RG 1.84, Design, Fabrication and Materials Code Case Acceptability, ASME Section III, Rev. 36, U.S. Nuclear Regulatory Commission, August 2014.
- ◆ RG 1.147, In-service Inspection Code Case Acceptability, ASME Section XI, Division 1, Rev. 17, U.S. Nuclear Regulatory Commission, August 2014.
- ◆ RG 1.192, Operation and Maintenance Code Case Acceptability, ASME OM Code, Rev. 1, U.S. Nuclear Regulatory Commission, August 2014.

# Reactor Coolant System and Connecting Systems

## ● 5.2.2 Overpressure Protection (1/4)

### ➤ Overpressure Protection of the RCS and Steam Generators

- ◆ Pilot-operated safety relief valves (POSRVs)
- ◆ Main steam safety valves (MSSVs)
- ◆ Reactor protection system (RPS)

### ➤ Maintain the RCS pressure below 110 percent of design pressure during the worst-case loss-of-load event with a delayed reactor trip

### ➤ Low Temperature Overpressure Protection (LTOP)

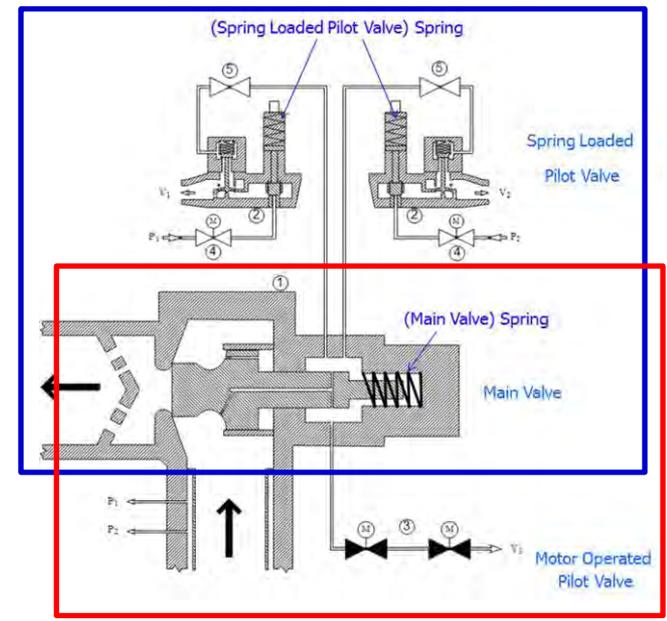
- ◆ Shutdown cooling system (SCS) suction line relief valve

# Reactor Coolant System and Connecting Systems

## ● 5.2.2 Overpressure Protection (2/4)

### ➤ Pressurizer POSRV

- ◆ Main Valve (1)
- ◆ Spring Loaded Pilot Valve (SLPV) (2)
  - ✓ Automatic actuation for RCS overpressure protection
- ◆ Motor Operated Pilot Valve (2)
  - ✓ Manual actuation for RCS rapid depressurization
- ◆ Pilot-Operated Pressure Relief Valves are Permitted by ASME Sec.III NB-7174 as Pressure Relief Device
  - ✓ Meeting the requirements of NB-7520
- ◆ ASME Rated Capacity (540,000 lbs/hr) for Saturated Steam according to NB-7734
  - ✓ Ex) ASME certification number: 64066
- ◆ Section 15.2 provides the Functional Design Evaluation of the Overpressurization Protection System.



M: Motor Operated Valve  
 Vi: Pilot Discharge  
 Pi: Impulse Line

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# Reactor Coolant System and Connecting Systems

## ● 5.2.2 Overpressure Protection (3/4)

- **Open Item (RAI No. 8244, Question 05.02.02-1, b/c), Date issued (10/2/15); KHNP responded (12/11/15)**
  - **Description of Issue** : Provide the description of the LTOP analysis and, more specifically provide the mass and energy addition transient results including the maximum  $\Delta T$ .
  - **Resolution** : Provided the description about the mass and energy addition event, transient results, and the assumption for the maximum  $\Delta T$ .
  
- **Open Item (RAI No. 8609, Question 05.02.02-7), Date issued (5/18/16); KHNP responded (6/8/16)**
  - **Description of Issue** : Provide the description about LTOP analysis methodology, input parameters, and assumption.
  - **Resolution** : Provided the description about detailed methodology, input parameters, and assumption. And provided why these inputs and assumption are suitably conservative.

# Reactor Coolant System and Connecting Systems

## ● 5.2.2 Overpressure Protection (4/4)

- Open Item (RAI No. 8244, Question 05.02.02-5), Date issued (10/2/15); KHNP responded (6/30/16)
  - **Description of Issue** : Address the difference between the pre-service testing in DCD Section 5.2.2.10 and Chapter 14 test for pressurizer POSRVs.
  - **Resolution** : Revised test plans in Section 14.2 to describe the complete pre-service testing for pressurizer POSRVs.

# Reactor Coolant System and Connecting Systems

## ● 5.2.3 Reactor Coolant Pressure Boundary Materials (1/5)

### ➤ Material Specification and Selection

- ◆ Conform to ASME Section III NB for Class 1 components and RG 1.84

### ➤ Low-alloy Steel and Carbon-steel

- ◆ RCS components fabricated from low-alloy and carbon steel forgings with cladding
- ◆ Conform to RG 1.43 for clad integrity
- ◆ Conform to 10 CFR 50 Appendix G for fracture toughness properties
- ◆  $RT_{NDT}$  control  $\leq 10^{\circ}F$  for RCPB,  $\leq -10^{\circ}F$  for RPV belt line materials
- ◆ Sulfur content limited to 0.010% max.
- ◆ Tight control on chemical elements for RPV belt line to reduce the neutron embrittlement
  - ✓ Cu: 0.05% / 0.03% (welds / forgings), Ni: 0.10% / 1.00% (welds / forgings), P: 0.012%, V: 0.030%, S: 0.010%
- ◆ Major structural materials: SA-508 Grade 3 Class 1, SA-508 Grade 1A

# Reactor Coolant System and Connecting Systems

## ● 5.2.3 Reactor Coolant Pressure Boundary Materials (2/5)

### ➤ Austenitic Stainless Steel

- ◆ Control of use of sensitized stainless steel (comply with RG 1.44)
- ◆ Solution annealed condition
- ◆ Reduced carbon content of base metals and welding materials (less than 0.065% or L-grade)
- ◆ No cold worked austenitic stainless steel for reactor coolant contact parts
- ◆ Limited cobalt content (0.05%)

### ➤ Ni-Cr-Fe Alloys (Alloy 690)

- ◆ Control on chemistry and mechanical properties with state-of-the-art industrial requirements
- ◆ Thermally treated (TT) after solution annealing
- ◆ Control on fabrication practices to limit residual cold work
- ◆ Limited cobalt content (0.014 % ave. / 0.020% max. for SG tube, 0.020% for other materials)
- ◆ SG tube, all ICI and CEDM nozzles and small nozzles
- ◆ Welding material of Alloy 52/52M/152 (Neither Alloy 600 nor 82/182 filler material is used.)

# Reactor Coolant System and Connecting Systems

## ● 5.2.3 Reactor Coolant Pressure Boundary Materials (3/5)

### ➤ Castings

- ◆ Delta ferrite content is limited to prevent thermal aging (CF8M  $\leq$  14% max.)
- ◆ Valve body material

### ➤ Compatibility with Reactor Coolant

- ◆ RCS water chemistry is controlled with up-to-date EPRI primary water chemistry guidelines (Rev. 7)
- ◆ Comply with RG 1.36 for non-metallic insulation

### ➤ Fabrication and Processing of Ferritic Materials

- ◆ Comply with ASME Section III NB for fabrication and Non Destruction Examination
- ◆ Welding procedure & personnel qualified with ASME Sec. III, IX and followings (if applicable)
  - ✓ Comply with RG 1.50 and Appendix D for pre-heat requirement
  - ✓ Hydrogen removing by post heating
  - ✓ Cladding with RG 1.43
  - ✓ Welder qualification of RG 1.71

# Reactor Coolant System and Connecting Systems

## ● 5.2.3 Reactor Coolant Pressure Boundary Materials (4/5)

### ➤ Fabrication and Processing of Austenitic Stainless Steel

- ◆ Avoidance of stress corrosion cracking
  - ✓ Solution heat treatment & rapid cooling and control on exposure to specific sensitizing temperature range (800°F-1500 °F)
  - ✓ Cold worked austenitic stainless steel is not used for RCPB
  - ✓ ASTM A262 Practice A or E corrosion test
- ◆ Avoidance of sensitization by welding
  - ✓ Welding procedure qualification with RG 1.44
  - ✓ Delta ferrite control on welding material
  - ✓ Weld heat input control
  - ✓ Interpass temperature control
  - ✓ Reduced carbon content
  - ✓ ASTM A262 Practice A or E corrosion test for ensuring non-sensitization
  - ✓ Nb-stabilized austenitic stainless steel (surge line pipe), L-grade (safe end)
- ◆ Control on cleaning and contamination during all phase of fabrication
  - ✓ Maintain cleanliness in accordance with NQA-1
  - ✓ Control on chemical elements of component cleaning water

# Reactor Coolant System and Connecting Systems

## ● 5.2.3 Reactor Coolant Pressure Boundary Materials (5/5)

### ➤ Open Item (DCD Section 5.2.3.4.1 d. Avoidance of Sensitization)

- **Description of Issue** : Can not determine whether the use of weld heat input, maximum interpass temperature, and maximum carbon content specified by the applicant will ensure non-sensitization of the materials.
- **Resolution** : The welding procedure specification (WPS) is qualified with ASME Sec. III and IX using the maximum heat input, interpass temperature and reduced carbon content specified in the DCD. In the qualification process, ASTM A262 Practice A or E test is also performed for ensuring non-sensitization of weld metal and weld heat-affected-zone.

Since the product welding is to be performed under weld heat input, interpass temperature and carbon content less than the maximum values allowed by the qualified WPS, the weld metal and weld heat-affected-zone will not be sensitized severely.

# Reactor Coolant System and Connecting Systems

## ● 5.2.4 Inservice Inspection and Testing

### ➤ Comply with ASME Section XI with 10 CFR 50.55a for PSI and ISI

- ◆ 10-year inspection interval plan
- ◆ COL applicant is to prepare the PSI and ISI program
- ◆ ASME code cases in accordance with RG 1.147

### ➤ Inspectability of Components

- ◆ Components designed to allow personnel and equipment to access for required examination in accordance with Sec. XI IWA-1500

### ➤ Qualification of Examination Personnel and Procedure

- ◆ Personnel qualification with ASME Sec. XI Appendix VII
- ◆ Performance demonstration with ASME Sec. XI Appendix VIII

### ➤ RPV Closure Head Examination with Code Case N-729-1 and 10 CFR 50.55a

### ➤ Other Inspection Program: Boric Acid Corrosion (BAC) Program

# Reactor Coolant System and Connecting Systems

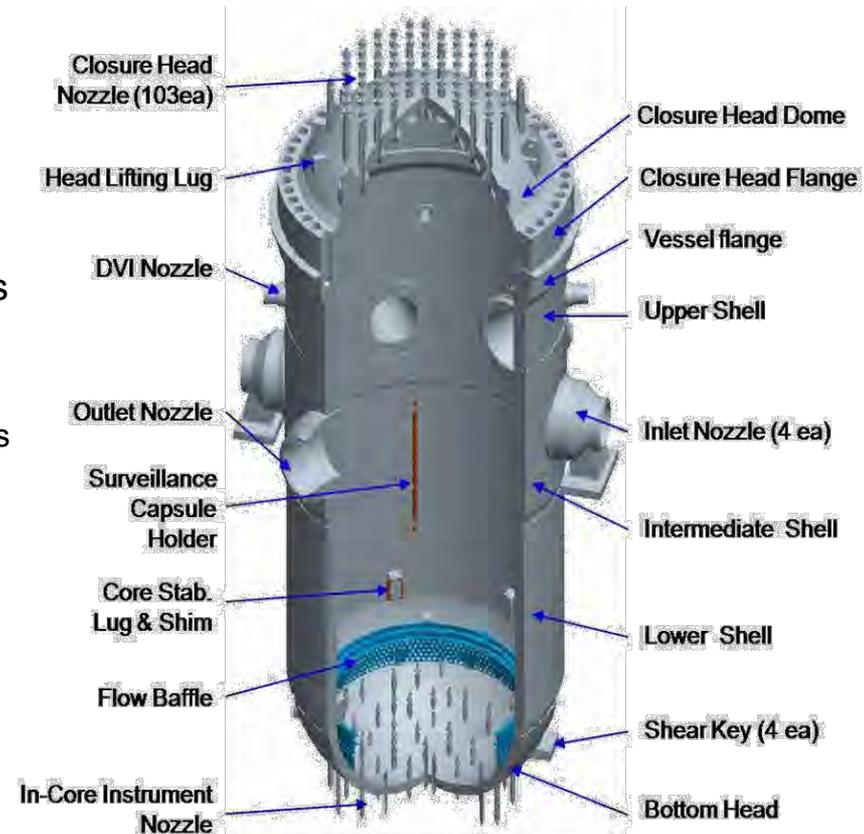
- **5.2.5 Reactor Coolant Pressure Boundary Leakage Detection**
  - **System Designed in accordance with RG 1.29 and conforms to RG 1.45**
  - **Unidentified Leakage**
    - ◆ Sensitivity: 0.5 gpm can be detected less than 1 hour
    - ◆ Methods: Inventory, sump level and flow, containment air particulate radioactivity monitoring, an acoustic leak monitoring system (ALMS)
  - **Identified Leakage**
    - ◆ Definition: (1) Captured/flow-metered/conducted to collection (2) leakage into the containment atmosphere from a known source
    - ◆ Leakage instrumentation in the main control room
    - ◆ POSRVs, RCP seals, valves, reactor vessel head flange leakage, leakage through steam generator tubes or tubesheet (Chapter 11), leakage to auxiliary systems (Chapter 11)

# Reactor Coolant System and Connecting Systems

## ● 5.3.1 Reactor Vessel Materials

### ➤ Comply with ASME Sec. II, III, V, IX and 10 CFR 50 & Appendices, NRC Reg. Guides

- ◆ SA-508 Gr. 3 Cl. 1 with stainless steel clad for RPV shells, main nozzles, heads
  - ✓ Initial  $RT_{NDT} \leq -10^{\circ}\text{F}$  for core belt line,  $\leq 10^{\circ}\text{F}$  for other RCPB part
  - ✓ Meet the fracture toughness requirements of ASME Sec. III App. G and 10 CFR 50 App. G
- ◆ Alloy 690 for CEDM nozzles and ICI nozzles
- ◆ Surveillance program for RPV in accordance with 10 CFR 50 App. H

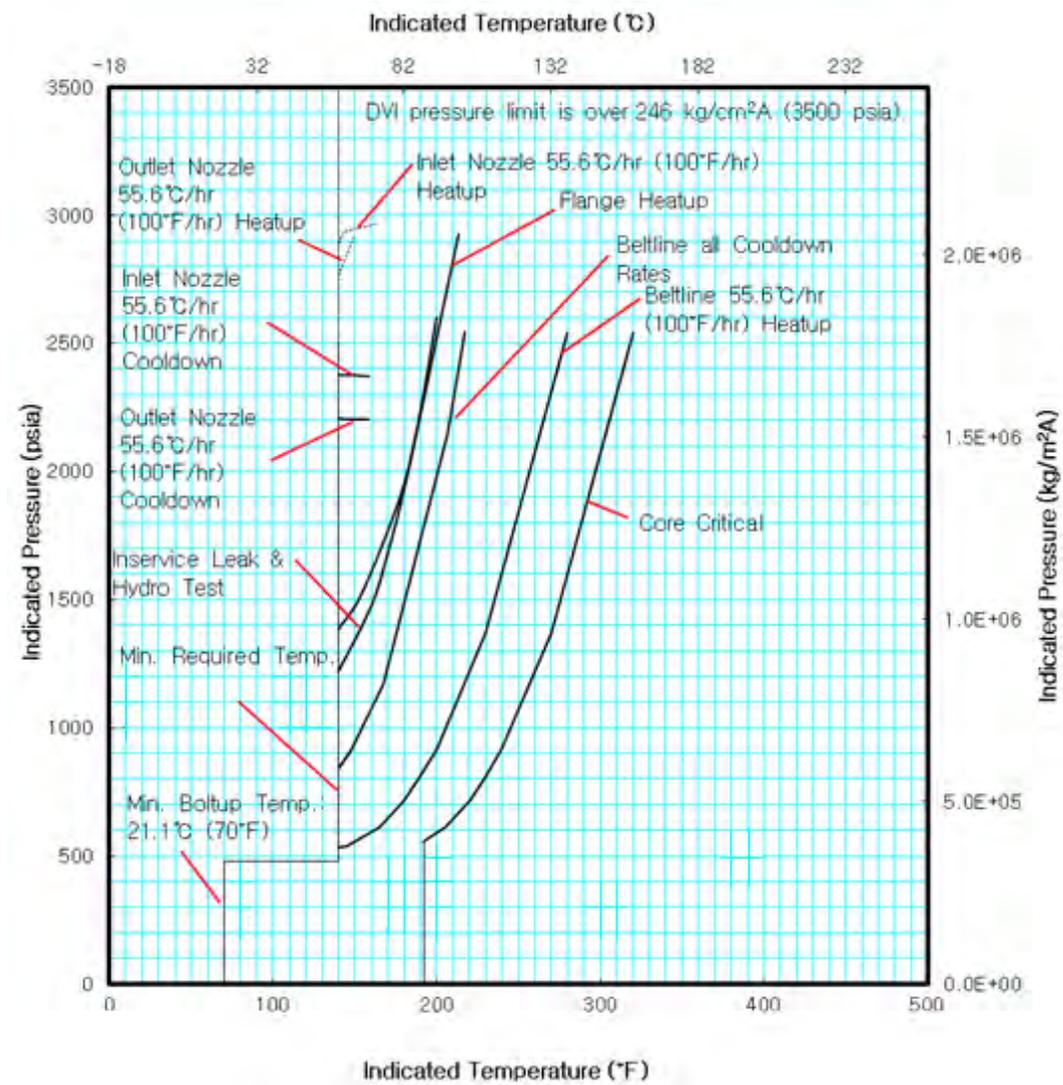


# Reactor Coolant System and Connecting Systems

- **5.3.2.1 Pressure-Temperature Limits (1/2)**
  - **Prevent RCPB materials from non-ductile fracture during heat-up and cool-down transients**
  - **Established in accordance with Appendix G of 10 CFR 50 and Appendix G of ASME Code Section XI**
  - **Based on end of life (60 years or 55.8 EFPYs based on 93% capacity factor) fast neutron fluence.**
  - **Critical Limiting Cases:**
    - ◆ RV Beltline: High neutron irradiation induced embrittlement region
    - ◆ RV Flange: Bolt preload-induced bending & internal pressure stressed region
    - ◆ Inlet, Outlet & Direct Vessel Injection Nozzles: High stressed region

# Reactor Coolant System and Connecting Systems

## ● 5.3.2.1 Pressure-Temperature Limits (2/2)



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# Reactor Coolant System and Connecting Systems

- 5.3.2.3 Pressurized Thermal Shock
  - RT<sub>PTS</sub> values at the end of life must be approved by NRC.
  - Satisfy the 10 CFR 50.61 Screening Criteria.

Material	Initial RT <sub>NDT</sub> (°C(°F))	Fluence Factor <sup>1)</sup>	Chemistry Factor <sup>2)</sup> (°C(°F))	ΔRT <sub>PTS</sub> (°C(°F))	Margin <sup>3)</sup> (°C(°F))	RT <sub>PTS</sub> (°C(°F))	Screening Criterion (°C(°F))
Lower Shell Course (beltline material)	-23.3 (-10)	1.51	11.1 (20)	16.8 (30.2)	16.8 (30.2)	10.2 (50.4)	132.2 (270)
Weld Material (G-2 & G-3)	-12.2 (10)	1.51	20.8 (37.5)	31.4 (56.6)	31.1 (56)	50.3 (122.6)	148.9 (300)

Notes:

- 1) Fluence Factor =  $f^{(0.28-0.10\log f)}$ , fast neutron fluence:  $f_{surf} = 9.5 \times 10^{19} \text{ n/cm}^2$ .
- 2) Chemistry Factor for Lower shell forging material of 0.03 wt% Cu & 1.00 wt% Ni, for Weld materials of 0.05 wt% Cu & 0.10 wt% Ni, respectively.
- 3) Margin =  $2(\sigma_u^2 + \sigma_\Delta^2)^{0.5}$ ,  
 where,  $\sigma_u = 0$  and  $\sigma_\Delta = \text{lesser of } 17^\circ\text{F or } 0.5 \times \Delta\text{RT}_{PTS}$  for the beltline material.  
 $\sigma_u = 0$  and  $\sigma_\Delta = \text{lesser of } 28^\circ\text{F or } 0.5 \times \Delta\text{RT}_{PTS}$  for the weld material.

ACRS Meeting (Sep.21-22. 2016)

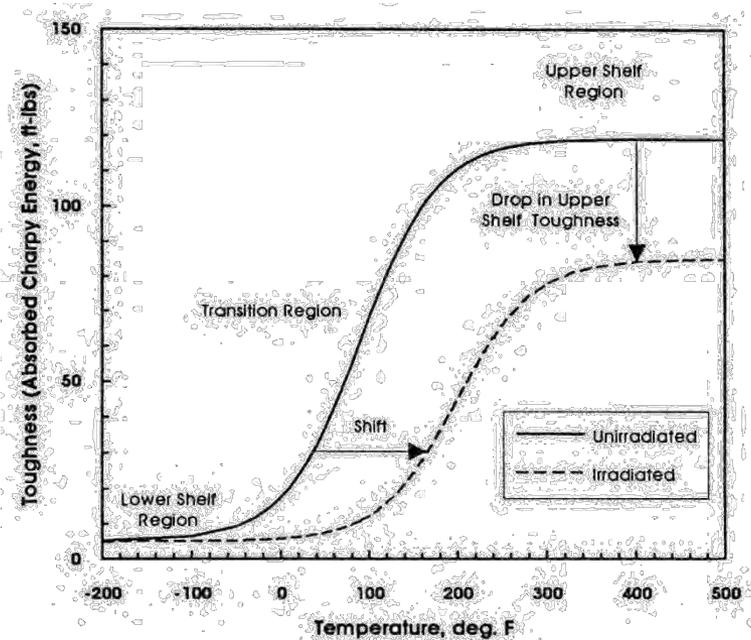
# Reactor Coolant System and Connecting Systems

## ● 5.3.2.4 Upper-Shelf Energy (USE)

➤ Established in accordance with Appendix G of 10 CFR 50 and Branch Tech. Position (BTP) 5-3 of NRC Standard Review Plan

- ◆ USE<sub>Initial</sub>, min.: Higher than 102 Joules (75 ft-lbs)
- ◆ USE<sub>End of Life</sub>, min.: Higher than 68 Joules (50 ft-lbs)

➤ With the initial limiting value of 102 Joules (75 ft-lbs), the end-of-life (EOL) USE for APR1400 is estimated to be 69.4 Joules (51 ft-lbs), which is greater than the limiting EOL value.



# Reactor Coolant System and Connecting Systems

## ● 5.3.3 Reactor Vessel Integrity

- **Proven Fabrication Techniques and Well-characterized Steels are used for RPV Integrity.**
- **Structural Integrity of RPV is provided by meeting the ASME Section III rules for Class 1 Components**
- **Materials, Fabrication Processes, Inspection, Shipment and Installation of RPV are in accordance with ASME Codes and Standards, 10 CFR 50 requirements and applicable Reg. Guides.**
- **Surveillance of RPV Integrity**
  - ◆ Inservice inspection program for RPV with ASME Sec. XI and 10 CFR 50.55a
  - ◆ Material surveillance program for RPV belt line region with 10 CFR 50 App. H

# Reactor Coolant System and Connecting Systems

## ● 5.4.1 Reactor Coolant Pump (1/7)

Parameter	Value
Number of units	4
Type	Vertical, single-stage centrifugal
Rated total dynamic head, m (ft)	109.7 (360)
Rated flow, L/min (gpm)	460,256 (121,600)
Design pressure, kg/cm <sup>2</sup> A (psia)	175.8 (2,500)
Design temperature, °C (°F)	343.3 (650)
Normal operating pressure, kg/cm <sup>2</sup> A (psia)	158.2 (2,250)
Normal operating temperature, °C (°F)	290.6 (555)
NPSH available (at rated flow), m (ft)	152.4 (500)
Suction temperature, °C (°F)	290.6 (555)
Water volume, each, m <sup>3</sup> (ft <sup>3</sup> )	3.26 (115)
Weight (including motor), dry, kg (lb)	144,515 (318,600)
Rotating inertia, pump, and motor: Assembly, minimum, kg-m <sup>2</sup> (lbs-ft <sup>2</sup> )	6,717 (159,400)
Shaft seals	Mechanical face seals
Pump speed, rpm	1190
Motor synchronous speed, rpm	1200
Motor type	AC induction
Horsepower, hot, kW (hp)	7,457 (10,000)
cold, kW (hp)	10,067 (13,500)
Rated brake horsepower, kW (hp)	7,457 (10,000)
Voltage, V	13200
Phase	3
Frequency, Hz	60
Insulation class	F
Starting current, at 100 % voltage, amps	3426

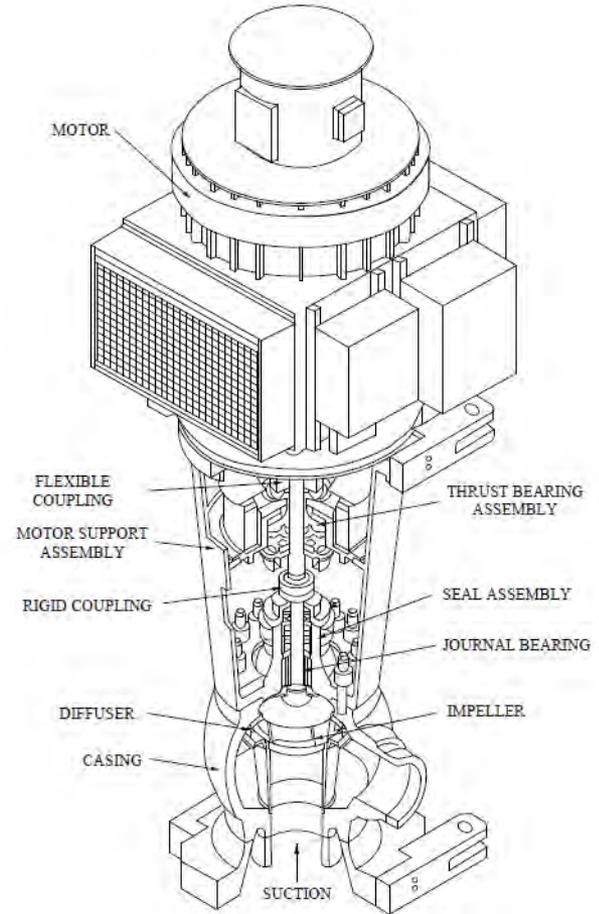


Figure 5.4.1-1 Reactor Coolant Pump

ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

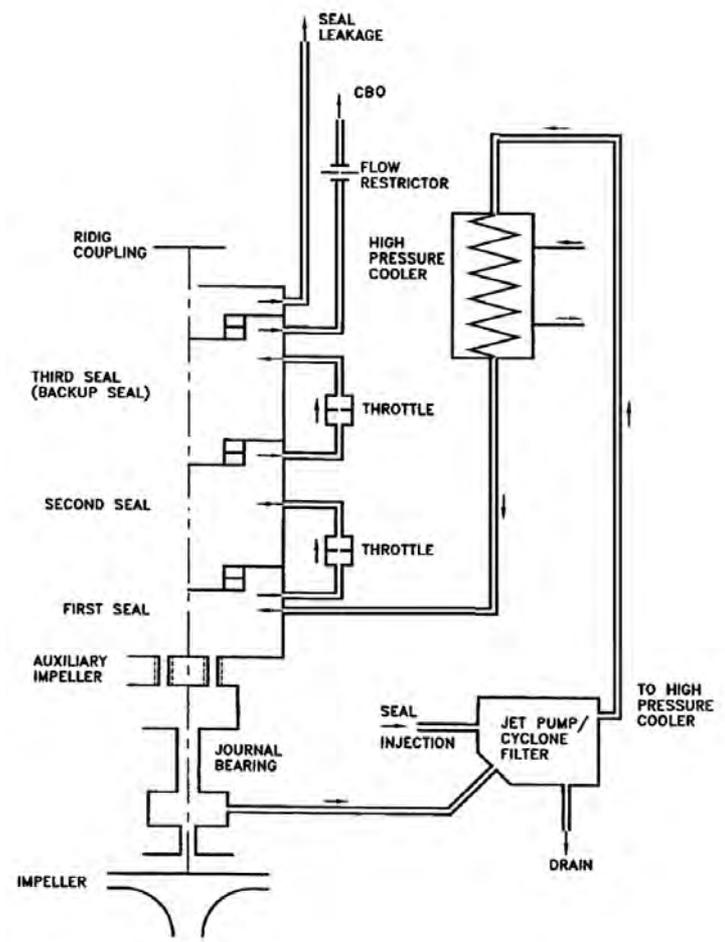
## ● 5.4.1 Reactor Coolant Pump (2/7)

### ➤ High Pressure Cooler

- ◆ The RCP seals are normally cooled by redundant systems (1) seal injection and (2) heat removal via the high pressure cooler with CCW system

### ➤ Type F seal

- ◆ Materials: Long-term exposure to high temperature and pressure environment
- ◆ Test results demonstrated the ability of the seal to survive an extended SBO event.
  - ✓ Simulation of a SBO event lasting up to 72 hours.
  - ✓ Seal performance under low sub-cooling conditions



ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

## ● 5.4.1 Reactor Coolant Pump (3/7)

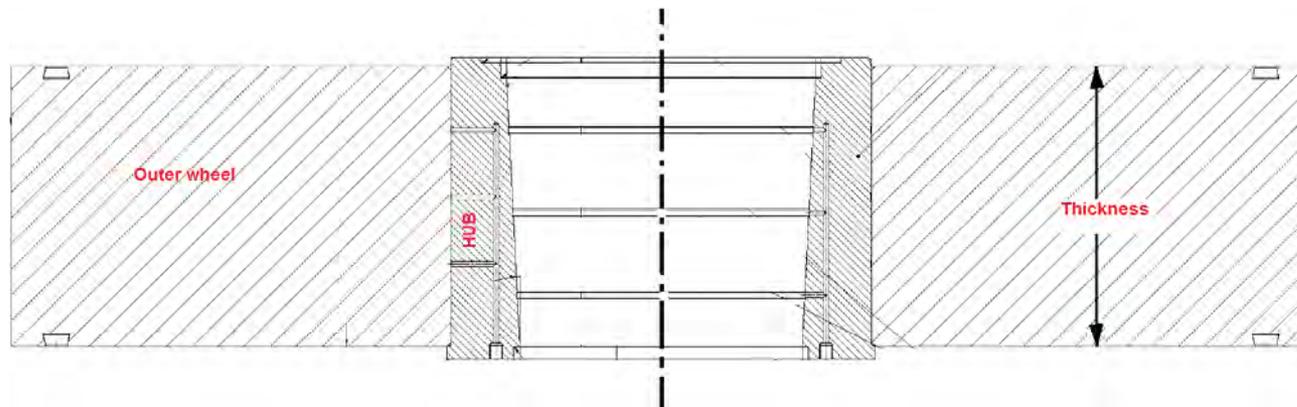
- **Open Item (RAI No. 8555, Question 05.04-2, Part 1), Date issued (3/15/16); KHNP responded (4/29/16)**
  - **Description of Issue** : Clarify regarding RCP seal water injection during 30-minute period (RAI 307-7835, Question 05.04-1, Part 5).
  - **Resolution** : RCP seal injection is supplied to the RCPs by two charging pumps or the auxiliary charging pump. Auxiliary charging pump can be powered from the onsite alternate AC power source.
  
- **Open Item (RAI No. 8555, Question 05.04-2, Part 2) , Date issued (3/15/16); KHNP responded (4/29/16)**
  - **Description of Issue** : Commitment regarding the seal test results. (RAI 307-7835, Question 05.04-1, Part 7).
  - **Resolution** : Seal test results are available to staff audit. A general summary of tests is incorporated into the DCD.

# Reactor Coolant System and Connecting Systems

## ● 5.4.1 Reactor Coolant Pump (4/7)

### ➤ Flywheel

- ◆ A cylindrical shrink fit of the outer wheel to the hub, and then a conical shrink fit between the hub and the shaft
- ◆ Material: 26NiCrMoV14-5, high strength ductile forged material
- ◆ Fracture toughness:  $K_{IC} > 165 \text{ MPa}\sqrt{\text{m}}$  (150 ksi $\sqrt{\text{in}}$ ).
- ◆ Design: APR1400-A-M-NR-14001-NP, KHNP APR1400 Flywheel Integrity Report



# Reactor Coolant System and Connecting Systems

## ● 5.4.1 Reactor Coolant Pump (5/7)

- **Open Item (RAI No. 8641, Question 05.04.01.01-7), Date issued (7/6/16); KHNP responded (9/12/16)**
  - **Description of Issue** : Describe acceptable approach for determining fracture toughness of the flywheel materials.
  - **Resolution** : Revised DCD to state fracture toughness of at least 150 ksi√in (to specify the direct method of determining fracture toughness)
  
- **Open Item (RAI No. 8641, Question 05.04.01.01-8), Date issued (7/6/16); KHNP responded (9/12/16)**
  - **Description of Issue** : Clarify operating experience table.
  - **Resolution** : Revised operating experience table with the same material used in Korean and German plants.

# Reactor Coolant System and Connecting Systems

## ● 5.4.1 Reactor Coolant Pump (6/7)

- **Open Item (RAI No. 8641, Question 05.04.01.01-9), Date issued (7/6/16)  
; KHNP responded (9/12/16)**
  - **Description of Issue** : Apply a RCP flywheel stress limit of one-third of the yield strength of the material or provide technical justification for use of one-third of ultimate strength.
  - **Resolution** : Apply a RCP flywheel stress limit of one-third of the yield strength of the material according to the SRP 5.4.1.1.
  
- **Open Item (RAI No. 8641, Question 05.04.01.01-10), Date issued (7/6/16)  
; KHNP responded (9/12/16)**
  - **Description of Issue** : Revise the technical report to include an analysis of the hub and provide the appropriate fatigue crack growth rates.
  - **Resolution** : Add a separate stress plot of the hub.

# Reactor Coolant System and Connecting Systems

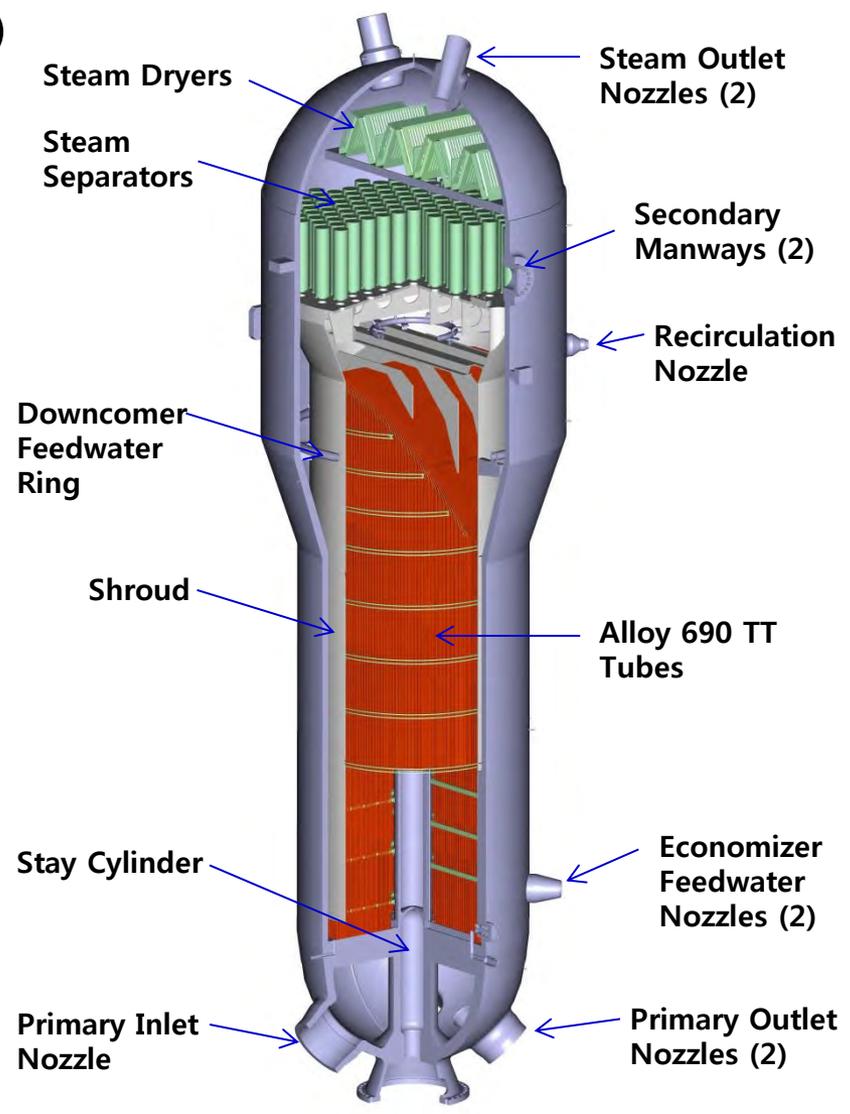
## ● 5.4.1 Reactor Coolant Pump (7/7)

- **Open Item (RAI No. 8641, Question 05.04.01.01-11), Date issued (7/6/16); KHNP responded (9/12/16)**
  - **Description of Issue** : Specify maximum flaw size used as the acceptance criteria and that it is bounding in determining the critical flaw size.
  - **Resolution** : Revised DCD to include inspection acceptance criteria.
- **Open Item (RAI No. 8641, Question 05.04.01.01-12 ), Date issued (7/6/16); KHNP responded (9/12/16)**
  - **Description of Issue** : Tests and inspections proposed for the flywheel also apply to the hub.
  - **Resolution** : The hub has oil channels that would make it difficult to perform UT inspection. Flaw propagation will be shown as negligible. Additional defense-in-depth notation will be added to the DCD for ISI instructions.

# Reactor Coolant System and Connecting Systems

## ● 5.4.2 Steam Generator (1/3)

- **Heat Transfer with 2 SGs**  
: 4,000 MWth / 1,400 MWe
- **Alloy 690TT, Vertical U-Tube**  
with 13,102 tubes/SG
- **Integral Economizer**
- **Steam Outlet Nozzle**  
with Flow Restrictor



ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

- 5.4.2 Steam Generator (2/3)



ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

## ● 5.4.2 Steam Generator (3/3)

- Open Item (RAI No. 8620, Question 05.04.02.02-6), Date issued (6/8/16); KHNP responded (7/26/16)
  - **Description of Issue** : Administrative issue of the eRAI number and inconsistency of the proposed leakage values between the TS bases and Chapter 15.
  - **Resolution**
    - Changed the eRAI number from 05.04.02.02-5 to 05.04.02.02-6
    - Revised the TS bases from 0.3 gpm to 0.6 gpm for all SGs primary to secondary leakage.



# Reactor Coolant System and Connecting Systems

## ● 5.4.7 Shutdown Cooling System (2/2)

- **Open Item (RAI No. 8614, Question 05.04.07-4), Date issued (5/26/16); KHNP responded (7/8/16)**
  - **Description of Issue** : Revise the ITAAC for gas accumulation addressing GL-2008-1 and NEI-09-10, Revision 1a-A as they relate to SCS, SIS, and CSS.
  - **Resolution** : Revised the ITAAC to include the as-built evaluation for gas entrainment.

# Reactor Coolant System and Connecting Systems

## ● 5.4.10 Pressurizer (1/3)

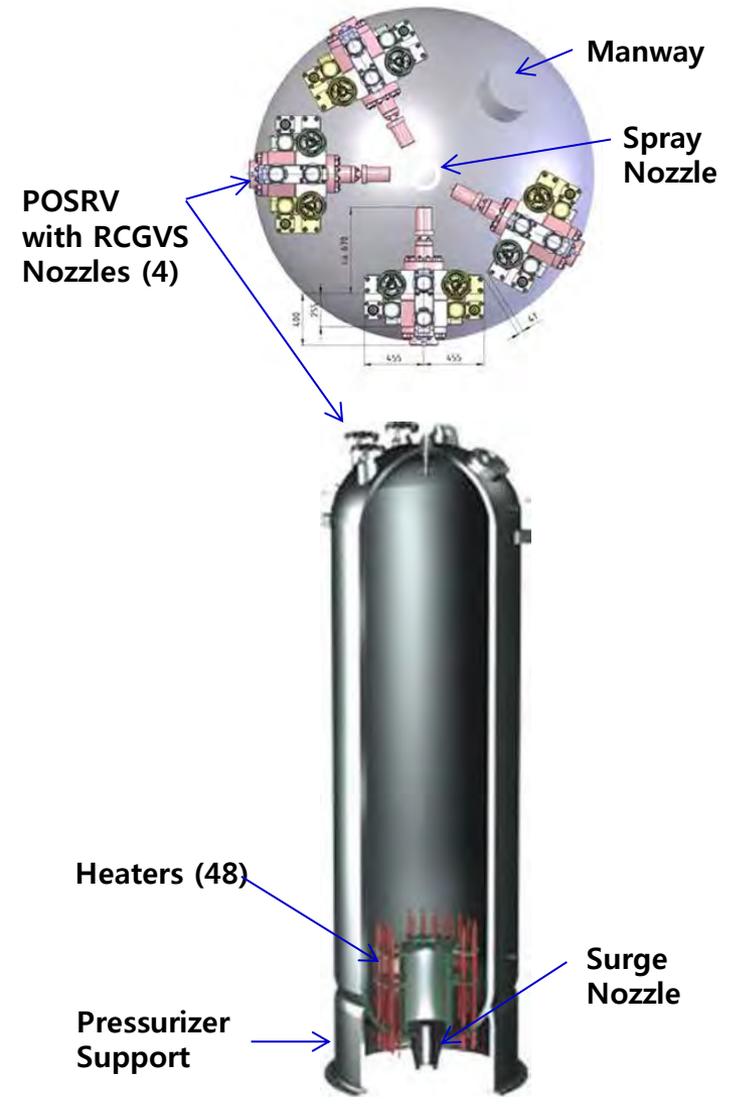
### ➤ RCS Pressure and Volume Control

- ◆ Internal volume: 2,400 ft<sup>3</sup>
- ◆ Connected with surge line

### ➤ 4 Pilot Operated Safety Relief

#### Valves (POSRVs)

- ◆ Overpressurization protection of RCS
- ◆ Integrated installed with reactor coolant gas vent system (RCGVSs)

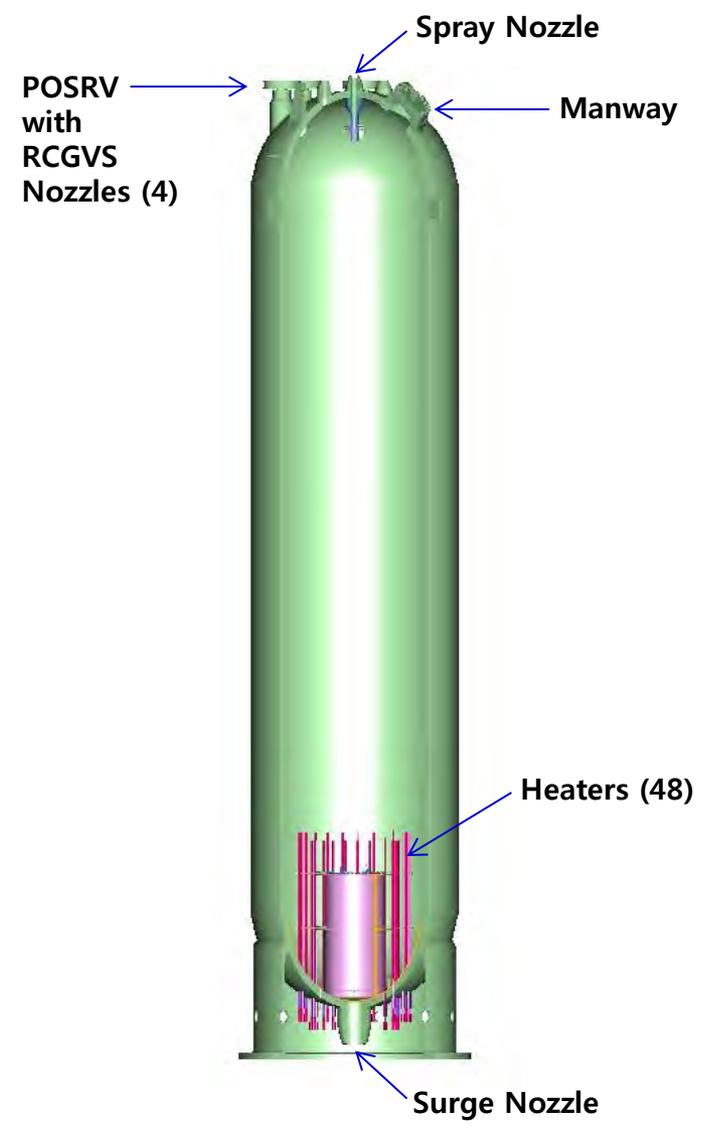


ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

## ● 5.4.10 Pressurizer (2/3)

Parameter	Value
Design pressure, kg/cm <sup>2</sup> A (psia)	175.8 (2,500)
Design temperature, °C (°F)	371.1 (700)
Normal operating pressure, kg/cm <sup>2</sup> A (psia)	158.2 (2,250)
Normal operating temperature, °C (°F)	344.8 (652.7)
Internal free volume, m <sup>3</sup> (ft <sup>3</sup> )	68.0 (2,400)
Normal (full power) operating water volume, m <sup>3</sup> (ft <sup>3</sup> )	33.2 (1,171)
Normal (full power) steam volume, m <sup>3</sup> (ft <sup>3</sup> )	35.7 (1,260)
Installed heater capacity, kW	2,400
Heater type	Immersion
Spray flow, minimum design capacity, L/min (gpm)	1,703.4 (450)
Bypass spray flow, continuous, L/min (gpm)	1.9~22.7 (0.5~6)
Nozzles:	
Surge, in (nominal)	12, schedule 160
Spray, in (nominal)	4, schedule 160
POSRV, in	6, Liner ID
	7.75, nozzle ID
Instrument:	
Level, in (nominal)	3/4, schedule 160
Temperature, in (nominal)	1, schedule 160
Pressure, in (nominal)	3/4, schedule 160
Heater, OD, mm (in)	31.75 (1-1/4)



ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

- 5.4.10 Pressurizer (3/3)



ACRS Meeting (Sep.21-22. 2016)

# Reactor Coolant System and Connecting Systems

## ● 5.4.12 Reactor Coolant System High Point Vents

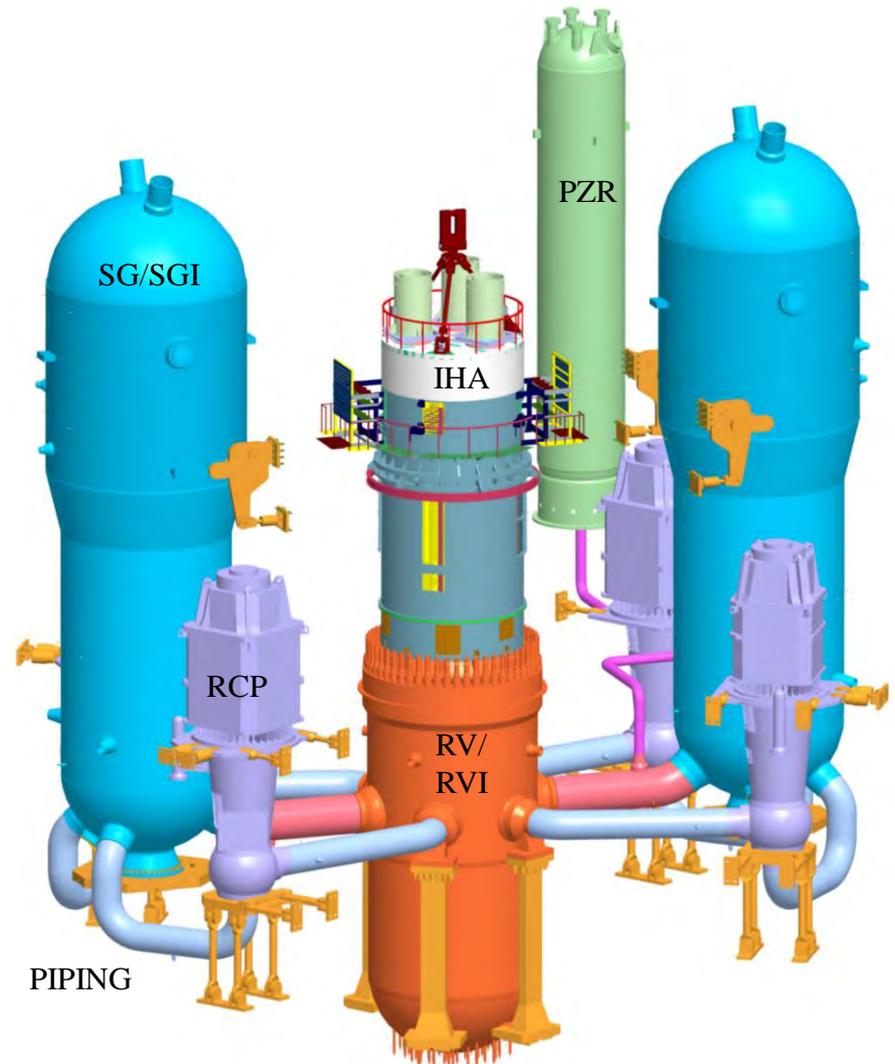
### ➤ Reactor Coolant Gas Vent System (RCGVS)

- ◆ Discharge non-condensable gases and steam from the high point of the RCS for venting or pressure control during post-accident conditions
- ◆ The in-containment refueling water storage tank (IRWST) collects and condenses the steam discharged from the reactor coolant gas vent system (RCGVS).

# Reactor Coolant System and Connecting Systems

## ● 5.4.15 Component Supports

- **Reactor Vessel**
  - ◆ 4 Vertical columns
- **Steam Generator (SG)**
  - ◆ 1 Sliding base
  - ◆ 2 Snubbers & keys
- **Pressurizer**
  - ◆ Integral support
- **Reactor Coolant Pump**
  - ◆ 4 Vertical columns
  - ◆ 2 Upper & lower horizontal columns
  - ◆ 2 Horizontal snubbers



# Summary

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- In chapter 5, the design features of the RCS of the APR1400 standard plant are described.
- All RCS components are located inside the containment building. Table 5.1.1-1 shows the principal parameters of the RCS.
- The reactor coolant pressure boundary (RCPB) components are consistent with 10 CFR 50.2 and 10 CFR 50.55a. Applicable codes and standards of RCS components are listed in Table 3.2-1

# Current Status

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- Chapter 5 is on a success path for completion on schedule.
- An SER with Open Items was issued
  - A path for closing each open item has been discussed with the NRC Staff and is being implemented.
  - KHNP believes that the open items except for flywheel which is in progress have been addressed.
- Chapter 5 as reviewed and marked-up in response to NRC's "Request for Additional Information" will be incorporated into the next revision of the Design Control Document.
- Monitoring of changes to other chapters for impacts on this chapter is conducted to maintain consistency.

# Attachment : Acronyms

- **ASME: American Society of Mechanical Engineers**
- **CEDM: Control Element Drive Mechanism**
- **CCW: Component Cooling Water**
- **CSP: Containment Spray Pump**
- **CSS: Containment Spray System**
- **EFPY: Effective Full Power Year**
- **ICI: In-Core Instrumentation**
- **IRWST: In-containment Refueling Water Storage Tank**
- **ISI: Inservice Inspection**
- **IST: Inservice Testing**
- **KHNP: Korea Hydro & Nuclear Power**
- **LTOP: Low Temperature Overpressure Protection**
- **POSRV: Pilot-operated Safety Relief Valve**
- **RCGVS: Reactor Coolant Gas Vent System**
- **RCP: Reactor Coolant Pump**
- **RCPB: Reactor Coolant Pressure Boundary**
- **RCS: Reactor Coolant System**
- **RG: Regulatory Guide**
- **RT<sub>NDT</sub>: Reference Temperature for Nil Ductility Transition**
- **SCS: Shutdown Cooling System**

# Attachment : List of COL Items for Ch. 5 (1/3)

COL No.	Description
COL 5.2(1)	The COL applicant is to address the addition of ASME Code Cases that are approved in NRC RG 1.84 at the time of the application.
COL 5.2(2)	The COL applicant is to address the ASME Code Cases approved in NRC RG 1.147 at the time of the application and invoked for the ISI program of a specific plant.
COL 5.2(3)	The COL applicant is to address the ASME Code Cases approved in NRC RG 1.192 at the time of the application and invoked for operation and maintenance activities of a specific plant.
COL 5.2(4)	The COL applicant is to address the material specifications, which are not shown in Table 5.2-2, as necessary.
COL 5.2(5)	The COL applicant is to specify the version of EPRI's, "Primary Water Chemistry Guidelines, that will be implemented.
COL 5.2(6)	The COL applicant is to address the actual, as-procured, fracture toughness data of the RCPB materials to the staff at a predetermined time by an appropriate method.
COL 5.2(7)	The COL applicant is to submit the actual, as-procured yield strength of the austenitic stainless steel materials used in RCPB to the staff at a predetermined time agreed-upon by the regulatory body.
COL 5.2(8)	The COL applicant is to provide and develop the implementation milestones for the inservice inspection and testing program for the RCPB, in accordance with ASME Section XI and 10 CFR 50.55a.
COL 5.2(9)	The COL applicant is to address the provisions to accessibility of Class 1 components for ISI if the design of the APR1400 Class 1 component is changed from the DCD design.

# Attachment : List of COL Items for Ch. 5 (2/3)

COL No.	Description
COL 5.2(10)	The COL applicant is to provide the list of Code exemptions in the ISI program of the specific plants, if it exists.
COL 5.2(11)	(Deleted)
COL 5.2(12)	(Deleted)
COL 5.2(13)	The COL applicant is to prepare and implement a boric acid corrosion (BAC) prevention program in conformance with Generic Letter 88-05.
COL 5.2(14)	The COL applicant is to prepare the preservice inspection and testing program.
COL 5.2(15)	The COL applicant is to address and develop the milestones for the preparation and implementation of the procedure for operator responses to prolonged low-level leakage.
COL 5.2(16)	The COL applicant is to address the portions of the later editions and addenda of ASME Code.
COL 5.3(1)	The COL applicant is to provide a reactor vessel material surveillance program for a specific plant.
COL 5.3(2)	The COL applicant is to develop P-T Limit curves based on plant-specific data.
COL 5.3(3)	The COL applicant is to verify the RTPTS value and the USE at EOL based on plant-specific material property and neutron fluences.

# Attachment : List of COL Items for Ch. 5 (3/3)

COL No.	Description
COL 5.3(4)	The COL applicant is to provide and develop the inservice inspection and testing program for the RCPB, in accordance with ASME Section XI and 10 CFR 50.55a.
COL 5.4(1)	The COL applicant is to prepare operational procedures and maintenance programs related to leak detection and contamination control of RCS.
COL 5.4(2)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations of RCS.
COL 5.4(3)	The COL applicant is to prepare operational procedures and maintenance programs related to leak detection and contamination control of SCS.
COL 5.4(4)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations of SCS.
COL 5.4(5)	The COL applicant is to verify the as-built RV support material properties and 60-year neutron fluence.
COL 5.4(6)	The COL applicant is to prepare a PSI and ISI programs of the SG tubes.
COL 5.4(6)	The COL applicant is to provide a procedure to protect the plant personnel from harsh environment and lengthen the work time within containment during hatch closure.
COL 5.4(7)	The COL applicant is to prepare an inspection and monitoring program for the cladding material integrity of SG channel heads.



# Presentation to the ACRS Subcommittee

**Korea Hydro Nuclear Power Co., Ltd (KHNP)  
APR1400 Design Certification Application Review**

**Safety Evaluation with Open Items: Chapter 5**

**REACTOR COOLANT SYSTEM AND CONNECTING SYSTEMS**

SEPTEMBER 22, 2016

- **Technical Staff Presenters**

- ♦ John Budzynski – DCD Sections 5.2.2, 5.4.1.2, 5.4.7, & 5.4.1.12
- ♦ Dan Widrevitz – DCD Section 5.2.3
- ♦ Jessica Umaña – DCD Section 5.2.5
- ♦ John Honcharik – DCD Section 5.4.1.1
- ♦ Greg Makar – DCD Sections 5.4.2.2

- **Project Managers**

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- ♦ Jessica Umaña – Chapter 5 Project Manager

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- ♦ **Hien Le**  
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- ♦ **Eric Reichelt**  
Materials & Chemical Engineering Branch

# Overview of Design Certification Application, Chapter 5

<b>SRP Section/Application Section</b>		<b>No. of Questions</b>	<b>Number of OI</b>
5.2.1.1	Compliance with the Codes and Standards Rule, 10 CFR 5055a	3	0
5.2.1.2	Compliance with Applicable Code Cases	2	0
5.2.2	Overpressure Protection	7	3
5.2.3	Reactor Coolant Pressure Boundary Materials	22	1
5.2.4	Inservice Inspection and Testing of the Reactor Coolant Pressure	2	0
5.2.5	Reactor Coolant Pressure Boundary Leakage Detection	3	0

# Overview of Design Certification Application, Chapter 5

<b>SRP Section/Application Section</b>		<b>No. of Questions</b>	<b>Number of OI</b>
5.3.1	Reactor Vessel Materials	0	0
5.3.2	Pressure-Temperature Limits, Pressurized Thermal Shock, and Upper-Shelf Energy Data and Analyses	1	0
5.3.3	Reactor Vessel Integrity	0	0
5.4	Reactor Coolant System Component and Subsystem Design	2	1
5.4.1.1	Reactor Coolant Pump Flywheel Integrity	12	6
5.4.1.2	Reactor Coolant Pump	0	0

# Overview of Design Certification Application, Chapter 5

<b>SRP Section/Application Section</b>		<b>No. of Questions</b>	<b>Number of OI</b>
5.4.2.1	Steam Generator Materials	3	0
5.4.2.2	Steam Generator Program	6	1
5.4.3	Reactor Coolant Piping	0	0
5.4.7	Residual Heat Removal System	4	1
5.4.10	Pressurizer	0	0

# Overview of Design Certification Application, Chapter 5

<b>SRP Section/Application Section</b>		<b>No. of Questions</b>	<b>Number of OI</b>
5.4.11	Pressurizer Relief Tank	0	0
5.4.12	Reactor Coolant System High-Point Vents	10	0
Totals		77	13

# Technical Topics

## Section 5.2.2 – Overpressure Protection

### **Technical Topics**

- System Design
  - ♦ Overpressure protection for (1) RCS, (2) primary side of systems connected to RCS, and (3) secondary side of SGs
    - RCPB overpressure protection consist of 4 POSRV, 2 SCS RV, and 20 MSSV (5 per steamline)
  - ♦ SCS suction line relief valves provide sufficient pressure relief capacity to mitigate the most limiting low temperature overpressure protection (LTOP)

# Technical Topics

## Section 5.2.2 – Overpressure Protection

### Open Items

- **RAI 8244, Question 05.02.02-1** – Provide information regarding the analysis performed to demonstrate that POSRV and SCS RV provide sufficient capacity to maintain the pressure below the limit during full power and LTOP conditions.
  - ♦ **Status:** The response was received on 12/11/2015. The POSRV analysis was adequately addressed; however, the LTOP analysis did not address staff concerns related to methodology, codes, input parameters, and assumptions used in the LTOP analysis. This question is closed unresolved.
- **RAI 8609, Question 05.02.02-7 Follow up question** - Provide a description of the analysis methodology, computer codes, input parameters, and assumptions used in the analysis of the limiting LTOP event(s). Provide justification that the inputs are suitably conservative.
  - ♦ **Status:** The response was received on 6/9/2016. The follow up RAI response is currently in evaluation.
- **RAI 8244, Question 05.02.02-5** - Address the difference between the pre-service testing requirements and Chapter 14 test.
  - ♦ **Status:** The response was received on 6/9/2016. The response was found acceptable because the complete pre-service testing is included in the Section 14.2 rewrite. The staff confirmed the revision. This question is closed resolved.

# Technical Topics

## Section 5.4.1.2 – Reactor Coolant Pumps

### **Technical Topics**

- Pump Design
  - ♦ RCP is a vertical shaft, single-stage, centrifugal pump
  - ♦ Loss of Component Cooling Water Event
    - CCW flows to pump/motor bearing oil coolers, motor air coolers, and high-pressure seal water cooler stopped
    - CVCS continues to provide seal water injection flow to the RCP seals
    - Pump/motor bearings designed to withstand loss of CCW for 30 minutes
    - CCWS Division 1 supports charging pump mini flow heat-exchanger in CVCS and all coolers on the RCPs
  - ♦ RCP seal design is improved to have low seal leakage rates during a station black-out (SBO) event

# Technical Topics

## Section 5.4.1.2 – Reactor Coolant Pumps

### Open Items

- **RAI 8555, Question 05.04-2, Part 1** – With respect to Loss of Component Cooling Water, provide a response to clarify whether the loss of CCW Division 1 affects the charging pump operation during the 30-minute period following the event
  - ♦ **Status:** The response was received 4/29/2016. The response was found acceptable because of the loss of the CCW to the charging pump only has a long term effect on its operation. This question is closed resolved.
- **RAI 8555, Question 05.04-2, Part 2** – Revise DCD Section 5.4 to include a summary of the seal leakage test results that show the low seal leakage rate during a simulated SBO event.
  - ♦ **Status:** The response was received on 4/29/2016). The response was found acceptable because the DCD is being revised to include a reference to the seal test report. This question is closed resolved.

# Technical Topics

## Section 5.4.7 – Shutdown Cooling

### **Technical Topics**

- System Design
  - ♦ Configuration Similar to Current PWR Designs,
    - Two independent trains – SCP interchangeable with CSP
  - ♦ Used during startup/shutdown and refueling operations
    - During shutdown and refueling RHR is placed in service below approximately 450 psig and 350°F
- Evaluated against GL-2008-01 and RIS 2013-09
- Evaluated against NEI 09-10 Rev 1a-A – Prevention and Management of System Gas Accumulation

# Technical Topics

## Section 5.4.7 – Shutdown Cooling

### Open Items

- **RAI 8614, Question 05.04.07-4** – Provide ITAAC to the SCS design that addresses GL-2008-01 and NEI 09-10 with respect to managing gas accumulation during plant operations
  - ♦ **Status:** The response was received on 7/8/2016. The ITAAC was adequately addressed and in compliance with NEI 09-10 Revision 1a-A; however, NEI 09-10 was referenced in the DCD. The staff will discuss the need to include the reference with the applicant. This question currently remains in evaluation.

# Technical Topics

## Section 5.4.12 – RCS High Point Vents

### **Technical Topics**

- 10 CFR 50.34(f)(2)(vi) and TMI Action Plan Item II.B.1 require high point vents, and 10 CFR 50.46a specifies acceptance criteria
  - ♦ Remove non-condensable gases from high points in the RCS to maintain adequate core cooling (enhance natural circulation)
  - ♦ The RCS high points are the reactor vessel head, pressurizer, and steam generator U-tubes; however, individual U-tubes are not required to have high point vents (10 CFR 50.46a)
- APR1400 High Point Vent Design: Standard Configuration
  - ♦ Safety-grade vent paths: (1) reactor vessel head to in-containment refueling water storage tank (IRWST); and (2) pressurizer head to IRWST
  - ♦ Each safety-grade vent path has two parallel vent paths with two normally closed solenoid-operated valves in series
  - ♦ Small-break loss-of-coolant accident analyses bound potential vent line breaks upstream of isolation valves
- Operating procedures described at a high level in the DCD; detailed operating procedures to be developed by COL applicant

# Technical Topics

## Section 5.2.3 – Reactor Coolant Pressure Boundary

### Open Item

- **Open Item, DCD Clarification** - It was determined that a portion of DCD text providing additional detail beyond the staff criteria for establishing that austenitic materials used for the RCPB will not be sensitized should be removed from the DCD. Since the DCD will be granted finality by rulemaking, this removal is necessary as the staff could not make a specific regulatory finding regarding its accuracy.
  - ♦ **Status:** The applicant has been notified and the staff has scheduled a meeting with the applicant to review this.

# Technical Topics

## Section 5.2.5 – Reactor Coolant Pressure Boundary Leakage Detection

### **Technical Topics**

- Regulatory Requirements: GDC30, GDC2
- Review Guidance: SRP Section 5.2.5  
For GDC 30 on RCPB leakage detection, the review is based on RG 1.45.  
For GDC 2 on seismic design, the review is based on RG 1.29 and RG 1.45.
- Review Areas: leakage detection capability, sensitivity, and response time; leakage detection systems; seismic qualification; leakage instrumentation in the control room; prolonged low-level RCS leakage; separation of identified and unidentified leakage; intersystem leakage; plant TSs; initial testing program; ITAAC; and COL information items.
- Three RAIs were issued and all are being resolved pending confirmation in the next revision of the DCD.
- One COL information item.

# Technical Topics

## Section 5.4.1.1 – Reactor Coolant Pump (RCP) Flywheel Integrity

### **Technical Topics**

RCP flywheel analyzed to prevent fracture and possible missile.

- KHNP provided:
  - ♦ Material selection, fabrication techniques, preservice and inservice inspections and overspeed testing per NUREG-0800
  - ♦ Analysis per RG 1.14 (APR1400-A-M-NR-14001)
    - Critical speeds for ductile and non-ductile fracture
    - Fatigue crack growth

# Technical Topics

## Section 5.4.1.1 – RCP Flywheel Integrity

### Open Items

- **RAI 8641, Question 05.04.04.01-7** – The applicant needs to provide the method for determining fracture toughness.
  - ♦ **Status:** This question is currently waiting a response.
- **RAI 8641, Question 05.04.01.01-8** - The applicant needs to provide operating experience for the flywheel material 26 NiCrMoV 14-5.
  - ♦ **Status:** This question is currently waiting a response.
- **RAI 8641, Question 05.04.01.01-9** - The applicant needs to provide analysis using design acceptance criteria of 1/3 yield strength or provide justification for using 1/3 ultimate strength as the design acceptance criteria.
  - ♦ **Status:** This question is currently waiting a response.
- **RAI 8641, Question 05.04.01.01-10** - The applicant needs to provide analysis of the hub and why crack growth rates used for the flywheel are applicable to the specific flywheel material.
  - ♦ **Status:** This question is currently waiting a response.
- **RAI 8641, Question 05.04.01.01-11** – The applicant needs to provide in the DCD the maximum flaw size used in the analysis and that can be detected by the applicable NDE method.
  - ♦ **Status:** This question is currently waiting a response.

# Technical Topics

## Section 5.4.1.1 – Reactor Coolant Pump (RCP) Flywheel Integrity

### Open Items (continued)

- **RAI 8641, Question 05.04.01.01-12** - The applicant needs to include in the DCD the applicable PSI and ISI for the hub that is consistent with the flywheel to ensure the integrity of the hub is maintained.
  - ♦ **Status:** This question is currently waiting a response.

# Technical Topics

## Section 5.4.2.2 – Steam Generator Program

### Open Items

- **RAI 494-8620, Question 05.04.02.02-6** - The assumed values for primary-to-secondary leakage described in the TS Bases (B 3.4.12 and B 3.4.17) appeared to be inconsistent with the accident analyses described in Chapter 15. Question 05.04.02.02-6 requested clarification of the leakage values in the TS Bases and how they are consistent with applicant's accident analyses and the Standard Technical Specifications (STS). Consistency between the accident analyses, APR1400 TS, and STS is needed to establish and implement a Steam Generator Program to ensure that tube integrity is maintained. This is part of meeting GDC 32.
  - ♦ **Status:** The response was received 7/26/2016. The response clarified the accident analysis assumptions and proposed revisions to TS Bases Sections B 3.4.12 and B 3.4.17 that are consistent with the accident analyses and STS. Therefore, the response is acceptable, this open item will be **closed**, and Question 5.04.02.02-6 will be tracked as a confirmatory item.

# ACRONYMS

10 CFR – Title 10 of the Code of Federal Regulations

CCW – component cooling water

CVCS – chemical and volume control system

COL – combined license

DV – depressurization valve

FSAR – Final Safety Analysis Report

MCR – main control room

MOV – motor operated valve

PRT- pressurizer relief tank

PTLR – Pressure – Temperature Limits Report

PTS – pressurized thermal shock

PWR – pressurized water reactor

RAI – request for additional information

RCP – reactor coolant pump

RCPB – reactor coolant pressure boundary

RCS – reactor coolant system

RCSHPV – reactor coolant system high point vent

RG – Regulatory Guide

RHR – residual heat removal

RVHVS – reactor vessel head vent system

RWSP – refueling water storage pit

SDV – safety depressurization valve

SER – safety evaluation report

SRP – Standard Review Plan

SRV – safety relief valve