

June 16, 2014

PRE-APPLICANT: KOREA HYDRO AND NUCLEAR POWER CO. LTD.
PROJECT: APR1400 DESIGN CERTIFICATION PRE-APPLICATION
SUBJECT: SUMMARY OF THE APRIL 30, 2014, THROUGH MAY 2, 2014, PUBLIC MEETINGS WITH KOREA HYDRO AND NUCLEAR POWER CO. LTD. TO DISCUSS VARIOUS TOPICS RELATED TO THE ADVANCED POWER REACTOR 1400 DESIGN

On April 30, 2014, through May 2, 2014, three public meetings were held between the U.S. Nuclear Regulatory Commission (NRC) and Korea Hydro and Nuclear Power Co. Ltd. (KHNP) at the NRC offices in Rockville, Maryland. The public meetings on April 30, 2014, and May 2, 2014, were open to the public, but the meeting on May 1, 2014, was closed to the public due to the proprietary presentation materials. The meeting notice was issued on April 16, 2014, and was documented in the Agencywide Documents Access and Management System (ADAMS) under accession number ML14105A360. The notice included the meeting agendas. The purpose of the meetings was to discuss various proprietary and non-proprietary pre-application topics related to the Advanced Power Reactor 1400 (APR1400) design, including metal/water reaction on the reactor vessel and steam generator tubing, critical heat flux correlation, large break loss-of-coolant-accident analysis methodology, and piping analysis. The non-proprietary meeting presentations are publicly available in ADAMS under accession numbers ML14132A133, "KCE-a Critical Heat Flux Correlation for PLUS7 Thermal Design (APR1400-F-C-RT-12002);" ML14132A137, "Topical Report APR1400-F-A-TR-12004(RO) Realistic Evaluation Methodology for Large-Break LOCA of APR1400 (CAREM);" ML14132A132, "Level of Detail for Pipe Rupture Hazards Analyses, Pre-Application Review Meeting;" ML14132A135, "Level of Detail for Piping Stress Analyses, Pre-Application Review Meeting;" and ML14065A067, "Piping Level of Detail for Design Certification – March 4, 2014." The List of Attendees is provided as an enclosure.

On April 30, 2014, the NRC provided an informational non-proprietary presentation entitled "NRC APR1400-DCD-6.2.1.3 – Metal Water Reaction Energy Item-Syed," (ML14134A332) on an item for consideration in loss-of-coolant accident analyses related to metal/water reaction mass and energy release with regard to sources of generated and stored energy in the reactor coolant system and secondary coolant system. KHNP provided an informational non-proprietary presentation entitled "KHNP APR1400-DCD-6.2.1.3- Metal KHNP Water Reaction Energy Item-Response," (ML14134A344) showing the considerations for use in the metal/water energy release analyses. KHNP will determine the best way to clarify the methodology and model correlation used in development of the metal/water reaction energy calculations for this section of the APR1400 design control document (DCD).

On Thursday morning, May 1, 2014, in a closed, proprietary meeting, KHNP presented background information and assumptions to be applied in development of the critical heat flux

(CHF) correlation for the reactor thermal design, based on the KHNP Topical Report “KCE-1 Critical Heat Flux Correlation for Plus7 Thermal Design.” The non-proprietary CHF presentation material is provided via ADAMS accession number ML14132A133, “KCE-a Critical Heat Flux Correlation for PLUS7 Thermal Design (APR1400-F-C-RT-12002).” This subject was discussed throughout the morning and continued briefly in an afternoon breakout session. The exchange between staff and KHNP technical personnel resulted in the need for clarity on some of the CHF issues discussed. The following were the main results of these discussions:

1. CHF Test for Plus7 Fuel: The NRC will issue a request for additional information (RAI) that will request clarification of the qualification status of the Columbia test facility. KHNP will include in the response backup material related to the test acceptance criteria and quality assurance program.
2. Assumptions Applied to CHF Correlation: KHNP agreed to provide how and why the Thermal Hydraulics of a Reactor Core (TORC) code is being used on the APR1400, in the form of a Technical Report, “Thermal Design Methodology” (APR1400-F-C-NR-12001-P, Rev. 0) that may serve as a summary of all codes, and their changes from previously approved applications, mentioned in the CHF topical report.
3. Assumptions Applied to CHF Correlation: The NRC requested that KHNP clarify how the data were developed for the two graphs on Slide 5 of the KHNP presentation handout.
4. Test Acceptance Criterion: KHNP agreed to explain heat loss under high power and high heat flux conditions to prevent uncertainty in use of the TORC code due to unaccounted for loss of heat.
5. MDNBR Elevation Prediction: KHNP will explain how the minimum departure from nucleate boiling ratio (MDNBR) elevation (location) is calculated as the predicted departure from nucleate boiling ratio (DNBR) minimum.
6. Test Plan: KHNP will clarify how well the tested cosine power distribution represents the actual distribution for the PLUS7 fuel design, and will also clarify the correlation factor calculations, along with how the <1 computed factors were dealt with.
7. Design Methodology to Support AOOs: A reference to anticipated operational occurrences (AOOs) will need to be provided in the design control document.
8. Source of Uncertainty: KHNP agreed to provide pointers to sources of additional information, and make those references available, possibly in its Virginia office. This would require quantifying and justifying the overall experimental uncertainty in the measurement of the critical heat flux.
9. CETOP-D Code: KHNP agreed to provide an explanation of the different uses of the CETOP-D code for the APR1400 design and why it is applicable to the PLUS7 fuel design.

10. Overfitting and Number of Test Data: KHNP will identify which data points were included and which were excluded from the CHF coefficient development process, and explain what is meant by “verification and validation of the KCE-1 CHF correlation.”

The closed, proprietary meeting format was continued during the afternoon of May 1, 2014. The NRC and KHNP engaged in discussions on evaluation methodology for large break loss-of-coolant accident (LBLOCA). The NRC provided an informational, non-proprietary presentation entitled “NRC Loop Seal Long-Term-Cooling-Final,”(ML14134A347) that generically explained the basics of the reactor problem known as “loop seal” that can occur during a LOCA. KHNP indicated they understood the message and agreed to review the issue for consideration in their DCD submittal. KHNP presented information on LBLOCA (ML14132A137, “Topical Report APR1400-F-A-TR-12004(RO) Realistic Evaluation Methodology for Large-Break LOCA of APR1400 (CAREM),” non-proprietary) that related to the Topical Report “Realistic Evaluation Methodology for Large-Break LOCA of the APR1400 (CAREM).” Discussion ensued on topics such as the KHNP Analysis Flow Process and Additional Input Structures (uncertainty parameters, containment condition calculations, and bias calculation inputs). The following were the main results of these discussions:

1. Analysis Flow Process: KHNP agreed to provide a make-file (build script) that the NRC can compile and use to prepare various test cases.
2. RELAP5 and CONTEMPT4 Codes: The NRC must review the calculations that relate to specific drawing elements. A date will be determined for the audit of these calculations. KHNP is determining the best way to make background information on these codes and calculations available to the NRC.
3. Loop Seal: A RAI on the loop seal issue will not be submitted by the NRC at this time, pending KHNP explanation in the resubmitted DCD.

On May 2, 2014, the NRC made a presentation on the concept of using a graded approach in the use of design acceptance criteria (DAC) to describe the level of detail in the APR1400 piping design (ML14065A067). KHNP understood the graded approach concept and will determine at a later time if this appears to be a viable option. KHNP made a presentation on Pipe Rupture Hazards Analyses (ML14132A132) to assist in understanding the scope of pipe rupture hazards to be completed for the APR1400. The presentation included discussion on pipe rupture hazards analyses work flow, current design approach, and a possible graded approach for pipe rupture hazards analyses. The schedule for related document development was also discussed. KHNP also made a presentation on Level of Detail for Piping Stress Analyses (ML14132A135) to assist in clarifying the scope of piping design work to be completed for the APR1400. The stress analysis work flow and the application of DAC to piping stress analysis were discussed, along with the application of the graded approach and forecast dates of design work to be completed. The methodology to address the Environmental Fatigue Evaluation for Class 1 Piping was the final item discussed. The steps to meet these requirements include an analysis method with bounding calculations, or a narrowly focused DAC. KHNP will decide on a method and define it in the DCD.

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At the conclusion of the meetings, KHNP stated they would continue to address staff comments and improve the DCD.

Please direct any inquiries to me at 301-415-1026, or via e-mail to James.steckel@nrc.gov.

/RA/

James Steckel, Project Manager
Licensing Branch 2
Division of New Reactor Licensing
Office of New Reactors

Project No.: 000782

Enclosure:
List of Attendees

cc w/enclosure: See next page

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ADAMS Accession No.: ML14154A030 via email* NRC-001

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NAME	JSteckel	CMurphy	JCiocco	JSteckel
DATE	06/11/2014	06/11/2014	06/16/2014	06/16/2014

OFFICIAL RECORD COPY

List of Attendees
KHNP APR1400 Design Topics Meeting - April 30, 2014; May 1, 2014; and May 2, 2014

<u>Representing</u>	<u>Last Name</u>	<u>First Name</u>	<u>30-Apr</u>	<u>1-May</u>	<u>02-May</u>
KHNP	Lee	Jae Yong	✓		
KHNP	Lee	Do Hwan		✓	✓
KHNP	Kim	Tae Soon			✓
KHNP	Kim	Yun Ho		✓	✓
KHNP	Chang	Hyun Seung	✓	✓	✓
KEPCO NF	Jeong	Jae Hoon		✓	
KEPCO NF	Kim	Kang Hoon		✓	
KEPCO NF	Park	Ho Young		✓	
KEPCO NF	Park	Ju Hyun		✓	
KEPCO E&C	Hur	Seok Hwan			✓
KEPCO E&C	Jeong	Won Sang			✓
KEPCO E&C	Song	Jeung Hyo	✓		
KEPCO E&C	Park	Seok Jeong	✓		
KEPCO E&C	Kim	Tae Han	✓		
Westinghouse	Sisk	Robert	✓	✓	✓
ENERCON	In	Young		✓	✓
NRC	McKirgan	John	✓		
NRC	Lee	Samuel	✓	✓	✓
NRC	Ciocco	Jeff	✓		
NRC	Olson	Bruce	✓	✓	✓
NRC	Steckel	James	✓	✓	✓
NRC	Haider	Sayed	✓	✓	
NRC	Kaizer	Joshua		✓	
NRC	Anzalone	Reed		✓	
NRC	Saenz	Diego		✓	
NRC	Lu	Shanlai		✓	
NRC	Gilmer	James		✓	
NRC	Drzewiecki	Tim		✓	
NRC	Frankl	Istvan		✓	
NRC	Van Wert	Chris		✓	
NRC	Li	Renee			✓
NRC	Tsirigotis	David			✓
NRC	Terao	David			✓
NRC	Clark	Theresa			✓
NRC	Ahmed	Sardar			✓
Westinghouse	Kling*	Chuck	✓		
NUMARK Associates	Kulick*	John	✓		✓
MNES	Sprengel*	Ryan			✓
*On-line, public participants					

Enclosure

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2/21/2013

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