

## KHNPDCDRAIsPEm Resource

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**From:** Ciocco, Jeff  
**Sent:** Thursday, August 13, 2015 10:54 AM  
**To:** KHNPDCDRAIsPEm Resource  
**Subject:** FW: APR1400 Design Certification Application RAI 128-7980 (18.6-Treatment of Important Human Actions - TIHAs)  
**Attachments:** image001.jpg; APR1400 DC RAI 128 COLP 7980.pdf

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**From:** Ward, William  
**Sent:** Wednesday, August 05, 2015 6:51 PM  
**To:** 'apr1400rai@khnp.co.kr' <apr1400rai@khnp.co.kr>; KHNPDCDRAIsPEm Resource <KHNPDCDRAIsPEm.Resource@nrc.gov>; 'Chang, Harry' <hyunseung.chang@gmail.com>; 'Yunho Kim (yshh8226@gmail.com)' <yshh8226@gmail.com>; jiyong.oh5@gmail.com; daegeun.ahn@gmail.com; Erin Wisler (erin.wisler@aecom.com) <erin.wisler@aecom.com>  
**Cc:** Ciocco, Jeff <Jeff.Ciocco@nrc.gov>; Lee, Samuel <Samuel.Lee@nrc.gov>; Junge, Michael <Michael.Junge@nrc.gov>; Kent, Lauren <Lauren.Kent@nrc.gov>; Ward, William <William.Ward@nrc.gov>  
**Subject:** APR1400 Design Certification Application RAI 128-7980 (18.6-Treatment of Important Human Actions - TIHAs)

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, the time shown below to respond to the RAI question. We may adjust the schedule accordingly.

<u>Question</u>	<u>Time to respond</u>
18-13	60 days
18-14	60 days
18-15	45 days
18-16	90 days
18-17	90 days
18-18	90 days
18-19	45 days
18-20	45 days
18-21	90 days
18-22	45 days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

**William R. Ward, P.E.**  
**Senior Project Manager**  
**U.S. Nuclear Regulatory Commission**  
**m/s T6-D38M**  
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**Sent Date:** 8/13/2015 10:54:27 AM  
**Received Date:** 8/13/2015 10:54:28 AM  
**From:** Ciocco, Jeff

**Created By:** Jeff.Ciocco@nrc.gov

**Recipients:**  
"KHNPDCDRAIsPEm Resource" <KHNPDCDRAIsPEm.Resource@nrc.gov>  
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image001.jpg	4205	
APR1400 DC RAI 128 COLP 7980.pdf		95803

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## REQUEST FOR ADDITIONAL INFORMATION 128-7980

Issue Date: 08/05/2015

Application Title: APR1400 Design Certification Review – 52-046

Operating Company: Korea Hydro & Nuclear Power Co. Ltd.

Docket No. 52-046

Review Section: 18 - Human Factors Engineering

Application Section: 18.6 - Treatment of Important Human Actions (TIHAs)

### QUESTIONS

#### 18-13

Title 10 of the Code of Federal Regulations (10CFR) Section 52.47(a)(8) requires an applicant for a design certification to provide an FSAR which includes the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), with certain exceptions. Section 10 CFR 50.34(f)(2)(ii) requires an applicant to "Establish a program, to begin during construction and follow into operation, for integrating and expanding current efforts to improve plant procedures. The scope of the program shall include.....human factors engineering..." The current NRC guidance for developing a human factors engineering (HFE) program is NUREG-0711, Rev 3, "Human Factors Engineering Program Review Model." The applicant stated in the FSAR, Tier 2, Chapter 18 "Human Factors Engineering," that it was working in accordance with the criteria of NUREG-0711 in establishing its HFE program.

Section 7.4 (1), "Review Criteria," of NUREG-0711, states in part that the applicant should identify risk-important human actions from the PRA/HRA. Additionally, Section 1.2.2, "Review Elements," of NUREG-0711 states in part that the NRC staff accepts implementation plans for review when the results for an HFE element are not available for the review.

The staff reviewed KHNP DCD Section 18.6, "Treatment of Important Human Actions." DCD Section 18.6.2.a, "RIHAs," states that the list of RIHAs is developed from the analysis results of Chapter 19, which includes the Level 1 and Level 2 PRAs for internal and external events during all modes. Section 18.6.3, "Results," states that "the TIHA ReSR includes the list of IHAs and their corresponding HFE characteristics, as extracted from the PRA..."

The staff reviewed DCD Chapter 19, "Probabilistic Risk Assessment and Severe Accident Evaluation." DCD Chapter 19 lists "risk-significant operator actions" for Level 1, Level 2, and low-power shutdown (LPSD) internal and external events, with the exception of seismic events, in Tables 19.1-24, 25, 38, 39, 55, 56, 61, 62, 72, 73, 78, 79, 104, 105, 117, 118, 130, 131, 145, 146, 159, and 160.

Provide the list of risk-important human actions (RIHAs) for staff review. Revise the application to reflect the RAI response.

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### 18-14

Section 7.4 (1), "Review Criteria," of NUREG-0711, states in part that the applicant should identify risk-important human actions from the PRA/HRA.

The staff reviewed KHNP DCD Section 18.6, "Treatment of Important Human Actions." DCD Section 18.6.2.a, "RIHAs," states that "for each RIHA, the PRA identifies assumptions regarding factors that lead to human performance error probability, including action location, time available to take the action, and action complexity." This section also claims that the RIHAs and associated HFE characteristics are clearly identified in the PRA documentation (DCD Chapter 19). The staff did not find associated HFE characteristics for any RIHA in DCD Chapter 19. APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP), Revision 0 also does not specify the location of the HFE characteristics.

Specify where the HFE characteristics for each RIHA are documented, and provide the HFE characteristics for each RIHA for staff review if the characteristics have been identified in documentation supporting the PRA. Revise the application to reflect the RAI response.

### 18-15

Section 18.6.3, "Results," of DCD Chapter 18 states that the TIHA ReSR includes the list of IHAs and their corresponding HFE characteristics. APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP), Revision 0, Section 6, "Results Summary Report," discusses an ITAAC associated with completion of the TIHA ReSR; however, Table 2.9-1, "Human Factors Engineering ITAAC," in DCD Tier 1 does not include ITAAC for completion of the TIHA ReSR.

Revise the DCD, Tiers 1 and 2, and the TIHA IP, to conform with each other respect to an ITAAC in DCD Tier 1, Table 2.9-1 for the completion of the TIHA ReSR.

### 18-16

Section 7.4 (2), "Review Criteria," of NUREG-0711, states in part that the applicant should identify deterministically-important human actions from the DCD Chapter 15 transient and accident analyses (TAA). Additionally, Section 1.2.2, "Review Elements," of NUREG-0711 states in part that the NRC staff accepts implementation plans for review when the results for an HFE element are not available for the review.

Section 18.6.2.b, "DIHAs," in DCD Chapter 18 states that DIHAs and their associated HFE characteristics are identified from the transient and accident analysis (TAA) in DCD Chapter 15. Section 4.2, "Deterministically-Important Human Actions Analyses," in APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP) Revision 0, describes the process for compiling the DIHAs and their associated HFE characteristics from the TAA in DCD Chapter 15.

DCD Chapter 15, "Transient and Accident Analyses," Revision 0, identifies operator actions credited for event mitigation (DIHAs). Some of the HFE characteristics are also included in DCD Chapter 15; however, the time required to perform those actions was not included in the TAA.

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Provide the list of deterministically-Important human actions (DIHAs) from the TAA for staff review and the associated HFE characteristics.

Specify where the HFE characteristics are documented if they are not available in DCD Chapter 15 (e.g., time required).

Revise the application to reflect the RAI response.

### 18-17

Section 7.4 (2), "Review Criteria," of NUREG-0711, states that applicants should identify deterministically-important HAs from the following licensing analyses: operator actions identified in the D3 coping analyses performed for DCD Chapter 7, as specified in Section 1 and 2 of Interim Staff Guidance DI&C-ISG-02, Diversity and Defense in Depth (D3) Issues (NRC, 2009). Section 1.2.2, "Review Elements," in NUREG-0711 states in part that when results are not available for review, the NRC staff accepts implementation plans as the basis for making a safety finding for a particular plant design.

Section 18.6.2.b, "DIHAs," in DCD Chapter 18 states that DIHAs and their associated HFE characteristics are identified from the D3 analysis in DCD Chapter 7. Section 4.2, "Deterministically-Important Human Actions Analyses," in APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP) Revision 0, describes the process for compiling the DIHAs and their associated HFE characteristics from the D3 coping analysis in DCD Chapter 7.

The staff reviewed DCD Chapter 7, "Instrumentation and Controls," Revision 0 and did not find any discussion of credited manual operator actions or their associated HFE characteristics. The staff reviewed the APR1400-Z-A-NR-14019-P, "CCF Coping Analysis," Revision 0, which is referenced in DCD Chapter 7. Section 5.3 of the CCF Coping Analysis provides an analysis of the effects of transients and accidents described in DCD Chapter 15 concurrent with a common cause (CCF) failure of the safety I&C system, and it identifies operator actions that would be required to mitigate the consequences of these events. Additionally, it appears that the associated HFE characteristics are also included in this report (i.e., Table 4-1).

Provide the list of deterministically-important human actions (DIHAs) from the D3 coping analysis for staff review and the associated HFE characteristics.

Specify where the HFE characteristics are documented if they are not available in DCD Chapter 15 (e.g., time required).

Revise the application to reflect the RAI response.

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### 18-18

Section 4.2, "Deterministically-Important Human Actions Analyses," of the TIHA IP discusses a relationship between Type A variables (as described in IEEE Std. 497-2002) and DIHAs identified in the transient and accident analysis in DCD Chapter 15.

The staff reviewed the TAA in DCD Chapter 15 and did not find any discussion of "Type A variables." Additionally, DCD Chapter 7, Section 7.5.1.1, "Accident Monitoring Instrumentation," (AMI) states, "There are no AMI Type A variables in the APR1400 design."

Clarify whether or not Type A variables are used to identify DIHAs.

If they are used, describe how.

Revise the submittal to reflect the RAI response.

### 18-19

Review Criteria 7.4 (3) of NUREG-0711 states, "The applicant should specify how important HAs are addressed by the HFE program, in Function Allocation, Task Analysis, HSI Design, Procedural Development, and Training Program Development, in order to minimize the likelihood of human error and facilitate error-detection and recovery capability." Additionally, review criteria 9.4 (4) in NUREG-0711, which is a subset of the review criteria for Section 13.5.2.1, "Operating and Emergency Operating Procedures," in Chapter 13, "Conduct of Operations," of NUREG-0800, states in part that the applicant's procedures should contain important human actions.

The staff reviewed DCD Section 18.6, Treatment of Important Human Actions, which states that all IHAs are addressed in the procedure development program element. DCD Section 18.8, Procedure Development, states that IHAs are considered when procedures are developed in accordance with Section 9.4, "Review Criteria," of Chapter 9, "Procedure Development," of NUREG-0711.

The staff also reviewed APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP), Revision 0. Section 3.5.5, "Procedure Development," of the TIHA IP states that procedure development is a COL applicant responsibility, and the second sentence is ambiguous. It is not clear that the COL applicant will know that the TIHA ReSR is an input to procedure development.

Clarify if the TIHA ReSR is an input to procedure development.

Additionally, clarify the meaning of the ambiguous second sentence of TIHA IP section 3.5.5.

Revise the submittal to reflect the RAI response.



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### 18-20

Review Criteria 7.4 (3) of NUREG-0711 states, "The applicant should specify how important HAs are addressed by the HFE program, in Function Allocation, Task Analysis, HSI Design, Procedural Development, and Training Program Development, in order to minimize the likelihood of human error and facilitate error-detection and recovery capability."

The staff reviewed DCD Section 18.6, "Treatment of Important Human Actions," which states that all IHAs are addressed in the training program development program element. Additionally, Section 4.7.3.5 in APR1400-E-I-NR-14001-P, "Human Factors Engineering Program Plan," Revision 0 describes how IHAs are used in the training program development.

Section 3.5.6 of APR1400-E-I-NR-14006-P, "Treatment of Important Human Actions Implementation Plan" (TIHA IP), Revision 0 TIHA IP states that training program development is a COL applicant responsibility. Additionally, the first sentence in this section is ambiguous. It is not clear whether or not the COL applicant will know that the TIHA ReSR is an input to training program development.

Describe in the TIHA IP if, and how, the TIHA ReSR is an input to training program development.

Additionally, clarify the meaning of the ambiguous first sentence of TIHA IP Section 3.5.6.

### 18-21

"Section 7.4 (2), "Review Criteria," of NUREG-0711, states that applicants should identify deterministically-important HAs from the following licensing analyses: operator actions credited in the DCD Chapter 15 accident and transient analyses.

The staff reviewed DCD Chapter 15 and Subsection 15.6.5.5.1.1, "Containment Leakage" states that, "... containment spray ... is assumed to be initiated 110 seconds after the start of the LOCA [loss of coolant accident] event. The CSS [containment spray system] is automatically initiated by a safety injection actuation signal (SIAS) or a containment spray actuation signal (CSAS)..." Containment spray reduces the concentration and quality of fission products released to the environment following postulated accidents, as required by General Design Criterion 41 of Appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR 50.

This information conflicts with the information in Section 4.2, "DIHAs," of the TIHA IP. Section 4.2, states that manual containment spray actuation signal (CSAS) is not a DIHA because it is not needed for more than [ ] after the event initiation (i.e., long after the plant has been stabilized).

Align the statement(s) in the TIHA IP concerning CSAS actuation with the information in Chapter 15.

Revise the submittal to reflect the RAI response."

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18-22

"Section 7.4 (2), "Review Criteria," of NUREG-0711, states in part that the applicant should identify deterministically-important human actions from the DCD Chapter 15, "Transient and Accident Analyses." Section 4.2, "Deterministically Important Human Actions Analyses," (DIHA) of the "Treatment of Important Human Actions Implementation Plan" (TIHA IP) provides examples of the types of operator actions that are excluded during the DIHA selection process.

The staff reviewed DCD Chapter 15. Section 15.6.5.2.3, "Description of Post Loss-of-Coolant Accident Long-Term Cooling," which states that the purpose of long-term cooling, including aligning the ECCS for simultaneous hot leg and direct vessel injection, is to maintain the core at safe temperature levels and to avoid the precipitation of boric acid in the core region. Additionally, DCD Chapter 15 states, "During the long term, operator action is needed to provide reasonable assurance that the core cooling is maintained until the plant is brought to a cold shutdown condition." This information appears to conflict with the information in the 4<sup>th</sup> bullet of Section 4.2 of the TIHA IP.

Align the statement in Section 4.2 of the TIHA IP with the information in Chapter 15, or describe why aligning the ECCS for long term cooling is not a DIHA. Revise the documentation as necessary to reflect the RAI response."