REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**235-8275**
SRP Section:	**12.03-12.04 – Radiation Protection Design Features**
Application Section:	**12.3-12.4**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-26

10 CFR 20.1101(b) requires licensees to control external occupational exposure, and to ensure that engineering controls are used to keep occupational doses ALARA. In 10 CFR 20, the definition for ALARA includes guidance to make every reasonable effort to maintain exposures below regulatory limits, taking into account the state of technology. 10 CFR 50 GDC 61 requires licensees to ensure that there is adequate shielding for routine activities in the area of the equipment.

While FSAR Sections 9.1.4 and 12.2.1.1.6 provide some information on in-core instrumentation (ICI), including the use of a hydraulic cutter to cut used ICI leads for disposal, and FSAR Section 12.3.2.3 discusses design features to limit access to the ICI chase, insufficient information is provided in the FSAR describing the insertion and removal process of in-core instrumentation. For example, the application does not clearly describe equipment used to insert and remove the in-core instruments. In addition, Industry experience shows that detectors can stick in the core, and require personnel to work at the location of the movable drive system to rectify the problem. There have been personnel over exposures due to working on in core detector systems. Insufficient information is available to determine the adequacy of the shielding and personnel protective features provided for the removal of in-core instrumentation.

1. Please discuss, in more detail, the process of removing and inserting in-core instrumentation from the core and preparing and transporting irradiated in-core instrumentation for storage and/or disposal and the equipment relied on to do so, including description of an underwater vacuum system to clean up debris from cutting ICI. If there is not an underwater vacuum system, discuss why this is acceptable.

2. In accordance with 10 CFR 20.1101(b), please update FSAR Section 12.3 to describe the personnel protective features and shielding provided for work on the ICI during an anticipated operational occurrence, such as stuck detectors and how the design ensures that doses to workers will remain ALARA during such an event.

Response – (Rev. 1)

1. In-Core Instrumentation (ICI) activities are divided into three parts: A - withdrawal, B - disposal, and C - insertion) to be performed during refueling outage. These activities are generally performed remotely by personnel staying outside the water pool for radiation ALARA purpose, and are guided by operating procedures to minimize radiation exposure.

   A. Process for withdrawing ICI from the core:

      1) Disconnect MI cable from ICI assembly and from Pool Wall Junction Panel (PWJP).

      2) Remove MI cable tray assembly to a temporary storage area.

      3) Install ICI holding frame.

      4) Connect ICI retrieval tool to every ICI assembly.

      5) Withdraw ICI assembly using the hoist as In and Outward sequence.

      6) Position ICI assembly on ICI holding frame.

      This process is performed after the reactor area is partially flooded, but prior to opening of the reactor head, and locally near the ICI seal table. The ICI table seal area is to be surveyed for radiation level before entry to this area for performance of withdrawal work.

   B. Process for disposal of a used ICI assembly

      1) Withdraw a selected ICI assembly using the reel installed on the CEA change platform.

      2) Suspend the withdrawal activity when the guide tube is about 2 feet from the seal housing in order to grab the ICI assembly with the air operated plier on the control element assembly change platform (CEACP)[1] to facilitate cutting of the ICI assembly for disposal.

      3) Grab the ICI assembly using air operated plier assembler

      4) Withdraw the ICI assembly completely.

      5) Direct ICI assembly into the funnel of ICI cutter on top of the transport container.

      6) Use hydraulic ICI cutter to shear ICI assembly into smaller pieces to fit into the transport container.

[1] KHNP will incorporate the abbreviation into the DCD as indicated in Attachment.

7) Transport CEA/ICI transport container to fuel handling area (Fuel Building).

8) Clean up the pool floor thoroughly after refueling operations are completed.

The process is performed remotely with operator staying further away from the ICI seal table and after the reactor area is fully flooded for refueling. Please note that the shearing operation uses a remotely operated hydraulic ICI cutter tool directly above the debris collection funnel so that debris from cutting the ICI assembly falls into the CEA/ICI transport container. This method minimizes the spread of chips and debris, and also minimizes radiation exposure from debris cleanup. Hence, underwater vacuum system is not required to be used.

C. Process for inserting ICI into the guide tubes

1) Hook ICI assembly to the hoist on the CEA/ICI change platform.

2) Insert ICI assembly into the guide tube as far as possible with insertion hand tool.

3) Install O-rings and backup rings on the seal plug as directed by the procedures.

4) Push down using the secondary insertion tool until the ICI assembly reaches to the top of the fuel.

5) Determine the number and size of spacers using a positioning gauge.

6) Remove the ICI holding frame.

7) Insert new ICI assembly into an unoccupied guide tube like same as Step C.2 above.

8) Put ICI MI cable tray assembly back in position.

9) Reconnect the MI cable to the ICI assembly and PWJP.

This process is performed locally near the ICI seal table.

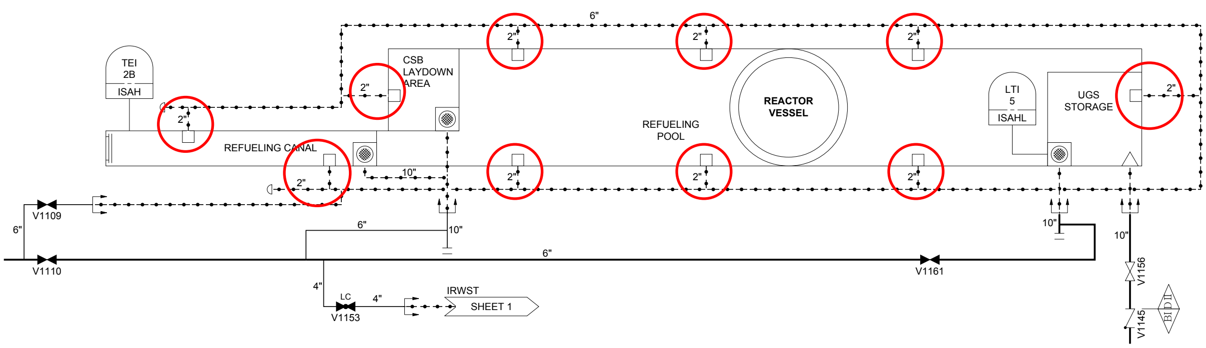
2. The APR1400 is designed with the capability of removing the suspended and/or dissolved contaminants in the refueling pool during refueling operation by using the Spent Fuel Pool Cooling and Cleanup System (SFPCCS). As discussed in DCD Section 9.1.3, the SFPCCS is designed to purify the water of the SFP, IRWST, fuel transfer canal and the refueling pool during the refueling operation as well as SFP cooling. As shown in Figure 1 below, captured from Figure 9.1.3-1 of the DCD, this system is designed such that the refueling pool water flows through the skimmer suctions of the refueling pool into the suction side of the SFP cleanup pumps for purification in SFPCCS. The purification loop of the SFPCCS is equipped with booster cleanup pumps, filters and demineralizers. Therefore, the SFPCCS can reduce suspended and dissolved radioactive contaminants in the refueling pool, and maintain the low radiation level during refueling operation. Also, the cleanup operation is

automated after operator initiation for reduction of worker radiation exposure and contamination in the refueling pool area. For this reason, the temporary filtration system to clean up the refueling pool is not required.

DCD Subsection 12.3.2.3 will be updated to include the following paragraph.

“The APR1400 ICI design adopts the bottom mounted In-Core Instrument system that has only fixed type detectors for normal operation. During refueling operation, all ICIs are withdrawn from the core up to the full length of 24 feet when the reactor area is flooded with refueling water. The highly irradiated portion of the ICIs still remains inside the ICI guide tubes which are filled with refueling water at the lower head area of the reactor vessel. The withdrawal and disposal operation of ICI is performed remotely and the operators are shielded by the pool of water as well as the distance between the reactor vessel and the CEACP; and administrative procedures are used to monitor radiation level to insure personnel safety and radiation is ALARA.”

Figure 1. Locations of Skimmer Suctions of Refueling Pool Water



Supplemental Questions and Responses

Clarification Question on the additional questions relating to Temporary Filtration System.

Regarding RAI 8275, Question 12.03-26, follow-ups. Please send this feedback to KHNP regarding their response to question 2. Part 1 is just asking them to spell out an abbreviation and is obviously acceptable.

10 CFR 20.1101(b) requires in part that licensees use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses ALARA. KHNP indicates that there is no intent to use a temporary filtration system in the refueling pool during refueling operations and when cutting in-core instrumentation. Similar temporary filtration systems are used widely in U.S. plants. A filtration system lowers contamination levels in the refueling pool water, reduces the amount of plate-out of radioactive particles on the refueling pool walls and floor when emptying the refueling pool, and reduces airborne radioactivity levels in containment due to lower contamination levels.

It is the staff’s position that in accordance with ALARA, the design should support the use of such a system. If the design does not include a sufficient power supply inside containment to support the use of a filtration system, the COL applicant may not be able to use such a system or it may result in additional operational constraints and potentially dose to provide power to such a system from elsewhere. It would be up to a COL applicant how they would use a temporary filtration system and where spent filters would be stored, which would be covered as part of the plants radiation protection and ALARA program, but the design should support its use. Therefore, the design should include information indicating that an appropriate power supply and connection would be available to support the use of a portable filtration system in containment and that there is adequate space in the refueling pool for its use (the applicant should ensure that the power supply is sufficient to support the use of portable filtration systems).

RESPONSE (October 6, 2016)

From the above question, KHNP interprets that the staff is concerned about the absence of the provision to purify the refueling pool. As discussed and illustrated in Figure 1 above, and summarized in DCD Section 9.1.3, the SFPCCS is designed to purify the water of the SFP, IRWST, fuel transfer canal and the refueling pool during the refueling operation as well as SFP cooling. Therefore, it can reduce the concentration level of radioactivity in the refueling pool, and thus maintain the lower level during refueling operation. This justifies that the temporary filtration system to clean up the refueling pool is not required.

Response to NRC CQ on RAI 8275 Question 12.03-26
(Issue of the overflowing of refueling pool)

Staff sent a comment, 2 paragraphs (11/1/16 or later). As indicated in the comments, staff has concerns related to potential pool overflow due to mis-operation, which could result in accidental contamination and possible release. Staff would like to have a call to discuss the design, and specifically, provisions to prevent overflow and to discuss what would happen if there were an overflow (where would the water go). Staff believes that a call would be the best next step to resolve this issue.

RESPONSE (October 6, 2016)

During refueling operations, once the reactor vessel head is opened, refueling water is manually turned on to fill the refueling pool from the IRWST through the direct vessel injection line via the shutdown cooling pump. The refueling pool is filled slowly and gradually, and the level is meticulously monitored via the level detection instrumentation. When the water level reaches the initial detector setpoint (elevation level 153’-10”, low level setpoint), an alarm is initiated to alert the operator to diligently focus on the operation of the pump to closely monitor the pumping water entering the refueling pool. Per operating procedures, the operator is to stop the pump when the refueling water level reaches 154’-0”. If the water continues to fill in the pool to reach the high setpoint (elevation level 154’-10”, high level setpoint), an alarm is initiated locally for immediate operator actions. As a back-up to this fill operation, a second alarm is indicated in the MCR for the low level and high level setpoints to alert the MCR operators to terminate pump operation in the event that the fill level is exceeded.

KHNP wants to emphasize that the levels of refueling water are scrupulously controlled through level detection instrumentation and operator monitoring actions based on procedures and training. Accordingly, the overflow of refueling water is prevented to the extent possible. However, in the event of an overflow of the refueling pool, floor drains located on the operating floor (elevation 156’-0”) are available in the vicinity of the refueling pool. These drains route any contaminated water, including overflow refueling water to the radioactive drain system for collection, which are then forwarded to the liquid radwaste system for processing.

Impact on DCD

DCD Chapter 12 ACRONYM AND ABBREVIATION LIST will be updated as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environment Report.

ACRONYM AND ABBREVIATION LIST

AB	auxiliary building
AC	alternation current
AFW	auxiliary feedwater
APR1400	Advanced Power Reactor 1400
AST	alternative source term
BOC	beginning of cycle
CCW	component cooling water
CEA	control element assembly
CEDE	committed effective dose equivalent
CLVPS	containment low-volume purge system
COL	combined license
CPIAS	containment purge isolation actuation signal
CS	containment spray
CSS	containment spray system
CVCS	chemical and volume control system
DBA	design basis accident
DCF	dose conversion factor
DDE	deep dose equivalent
DE	dose equivalent
DF	decontamination factor
EAB	exclusion area boundary
EDE	effective dose equivalent
EFPD	effective full-power day
EOC	end of cycle
ESF	engineered safety features
ESFAS	engineered safety features actuation system
FF	flash fraction
GDC	general design criteria
HEPA	high-efficiency particulate air

"Add"

CEACP	control element assembly change platform