
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.: 260-8283
SRP Section: 18 – Human Factors Engineering
Application Section: 18.6
Date of RAI Issue: 10/19/2015

Question No. 18-30

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 10 CFR 50.34(f)(3) requires an applicant to provide sufficient information to demonstrate that the following requirement(s) has been met.... "(i) Provide administrative procedures for evaluating operating, design and construction experience and for ensuring that applicable important industry experiences will be provided in a timely manner to those designing and constructing the plant."

NUREG-0711, Section 5.4(1), "Review Criteria," describes the types of tasks that should be selected for task analysis. Additionally, Section 1.2.2, "Review Elements," of NUREG-0711 states in part, "To determine whether an implementation plan (IP) is acceptable, the NRC staff evaluates whether the IP is:... detailed, i.e., the IP describes the methodology in a step-by-step format to ensure that the applicant's design personnel can reliably use the IP, and that knowledgeable engineers will obtain consistent results from executing the methodology..."

Task selection is described in DCD Tier 2 Section 18.4, "Task Analysis," and also in several places in the "Task Analysis [TA] Implementation Plan [IP]", APR1400-E-I-NR-14004-P, Rev 0:

- Section 4.1, "Task Selection" of the TA IP describes the types of tasks that are selected for task analysis. This list is similar to the list under the second bullet in NUREG-0711, Criterion 5.4(1).
- Section 2, "Scope," of the TA IP and DCD Tier 2 Section 18.4.1, "Objectives and Scope," describe the types of tasks to be included in the scope. This list includes some selection criteria that are not specifically listed in NUREG-0711 Criterion 5.4(1), and that is acceptable, but this list does not include some of the criteria that are listed in Section 4.1, "Task Selection," and in NUREG-0711 Criterion 5.4(1).

Because the information in these three places in the application are not the same, the staff cannot be certain that the subject matter experts (SMEs) will select tasks reliably and obtain consistent results.

1. Align DCD Tier 2, Section 18.4.1, Section 2.0 of the TA IP, and Section 4.1 of the TA IP so that the information about the scope of task selection is the same in each of the sections.
2. Revise the documentation to reflect the RAI response.

Response

Task selection criteria described in NUREG-0711, Section 5.4(1) will be added in DCD Tier 2, Section 18.4.1 and Section 2 of the TA IP, as indicated in the attachments associated with this response.

Impact on DCD

APR1400 DCD, Tier 2, Subsection 18.4.1 will be revised, as indicated in Attachment 1 to this response.

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

Technical report APR1400-E-I-NR-14004-NP, Rev.0, "Task Analysis Implementation Plan," will be revised, as indicated in Attachments 2 and 3 to this response.

APR1400 DCD TIER 2

- e. Establishes the basis for task support verification within HFE verification and validation (V&V) program element.

TA may be conducted before or after instrumentation and control (I&C) design requirements have been established by the mechanical and I&C system designers for a specific plant system. If TA is conducted before the I&C design, then TA establishes HSI inventory requirements that are fulfilled by the plant system design. If TA is conducted after the I&C design has been developed for a specific plant system, then the TA confirms that the I&C design is acceptable to support the HSI inventory; if not, HEDs are generated as the conclusion of TA. For all plant systems, the piping and instrumentation diagrams (P&IDs) are the starting point for creating HSI indication and control designs during the HD. Any discrepancies between those HSI designs and TA are identified during V&V. The HFEPP describes the HED resolution process.

The TA scope includes:

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- a. ~~TA is implemented for plant operations tasks conducted by licensed and non-licensed operators from the main control room (MCR) and remote shutdown room (RSR), which are identified in (1) operating procedures that are available at the time the TA is conducted, or (2) procedures from predecessor plants or predecessor designs; these predecessors are identified in the HFEPP. This encompasses normal, abnormal, emergency, and alarm response procedures. Abnormal procedures include the following degraded HSI conditions:~~
 - 1) Continued stable operation with loss of all non-safety HSI
 - 2) Accident mitigation and safe shutdown with only safety HSI
 - 3) Accident mitigation and plant stabilization with concurrent common-cause failure (CCF) in digital I&C systems (as defined by the D3CA)
 - 4) Safe shutdown from the RSR

APR1400 DCD TIER 2

b. ~~The full range of plant operating modes startup, normal operations, abnormal and emergency operations, transient conditions, and low power and shutdown conditions.~~

The tasks identified in the TA scope defined above originate from other HFE program elements or plant procedures. The tasks include tasks executed with both paper and computer-based procedures. SME judgment is therefore not required in the task selection.

e. ~~IHAs identified in the TIHA.~~

e →

d. Tasks performed from the technical support center (TSC) and local control stations (LCSs) that directly support operations, ~~or~~ abnormal event or accident mitigation. The TA encompasses communication with operators in the MCR or RSR.

f →

e. TA for the emergency operations facility (EOF) is limited to defining the plant safety information requirements (i.e., safety parameter display system) and communication with operators in the MCR or RSR.

~~The tasks identified above originate from other HFE program elements or plant procedures. Therefore, there is no SME judgment required in the task selection.~~ The following areas are evaluated by SMEs using their plant operations and simulator training experience to identify and select additional tasks that have challenged predecessor plant operating crews:

a. Surveillance, test, inspection, and maintenance, with special focus on tasks that pose potential threats to personnel safety

and plant safety.

b. Operational tasks that are precursors to plant transients that are not procedure based and are not IHAs. These include unusual failure modes that may not have alarm response procedures, such as spurious opening of a pressurizer spray valve and spurious control rod withdrawal, or situations where the operators have had to revert to skill-based manual operation (e.g., low-power steam generator level control).

a

tasks

in which

c. Beyond-design-basis conditions such as station blackout and severe accident

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d. Tasks associated with the fire safe shutdown analysis

b. Tasks required for manual control for the control actions with human allocations from the FRA/FA program element.
c. Tasks required for supervising and backing up automation for the control actions with machine allocations from the FRA/FA program element.
d. Tasks associated with issues identified in the OER program element that are assumed to be resolved by actions assigned to plant operators.

APR1400 DCD TIER 2

In addition, SMEs ~~will~~ use their judgment and ~~past~~ experience to identify and select tasks ~~that they believe will~~ challenge plant ~~operating~~ crews based on new or unique features of the APR1400 plant design.

The additional tasks selected by SME judgment are those that are not already encompassed by previous HFE program elements and operating procedures.

18.4.2 Methodology

TA includes the following methods:

- a. Basic task analysis is used to define HSI inventory requirements, including the characteristics of that inventory that are needed for all tasks within the scope of TA.
- b. Task timing analysis (TTA) is applied to selected tasks to evaluate the operator's workload and the margin between the time available for the task and the time required to perform the task. The selection criteria are described below.

18.4.2.1 Basic Task Analysis

For each task, there are three distinct outputs generated during the basic task analysis:

Task Narrative

For each task, a task narrative describes (in text format) the task goal (e.g., start reactor coolant pump) and what plant operations personnel need to do to accomplish the task. The task narrative identifies the applicable plant conditions and any required precursors or permissives. The task narrative describes the required HSI inventory and also includes task support requirements, situational and performance-shaping factors, and time constraints.

For tasks related to plant systems that are site specific, such as the switchyard and ultimate heat sink, the TA is based on generic assumptions that are made to establish a complete plant design that is ultimately reflected in the complete APR1400 HSI design for verification and validation (V&V). These generic assumptions are modified as necessary for each plant-specific application of the APR1400 during the design implementation (DI) program element.

The scope of TA includes:

- All important HAs as determined by probabilistic and deterministic means
- Tasks that were not identified as “important HAs” but have negative consequences if performed incorrectly
- Tasks that are new compared to those in predecessor plants, such as ones related to new systems or procedures
- Tasks that, while not new, are performed significantly differently from predecessor plants
- Tasks related to monitoring of automated systems that are important to plant safety, and the use of automated support aids for personnel, such as computer based procedures
- Tasks related to identifying the failure or degradation of automation, and implementing backup responses
- Tasks anticipated to impose high demands on personnel, e.g., little time or high workload (such as administrative tasks that contribute to work load and challenge ability to monitor the plant)
- Tasks important to plant safety that are undertaken during maintenance, tests, inspections, and surveillances
- Tasks with potential concerns for personnel safety (such as maintenance tasks performed in the containment)

The TA scope additionally includes tasks performed by senior reactor operators (SROs), reactor operators (ROs) and non-licensed operators (NLOs) in the main control room (MCR), remote shutdown room (RSR), technical support center (TSC), emergency operation facility (EOF), and local control stations (LCSs), as follows:

- a. Tasks directed by normal, abnormal, emergency, and alarm response procedures from APR1400 or procedures from predecessor plants or designs, during all modes of operation, shutdown, and refueling. Abnormal procedures include the following degraded HSI conditions:



2. SCOPE

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4. IMPLEMENTATION

TS

4.1. Task Selection

TS

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Docket No. 52-046

RAI No.: 260-8283
SRP Section: 18 – Human Factors Engineering
Application Section: 18.6
Date of RAI Issue: 10/19/2015

Question No. 18-32

Section 5.4 (2), "Review Criteria," of NUREG-0711 states that "the applicant should describe the screening methodology used to select the tasks for analysis, based on criteria specifically established to determine whether analyzing a particular task is necessary." Additionally, Section 1.2.2, "Review Elements," of NUREG-0711 states in part, "To determine whether an implementation plan (IP) is acceptable, the NRC staff evaluates whether the IP is:... detailed, i.e., the IP describes the methodology in a step-by-step format to ensure that the applicant's design personnel can reliably use the IP, and that knowledgeable engineers will obtain consistent results from executing the methodology..."

Section 4.1.2, "Plant Operating Procedures," in the TA IP describes the use of plant procedures to select tasks. It is not clear if the SME is supposed to identify each procedure step as a task or subtask in the TA database, or if screening criteria will be applied.

1. Specify how the personnel performing the task analysis will use the emergency operating procedures/guidelines and the procedures listed in Section 4.1.2 of the TA IP to select tasks for task analysis. Clarify whether or not all of the procedure steps should be listed, or if screening criteria are to be applied.
2. If any screening criteria are to be applied, clearly describe it.
3. Revise the submittal as necessary.

Response

All of the procedure steps and sub-steps from emergency operating procedures, general operating procedures, abnormal operating procedures, system operating procedures, and alarm response procedures will be identified as tasks and sub-tasks, respectively, in the TA database. No screening criteria will be applied to exempt procedure steps and sub-steps from inclusion in

the TA database.

Impact on DCD

There is no impact on the DCD.

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 Environmental Report.

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Question No. 18-39

Section 5.4(7), "Review Criteria," of NUREG-0711 states "the applicant should identify the knowledge and abilities required to perform each task."

Item 18, "Staff," in Subsection 4.2.1, "Task Narrative," of the TA IP discusses entering the knowledge and abilities required to perform the task into the TA database, but with caveats and without details.

Also, Section 4.5.3, "Task Analysis," of APR1400-K-I-NR-14005-P, "Staffing and Qualifications Implementation Plan," Revision 0, dated December 2014, states that the staffing and qualifications analysis relies on the TA, including the knowledge and abilities required.

1. Describe how the knowledge and abilities required to perform each task will be identified in the task analysis program element.
2. Revise the documentation as necessary.

Response

The qualification of operators required to perform the task (e.g., reactor operator, non-licensed operator) is entered into the TA database. Any special knowledge or abilities (e.g., chemical analysis for RCS, SGTR secondary radiation sample test) required to perform the task are entered into the TA database based upon the SME's judgement using their plant operations experience or by referring to plant procedures. Technical report APR1400-E-I-NR-14004-NP, Rev.0, "Task Analysis Implementation Plan," Subsection 4.2.1 will be revised to describe the process to determine special knowledge or abilities required to perform a task.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

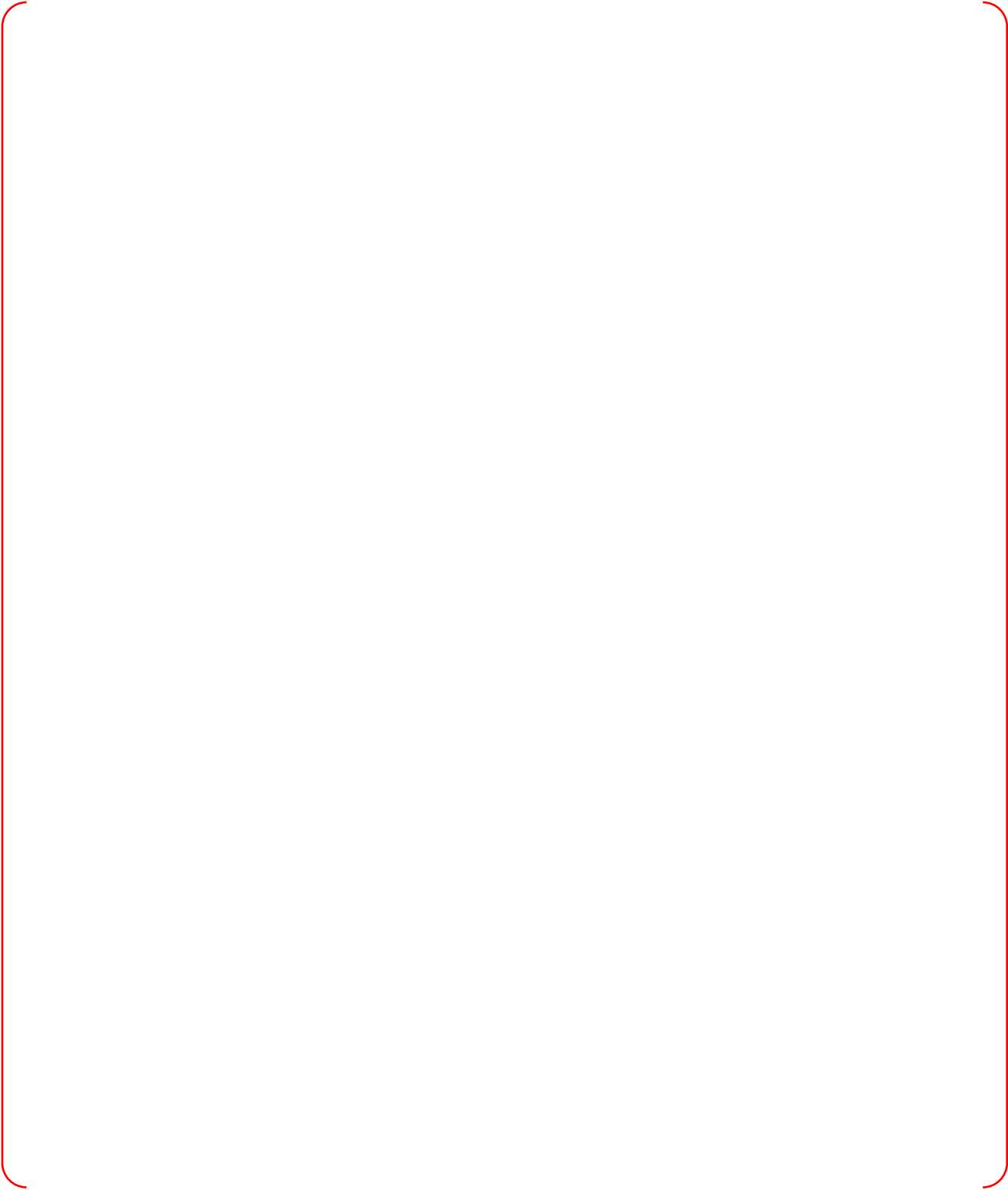
There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical report APR1400-E-I-NR-14004-NP, Rev.0, "Task Analysis Implementation Plan," Subsection 4.2.1 will be revised, as indicated in the attachment associated with this response.



4.2.2. Human-System Interface Inventory

