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.: **553-9084**

SRP Section: **18 – Human Factors Engineering**

Application Section:

Date of RAI Issue: **09/06/2017**

Question No. 18-134

Acceptance Criteria

NUREG-0800, Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” Appendix A, “Information on Prior Design Certification Reviews,” says, “Tier 1 information includes…iii. Inspections, tests, analyses, and acceptance criteria (ITAAC)…”

SECY-92-053, “Use of Design Acceptance Criteria During 10 CFR Part 52 Design Certification Reviews,” says, “The DAC [design acceptance criteria] are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. The DAC are to be objective (measurable, testable, or subject to analysis using pre-approved methods), and must be verified as a part of the ITAAC [inspections, tests, analyses, and acceptance criteria] performed to demonstrate that the as built facility conforms to the certified design. That is, the acceptance criteria for DAC become the acceptance criteria for ITAAC, which are part of the design certification.”

SECY-17-0075, “Planned Improvements in Design Certification Tiered Information Designations,” dated July 24, 2017 (ADAMS Accession No. ML16196A321), explains that Tier 2* information must be demonstrated to have the same safety significance as Tier 1, and Tier 2* should be applied only when an applicant determines the additional flexibility for making changes could be beneficial.

Application

KHNP is using design acceptance criteria (DAC) for Chapter 18. HFE implementation plans describing activities that will be performed to develop an APR1400 control room design that reflects state-of-the-art human factors principles have been provided in lieu of a control room design that reflects state-of-the-art human factors principles. In order to develop a control room

design that reflects state-of-the-art human factors principles, the COL applicant will need to perform the activities described in each of the HFE implementation plans.

DCD Tier 2, Rev. 1, Section 14.3.2.9, “ITAAC for Human Factors Engineering,” and DCD Tier 1, Rev. 1, Section 2.9, “Human Factors Engineering,” describe the HFE-related ITAAC for the APR1400. ITAAC 1 in Table 2.9-1, “Human Factors Engineering ITAAC” (shown below) contains the design ITAAC only for the integrated systems validation (ISV), which is one of the major verification and validation (V&V) activities described in APR1400-E-I-NR-14008-P, “Human Factors Verification and Validation Implementation Plan” (V&V IP), Rev. 1.

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The control room design incorporates HFE principles that minimize the potential for operator error.	1. An Integrated System Validation Test will be performed in accordance with the Verification and Validation Implementation Plan. [Design ITAAC]	1. An Integrated System Validation Report exists and concludes that acceptance criteria associated with each test scenario are satisfied upon initial performance of the scenarios or upon remediation of failures.
2. The as-built control room HSIs are consistent with the final validated design specifications.	2. An inspection of the as-built control room HSIs will be performed.	2. The as-built control room HSIs conform to the validated design with no configuration deviations.

ITAAC 1 is limited to only verifying completion of the ISV scenarios, and there are no other HFE ITAAC in the application to verify the completion of the other HFE activities in accordance with their implementation plans. Also, ITAAC 1 is limited to the ISV and excludes the other V&V activities described in the V&V IP. The staff thinks that ITAAC should be included to verify the HFE activities that will be completed in accordance with the implementation plans (the staff notes an ITAAC is not specifically required for implementation of the HFE Program Plan because the information in the HFE Program Plan is used to perform the activities in the other HFE implementation plans).

Additionally, because KHNP has used DAC, the staff is using information in the HFE implementation plans to make a final safety determination to support a design certification. Some portions of the HFE implementation plans contain the acceptance criteria for the DAC, which would be acceptance criteria for HFE ITAAC. Additionally, APR1400-E-I-NR-14010-P, Rev. 1, “Human Factors Verification and Validation Scenarios” (the scenarios document), says that it contains the scenarios that will be used to perform the activities described in the V&V IP. The V&V IP, Section 4.1.4, “Scenario Definition,” also contains information that indicates the scenarios in the scenarios document are the minimum set of scenarios for the V&V activities. As such, the staff considers the scenarios document to be an extension of the V&V IP. Therefore, the staff thinks the following information should be identified as Tier 1 information because the information contains the acceptance criteria for the DAC that will be the acceptance criteria for the HFE ITAAC, which is Tier 1 information:

- Section 2, “Scope;” Section 3, “Methodology Overview;” Section 4, “Implementation;” Section 5, “Implementation Team;” Section 6, “Results Summary Report;” and Section 8, “Definitions” of the following HFE implementation plans:
  - APR1400-E-I-NR-14001, “Human Factors Engineering Program Plan”
  - APR1400-E-I-NR-14002, “Operating Experience Review Implementation Plan”
  - APR1400-E-I-NR-14003, “Functional Requirements Analysis and Function Allocation Implementation Plan”
  - APR1400-E-I-NR-14004, “Task Analysis Implementation Plan”
  - APR1400-K-I-NR-14005, “Staffing and Qualifications Implementation Plan”
  - APR1400-E-I-NR-14006, "Treatment of Important Human Actions Implementation Plan”
  - APR1400-E-I-NR-14007, “Human-System Interface Design Implementation Plan”
  - APR1400-E-I-NR-14008, “Human Factors Verification and Validation Implementation Plan”
  - APR1400-K-J-NR-14009, “Design Implementation Plan”
- Section 3, “Sampling of Operational Conditions for the Integrated System Verification;” Section 5, “APR1400 Human Factors Verification and Validation Scenarios;” and Appendices A, B, C, D, E, F, and G of APR1400-E-I-NR-14010, “Human Factors Verification and Validation Scenarios.”

Alternatively, the staff would also evaluate a proposal to identify the above listed sections of the HFE implementation plans and scenarios document as Tier 2* information instead of Tier 1.

Questions

a. Either (1) expand the scope of ITAAC Item 1 in Table 2.9-1 to include the other HFE activities that have associated implementation plans as well as the other V&V activities, or (2) add additional ITAAC to Table 2.9-1 for each HFE activity that has an associated implementation plan. DCD Tier 2, Section 14.3.2.9, “ITAAC for Human Factors Engineering,” and Section 14.3.5, “Design ITAAC Closure Process,” should be revised if DCD Tier 1, Section 2.9, “Human Factors Engineering,” is revised.

b. Explain why the sections of the HFE IPs and the scenarios document listed above are not Tier 1 given they contain DAC that will be acceptance criteria for ITAAC.

c. If the sections listed above of the HFE implementation plans and scenarios document will be Tier 1, then delete the HFE implementation plans from DCD Tier 2, Table 1.6-2, and include the sections listed above of the HFE implementation plans and the scenarios document in the DCD Tier 1. If KHNP proposes to make the sections listed above of the HFE implementation plans and the scenarios document Tier 2* instead of

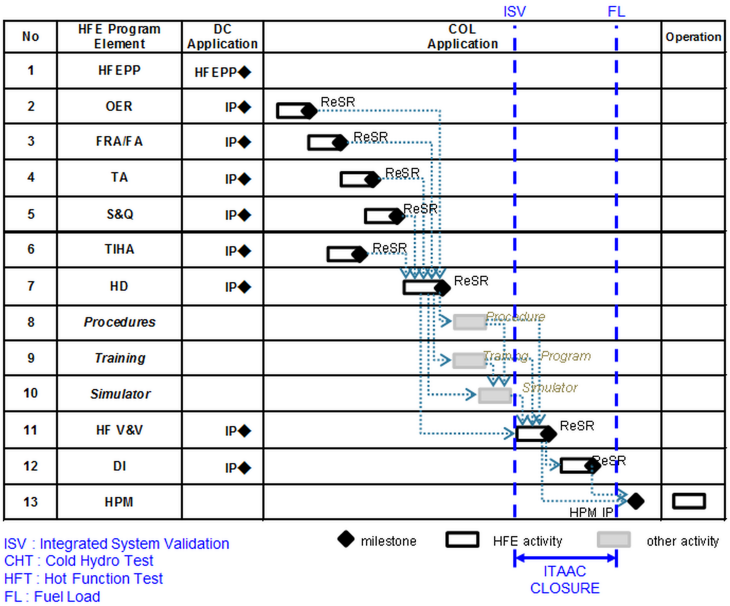
Tier 1, then add the scenarios document to DCD Tier 2, Table 1.6-2, and uniquely identify proposed Tier 2* information in the application (e.g., with brackets and italics).

Response – (Rev. 1)

The APR1400 human factors engineering (HFE) program ensures that human-system interface (HSI) of the main control room, remote shutdown room, technical support center, emergency operations facility, and local control stations associated with important human actions reflects state-of-the-art HFE principles, and satisfies all specific regulatory criteria and support the operator in safely operating the plant. The HSI system is designed in accordance with the HFE program to provide reasonable assurance that the HFE design is properly developed and effectively implemented to conform to NUREG-0711, Rev. 3.

Pursuant to NUREG-0711, Rev. 3, human factors verification and validation (HF V&V) evaluations are to determine that the final HFE design conforms to accepted design principles, and enables personnel to successfully and safely perform their tasks to achieve operational goals. When work described by the implementation plan (IP) is completed, the applicant is to submit the result summary report (ReSR) for NRC verification to ensure criteria in Section 11.4 are met. An ReSR should, amongst other things, include: a description of the methodology, if an NRC approved IP was not used, a list of human engineering discrepancies (HEDs) will be generated from the HSI inventory and characterization, task support verification, HFE design verification, and integrated system validation. The analyses associated with these HEDs, along with their resolutions, should ensure the applicant assessed the importance of HEDs, corrected important ones, and that the corrections are acceptable.

To that end, the HFE program objectives for the APR1400 design are that the design is human-centered, it incorporates HFE principals and methods, and is developed according to a systematic top-down integrated approach in accordance with applicable requirements and acceptance criteria, including performance of the HFE program element IPs and ReSRs to support Inspections, tests, analyses, and acceptance criteria (ITAAC) closure. KHNP adopted industry standard HFE ITAAC based on Pre-application Review Meeting discussions and DCD interactions with the NRC staff, as well as NRC and Industry efforts and agreements on developing a standard HFE ITAAC (see ML15036A211). The APR1400 ITAAC, provided in DCD Tier 1, Table 2.9-1, verifies that each HFE program element is conducted in accordance with corresponding IP, and the result of each HFE program element is documented in the corresponding ReSR and supports closure of the ITAAC, as illustrated in the figure below.



The HFE program is in effect at least from the start of the design cycle through completion of initial plant startup test program to conform to NUREG-0711, Rev. 3. The combined license (COL) applicant is to provide a design ITAAC closure schedule for implementing the V&V design ITAAC (COL 14.3(2)). Design ITAAC will be closed in accordance with guidance in Regulatory Guide 1.215 “Guidance for ITAAC Closure Under Part 52” which provides agency direction including, amongst other things that design acceptance criteria (DAC) can be resolved through three different options: (1) an amendment to the design certification (generic), (2) a submittal as part of the combined license application (plant-specific), and (3) closure of the DAC during construction (plant-specific). As-built ITAAC will be used to demonstrate that the as-built facility conforms to the completed DAC and the as-built ITAAC will be resolved as part of the ITAAC closure process. The Commission policy for DAC, as defined in SECY-92-053, allows a licensee to provide HFE design process milestones as ITAAC in lieu of a completed design and such ITAAC are inspected as the development process for the HFE design progresses and the licensee completes the ITAAC throughout the facility post-COL (construction) phase.

The successful completion of the as-built ITAAC will be documented through the ITAAC completion documentation and subject to NRC Inspection. NRC has developed and applied a number of Inspection Procedures to confirm and provide reasonable assurance that a COL holder (licensee) implemented HFE and ITAAC activities in accordance with NRC approved IPs, for example IP 65001.23, “Inspection of Human Factors Engineering Verification and Validation”, IP 65001.24, “AP1000 Human Factor Engineering (HFE) Task Support Verification”, IP 65001.25, “Inspection of Human Factors Engineering Design Verification – Design Acceptance Criteria (DAC) – Related ITAAC” and IP 65001.26, “Inspection of Human Engineering Discrepancy (HED) Resolution Verification” (see NRC Manual Chapter 2503, Construction Inspection Program: Inspections of ITAAC Related Work). Successful COL licensee completion and NRC inspection of HFE and ITAAC activities will support the Commission finding required by 10 CFR 52.103(g) on the completion of the ITAAC, and the plant’s readiness to load fuel and operate.

Change guidance affecting the APR1400 HFE program plans, i.e., IPs, ReSRs and ITAAC, are further provided by Regulatory Guide 1.206 “Combined License Applications for Nuclear Power Plants.” Criteria is provided that requires if a COL applicant intends to change plan(s), changes should be described and justified, details should be sufficient to allow staff to conduct appropriate reviews, inspections, and analyses, during the COL review period. Furthermore, if the Design Certification element resulted in an approved IP then any changes must receive NRC review and preapprove, as appropriate, any changes to methodology. Furthermore, the APR1400 DC 10 CFR 52 Appendix, Section VIII will include additional processes for changes and departures by rulemaking.

In summary, the APR1400’s HFE program elements, e.g. IPs, ReSRs and ITAAC form an integrated set of methods and criteria established to ensure HFE is properly implemented to conform to NUREG-0711, Rev. 3, and that sufficient HFE programmatic and regulatory control processes exist to ensure any potential changes or departures from prior NRC approved HFE elements and IPs will receive the necessary assessment, and that any changes implemented will be subject to additional NRC review and inspections of HFE design process milestones as ITAAC in lieu of a completed design are evaluated. The DCD Tier 1, Section 2.9.1 will be revised as indicated in the attachment associated with this response.

Impact on DCD

APR1400 DCD, Tier 1, Section 2.9.1 and Table 2.9-1 will be revised as indicated in the Attachment 1 associated with this response.

APR1400 DCD, Tier 2, Table 1.6-2 and Section 18.4 will be revised as indicated in the Attachment 2 associated with 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-14008-NP, Rev.2, “Human Factors Verification and Validation Implementation Plan,” Section 3 and Section 4.5.5.2 will be revised as indicated in the Attachment 3 associated with this response.

Technical report APR1400-E-I-NR-14001-NP, Rev.2, “Human Factors Engineering Program Plan,” Appendix A will be revised as indicated in the Attachment 4 associated with this response.

FPS	fire protection system
FTS	fuel transfer system
FWCS	feedwater control system
GCB	generator circuit breaker
GDC	general design criteria (of 10 CFR Part 50, Appendix A)
GTG	gas turbine generator
GWMS	gaseous waste management system
HFE	human factors engineering
HI	hydrogen ignitor
HJTC	heated junction thermo couple
HRAS	high radiation actuation signal
HSI	human-system interface
HVAC	heating, ventilation, and air conditioning
HVT	holdup volume tank
HX	heat exchanger
I&C	instrumentation and control
ICI	in-core instrumentation
IHA	integrated head assembly
IPS	information processing system
IRWST	in-containment refueling water storage tank
ISV	intermediate stop valve
ITAAC	inspections, tests, analyses, and acceptance criteria
ITP	interface and test processor
IWSS	in-containment water storage system
LBB	leak before break
LC	load center
LCS	local control station
LLHS	light load handling system
LOCA	loss of coolant accident
LOOP	loss of offsite power
IP	implementation plan

2.9 Human Factors Engineering

2.9.1 Design Description

The Human factors engineering (HFE) program ensures that human-system interface (HSI) of the main control room, remote shutdown room, technical support center, emergency operations facility, and local control stations associated with important human actions reflects state-of-the-art HFE principles, and satisfies all specific regulatory criteria and support the operator in safely operating the plant.

The HSI ~~system~~ is designed in accordance with the HFE program to provide reasonable assurance that the HFE design is properly developed and effectively implemented to conform to NUREG-0711, Rev. 3. The HFE program objectives for the design are that the design is human-centered, it incorporates HFE ~~principals~~ principles and methods, and is developed according to a systematic top-down integrated approach in accordance with applicable requirements and performance of the HFE program element implementation plans (IPs) and results summary reports to support ITAAC closure. ~~Design~~ ITAAC is applied to the human factors verification and validation (HF V&V) for the APR1400. The HFE program ~~is~~ in effect at least from the start of the design cycle through completion of initial plant startup test program ~~to conform to~~ NUREG-0711, Rev. 3. The COL applicant is to provide a design ITAAC closure schedule for implementing the V&V design ITAAC. ~~Design~~ ITAAC will be closed in accordance with applicable regulatory guidance. Any changes and departures will be governed by applicable regulatory guidance and ~~that~~ included with the design certification rulemaking.

The HFE program elements for ITAAC are as follows:

. The implementation plans are complete and conform to the review criteria of to the implementation plans requirements and IPs are

1. The HF V&V determines that the final HSI design conforms to accepted HFE design principles and it enables plant personnel to successfully perform their tasks to assure plant safety and operational goals.

2. The human factors design implementation verifies that the as-built design conforms to the verified and validated design resulting from the HFE design process.

Insert "A" on next pages

2.9.2 Inspections, Tests, Analyses, and Acceptance Criteria

The ITAAC for HFE program elements are described in the Table 2.9-1.

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The HF V&V program element is performed to confirm that the HSI design conforms to HFE design principles and that it enables plant personnel to successfully perform tasks to achieve plant safety and other operational goals. The HF V&V of the HSI design demonstrates operator task performance capabilities and the capabilities to perform operator functions. All HF V&V activities are performed according to the HF V&V Implementation Plan and it applies to all HSIs in the main control room, remote shutdown room, and voice communications when it influences the main control room crew's performance, between the main control room and the technical support center, emergency operations facility, and other offsite emergency entities. The HF V&V also includes the HSIs on local control stations associated with the important human actions. The HF V&V consists of the following steps: (1) Sampling of operational conditions; (2) Design verification; (3) Integrated system validation (ISV); (4) Human engineering discrepancies; and (5) Documentation of results of the HF V&V program.

By applying performance-based testing of the final integrated system, the ISV validates that the final integrated design supports safe plant operation. The realistic scenarios, defined by the sampling of operating conditions, are used to determine if human errors could occur due to operational complexity or excessive task load. For ISV, it uses a method to reduce the bias due to the allocation of scenarios to the operators and the learning effect from the order in which the scenarios are run, and the test design is such that each operating team performs all scenarios. The scenario sequence of the ISV is based on seven scenarios. Plant participants in the ISV are trained in APR1400 plant operation and are divided into three crew teams, each team having five operators. When the test personnel identify errors, loss of situation awareness, or work load increase conditions, these conditions are compared to the recorded plant parameters to evaluate the measure of performance. Two significant dimensions that are measured are situation awareness and workload. Measures of situation awareness include the use of the situation awareness rating tool and measures of workload use the workload rating tool. These tools are valid, reliable and sensitive.

The situation awareness rating tool is the primary tool that is used to measure situation awareness, along with questionnaires and debriefings. The workload rating tool is used to measure the categories of workload, such as mental demand, physical demand, temporal demand, performance, effort, and frustration level. Situation awareness is used to evaluate the operator responses on each question (i.e., perception, comprehension, and projection) and it is measured using situation awareness rating tool after the scenario is complete. The data are sorted and compared with situation awareness data for a predecessor or reference plant. Appropriateness of the responses is converted into a percentage point based on a 7-point Likert scale and is compared with the value of the predecessor or reference plant using the T-test results. If the measure is equal or higher than the predecessor or reference plant, it is determined that the situation awareness for the ISV is appropriate. The performance of the APR1400 is acceptable when it meets or exceeds the performance of predecessors.

Workload is measured using a questionnaire based on the workload rating tool that is completed at the end of the scenario, and results are compared with the results from a predecessor or reference plant. Workload analysis is performed by quantifying the operator responses to the questions (e.g. mental, physical, temporal, performance, effort, and frustration) and then comparing it with the workload values from the predecessor or reference plant. If the measure is equal or lower than that of the predecessor or reference, it is considered that the workload rate for the ISV is appropriate. The performance of the APR1400 is acceptable when it meets or exceeds the performance of predecessors.

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Plant performance measures are plant process variables that are required to confirm whether the operator has checked the plant status correctly for each scenario and to verify that the operator has controlled the plant safely. For this reason, process variables are developed separately for each scenario in the ISV and are obtained through the simulator logging system. Process variable include trend graph data values recorded from the start of a scenario until the end. Suitability criteria of the plant performance measure are based on the plant's operating procedures, technical specifications and the DCD Tier 2, Chapters 7, 15, and 19. A requirement criterion is successful only if it is within the requirement range, and it has a pass/fail characteristic.

Primary task measures support the analysis of the plant performance measures and have a diagnostic characteristic. When a pass/fail requirement applies to the time measure, as when assessing credited manual actions and safe plant parameter envelopes, it is based on the amount of time required for an operator to execute an action. Time is measured for each scenario as applicable and includes the total execution time and partial execution time of tasks. Time measurements are taken from simulator history files or measured manually through observations of the HFE team. When time represents required normative criteria, a violation of the time required analysis from the DCD Tier 2, Chapters 7, 15, or 19, it is a pass/fail measure.

Secondary task measures are based on an operator survey, observation by HFE experts on the HFE team, and debriefing of the operators. The survey is completed by the operators after the scenario has ended, and HFE expert observations are used during the debriefing, with final questions included in the result summary report (ReSR). The observer survey for secondary task measures will apply a questionnaire that will be developed later in the design process, when the final user interfaces have been completed. This will be done prior to the start of the HF V&V program. This questionnaire will be available for audit and will be included in the HF V&V ReSR. Acceptance of the performance of a secondary task is determined by averaging the points with all of 3 or less on a 7-point Likert scale with the average representing a failure.

Subjective reports of participants, based on expert judgment, are obtained through a debriefing with the operator at the completion of the ISV scenario, and through a detailed discussion about the performance of the operator tasks. Criteria for analyzing the measure are often based on expert judgment based on the operating plant experience of the SMEs and the decision process. The anthropometric and physiological survey uses a 7-point Likert scale. Operator surveys are completed by the operators when the scenario has ended. Operators are debriefed, and HFE specialist observations are recorded at the end of the scenario. The determination of the appropriateness of anthropometric and physiological measures is based on an acceptable measure of 4 points on a 7-point scale (e.g., median score agreed upon by the HFE specialists) using the data from the survey. The performance criteria for anthropometric and physiological measures have a pass/fail characteristic, and any unsatisfactory performance identified through any measure on important human actions, as listed in the treatment of important human actions ReSR, is identified as pass/fail.

"A" (cont.)

Table 2.9-1

Human Factors Engineering ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The control room design incorporates HFE principles that minimize the potential for operator error.	1. An Integrated System Validation Test will be performed in accordance with the Verification and Validation Implementation Plan. ~~[Design ITAAC]~~	1. An Integrated System Validation Report exists and concludes that acceptance criteria associated with each test scenario are satisfied upon initial performance of the scenarios or upon remediation of failures.
2. The as-built control room HSIs are consistent with the final validated design specifications.	2. An inspection of the as-built control room HSIs will be performed.	2. The as-built control room HSIs conform to the validated design with no configuration deviations.

Table 1.6-2 (1 of 4)

List of Technical Reports

Report Number (1)	Title	DCD Tier 2 Section
APR1400-E-A-NR-14002-P-SGI	Physical Security Design Features	13.6.2
APR1400-E-I-NR-14001-P APR1400-E-I-NR-14001-NP	Human Factors Engineering Program Plan	18.1
APR1400-E-I-NR-14002-P APR1400-E-I-NR-14002-NP	Operating Experience Review Implementation Plan	18.2
APR1400-E-I-NR-14003-P APR1400-E-I-NR-14003-NP	Functional Requirements Analysis and Function Allocation Implementation Plan	18.3
APR1400-E-I-NR-14004-P APR1400-E-I-NR-14004-NP	Task Analysis Implementation Plan	18.4
APR1400-E-I-NR-14006-P APR1400-E-I-NR-14006-NP	Treatment of Important Human Actions Implementation Plan	18.6
APR1400-E-I-NR-14007-P APR1400-E-I-NR-14007-NP	Human-System Interface Design Implementation Plan	18.7
APR1400-E-I-NR-14008-P APR1400-E-I-NR-14008-NP	Human Factors Verification and Validation Implementation Plan	18.10
APR1400-E-I-NR-14011-P APR1400-E-I-NR-14011-NP	Basic Human-System Interface	18.7
APR1400-E-I-NR-14012-P APR1400-E-I-NR-14012-NP	Style Guide	18.7
APR1400-E-N-NR-14001-P APR1400-E-N-NR-14001-NP	Design Features to Address GSI-191	6.2.1.1.2.2 6.8.2.2.1
APR1400-E-P-NR-14005-P APR1400-E-P-NR-14005-NP	Evaluations and Design Enhancements to Incorporate Lessons Learned from FUKUSHIMA DAI-CHI Nuclear Accident	1.9.6, 19.3
APR1400-E-S-NR-14004-P APR1400-E-S-NR-14004-NP	Evaluation of Effects of HRHF Response Spectra on SSCs	3.7B.1
APR1400-E-I-NR-14010-P APR1400-E-I-NR-14010-NP	Human Factors Verification and Validation Scenarios	18.4, 18.10

18.4 Task Analysis

18.4.1 Objectives and Scope

Task analysis (TA) is an activity of human factors engineering (HFE) that examines task requirements allocated to personnel. The HFE TA program element is performed in compliance with NUREG-0711 (Reference 1), and according to the Human Factors Engineering Program Plan (Reference 2), and the Task Analysis Implementation Plan (Reference 3).

TA identifies the tasks that are needed to accomplish the functions allocated to plant operations personnel, including the tasks required to monitor and back up automated systems. TA analyzes the information, controls, and task support requirements needed to perform these tasks.

The completed TA provides the following analytical bases for the HFE design:

a. Identifies the human-system interface (HSI) inventory to be implemented in the HFE HSI design (HD) program element

b. Establishes the number and qualifications of operations personnel for each plant operations task. Staffing for individual tasks provides input to the staffing and qualification (S&Q) program element, which examines multiple tasks as they are aggregated together for various plant scenarios. (Reference 4)

c. Confirms the human performance assumptions for important human actions (IHAs), which are extracted from the probabilistic risk assessment (PRA), transient and accident analysis (TAA), and diversity and defense-in-depth coping analysis (D3CA) during the HFE treatment of important human actions (TIHA) program element

d. Confirms the allocation results from the FRA/FA program element and resolves any HEDs generated during FRA/FA for allocations that are not consistent with the plant design at the time the FRA/FA is conducted

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

3. APR1400-E-I-NR-14004-P, “Task Analysis Implementation Plan,” Rev. 2, KHNP, January 2018.

4. APR1400-E-I-NR-14010-P, "Human Factors Verification and Validation Scenarios," Rev. 2, KHNP, January 2018.

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LIST OF TABLES

Figure 3-1 ITAAC Closure Schedule

LIST OF FIGURES

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3. METHODOLOGY OVERVIEW

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Table 4-6 Summary of Performance Measures

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NUREG-0711 Rev. 3 Review Criteria	IP Section and Paragraph
In addition, the HFE design process should identify training program input for the following personnel identified in 10CFR 50.120: instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel. In addition, any other personnel who perform tasks directly related to plant safety should be included, such as information technology technicians who troubleshoot and maintain support systems and their HSIs.	2.1 Applicable HSIs, Procedures and Training
6) *Personnel* – The applicant's HFE program should consider operations staffing and qualifications, including licensed control-room operators as defined in 10 CFR Part 55, and the following categories of personnel: non-licensed operators, shift supervisor, and shift technical advisor.	4.1 Assumptions and Constraints. 4.4.2.2 HFE Design Process 4.7.3.4 S&Q Interfaces
7) Additional Considerations for Reviewing the HFE Aspects of Plant Modifications	~~4.4.2.1 General process Procedures~~ N/A
2.4.2 HFE Team and Organization In this document, the term "HFE team" means the primary organization(s) responsible for the applicant's HFE program. However, we do not assume that HFE is the responsibility of a single organizational unit, or that there is an organizational unit called the "HFE team." (1) Responsibility – The applicant's team should be responsible for: • developing all HFE plans and procedures • overseeing and reviewing all activities in HFE design, development, test, and evaluation, including the initiation, recommendation, and provision of solutions through designated channels for problems identified in implementing the HFE work • verifying that the team's recommendations are implemented • assuring that all HFE activities comply with the HFE plans and procedures • scheduling work and milestones	4.3.1 HFE Design Team Responsibilities