Design Implementation Plan

Revision 1

Non-Proprietary

February 2017

REVISION HISTORY

Revision	Date	Page	Description
0	December 2014	All	First Issue
1	February 2017	6,12	Specify the “Style Guide” as the human factors engineering guidelines (RAI 8388 Q18-58)

ABSTRACT

This document presents the implementation plan (IP) for the human-system interface (HSI) design implementation of the Advance Power Reactor 1400 (APR1400), also referred to as design implementation (DI) element of the human factors engineering (HFE) program.

This IP demonstrates that the APR1400 as-built design reflects the verified and validated APR1400 HSI design. Any design aspects that are not evaluated as part of the human factors (HF) verification and validation (V&V) program, or that are introduced via a design change following completion of the HF V&V program element are verified in accordance with this plan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

APR1400	Advanced Power Reactor 1400
CBP	computer-based procedure
CFR	Code of Federal Regulations
DCD	Design Control Document
DI	design implementation
EOF	emergency operation facility
HA	human action
HED	human engineering discrepancy
HF	human factors
HFE	human factors engineering
HFEPP	human factors engineering program plan
HSI	human-system interface
IHA	important human action
IP	implementation plan
ISV	integrated system validation
ITS	issue tracking system
KEPCO	Korea Electric Power Corporation
KHNP	Korea Hydro & Nuclear Power Co., Ltd.
LCS	local control station
LDP	large display panel
MCR	main control room
PBP	paper-based procedure
RSR	remote shutdown room
ReSR	results summary report
SME	subject matter expert
TS	trade secret
TSC	technical support center
V&V	verification and validation

1. PURPOSE

This document presents the implementation plan (IP) for design implementation of the Advanced Power Reactor 1400 (APR1400) human factors engineering (HFE) program. The plan describes the methodology for an analysis that is conducted to provide reasonable assurance that the final as-built design conforms to the verified and validated design that was created using the APR1400 HFE design process.

2. SCOPE

The scope of the analysis includes all human systems interfaces (HSI) for the full range of operating conditions (i.e., normal, abnormal, emergency, plant maintenance, and plant surveillance testing) as required by 10 CFR 50.54 (Reference 1).

The scope of the DI includes the following facilities and equipment consistent with the "Human Factors Engineering Program Plan" (HFEPP) (Reference 2):

- Main control room (MCR) including HSI resources (e.g. controls, alarms, information displays)
- MCR support facilities (e.g. remote shutdown room (RSR), technical support center (TSC), emergency operation facility (EOF))
- Local control stations (LCSs) associated with important human actions (IHAs)
- Procedures and training associated with HSI design aspects
- HSIs associated with IHAs

Any design modifications that are implemented after human factors (HF) verification and validation (V&V) completion are implemented in accordance with an established APR1400 design change process which includes documentation of conformance with the HF V&V IP and the DI IP. A significance determination is performed during the process to justify the existing difference or to determine retest requirements if needed.

3. METHODOLOGY OVERVIEW

TS

TS

4. IMPLEMENTATION

TS

TS

TS

5. IMPLEMENTATION TEAM

The HFEPP establishes SME qualifications and the composition of the implementation team. SME assignments for DI activities are listed in Table 5-1.

Table 5-1 Design Implementation Team SME Assignments

Design Implementation Activity	Subject Matter Expert
MCR software configuration	I&C engineer – software
MCR hardware configuration	HSI and I&C engineer
MCR facility	Operations expert and HFE specialist
RSR software configuration	I&C engineer – software
RSR hardware configuration	HSI and I&C engineer
RSR facility	Operations expert
TSC software configuration	I&C engineer – software
TSC hardware configuration	HSI and I&C engineer
TSC facility	Operations expert
EOF software configuration	I&C engineer – software
LCS design configuration	HSI and I&C engineer
LCS HSI HFE review	HFE specialist
LCS HSI facilities	Operations expert and HFE specialist
Training	Training expert
Procedures	Operations expert
HEDs	HFE design team leader

6. RESULTS SUMMARY REPORT

The DI ReSR documents that the APR1400 Design Implementation results in a final verified and validated as-built HFE design. All DI program element results are compiled and documented in the DI ReSR. The DI ReSR addresses the following areas at a minimum.

- Description of how the design meets the general criteria in NUREG-0711 Rev.3, Section 12.4.1.
- Explanation of how all aspects of the design that are not addressed during the V&V activities were covered in implementing the design
- Documentation of the APR1400's verification and concluding statement that the as-built plant conforms to the approved, validated design
- Corroboration that all HEDs have been satisfactorily resolved and provide an explanation for each HFE ITS item that will be left open detailing how and why it does not adversely affect HF V&V results
- Delineation of how the HFE program addressed each important HA
- Names, area(s) of experience, and qualifications of the SMEs

A conclusion that the DI program element has been conducted in accordance with the DI, that the as-built HSI system and corresponding facilities are the same as those included in the APR1400 HF V&V program element, or that differences between the as-built and the HF V&V design do not adversely affect the HF V&V results.

7. REFERENCES

1. 10 CFR 50.54, "Conditions of Licenses," U.S. Nuclear Regulatory Commission.
2. APR1400-E-I-NR-14001-P, “Human Factors Engineering Program Plan,” Rev. 0, KHNP, December 2014.
3. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 3, U.S. Nuclear Regulatory Commission, November 2012.
4. APR1400-K-X-FS-14002, "APR1400 Design Control Document Tier 2," Rev. 0, KHNP, December 2014.
5. APR1400-E-I-NR-14012-P, “Style Guide,” Rev. 0, KHNP, December 2014.

8. DEFINITIONS

1. Human Factors Engineering: The study of designing industrial equipment or system to optimally fit the human body and its cognitive abilities.
2. HSI Style Guide: Equipment and system design guidance formulated to incorporate human factors principles.
3. HFE Principles: General principles of human factors, such as perception, cognition, and human actions that have practical implications for adequate and usable design.
4. HFE Specialists: Credited Individuals in the area of HFE equivalent to: (a) at least two years of successful graduate-level study of applicable subjects, plus a year of related design experience, or (b) five years of related design experience, or (c) any evenly proportioned combination of (a) and (b).
5. Human-System Interface: The means through which personnel interact with the plant system, including the alarms, displays, controls, and job performance aids. This includes maintenance, test, and inspection interface as well.
6. Operations Experts: Currently or formerly licensed operators with operating experience on similar US plants.
7. Task Analysis: Formalized method of decomposing human job and task activities into constituent elements that information inputs and action outputs are identified.
8. Verification: The process by which the HSI design is evaluated to determine if it provides the information, controls and task support needed to accomplish the tasks identified by the HFE Task Analysis program element, and that they conform to good and accepted human factors standards as contained in the KHNP Style Guide.
9. Validation: The set of performance based activities to ensure that the plant personnel can successfully perform their tasks to achieve plant safety and power production goals.

APPENDIX A – NUREG-0711 Rev. 3 COMPLIANCE TABLE

NUREG-0711 rev. 3 Review Criteria	IP Section and Paragraph
12.4 Review Criteria (Section 12.4.1, Final Plant HFE Design Verification, applies to both new and modified plant designs. The remainder of section 12.4.2 applies to the review of plant modifications).	N/A
12.4.1 Final Plant HFE Design Verification for New Plants	
(1) The applicant should evaluate aspects of the design that were not addressed in V&V by an appropriate V&V method. Additional Information: Aspects of the design addressed by this criterion may include design characteristics, such as new or modified displays for plant-specific design features.	Section 4.0 Section 4.1
(2) The applicant should compare the final HSIs, procedures, and training with the detailed description of the design to verify that they conform to the planned design resulting from the HFE design process and V&V activities. This verification should compare the actual HSI, procedures, and training materials to design descriptions and documents. Any identified discrepancies should be corrected, or justified. Additional Information: Final design means the design existing in the actual plant.	HSI - Section 4.3.3 Procedures - Section 4.3.4 Training - Section 4.3.4 Figure 4-1
(3) All HFE-related issues documented in the ITS should be verified as adequately addressed.	Section 4, Paragraph 1
(4) The applicant should provide a description of how the HFE program addressed each important HA.	Section 4.1.5 Section 4.3.5