



20004-017 (09/21/2009)

AREVA NP Inc.,
an AREVA and Siemens company

Implementation Plan

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U.S. EPR Human Factors Engineering (HFE) Design Implementation Plan



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Safety Related? YES NO

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Does this document contain Customer Required Format? YES NO

Signature Block

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Record of Revision

Revision No.	Pages/Sections/ Paragraphs Changed	Brief Description / Change Authorization
000	N/A	Initial Issue
001	ALL	Formatted into new template, added trademark sign to EPR, deleted document numbers for internal references.
002	ALL	Changes dues to RAI batches 322 and 328

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1.0 INTRODUCTION

1.1 Applicability

This plan applies to New Plants Engineering Instrumentation and Controls Engineering.

1.2 Owner

Program Manager, Human Factors Engineering (HFE) is responsible for maintaining and assuring the execution of this implementation plan.

1.3 Purpose

The Design Implementation Plan demonstrates the "as-built" design conforms to the standard EPR™ design that resulted from the V&V process and that all HEDs and issues identified in the HFE Issues Tracking Database (HITS) are resolved. The purpose of the Design Implementation Plan is to provide a method to verify:

- Aspects of human factors that are not verified during V&V are addressed.
- The "as-built" design implemented conforms to the standard EPR™ design that resulted from the HFE design and V&V processes.
- All issues entered in the HITS database have been adequately addressed.

1.4 Scope

The verification of the "as-built" control room and Human System Interface (HSI) design covers:

- Location, accessibility requirements, layout, and physical environment of the locations included in the scope of the HFE and control room design program. This includes the Main Control Room (MCR), Technical Support Center (TSC), Remote Shutdown Station (RSS), Instrumentation and Control Service Center (I&CSC), and Local Control Stations (LCSs).
- Information displays, controls, indications, and alarms for HSI control stations.
- Coding and labeling of control room and plant components, controls, indications, and displays.
- Screen-based HSI layout and dialogues.
- Ergonomics and anthropometrics of the operator work stations and work spaces.
- Operating procedures system.
- Staffing level requirements.
- Training manuals.

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- Habitability systems.
- Communications equipment.

1.5 Responsibilities

Final HFE design verification is the joint responsibility of the designer and combined operating license (COL) applicant.

1. AREVA NP Program Manager, Human Factors Engineering
 - Approves the Design Implementation Plan.
2. Responsible AREVA NP Human Factors Engineer
 - Identifies all aspects of the design that were not addressed during the HFE V&V process.
 - Provides standard EPR™ documentation required by the COL applicant.
3. COL applicant in conjunction with the responsible AREVA NP Human Factors Engineer
 - Compares the standard EPR™ HSI, procedures, and training against the "as-built" detailed design descriptions.
 - Verifies that all HFE-related issues documented in the HITS database were adequately addressed.
 - Evaluates the identified aspects of the design that were not addressed in the standard EPR™ HFE V&V Plan.
 - Performs the site specific tests and measurements that validate the implementation of HFE functional requirements.

1.6 Definitions

Human System Interface (HSI): The HSI is a system of devices, which includes hardware and software, used by personnel to control, monitor and interact with the plant including the alarms, displays, controls, and decision support aids.

Verification: The process of evaluating a system or component (including software and human interactions) to determine whether the products of a given development process satisfy the requirements imposed at the start of that process.

1.7 Acronyms

COL	Combined Operating License
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EPR™	Trademarked brand name for AREVA's evolutionary PWR reactor design
FSS	Full Scope Simulator
HED	Human Engineering Discrepancy
HFE	Human Factors Engineering
HITS	HFE Issues Tracking System
HSI	Human System Interface
HVAC	Heating, Ventilation, and Air Conditioning
I&CSC	Instrumentation and Control Service Center
LCS	Local Control Station
MCR	Main Control Room
NRC	Nuclear Regulatory Commission
NUREG	Publications prepared by the NRC staff
QA	Quality Assurance
RSS	Remote Shutdown Station
SDD	System Description Document
SDRD	System Design Requirements Document
SSC	System, Structure, and Component
TSC	Technical Support Center
V&V	Verification and Validation

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2.0 CODES, STANDARDS, AND REGULATIONS

There are no codes and standards from industry that apply to HFE Design Implementation. The following are the regulatory guidance that was used in development of this document.

- NUREG-0700: Human-System Interface Design Review Guidelines (NRC, 2002).
- NUREG-0711, Human Factors Engineering Program Review Model, Rev. 2, U.S Nuclear Regulatory Commission (NRC), January 2004.
- NUREG-0800: Standard Review Plan, Chapter 18 Human Factors Engineering (NRC, 2004).

3.0 METHOD

3.1 Quality Assurance Process

The HSI design products are required to meet the AREVA NP design control process and requirements. The design control process facilitates the translation of:

- High level requirements to detailed lower-level requirements
- Design inputs to design outputs
- High-level design features from lower-level subsystem and component design features.

3.2 Documentation

Final "as-built" Documents

For the purposes of design implementation, the "as-built" documentation consists of both plant-specific procedures and training material as well HSI documentation. The final HSI documents consist of the AREVA NP Design Specification Documents, the COL applicant's procurement and fabrication documents, manufacturer specifications and drawings, and equipment lists. Design modifications from the standard EPR™ plant are documented in the as-built design change documentation.

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Standard EPR™ Detailed Design Documents

The standard EPR™ detailed design documentation consists of HFE System Design Requirement Documents (SDRD), System Description Documents (SDD), System, Structure, and Component (SSC) Design Bases Documents, SSC Safety Classification Documents, and Design Text Documents. AREVA NP also has standard procedures and training materials that are used throughout the V&V process.

3.3 Verification of Features that cannot be evaluated with a Simulator

The V&V process in Reference 3 does not address aspects of the HFE design that cannot be verified by the Full Scope Simulator (FSS). Therefore, these aspects of the HFE design are recorded as Human Engineering Discrepancies (HEDs) and are addressed using the method described in Section 3.3.1. The following gives some of those aspects that cannot be verified with a simulator. Specific tests are developed after the detailed design is completed and installed in the plant.

- Control Room Lighting - Both normal and emergency lighting location and illumination levels.
- Acoustics - The control rooms' background noise during normal and abnormal operating conditions.
- Room habitability, heating, ventilation, and air conditioning (HVAC) - Climate control and protection from toxic substances in the air.
- Communication System - The different elements, including the loudspeaker system, telephones, two-way radio capability, etc. Each of these elements is verified for proper functionality and completeness.
- Accessibility of instrumentation/equipment – All the instruments and equipment are laid out in accessible locations.

3.3.1 Verification Steps and Acceptance Criteria

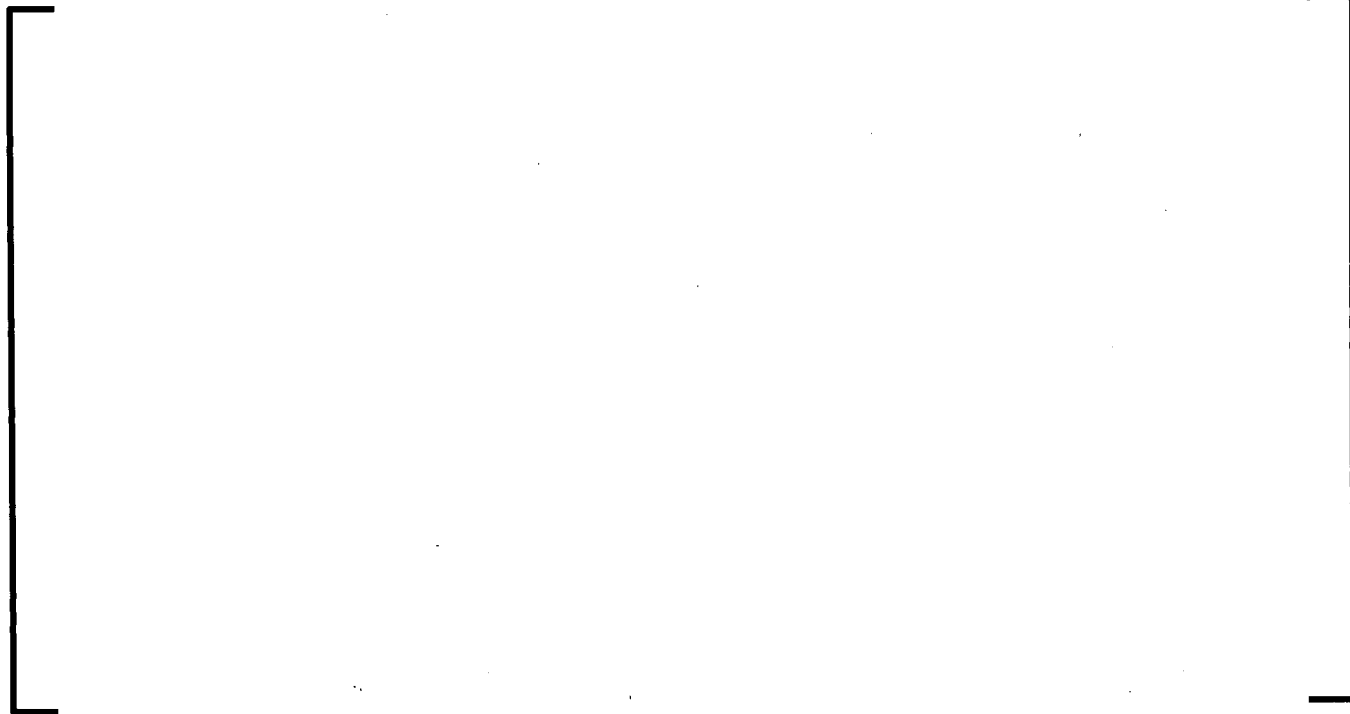
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3.4 Verification of Modifications to the Standard Design

Modifications are verified that they conform to the standard EPRTM design that resulted from the V&V process.

3.4.1 Verification Process



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3.5 Verification of final "as-built" HSIs

To verify that the "as-built" design conforms to the standard EPR™ design resulting from the V&V process, the final HSI design is reviewed. This HSI design is audited for design requirement conformance. Any deviations noted are documented in the HITS.

3.5.1 Verification Steps and Acceptance Criteria

Verification of the "as-built" design consists of a detailed audit and review of the "as-built" documentation listed in Section 3.2 and a physical verification using the as-built HSI. Figure 3-1 shows the general flow of this task.

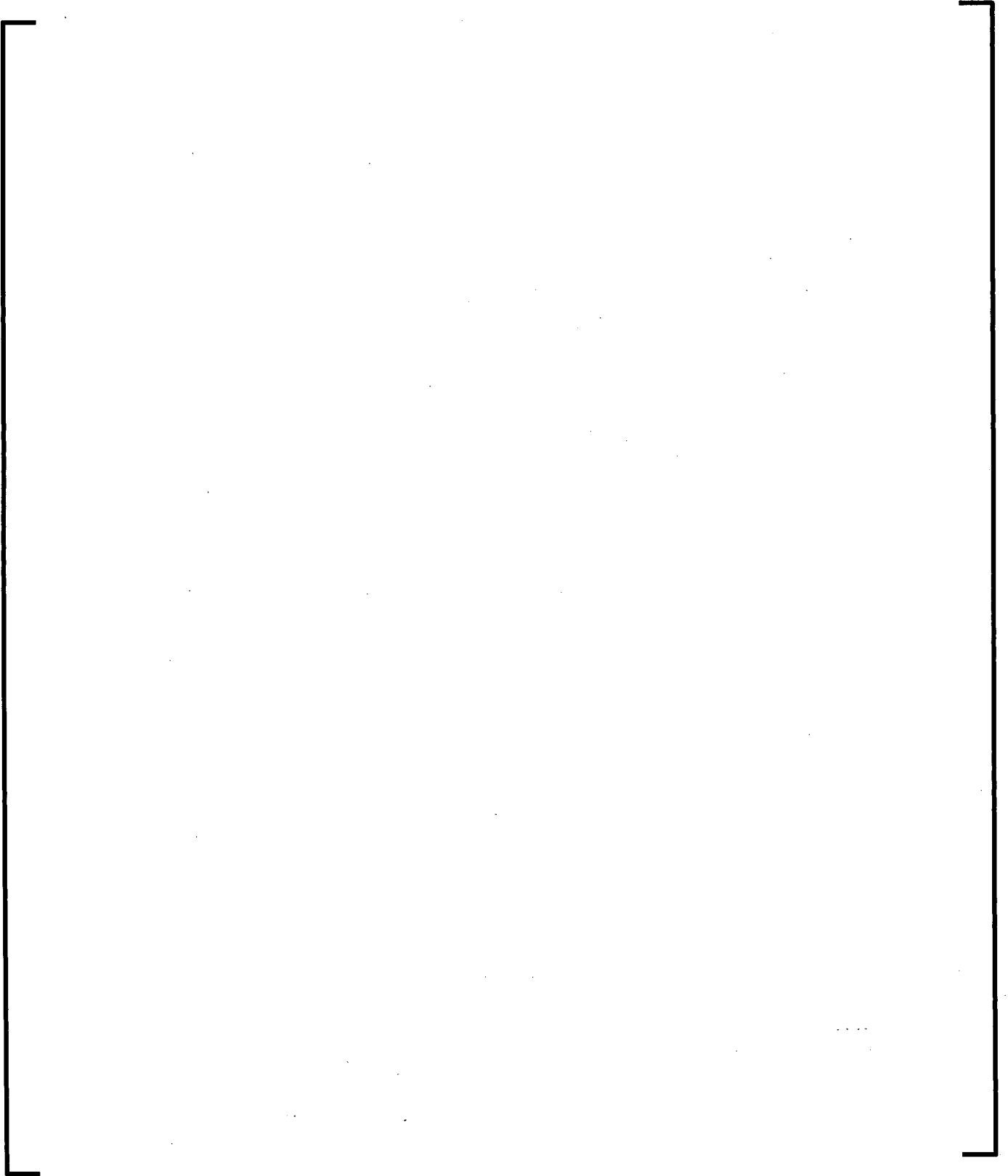


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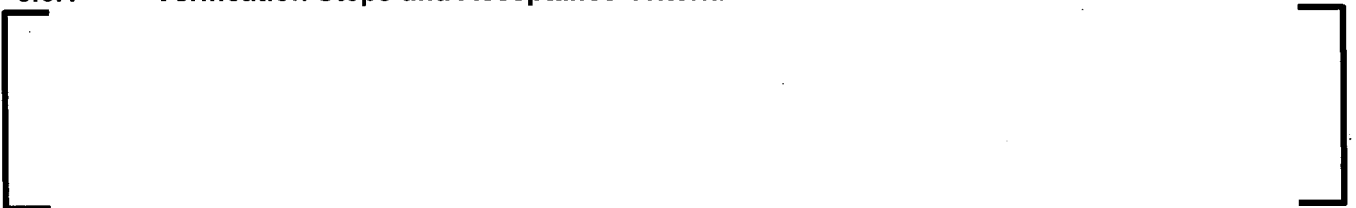
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3.6 Verification of Plant-Specific Procedures and Training

For plant-specific procedures and training, AREVA NP supplies the COL applicant guidance on developing procedures and training. It is then the COL applicant's responsibility to develop the plant-specific procedures and training materials they need. Verification that these plant-specific procedures and training material conform to the design that resulted from the V&V process is performed.

3.6.1 Verification Steps and Acceptance Criteria





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3.7 HFE-related issues documented in the HFE Issue Tracking Database

To complete the design implementation process, all HFE-related issues identified in the HITS must be completely addressed. Verification that these issues have been appropriately addressed and implemented is performed.

3.7.1 Verification Steps and Acceptance Criteria



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4.0 RESULTS

The completion of the HFE design verification is documented in a final summary report. This report is compiled from the results of the different elements of design implementation. The final summary report includes the following:

- Documentation showing that verification of the design is complete.
- Steps taken to verify the design aspects that were not verified during V&V.



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- Steps taken to verify that the "as-built" design matches the design resulting from the V&V process.
- Documentation showing all HFE issues are logged in the HITS. These issues are reported as either resolved during the HFE design implementation process or turned over to the COL applicant for future resolution.

This results summary report is turned over to the COL applicant.



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5.0 REFERENCES

1. AREVA NP Procedure, "Design Control Process"
2. AREVA NP Topical Report, ANP-10266NP, "AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR Topical Report," February 2007.
3. AREVA NP Document, "US EPR Human Factors Verification and Validation Implementation Plan".
4. AREVA NP Document, "U.S. EPR Human Factors Procedure Implementation Plan"
5. AREVA NP Document, "U.S. EPR Human Factors Training Implementation Plan"

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APPENDIX A: HFE DESIGN PROCESS

