18.11 Design Implementation

Design implementation of the human factors engineering (HFE) aspects of the plant verifies that the as-built design conforms to the standard U.S. EPR design resulting from the HFE verification and validation (V&V) process. Design implementation also verifies that issues and discrepancies defined as human engineering discrepancies (HED) identified in the HFE Issues Tracking Database are addressed. V&V of the HFE program is addressed in Section 18.10.

18.11.1 Objectives and Scope

The verification associated with the design implementation process includes design of the main control room (MCR), remote shutdown station (RSS), Technical Support Center (TSC), local control stations (LCS), the human system interfaces (HSI) important to plant safety which are located within these facilities, and plant-specific procedures and training. The U.S. EPR design implementation is completed after construction is complete, but before plant startup. The implementation phase is defined by a structured plan as noted in the Quality Assurance Plan (QAP) for Design Certification of the AREVA QAP Topical Report (Reference 3) and monitored using the HFE Issues Tracking Database.

Design implementation verifies the following:

- Aspects of the design that were not verified during the V&V process.
- Modifications to the standard U.S. EPR design conform to the HFE principles and design guidance expressed in the HFE style guide and meets the HFE review criteria in NUREG-0711 (Reference 1) and NUREG-0700 (Reference 4).
- As-built HSIs, plant-specific procedures, and training conform to the design that resulted from the V&V process.
- Items in the HFE Issues Tracking Database have been adequately addressed.

Design implementation involves comparing engineering design data with documentation of the as-built design (owned by the U.S. EPR operator).

18.11.2 Methodology

Each area of design implementation is verified using a structured process. This process uses guidance from the V&V (see Section 18.10) to develop methods and verification criteria. The methods for HFE design implementation are described further in the HFE design implementation plan (Reference 5).

Design implementation relies on the accuracy of the detailed design documents resulting from the standard U.S. EPR design as well as the as-built and plant-specific documents. These documents are produced using the generic design control process as

described in Section 4.4 of the U.S. EPR HFE program management plan (Reference 2). Modifications made after the design has been verified must follow a design control process similar to that described in Reference 2 to maintain design documentation accuracy.

The HFE Issues Tracking Database is used throughout the process to capture, track, and address HEDs found during design implementation. Each HED follows the same resolution process as outlined for V&V (see Section 18.10). If an HED requires a design change, the AREVA NP design control process is used. When the design change has been implemented, verified, validated, and documented, the HED is closed. If an HED does not require a design change, the HED may be closed with sufficient documented evidence for that decision. HFE-related modifications by U.S. EPR owners after the design is complete are governed by a human performance monitoring (HPM) program similar to that described in Section 18.12.

18.11.2.1 Aspects of the Design Not Verified During the V&V Process

Design implementation addresses features of the design that are not verifiable using a full-scope simulator (e.g., control room lighting, communication systems, background noise levels, ventilation and climate control). Verification that these features conform to the design that resulted from the V&V process is confirmed by matching the design requirements to the actual as-built design documentation.

Other aspects that are not verified during V&V include customer-specific modifications made to the standard U.S. EPR design. These modifications are verified for conformance to the design that resulted from the V&V process. This is accomplished by comparing the HFE aspects of the modification documentation to the standard HFE design documentation.

18.11.2.2 Verification of the As-Built HSIs

A review and audit of the as-built documentation and a physical verification is performed to verify conformance of the as-built design to the standard design resulting from the V&V process. This verification confirms that the as-built documentation is current for the plant, that it conforms to the design requirements, and that it matches the design documentation.

18.11.3 Verification of the Plant-Specific Procedures and Training

AREVA NP supplies guidance for developing procedures and training. Verification that the plant-specific procedures and training are developed using that guidance and that they conform to the design resulting from the V&V effort (as described in Section 18.10) is conducted using the process described in the U.S. EPR Human Factors Engineering Design Implementation Plan (Reference 5).

18.11.3.1 Verification that HFE Issues Tracking Database Items Have Been Addressed

This verification process confirms that HEDs being tracked are adequately addressed. This is accomplished by reviewing the database, verifying that HEDs have been addressed, and addressing any remaining HEDs as necessary. In some cases, there are HEDs that require a design change, but are not implemented by the time design implementation is finished and closed. Those HEDs are turned over to the U.S. EPR operator for implementation or closure at a later date.

18.11.4 Results Summary

Throughout the design implementation, the HFE Issues Tracking Database is updated as new HEDs are discovered during the process. Resolution for these HEDs is also updated in the HFE Issues Tracking Database. A results summary report is generated detailing the status of HEDs tracked including any that remain unresolved and concludes HFE issues have been adequately addressed. The results summary report concludes the design implementation was performed in accordance with the prescribed process for validating that the as built design conforms to the standard design resulting from the HFE V&V process. Also included are the methods and criteria used during the design implementation process and the results of the verification. This report becomes part of the final design documentation owned by the U.S. EPR operator.

18.11.5 References

1. NUREG-0711, “Human Factors Engineering Program Review Model,” U.S. Nuclear Regulatory Commission, 1994.

2. U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2009.

3. ANP-10266A, Revision 1, “AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR,” AREVA NP Inc., April 2007.

4. NUREG-0700, “Human-System Interface Design Review Guidelines,” Revision 2, U.S. Nuclear Regulatory Commission, May 2002.

5. U.S. EPR Human Factors Engineering (HFE) Design Implementation Plan, AREVA NP Inc., 2009.

Next File