

DRAFT

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U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 18 - Human Factors Engineering
Application Section: FSAR Ch 18

QUESTIONS

18-7

NUREG 0711 Section 8.4.2 and 8.4.3 contains program elements related to concept of operation.

DC FSAR Section 18.7.2.3 states that an "HSI design implementation plan" specifies how the automation criteria and the role of operators as supervisors of automation are translated into the design guidance for the HSI.

DC FSAR Section 18.7.4.3 states the same plan describes how the HFE and Control Room Design Team organizes and presents the alarms, displays, and controls on the HSIs.

The staff has not been able to locate this implementation plan.

Please describe the location of the plan if it is a subset of the topical report or DCD. Please submit the implementation pan for review if it is a stand alone document.

18-8

NUREG 0711 Section 8.4.4 contains five criteria that specify alternative approaches and studies be evaluated to ensure the HFE designs used are consistent with latest HFE principles.

The applicant did not address the criteria in this section.

Please provide a detailed description of how the five criteria in NUREG 0711 Section 8.4.4 were addressed.

18-9

NUREG-0711 Section 8.4.5 (1) describes the HFE style guide.

The applicant states that an HSI style guide is used in the design of the HSI features, layout, and environment. The level of detail provided is insufficient to verify all style guide related criteria have been implemented.

Please submit the style guide for review or provide sufficient descriptions and examples that demonstrate how the criteria in this section have been addressed. If the style guide has not been completed please provide estimated completion date.

18-10

NUREG-0711 Section 8.4.5 (4):

When developing functional requirements for monitoring and control capabilities that may be provided either in the control room or locally in the plant, the following factors should be considered: Communication, coordination, workload, feedback, local environment, inspection, test, and maintenance , importance to safety.

Chapter 18.1 outlines a series of V&V interim checks that provide feedback to the design process. There are no other references to feedback in Chapter 18.7.

Please document any other feedback mechanisms used in the HSI design process.

18-11

NUREG-0711 Section 8.4.5 (4):

*When developing functional requirements for monitoring and control capabilities that may be provided either in the control room or **locally in the plant**, the following factors should be considered: Communication, coordination, workload, feedback, **local environment**, inspection, test, and maintenance , importance to safety.*

NUREG-0711 Section 8.4.5 (8):

For the remote shutdown facility and local control stations, requirements should address constraints imposed by the ambient environment (e.g., noise, temperature, contamination) and by protective clothing (if necessary).

Environmental issues such as lighting, acoustics, personnel protection equipment, and ambient conditions suitable for personnel are included in the scope of the style guide(Sections 18.7.5, 18.7.6.2) for the Main Control Room. No mention is made of local environment associated with local control stations. Local control stations are not addressed within chapter 18.7.

Please explain how Local control stations (Including the remote shutdown facility) will be addressed within the HSI design.

18-12

NUREG-0711 Section 8.4.5 (8):

*HSI characteristics should support human performance under the full range of environmental conditions, e.g., normal as well as **credible extreme conditions**. For the main control room requirements should address conditions such as loss of lighting, loss of ventilation, and main control room evacuation.*

Human performance under credible extreme conditions is not addressed in the DC application Chapter 18.7.

Please address the HSI characteristics supporting human performance under credible extreme conditions including the specific examples within this criterion.

18-13

NUREG-0711 criteria 8.4.6.1 and 8.4.6.2: These criteria summarize the characteristics of trade-off evaluations and performance based tests.

In DC FSAR Section 18.7.7, the applicant states that testing and evaluation is conducted throughout the HSI design at various stages of the development so that the complex HSI design functions properly before the design process is resolved and validation occurs. Chapter 18.1, Figure 18.1-2 shows V&V interim checks after each major milestone. The applicant provided a programmatic level description stating that activities such as concept testing, mock-up activities, trade-off evaluations, and performance based tests are utilized at various stages of the design. The applicant states the criteria used to decide which type of testing or evaluation technique to use is contained in the V&V implementation plan contained in Chapter 18.10. Chapter 18.10 does not contain these criteria nor any description of the techniques listed above in the context of various stages of design. (Integrated system validation is noted as a performance based test - Is performance based testing used in other design stages?)

1. Please explain which testing and evaluating techniques are being used and how they interface with the V&V interim checks.
2. For the techniques being used, please explain how the NUREG criteria listed above are applied.
3. As currently stated in DC FSAR Section 18.7.7, please document the criteria being used for applying testing or evaluation techniques

18-14

NUREG-0711 Section 8.4.7 (1):

The HSI design should document the following features:

- *the detailed HSI description, including the format and performance characteristics*

- *the basis for the HSI design characteristics with respect to operating experience and literature analyses, trade-off studies, engineering evaluations and experiments, and benchmark evaluations*
- *records of the basis of the design changes*

The DC FSAR addresses all of the criterion guidance with the exception of recording design basis changes. The DC FSAR references ANP 10266, "Areva NP Inc. Quality Assurance Manual for the Design Certification of the US EPR," which specifies that design records include the final design output and revisions to the final output, important design steps (e.g., calculations, analyses, and computer programs) and the sources of input that support the final output. This document does not explicitly address recording design basis changes.

Please explain how the basis for design changes is documented.

18-15

NUREG-0711, Element 12 for Design Implementation, states that the applicant should provide for staff review an implementation plan. After staff's review of the EPR FSAR and the topical report (ANP-10279, Rev. 0), AREVA provided to the staff a programmatic description of the design implementation process. However, the staff could not determine how the design implementation process will be executed.

Please provide the implementation plan for the design implementation process for staff review. If this is not available, please provide detailed information as to how AREVA will execute the design implementation process.

18-16

NUREG-0711 Section 11.4.2.1.2 (2):

The inventory should describe the characteristics of each HSI component within the scope of the review, including the unique identification code number or name, associated plant system and subsystem, associated personnel functions/subfunctions, type of HSI component, display characteristics and functionality, control characteristics and functionality, user-system interaction and dialog type, location in the data management system, and physical location of the HSI, if applicable. The inventory should also include photos, copies of video display unit screens, and samples of HSI components.

In DC FSAR Section 18.10.3.1, the applicant states that the HSI inventory provides an accurate and complete description of the HSI components. The list of description attributes included in the text contains all the elements in this criterion except "associated personnel functions/subfunctions."

Please explain how "associated personnel functions/subfunctions" is addressed.

8-17

NUREG-0711 Section 11.4.2.1.2 (3):

The HSI inventory should be based on the best available sources (e.g., equipment lists, design specifications, and drawings). These descriptions should be compared by directly observing the components, both hardwired and computer-generated, to verify that the inventory accurately reflects their current state.

The V&V plan as outlined in DC FSAR Section 18.10 does not address the verification of field components.

Please explain how the V&V program will address verification of the HSI inventory against field components.

If this action is not planned, please explain why not performing this part of the criterion is acceptable.

18-18

NUREG-0711 Section 7.4, Review Criteria 1 – 4, describes the review for the Human Reliability Analysis (HRA).

The Final Safety Analysis Report (FSAR) states that “an output report identifies the list of risk-important HAs and summarizes how those HAs and the associated tasks and scenarios were addressed during the various parts of the HFE design process.” The level of detail provided is insufficient to verify that the HRA criteria have been implemented.

Please submit the HRA results for review or provide sufficient descriptions and examples that demonstrate how the criteria in Element 7 of NUREG-0711 have been addressed. If the HRA analysis has not been completed, please provide the estimated completion date.

18-19

NUREG-0711 Section 11.4.2.2.2 (4):

An HED should be identified for HSIs that are available in the HSI but are not needed for any task.

In DC FSAR Section 18.10.3.2, the applicant states that HSI elements that do not support personnel tasks are identified during the HSI design. The number of HSI elements or screens is reduced if the HFE and Control Room Design Team determines that an excessive number of display elements or screens interfere with operator awareness or leads to information overload issues. This addresses the case where the HSI element is unneeded, but not the case where there is an incomplete task or function analysis, or the element is outside the scope of the analyses. Also, there is no information provided on documenting the discrepancy on an HED.

For an HSI element without a corresponding task, please address how causes other than an unnecessary element will be addressed. Please include HED requirements within this discussion.

18-20

NUREG-0711 Section 11.4.3.1:

Plant personnel should perform operational events (for integrated system testing) using a simulator or other suitable representation of the system to determine its adequacy to support safety operation. This should be undertaken after significant HEDs that were identified in verification reviews have been resolved.

The applicant takes a more general strategy with respect to HEDs stating in DC FSAR Section 18.10.3.5.5 that they will verify that previously generated HEDs have been addressed or are tracked for further consideration. While the applicant states in Section 18.10.3. that HED resolution is performed iteratively throughout the HSI design process so that issues are identified and corrected early and that some HEDs identified during verification are resolved prior to proceeding with validation of the HSI design, this does not specifically reflect the element of the criterion stating all significant HEDs have been resolved.

Please explain how significant HEDs will be managed relative to the ISV.

18-21

NUREG-0711 Section 11.4.3.2.1 (1):

Detailed objectives should be developed to provide evidence that the integrated system adequately supports plant personnel in the safe operation of the plant. The objectives should be to:

- *Validate that the shift staffing, assignment of tasks to crew members, **and crew coordination** (both within the control room as well as **between the control room and local control stations and support centers**) is acceptable. This should include validation of the nominal shift levels, minimal shift levels, and **shift turnover**.*
- *Validate that specific personnel tasks can be accomplished within time and performance criteria, with a high degree of operating crew situation awareness, and with acceptable workload levels that provide a balance between a minimum level of vigilance and operator burden. Validate that the operator interfaces minimize operator error and provide for error detection and recovery capability when errors occur.*

In DC FSAR Section 18.10.3.5.4, the applicant describes ISV test objective. These objectives restate the criteria above with two exceptions.

- The objective to validate shift staffing does not include the concept of validating crew coordination between the control room and local control stations and support centers. It also does not include the concept of validating performance during shift turnover.

- The objective to validate that specific personnel tasks can be accomplished within time and performance criteria is not directly correlated to any of the criteria in the DC FSAR section. The closest ISV objective is to validate that the functional requirements are met for the major HSI features. The objective loses some of the intent of the criterion in that it could be applied with limited focus on equipment functionality and potentially miss the human elements described in the criterion.

Please explain how the following ISV test objectives will be addressed

1. Coordination between the MCR and local control stations
2. performance during shift turnover
3. the validation of personnel tasks with focus on crew situation awareness, balanced workloads supporting vigilance, minimization of operator error, error detection and recovery.

18-22

NUREG-0711 Section 11.4.3.2.2:

Validation should be performed by evaluating dynamic task performance using tools that are appropriate to the accomplishment of this objective. The primary tool for this purpose is a simulator. One approach to identifying a validation testbed that is consistent with the following review criteria, is to use the American National Standard "Nuclear power plant simulators for use in operator training," (ANSI/ANS 3.5-1998) as a guide.

- *Interface Completeness*
- *Interface Physical Fidelity*
- *Interface Functional Fidelity*
- *Environment Fidelity*
- *Data Completeness Fidelity*
- *Data Content Fidelity*
- *Data Dynamics Fidelity-*
- *For important actions at complex HSIs remote from the main control room, where timely and precise human actions are required, the use of a simulation or mockup should be considered to verify that human performance requirements can be achieved. (For less risk-important HAs or where the HSIs are not complex, human performance may be assessed based on analysis such as task analysis rather than simulation.)*
- *The testbeds should be verified for conformance to the testbed characteristics identified above before validations are conducted.*

In DC FSAR Section 18.10.3.5.5, the applicant states that the ISV will be performed on a high-fidelity simulator meeting the requirements in 10 CFR 50.34(f)(2)(i). There is no discussion of validation methods that will be applied at the non-control room locations. Also, the 10 CFR reference is incorrect (34.f.2.i verses 34.f.2.xii.C.2.i).

DC FSAR Section 18.10.3.5 states that the full scope simulator cannot evaluate every performance shaping factor such as ambient temperature and noise. A reference to Section 18.11 is provided for a description of how such conditions will be handled. There is no section numbered as 18.11 and no explanation was found in any other section.

1. Please explain what validation methods will be applied to non-control room locations. Please verify the 10 CFR reference.
2. Please explain how performance shaping factors that cannot be evaluated on the simulator will be handled. Please provide a correct reference.

18-23

NUREG -0711 Section 11.4.3.2.4:

The operational conditions selected for inclusion in the validation tests should be developed in detail so they can be performed on a simulator. The following information should be defined to provide reasonable assurance that important performance dimensions are addressed and to allow scenarios to be accurately and consistently presented for repeated trials:

- *task support needs*
- *staffing objectives*

In DC FSAR Section 18.10.3.4.4, the applicant provides a set of criteria used to fully define the scenarios to be validated. All elements for the NUREG criterion are included in this set with the exception of “task support needs” and “staffing objectives.”

Please explain how task support needs and staffing objectives are included in the V&V scenarios documentation.

18-24

NUREG-0711 Section 11.4.3.2.4 (2):

Scenarios should have appropriate task fidelity so that realistic task performance will be observed in the tests and so that test results can be generalized to actual operation of the real plant.

In DC FSAR Section 18.10.3.5, the applicant states that Formal ISV tests are performed using the plant simulator with a representative set of realistic scenarios selected from OCS input to confirm that the HSIs, the procedures, the function allocation, and the task design also supports the operator during task performance. There are no additional details on how task fidelity is maintained within scenarios.

Please explain how task fidelity is maintained within scenarios.

18-25

NUREG-0711 Section 11.4.3.2.5:

The review criteria for performance measurement are divided into three sections. Section 11.4.3.2.5.1 addresses the measurement characteristics that effect the quality of the performance measures, Section 11.4.3.2.5.2 addresses the

identification and selection of variables to represent measures of performance, and Section 11.4.3.2.5.3 addresses the development of performance criteria.

DC FSAR Section 18.10.3.5.5 states that human performance measure will be developed as part of the ISV strategy. However, the design certification does not address the performance measurement criterion in this section of the NUREG in any further detail.

Please address the criterion contained in section 11.4.3.2.5 of NUREG-0711.

18-26

NUREG-0711 Section 11.4.3.2.6:

The review criteria for test design are divided into five sections. Section 11.4.3.2.6.1 addresses coupling crews and scenarios, Section 11.4.3.2.6.2 addresses test procedures, Section 11.4.3.2.6.3 addresses the training of test conductors, Section 11.4.3.2.6.4 addresses the training of test participants, and Section 11.4.3.2.6.5 addresses the conduct of pilot studies.

The Design Certification FSAR did not contain information addressing test-design related criteria from NUREG-0711 section 11.4.3.2.6 with the exception of subsection 11.4.3.2.6.4, "Pilot testing."

Please address all "test design" related criteria from NUREG-0711 Section 11.4.3.2.6 with the exception of those relating to Pilot Testing (subsection 11.4.3.2.6.4.)

18-27

NUREG-0711 Section 11.4.3.2.7 contains performance criteria associated with ISV data analysis and interpretation. NUREG-0711 Section 11.4.3.2.8 contains criteria associated with ISV validation conclusions.

The design certification does not address these two sections of NUREG-0711.

Please explain how the criteria in NUREG-0711 Sections 11.4.3.2.7 and 11.4.3.2.8 will be addressed within the V&V program

18-28

NUREG-0711 Section 11.4.4.2:

This criterion describes elements that should be contained in and HED evaluation.

In DC FSAR section 18.10.3.6, the applicant provides documentation requirements for an HED. The description includes categories that cover all the NUREG criterion concepts but without the details addressed within the criterion.

Please explain how and when the the additional detail in NUREG-0711 section 11.4.4.2 will be addressed.

18-29

10 CFR 50.34(f)(2)(iv):

Provide a plant safety parameter display console that will display to operators a minimum set of parameters defining the safety status of the plant, important plant parameter and data trends on demand, and capable of indication when process limits are being approached or exceeded.

As described in DC FSAR, Tier 2, Section 18.7.1.3.3, "Safety Parameter Display System," the applicant addressed the SPDS requirement with an integrated design, rather than a stand-alone, add-on system as is used at most currently operating plants. The EPR design will address the regulatory requirements by integrating the SPDS requirements into the design requirements for the Plant Information Control and Safety Information Control systems. In NUREG-0800, the staff indicated that for applicants who are in the early stages of the control room design, the "function of a separate SPDS may be integrated into the overall control room design."

However, because the 10 CFR 50.34 regulation specifies a safety parameter display console, the staff has determined that an exemption must be processed. The exemption must conform to the special circumstances described in 10 CFR 50.12(a)(2)(ii).

To support the staffs review of an exemption from the requirements of 10 CFR 50.34(f)(2)(iv) for an SPDS console and instead the accomplishment of the SPDS console by integration of its functions into the overall design, the following information is requested.

Please explain how the SPDS related criteria contained in 50.34(f)(2)(iv), NUREG-0737 supplement 1, and NUREG-1342 are addressed within the integrated control room design.

18-30

NUREG-0711 Section 2.4.1 (3):

The HFE Program should address the Main Control Room (MCR), remote shutdown facility, technical support center (TSC), emergency operations facility (EOF), and local control stations (LCSs).

The applicant states that the EOF is a COL responsibility. The TSC remains a responsibility of the DC applicant.

Please explain how the HFE program will be applied to the Technical Support Center. Will all program elements be applied? If yes, please explain how differences between MCR and TSC will be addressed. For example, will there be a function and task analysis specific to the TSC and how will the V&V be conducted?

18-31

NUREG-0711 Section 4.4 (1):

The applicant should perform the functional requirements analysis and function allocation using a structured, documented process reflecting HFE principles.

In support of a completed element review, please submit the function analysis results. If the function analysis has not been completed, please provide and estimated completion date.