ArevaEPRDCPEm Resource

From: BRYAN Martin (EXT) [Martin.Bryan.ext@areva.com]
Sent: Monday, April 05, 2010 3:03 PM
To: Tesfaye, Getachew
Cc: DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); PANNELL George L (AREVA NP INC); LENTZ Tony F (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 369, FSAR Ch. 18
Attachments: RAI 369 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 369 Response US EPR DC.pdf" provides technically correct and complete responses to 16 of the 16 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 369 Questions 18-135, 18-136, 18-137, 18-138, 18-139, 18-140, 18-141, and 18-142.

The following table indicates the respective pages in the response document, "RAI 369 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

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This concludes the formal AREVA NP response to RAI 369, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
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Cc: Walker, Jacqwan; Marble, Julie; Bongarra, James; Keefe, Molly; Junge, Michael; Steckel, James; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 369(4101,4168,4268), FSAR Ch. 18

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on February 18, 2010, and on March 2, 2010, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAI that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
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Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1288

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Response to

Request for Additional Information No. 369 (4101, 4168, 4268), Revision 1

3/04/2010

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 for Operating Licensing and Human Performance Branch (AP1000/EPR Projects) (COLP)

Question 18-127:

The FSAR should contain all information (either directly or by reference) the staff uses in its evaluation. Provide a reference in the FSAR to the submitted Training Development Implementation plan (document no. 118-9111656-000) in FSAR Section 18.9.

Response to Question 18-127:

The Response to RAI 322, Supplement 1, Question 18-52 revised U.S. EPR FSAR Tier 2, Chapter 18 to include references to the U.S. EPR Training Implementation Plan and other referenced HFE implementation plans.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question

Question 18-128:

In section 3.1 of the TDIP, a reference to ACAD 02-001, "The Objectives and Criteria for Accreditation of Training in the Nuclear Power Industry," is provided. The following staff concerns need to be addressed:

1. Provide clarifying information describing the role of this document within the US EPR training development process.
2. In addition to the overall role of the document, describe what outputs (if any) from the US EPR training process will be used as input to the ACAD 02-001 systematic approach to training, and describe the plan to have these outputs processed into ACAD 02-001.

Response to Question 18-128:

1. Training objective 3 of ACAD 02-001 contains the initial training and qualification objectives. This describes the methods and attributes that a systematic approach to initial training and qualification program contains. The initial training is based on analysis of the tasks performed for each plant function. The output described is the results of the task analysis that is delivered to training. These task analysis sheets describe the knowledge and ability requirements determined through a rigorous workload analysis process. The U.S. EPR Training Implementation Plan describes the inputs and outputs to the training process. The task analysis process and output is found within the U.S. EPR Task Analysis Implementation Plan. ACAD 02-001 is referenced in the U.S. EPR Training Implementation Plan to verify that the training program is structured according to the systematic approach to training objectives and criteria for accreditation of the training program.
2. The process of obtaining task analysis data and following the systematic approach to training is described in the U.S. EPR Training Implementation Plan. This process of constructing and developing the training program as well as the delivery of training and evaluation of results are used for the accreditation process. The U.S. EPR Training Implementation Plan discusses the results and documentation in Section 4.0, which lists the documentation for review. These results describe the size and scope of the training program, the training plans, and the review of the training assessments provided for program verification and validation.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question

Question 18-129:

Section 1.8 of the HRA IP states that integration of Human Reliability Analysis (HRA) into the HFE program is discussed in Section 3.2 of the plan. Section 3.2 discusses Responsibilities of the HFE Team members. In which section is information on HRA integration into the HFE program to be found.

Response to Question 18-129:

Section 1.8 of the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program referenced an incorrect section of the implementation plan. The reference will be corrected to refer to Section 3.1 and Section 3.4.

The schedule for providing the revised U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program is as follows:

Document Name	Commitment date
U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program	05/10/2010

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-130:

Figures 3-1 and 3-2 are not referenced by the text. Figure 3-2 is captioned that it is used to illustrate how HRA is integrated into the HFE program. Please describe and clarify the processes illustrated by these figures in the text.

Response to Question 18-130:

Figures 3-1 and 3.2 of the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program will be referenced by the text. Figure 3.1 is referenced in Section 3.1 and Section 3.4. Section 3.1 describes the relevant relationships held within the figure. Figure 3.2 is referenced in Section 3.1 and Section 3.4. Section 3.1 describes process flows relating to the figure. Section 3.4 describes areas of responsibility for those associated with this work.

The following statement will be added in Section 3.1 for clarification:

> "Figure 3-1 displays the relationship of HRA to the other elements within the HFE design process. The various pathways of information exchange can be seen from the solid lines. The arrows show the direction of expected information exchange. Task analysis is expected to give and receive information."

Section 3.1 describes the general requirements and overall flow of the HFE design process in relation to HRA. Section 3.2 describes responsibilities of the departments and personnel involved in the process. Section 3.3 describes the HRA process and methodology. Section 3.4 is the HRA-HFE integration implementation section which describes the general flow associated with Figure 3.2. Each of these sections describes different parts of each figure. This is the reason both figures were referenced at different places throughout the implementation plan.

The schedule for providing the revised U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program is as follows:

Document Name	Commitment date
U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program	05/10/2010

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-131:

Section 3.1.1 of the HRA IP discusses Risk-Significant Human Actions (HAs). This section discusses the role of and use of Performance Shaping Factors (PSFs) to adjust base HEPs to account for conditions that may affect the probability of human error. This section contains the statement, "The intent of the HFE/HRA implementation plan is to identify risk-significant human actions, and influence the HFE and EPG during the detailed design process to improve the PSFs for those actions."

This statement is not clear. Please clarify what is meant that the HRA will be used to influence the HFE and EPG to improve the PSFs for risk-significant actions. Refer to NUREG-0711, 7.4(1)

Response to Question 18-131:

Probabilistic risk assessment (PRA) provides a list of PSFs. These PSFs are subjective values that are assigned in the HRA for complexity, stress, ergonomics, training, and timing (margins). The process describes how the PSF and their bases will be improved so that the PRA results can be improved. HFE provides PRA the necessary data so that assumptive inputs can be replaced with HFE design basis information. This is controlled through the design process and iterations of the analysis. NUREG-0711, 7.4(1) refers to configuration control and how our design control process allows HRA/PRA to track the changes and increasing detail of the HFE and emergency procedure guideline (EPG) design. Currently the HRA uses subjective analysis due to the lack of detailed design input. The process is arranged to provide feedback from the workload analysis section of the task analysis in the form of detailed task requirements. This is shown in Figure 3.1 of the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program. There will also be feedback from the HFE design process when human system interfaces (HSI) design, procedure development, and training development have progressed to a point where there is measurable output. When this detailed design information is produced and delivered to HRA, the modification of the HRA assessment can be based on a more objective determination. This iterative path allows HRA to be used to influence the HFE and EPG to improve the PSFs for risk-significant actions.

The statement will be changed as follows for clarification to include the word “process” because there are several elements within the HFE design process affecting changes for input to HRA:

> “HRA will be used to influence the HFE design process and EPG development to improve the PSFs for risk-significant actions.”

Section 3.3 of the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program describes this methodology:

> “As the U.S. EPR™ plant and interface designs develop, the HRA model is refined to incorporate other HFE elements that will affect human performance. This includes the functional analysis, functional allocation, task-analysis, procedures, training, and operator interface design. These elements influence the HEP estimates through the PSF values, and the PRA evaluates the impact of these errors on accident scenarios. The HRA supports the HFE by providing the HSI design team with feedback identifying where additional design

effort has high potential for minimizing personnel errors that have high risk-significance and improving operator recovery from human errors and plant system failures."

Section 4.4 of the U.S. EPR Task Analysis Implementation Plan will be revised to discuss workload analysis, the feedback for HRA process:

"Upon completion of the task data sheets, HRA is supplied with task details. It is through this iterative process that task analysis performs as a feedback mechanism for mitigating performance shaping factors (PSF) in risk-significant human actions defined through HRA."

The schedule for providing the revised U.S. EPR Task Analysis Implementation Plan is as follows:

Document Name	Commitment date
U.S. EPR Task Analysis Implementation Plan	05/10/2010

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-132:

Section 5.0 of the HRA IP provides references to 8. AREVA NP Document, "EPR Design Certification Project General Arrangement Drawing Safeguard Building 2 & 3 Plan EL +39 ft." and AREVA NP Document, "EPR Design Certification Project General Arrangement Drawing Safeguard Building 2 & 3 Plan EL +53 ft."

These citations are not referenced in the text. Please clarify that these references are correct and indicate what they will be used support. Refer to NUREG-0711, 7.4(2).

Response to Question 18-132:

These references were not used within the text and will be removed from Section 5.0 of the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program.

The schedule for providing the revised U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program is as follows:

Document Name	Commitment date
U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program	05/10/2010

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-133:

A review of FSAR Chapter. 19, Rev. 0 shows some basic events with embedded HAs. Some of these have RAW values significantly above the R-S threshold of 2.0, but they are not on the Tables of R-S HAs. For example, Table 19.1-36 has the following basic events with RAW values of 39.9, 54.1, and 9.1:

- LOOP24+REC
- LOOPCON+REC
- LOOPCSD+REC

These all contain some HAs related to operator failure to recover offsite power. This action could certainly benefit from improved HSI. Please describe how the U.S. EPR methodology will address such embedded HAs.

Response to Question 18-133:

See the Response to RAI 193, Question 18-35.

These are events, not operator actions. These basic events are statistical estimates based on historical operating experience of the duration of various loss of offsite power events. The probabilistic risk assessment (PRA) does not have any detailed modeling of the specific mechanisms for loss of offsite power or subsequent recovery. Any operator actions imbedded in these were not modeled in the PRA.

The use of the operating experience review (OER) as input into the entire human factors engineering (HFE) design process, as described within the U.S. EPR Human Factors Operating Experience Review Implementation Plan, describes how operator actions from previous industry experience is extracted and reviewed for input into the HRA process and the design process for evaluation during detailed design. A task analysis is conducted for OER reports generated from these types of events during the analysis of the associated systems. Because the causal factors resulting from the individual human system interfaces (HSI) where these individual events took place cannot be completely understood, the HSI for the EPR will be constructed to preclude the results of such events from occurring.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-134:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Please explain why the first column of Table 3.4-1 is titled, "Commitment Wording" rather than "Design Description" as identified in the SRP 14.3 guidance.

Response to Question 18-134:

The first column titled “Commitment Wording” is used consistently throughout Tier 1 of the U.S. EPR FSAR. The Human Factors Engineering Section 3.4 is consistent with this format.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 18-135:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 1 of Table 3.4-1, "Acceptance Criteria," states, "an output summary report exists and concludes…" but does not indicate what the report contains, e.g, scope of OER, etc. Please reconcile this discrepancy.

Response to Question 18-135:

The following items are discussed in the results summary report section of the U.S. EPR Operating Experience Review Implementation Plan and will be added to the Acceptance Criteria of Commitment 1.0 in Table 3.4-1:

"The report addresses the scope and results of the OER process including:

- A list of databases used for searching.
- A list of analyzed documents.
- A list of significant issues found along with their implementation status at the time of the report."

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 will be revised as described in the response and indicated on the enclosed markup.

Question 18-136:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entries 2 and 3 of Table 3.4-1, "Commitment Wording," use the terminology, “FRA Implementation Plan.” This terminology is inconsistent with the title of the Plan, which is “Functional Requirements Analysis and Functional Allocation Implementation Plan.” Please reconcile the discrepancy.

Response to Question 18-136:

The terminology used in Commitment 2.0 and 3.0 of Table 3.4-1 and Tier 2, Sections 18.3, 18.7 and 18.10.3 will be changed to be consistent with the title of the U.S. EPR Functional Requirements Analysis and Functional Allocation Implementation Plan.

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 and U.S. EPR FSAR Tier 2, Sections 18.3, 18.7 and 18.10.3 will be revised as described in the response and indicated on the enclosed markup.

Question 18-137:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 4 of Table 3.4-1, "Acceptance Criteria, states, "The output summary report exists and includes a description of how iterations of TA for procedure development…" However, the criteria do not include assuring that the TA was conducted in accordance with the TA IP, nor provide any indication or examples of results of the task analysis. Please reconcile these discrepancies. Also, please explain the meaning and intent of item b, "The draft operating procedure guidelines identify functions needed to complete the given series of tasks."

Response to Question 18-137:

The following will be added to the Acceptance Criteria for Commitment 4.0 of Table 3.4-1:

> "b. The output summary report includes documentation that shows the task analysis process was conducted in accordance with the U.S. EPR Task Analysis Implementation Plan. This includes the functional branch tree database which contains the results of TA as described in the U.S. EPR Task Analysis Implementation Plan. {{DAC}}"

The current Acceptance Criteria, Item b for Commitment 4.0 will be removed as it no longer applies to the TA process.

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 will be revised as described in the response and indicated on the enclosed markup.

Question 18-138:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 5 of Table 3.4-1, "Acceptance Criteria," does not indicate that the S&Q design was conducted in accordance with the S&Q analysis process used for the US EPR. Please reconcile this discrepancy. Also, please explain what is meant by the statement in the Inspections, Test, and Analyses column, "An analysis of the V&V activities driven by the initial staffing assumptions for the U.S. EPR document has been performed." How does this relate to the design commitment and the acceptance criteria?

Response to Question 18-138:

The Inspection, Tests, And Analyses for Commitment 5.0 of Table 3.4-1 will be revised as follows:

> "An analysis of the output summary report has been performed."

The following will be added to the Acceptance Criteria for Commitment 5.0 of Table 3.4-1:

> "The output summary report includes documentation that shows the staffing and qualification design process was conducted in accordance with the U.S. EPR Task Analysis Implementation Plan. {{DAC}}"

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 will be revised as described in the response and indicated on the enclosed markup.

Question 18-139:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 6 of Table 3.4-1, "Acceptance Criteria," does not indicate that the HRA will be assessed to determine that it was conducted in accordance with the accepted HRA IP. Please reconcile this discrepancy.

Response to Question 18-139:

The following will be added to Acceptance Criteria for Commitment 6.0 of Table 3.4-1:

"b. The output summary report includes documentation that shows the HRA process was conducted in accordance with the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program. {{DAC}}"

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 will be revised as described in the response and indicated on the enclosed markup.

Question 18-140:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 8 of Table 3.4-1, "Commitment Wording," states, "The selection of the minimum inventory is performed in accordance with the HSI Design Implementation Plan." The HSI IP and FSAR do not contain a process for selecting/developing the minimum inventory. They merely reference a lower-level AREVA NP document available for staff audit that contains the methodology. The "Commitment Wording" should be revised to identify the accurate source document that contains the methodology used to develop the minimum inventory and subsequently reviewed and approved by the staff. Also, the Acceptance Criteria should identify that the summary report concludes that all MCR and RSS minimum inventory HSIs described in the AREVA EPR FSAR have been incorporated into the final inventory of HSIs.

Response to Question 18-140:

The methodology for minimum inventory selection will be added to the U.S. EPR Human System Interface Design Implementation Plan. The HSI design IP will be revised to delete reference to the lower-level document for the minimum inventory methodology.

The Acceptance Criteria of Commitment 8.0 of Table 3.4-1 will be revised to add the following:

"• The minimum inventory of main control room and remote shutdown station fixed alarms, displays, and controls."

The schedule for providing the revised U.S. EPR Human System Interface Design Implementation Plan is as follows:

Document Name	Commitment Date
U.S. EPR Human System Interface Design Implementation Plan	4/23/2010

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 will be revised as described in the response and indicated on the enclosed markup.

Question 18-141:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

In Entry 9 of Table 3.4-1, "Acceptance Criteria," clarify what is meant by "support equipment." Also, the criteria should assure that the output summary report includes a description of the plant procedures derived from the AREVA EPR Severe Accident Guidelines, including the technical basis for severe accident management.

Response to Question 18-141:

The term "support equipment" refers to the resources used to verify procedures. These resources are addressed in the task analysis and V&V portions of the HFE program results summaries, therefore the term "support equipment" will be removed from the U.S. EPR FSAR Tier 1, Table 3.4-1, Commitment 9.0 and U.S. EPR FSAR Tier 2, Section 18.8.3.

The U.S. EPR uses the Operating Strategies for Severe Accidents (OSSA) reports, which are used by the COL applicant to develop their Severe Accident Management Guidelines (SAMGs). The guidelines provided are not procedures, and are not subject to the same level of verification and validation as the Emergency Operating Procedures (EOP) (see U.S. EPR FSAR Tier 2, Sections 19.2.5.2 and 19.2.5.3).

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 and U.S. EPR FSAR Tier 2, Section 18.8.3 will be revised as described in the response and indicated on the enclosed markup.

Question 18-142:

The staff has reviewed FSAR Section 3.4, Rev 1, Human Factors Engineering, and Table 3.4-1, which addresses the AREVA U.S. EPR Tier 1 ITAAC for Human Factors Engineering. As a result of the review, the staff has the following question:

Entry 10 of Table 3.4-1, “Acceptance Criteria,” also should indicate that summary report includes a description of the scope and purpose of training and that the training design was conducted in accordance with the Training Implementation Plan.

Response to Question 18-142:

The following criteria will be added to U.S. EPR FSAR Tier 1, Table 3.4-1, Commitment 10.0, Acceptance Criteria and U.S. EPR FSAR Tier 2, Section 18.9.3:

“• Description of the purpose and scope of training.

• Conclusion of the training development process conducted in accordance with the Human Factors Training Implementation Plan.”

FSAR Impact:

U.S. EPR FSAR Tier 1, Table 3.4-1 and U.S. EPR FSAR Tier 2, Section 18.9.3 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

applicable system design and follows guidelines established by the HFE and Control Room Design Team. The HFE and Control Room Design Team also participates in the design of the Emergency Operations Facility (EOF).

The scope of the HFE program includes HSI that are related to plant process monitoring and control, as well as input to procedures and training associated with monitoring and controlling instrumentation and control (I&C) systems. The I&C systems include those required during normal operating modes as well as those required during tests, inspections, surveillances, maintenance, abnormal, emergency, and accident conditions. HSI associated with non-I&C systems (e.g., manual valve operators and other LCS) follow guidelines established by the HFE and Control Room Design Team.

2.0 Design Features

1.0 HFE operating experience review (OER) is performed in accordance with the prescribed process described in the U.S. EPR Human Factors Operating Experience Review~~OER~~ Implementation Plan.

18-136

2.0 Functional requirements are performed in accordance with the prescribed process described in the Functional Requirements Analysis ~~(FRA)~~ and Functional Allocation Implementation Plan.

3.0 Functional allocation decisions are made based on a set of automation criteria which is defined and validated with the prescribed process described in the ~~FRA~~ Functional Requirements Analysis and Functional Allocation Implementation Plan.

4.0 A task analysis is performed in accordance with the prescribed process described in the U.S. EPR Task Analysis (TA) Implementation Plan.

5.0 The staffing and qualification analysis includes an evaluation of the number and qualifications of personnel needed to operate, maintain, and test the U.S. EPR based on HSI design features.

6.0 Human reliability analysis evaluates the potential for, and mechanisms of, human errors that may affect plant safety. Integration of human reliability analysis findings with HFE design is performed in accordance with the ~~Human Reliability Analysis (HRA)~~ U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program.

7.0 HSI design is performed in accordance with the prescribed process described in the ~~HSI~~ U.S. EPR Human System Interface Design Implementation Plan. .

8.0 The selection of the minimum inventory is performed in accordance with the ~~HSI~~ U.S. EPR Human System Interface Design Implementation Plan.

9.0 Procedures are developed in accordance with the Procedure Implementation Plan which directs the integration of the ~~HFE~~ U.S. EPR Human Factors procedure development. .

10.0 Training is developed in accordance with the U.S. EPR Training Implementation

Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
1.0	HFE operating experience review (OER) is performed in accordance with the prescribed process described in the U.S. EPR Human Factors Operating Experience Review ~~OER~~ Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}**	An output summary report exists and concludes that the lessons learned from the reviewed operating experience have been incorporated into the HSI design. The report addresses the scope and results of the OER process including: • A list of databases used for searching. • A list of analyzed documents. • A list of significant issues found along with their implementation status at the time of the report. **{{DAC}}**
2.0	Functional requirements are performed in accordance with the prescribed process described in the Functional Requirements Analysis and Functional Allocation ~~(FRA)~~ Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}**	An output summary report exists and includes: • A list of functions in-scope for meeting plant safety objectives. • Details of the differences between functional requirements for safety functions between predecessor designs and the U.S. EPR. • Technical justification and design basis for each difference between predecessor and U.S. EPR functional requirement. **{{DAC}}**

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Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
3.0	Functional allocation decisions are made based on a set of automation criteria which is defined and validated with the prescribed process described in the Functional Requirements Analysis and Functional Allocation ~~FRA~~ Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}** 18-136	The output summary report exists and includes: • The complete set of automation criteria used including the established control hierarchy between automatic and manual actions. • A list of the functions automated for predecessor EPRs and the differences between the predecessors and the U.S. EPR. • Technical justification for each difference in functional allocation. **{{DAC}}**
4.0	A task analysis is performed in accordance with the prescribed process described in the U.S. EPR Task Analysis (TA) Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}**	a. The output summary report exists and includes a description of how iterations of TA for procedure development, the procedures themselves, and training programs result in an HSI design that supports in-scope control, information, and support requirements. **{{DAC}}**

Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
		18-137 →	b. ~~The draft operating procedure guidelines identify functions needed to complete the given series of tasks.~~ The output summary report includes documentation that shows the task analysis process was conducted in accordance with the U.S. EPR Task Analysis Implementation Plan. This includes the functional branch tree database which contains the results of TA as described in the U.S. EPR Task Analysis Implementation Plan. **{{DAC}}**
5.0	The staffing and qualification analysis includes an evaluation of the number and qualifications of personnel needed to operate, maintain, and test the U.S. EPR based on HSI design features.	An analysis of the ~~V&V activities driven by the initial staffing assumptions for the U.S. EPR document~~ output summary report has been performed. **{{DAC}}** 18-138 →	a. The output summary report of the U.S. EPR staffing and qualifications analyses demonstrates that the HSI design supports the number, roles, and responsibilities of the plant operating staff to adequately meet the demands of the processes of the plant. **{{DAC}}** b. The output summary report includes documentation that shows the staffing and qualifications design process was conducted in accordance with the U.S. EPR Task Analysis Implementation Plan. **{{DAC}}**

Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
6.0	Human reliability analysis evaluates the potential for, and mechanisms of, human errors that may affect plant safety. Integration of human reliability analysis findings with HFE design is performed in accordance with the ~~Human Reliability Analysis (HRA)~~ U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program. ~~Implementation Plan.~~	An analysis of the output summary report has been performed. **{{DAC}}**	a. The output summary report exists and documents the list of risk-important human actions (HA) and summarizes how those HA and the associated tasks and scenarios were addressed during the various parts of the HFE design process including validation of HRA assumptions. **{{DAC}}** 18-139 b. The output summary report includes documentation that shows the HRA process was conducted in accordance with the U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) into the Human Factors Engineering (HFE) Program. **{{DAC}}**
7.0	HSI design is performed in accordance with the prescribed process described in the ~~HSI~~ U.S. EPR Human System Interface Design Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}**	The output summary report exists which: • Demonstrates that the HSI design was performed in accordance with the prescribed process. • Documents the HSI descriptions including how the design requirements and design characteristics were met. • Documents the outcome of tests and evaluations performed in support of V&V of HSI design. **{{DAC}}**

Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
8.0	The selection of the minimum inventory is performed in accordance with the ~~HSI~~ U.S. EPR Human System Interface Design Implementation Plan.	An analysis is performed on the final HSI design results documents. **{{DAC}}**	A final results summary document exists that concludes that the HSI design process for the minimum inventory was conducted in accordance with the implementation plan and contains: • The detailed HSI description including its form, function and performance requirements and characteristics. • The basis for the HSI requirements and design characteristics. • The records of the basis of the design changes. • The outcomes of tests and evaluations. 18-140 → • The minimum inventory of main control room and remote shutdown station fixed alarms, displays, and controls. **{{DAC}}**

Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
9.0	Procedures are developed in accordance with the Procedure Implementation Plan which directs the integration of the ~~HFE~~ U.S. EPR Human Factors procedure development.	An analysis of the output summary report has been performed. **{{DAC}}**	An output summary report exists which: • Addresses the final set of procedures ~~and support equipment~~ developed using the established methodology. • Includes the results of verification and validation activities as they relate to procedure development. • Describes how procedures will be maintained and updates controlled. • Gives a description of how operators access and use procedures, especially during operational events including: - Storage of procedures. - Ease of operator access to the correct procedures. **{{DAC}}**

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Table 3.4-1—Human Factors Engineering ITAAC (5 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
10.0	Training is developed in accordance with the U.S. EPR Training Implementation Plan.	An analysis of the output summary report has been performed. **{{DAC}}**	An output summary report exists and includes: • A description of the purpose and scope of training. • The training development process was conducted in accordance with the U.S. EPR Training Implementation Plan. • The roles of organizations that contributed to the training program. • How learning objectives were developed and translated into the use of associated knowledge, skills, and attributes. • The use of resources (e.g., lectures, simulators, computer-based training, schedule) for training. • Methods used to evaluate effectiveness of the program. **{{DAC}}**

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18.3 Functional Requirements Analysis and Functional Allocation

Functional requirements analysis (FRA) is the identification and analysis of functions that must be performed in accordance with NUREG-0711 (Reference 1) to satisfy plant safety objectives (i.e., to prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public).

Functional allocation (FA) is the analysis of the requirements for plant control and the assignment of control functions in accordance with References 1 and NUREG-0800 (Reference 2) for the following:

- Personnel (e.g., manual control).
- System elements (e.g., automatic control and passive, self-controlling phenomena).
- Combinations of personnel and system elements (e.g., shared control and automatic systems with manual backup).

18.3.1 Objectives and Scope

The purpose of the FRA and FA is to verify that plant safety functions have been defined and that the allocation of those functions to human and system resources has resulted in a role for personnel that takes advantage of human strengths and avoids human limitations (References 1 and 2).

All functions are considered in-scope in that they need to be captured and allocated. Particular significance is placed on functions that satisfy safety objectives (i.e., critical safety functions, as defined by NUREG-0696 (Reference 4)). Section 18.10 describes how procedure verification and validation (V&V) includes an explicit identification of functions to be performed to achieve plant safety objectives.

18.3.2 Functional Requirement Analysis Methodology and Results Summary

~~The U.S. EPR is an evolutionary PWR design based on years of operation and design experience from the precursor PWR plants (i.e., based on European N4 and Konvoi plants which are in turn based upon Westinghouse-designed PWRs currently operating in the U.S). The U.S. EPR also uses similar control of system functions and instrumentation and control (I&C) concepts as the predecessor PWRs and the Olkiluoto 3 (OL3) EPR.~~

~~Because the U.S. EPR evolved from previous PWR designs, the underlying nuclear and thermodynamic processes and most individual component functions for the U.S. EPR are inherited from the predecessor designs. During the early plant design stages for the OL3 EPR, process functions and their resulting functional requirements were derived from traditional PWR design principles established at the overall plant concept level. For screen-based human system interfaces (HSIs), functional~~

18.7 Human System Interface Design

The human system interface (HSI) design process translates function and task requirements into HSI characteristics and functions. The HSI uses a structured methodology that guides designers in identifying and selecting candidate HSI approaches, defining the detailed design, and performing HSI tests and evaluations. The HSI promotes the development and use of human factors engineering (HFE) guidelines that are tailored to the unique aspects of the design (e.g., an HSI style guide that defines design-specific conventions). The HSI also promotes standardization and consistency in applying HFE principles. The process and the rationale for the HSI design is documented and controlled under the design control process described in the AREVA Quality Assurance Program (QAP) Topical Report (Reference 1).

This section describes how HFE activities and analyses described in Sections 18.2, 18.3, 18.4, and 18.5 are performed as part of the overall HSI design process.

18.7.1 Human System Interface Design Inputs

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The HSI design is developed based on various design inputs. The HFE program element design inputs (i.e., operating experience review (OER), functional requirements analysis (FRA) and functional allocation (FA), task analysis (TA), and staffing analysis) are used by the HSI design team to make design decisions. Additionally, the HSI design team considers applicable regulatory documents and codes as well as generic HFE standards and industry guidelines.

18.7.1.1 Analysis of Personnel Task Requirements

Several analyses are performed in the early stages of the design process to identify HSI design requirements.

18.7.1.1.1 Operating Experience Review

An OER is performed as described in Section 18.2 to determine how the strengths and weaknesses of the HSI technology concept impact the effectiveness of the operator when using the technology. The goal of the OER is to compare the analysis of current work practices, operational problems and issues in current designs, and industry experience with candidate technological approaches to system and HSI technology and specific supplier solutions.

At the onset of OER activities, the first HFE task is to identify how candidate functions, tasks, and HSIs are different from predecessor designs. Plant specific and industry experience is sought from a variety of data sources, including: available operating experience databases (documentation), interviews, talkthroughs and walkthroughs with personnel, and interactions with other facilities and organizations.

18.8.2.3 Electronic Procedures

Operating procedures are implemented in a screen-based format that provides access to process information by direct links. These electronic procedures also provide access to related information and direct the operator to the appropriate control screens. Refer to Section ~~2.2.9~~6.2.9 of the U.S. EPR Human Factors Program Management Plan (Reference 1) for further details on the development of electronic procedures.

Paper-based procedures serve as backup to screen-based (i.e., electronic) procedures and contain the same guidance and format. Hard copy backups of operating procedures are provided in the main control room (MCR), remote shutdown station (RSS), and the Technical Support Center (TSC) in the event that a failure of the operating procedure computer occurs. Aside from differences in how electronic and hard copy procedures are used (i.e., the navigation and layout) as well as the availability of live data, electronic and hard copy procedures contain the same information in the same format. Adequate space is provided at appropriate workstations in the MCR and RSS for operators to display paper-based procedures, when required.

18.8.3 Results

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A results summary report addresses the final set of procedures ~~and support equipment~~ developed using the established methodology. The results summary report includes:

- The results of verification and validation (V&V) activities as they relate to procedure development.
- How procedures will be maintained and updates controlled.
- A description of how operators access and use procedures, especially during operational events including:
  - Storage of procedures.
  - Ease of operator access to the correct procedures.

18.8.4 References

1. ~~ANP-10279, Revision 0, "U.S. EPR Human Factors Engineering Program," AREVA NP Inc., January 2007.~~U.S. EPR Human Factors Procedure Implementation Plan, AREVA NP Inc., 2009.

Next File

18.9 Training Program Development

Training plant personnel is an important factor in promoting the safe and reliable operation of a nuclear power plant. A methodical analysis of job and task requirements and a Systematic Approach to Training (SAT) are used to provide plant personnel with required knowledge, skills, and attributes (KSA) to perform assigned tasks.

A COL applicant that references the U.S. EPR design certification will describe how HFE principles and criteria are incorporated into the development of training program scope, structure, and methodology.

18.9.1 Objectives and Scope

Section ~~5.4.10 of the AREVA NP Human Factors Topical Report~~ 1.5 of the U.S. EPR Human Factors Training Implementation Plan (Reference 1) describes the objectives of the training program development as they relate to the HFE program.

An implementation plan describes training program scope including:

- Categories of personnel to be trained (similar to the scope of analysis conducted for staffing, see Section 18.5.1).
- Specific plant conditions, operational activities (e.g., operations, maintenance, testing and surveillance), and HSIs which effect training scenarios and methods.

18.9.2 Methodology

Section ~~5.4.10~~3.2.1 of the U.S. EPR Human Factors Training Implementation Plan (Reference 1) provides an outline of the design process used in developing a training program for the U.S. EPR.

Specific training objectives unique to the operation of the U.S. EPR are developed to coordinate with the HSI design process and the development of procedure guidelines. These training objectives are provided to each COL applicant referencing the U.S. EPR standard design for implementation into their site-specific training program.

18.9.3 Results

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A results summary report addresses the training program development including:

- A description of the purpose and scope of training.
- How the development process was conducted in accordance with the U.S. EPR Human Factors Training Implementation Plan.
- The roles of organizations that contributed to the training program.

- Crew coordination and communication.
- Display navigation, information retrieval, and access to controls.
- Automation and the features of automation including monitoring and control.
- Layout, configuration, and anthropometrics of workplaces and workstations and the features and equipment required for those spaces (e.g., laydown areas, access and egress, radios, phones, and hard copies of procedures and drawings).
- Workplace environment (e.g., lighting, temperature, noise).
- Provisions for routine tests and maintenance.
- Effectiveness of training materials.

The techniques for HFE V&V are described in Section 18.10.3. Application of the various techniques to different aspects of the HFE design is included in the description of the technique.

18.10.3 Methodology

The first step in verification is to identify the HSI components that are subject to verification. The HSI inventory and characterization activity describes the HSI displays, controls, and related equipment within the scope of the HSI design to be verified. HSI inventory and characterization is described in Section 18.10.3.1.

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The second step in verification is the HSI task support verification (TSV) used to establish that the HSI provides the alarms, information, and control capabilities required as a result of the functional requirements analysis (FRA), functional allocation (FA), and TA activities. TSV is also used to establish that the characteristics of those alarms, information, and controls conform to the requirements developed during the TA. HSI TSV is described in Section 18.10.3.2.

HFE design verification (DV) (see Section 18.10.3.3) verifies that the characteristics of the HSI and the environment in which it is used conform to the established design-specific state-of-the-art HFE guidelines, as described in the style guide (see Section 18.7.6.1) and the industry standard practices in accordance with NUREG-0700 (Reference 1).

There are a large number of HSI components used in the U.S. EPR. Each HSI component represents at least one personnel task; therefore, a large number of events could be encountered during operation of the plant. It is neither practical nor appropriate to evaluate every scenario to confirm the adequacy and effectiveness of the HSI and establish that the performance requirements are met for each operating condition. Operational condition sampling (OCS) (see Section 18.10.3.4) is used to choose a representative set of scenarios for validation.