

ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, December 16, 2010 2:47 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); NOXON David (AREVA); PANNELL George (AREVA); Miernicki, Michael; Ford, Tanya
Subject: Response to U.S. EPR Design Certification Application RAI No. 433, FSAR Ch. 18, Supplement 3
Attachments: RAI 433 Supplement 3 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for a technically correct and complete response to RAI 433 on October 4, 2010. On October 28, 2010, and November 29, 2010 a revised schedule was provided. The attached file, "RAI 433 Supplement 3 Response US EPR DC.pdf" provides technically correct and complete responses to the 15 questions, as committed.

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan supporting RAI 433, has been revised, and the plan is submitted under a separate cover letter.

The response to RAI 421 will revise the U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan to address RAI 433 Questions 18-221 thru 18-230.

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 433 Questions 18-215, 18-222 and 18-230.

The following table indicates the respective pages in the response document, "RAI 433 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 433 — 18-215	2	2
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RAI 433 — 18-229	15	15
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This concludes the formal AREVA NP response to RAI 433, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Monday, November 29, 2010 2:13 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 433, FSAR Ch. 18, Supplement 2

Getachew,

On October 4, 2010 AREVA NP Inc. provided a schedule for technically correct and complete responses to the 15 questions. On October 28, 2010 AREVA NP provided a revised schedule. To allow additional time to interact with the NRC staff, a revised schedule is provided.

The schedule for a technically correct and complete response to these questions is changed and is provided below.

Question #	Response Date
RAI 433 — 18-215	December 16, 2010
RAI 433 — 18-216	December 16, 2010
RAI 433 — 18-217	December 16, 2010
RAI 433 — 18-218	December 16, 2010
RAI 433 — 18-219	December 16, 2010
RAI 433 — 18-220	December 16, 2010
RAI 433 — 18-221	December 16, 2010
RAI 433 — 18-222	December 16, 2010
RAI 433 — 18-223	December 16, 2010
RAI 433 — 18-225	December 16, 2010
RAI 433 — 18-226	December 16, 2010
RAI 433 — 18-227	December 16, 2010
RAI 433 — 18-228	December 16, 2010
RAI 433 — 18-229	December 16, 2010
RAI 433 — 18-230	December 16, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

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From: BRYAN Martin (External RS/NB)
Sent: Thursday, October 28, 2010 5:33 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 433, FSAR Ch. 18, Supplement 1

Getachew,

On October 4, 2010 AREVA NP Inc. provided a schedule for technically correct and complete responses to the 15 questions. To allow additional time to interact with the NRC staff, a revised schedule is provided.

The schedule for a technically correct and complete response to these questions is changed and is provided below.

Question #	Response Date
RAI 433 — 18-215	November 30, 2010
RAI 433 — 18-216	November 30, 2010
RAI 433 — 18-217	November 30, 2010
RAI 433 — 18-218	November 30, 2010
RAI 433 — 18-219	November 30, 2010
RAI 433 — 18-220	November 30, 2010
RAI 433 — 18-221	November 30, 2010
RAI 433 — 18-222	November 30, 2010
RAI 433 — 18-223	November 30, 2010
RAI 433 — 18-225	November 30, 2010
RAI 433 — 18-226	November 30, 2010
RAI 433 — 18-227	November 30, 2010
RAI 433 — 18-228	November 30, 2010
RAI 433 — 18-229	November 30, 2010
RAI 433 — 18-230	November 30, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016

From: BRYAN Martin (External RS/NB)
Sent: Monday, October 04, 2010 5:33 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
Subject: Response to U.S. EPR Design Certification Application RAI No. 433, FSAR Ch. 18

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 433 Response US EPR DC.pdf," provides the schedule for a technically correct and complete response to the questions.

The following table indicates the respective pages in the response document, "RAI 433 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 433 — 18-215	2	2
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RAI 433 — 18-220	7	7
RAI 433 — 18-221	8	8
RAI 433 — 18-222	9	9
RAI 433 — 18-223	10	10
RAI 433 — 18-225	11	11
RAI 433 — 18-226	12	12
RAI 433 — 18-227	13	13
RAI 433 — 18-228	14	14
RAI 433 — 18-229	15	15
RAI 433 — 18-230	16	16

The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 433 — 18-215	October 29, 2010
RAI 433 — 18-216	October 29, 2010
RAI 433 — 18-217	October 29, 2010
RAI 433 — 18-218	October 29, 2010
RAI 433 — 18-219	October 29, 2010
RAI 433 — 18-220	October 29, 2010
RAI 433 — 18-221	October 29, 2010
RAI 433 — 18-222	October 29, 2010
RAI 433 — 18-223	October 29, 2010
RAI 433 — 18-225	October 29, 2010
RAI 433 — 18-226	October 29, 2010
RAI 433 — 18-227	October 29, 2010
RAI 433 — 18-228	October 29, 2010
RAI 433 — 18-229	October 29, 2010

Sincerely,

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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, September 02, 2010 4:27 PM
To: ZZ-DL-A-USEPR-DL
Cc: Bongarra, James; Marble, Julie; Junge, Michael; Eudy, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 433 (4930, 4910), FSAR Ch. 18

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on August 6, 2010, and discussed with your staff on August 26, 2010. Draft RAI Question 18-224 was deleted and Draft RAI Question 18-221 was modified as a result of that discussion. 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 RAIs 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
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2374

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71086ED23C)

Subject: Response to U.S. EPR Design Certification Application RAI No. 433, FSAR Ch. 18, Supplement 3
Sent Date: 12/16/2010 2:46:38 PM
Received Date: 12/16/2010 2:46:41 PM
From: BRYAN Martin (EXTERNAL AREVA)

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MESSAGE	8617	12/16/2010 2:46:41 PM
RAI 433 Supplement 3 Response US EPR DC.pdf		87590

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Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
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Response to

Request for Additional Information No. 433(4830, 4910), Revision 1, Supplement 3

10/29/2010

U. S. EPR Standard Design Certification

AREVA NP Inc.

Docket No. 52-020

SRP Section: 18 - Human Factors Engineering

Application Section: Ch 18

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

Question 18-215:

Follow-up to RAI 374, Question 18-148

The applicant did not satisfactorily address this question in its response to RAI 374, Question 18-148, dated May, 17, 2010. The question asked the applicant to describe how, for example, all functions necessary for achieving safe operation (and power goals) are identified, how all requirements of each function are identified, etc. The question asked the applicant to explain how all the six bullets (listed under, "The FRA plan establishes methods to ...") would be accomplished. The applicant's response points to "detailed work instructions" and includes excerpts from "the Plant-level work plan."

The staff requests for the applicant to describe how, for example, all functions necessary for achieving safe operation (and power goals) are identified and how all requirements of each function are identified, etc. In addition, the applicant is requested to indicate what "Plant-level work plan" is being cited or provide a description of the methods used to accomplish the six, bulleted items in section 1.5.5.

Response to Question 18-215:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised, and the proprietary plan is submitted under a separate cover letter. Additional detail has been added to Section 3.1 of the plan to address this question. U.S. EPR FSAR Tier 2, Section 18.3.5 has been updated to reference the revised plan. Clarifying changes were made in U.S. EPR FSAR Tier 2, Section 18.3 for consistency with the revised plan.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 18.3 will be revised as described in the response and indicated on the enclosed markup.

Question 18-216:**Follow-up to RAI 374, Question 18-149**

The applicant did not satisfactorily address this question in its response to 374, Question 18-149, dated May, 17, 2010. The question asked the applicant to describe the methods used to accomplish the activities identified in sub-section 1.5.2 of the Plan. For example, how, functional allocation (FA) will use the FRA to determine the requirements for plant control; how (i.e., what methods are used) FA will allocate control functions; and how FA will be used as input for the tasks analysis and PRA/HRA.

The applicant's response provides, what appears to be, an example checklist used by systems engineers to make an initial function allocation determination. Because the applicant, in its FRA/FA IP, states that the FA establishes "methods" to accomplish the four bullets listed under IP section 1.5.2, it is unclear if the example checklist is the only method used to accomplish the bulleted list or if there are others as well. The staff requests for the applicant to provide an additional explanation to resolve this discrepancy.

In addition, the applicant's response states that the implementation plan provides a "general approach" for integrating FRA/FA into the HFE design and that, "specific information concerning methodology [emphasis added] and personnel are found in the FRA/FA work plans." In order to satisfy regulatory criteria (i.e., NUREG-0711), the applicant should describe the methodology for accomplishing the FRA/FA in the FSAR or in the associated implementation plans (an implementation plan, by definition, is a methodology). Further, the applicant's current FRA/FA IP does not cite FRA/FA work plans nor include them in the reference section of the IP. The staff requests for the applicant to specify if there are additional guidance sources that the applicant expects to use in conducting the FRA/FA, then these sources should be cited and/referenced in the FSAR/IP.

Further, the staff requests for the applicant to clarify how Functional Allocation accomplishes the four bullets listed under IP section 1.5.2. and also include any additional guidance sources in the FSAR or IP, cited in the text or in the references.

Response to Question 18-216:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised as described in the response to Question 18-215. Additional detail on the methodology has been added to Section 3.3 of the plan to address the above question.

FSAR Impact:

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

Question 18-217:

Follow-up to RAI 374, Question 18-150

The applicant did not satisfactorily address this question. In response to RAI 374, Question 18-150, dated May, 17, 2010, the applicant stated that, "The objectives for the FRA/FA implementation plan are changed to state: "The HFE design process is illustrated by Figure 1-1: HFE Process Integration. The figure illustrates the FRA/FA process within the framework of the overall HFE integration process. Outputs are used in task analysis and other HFE defined processes."

Figure 1-1 continues to illustrate that the FRA/FA only provides output to task analysis, i.e., there are no vectors from FRA/FA to any other "HFE process" illustrated in the figure. The staff requests for the applicant to reconcile this discrepancy accordingly.

Response to Question 18-217:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised as described in the response to Question 18-215. Additional detail has been added to Section 4.4 of the plan to describe the inputs and outputs to address the above question.

FSAR Impact:

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

Question 18-218:**Follow-up to RAI 374, Question 18-151**

In response to RAI, 374, Question 18-151, dated May, 17, 2010, the applicant indicated that, "The requirements management tool presents the functional requirements through a mapping function allowing visual observation of the relationships between objectives and functions. Section 1.6 of the FRA/FA Plan is revised to incorporate the standard NUREG-0711 definition for mapping functions."

- a. The applicant's response proposes to change section 1.6 of the IP "to incorporate the NUREG-711 definition of mapping functions". Since NUREG-0711 does not contain a definition for mapping functions, the staff requests for the applicant to provide an explanation of this proposed change to IP section 1.6.
- b. The applicant has indicated in its response that the FSAR will not be changed. The staff notes that the latest FSAR, Rev 2 (interim submission), uses the term "mapping" in two places, i.e., pages 18.3-4 and 18.3-5. When AREVA revises the FRA/FA IP to incorporate the "NUREG-0711 definition (i.e., the definition that AREVA provides in response to the first part of this supplemental question) the staff cautions the applicant to make certain that the meaning of the term "mapping" as currently on used on pages 18.3-4, 18.3-5 agrees with the definition AREVA proposes for use in the IP. Provide the requested information and address the potential discrepancy.
- c. In its response, the applicant introduced the term, "requirements management tool." With respect to an association with FRA/FA, the staff is not familiar with this term. The staff requests for the applicant to please identify where this term is explained in previously submitted documentation or provide an explanation for the term accordingly.

Response to Question 18-218:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised as described in the response to Question 18-215. Section 3.1.4 of the plan has been clarified and "mapping" has been changed to "logically linked." Section 1.6 of the plan has been revised to define "requirements management tool."

FSAR Impact:

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

Question 18-219:

Follow-up to RAI 374, Question 18-156

The staff reviewed the applicant's response to RAI letter 374, question 18-156, dated May 17, 2010, and determined that the response was inadequate. AREVA's response to 18-156 was, "See response to Question 18-148. The staff determined that AREVA's response to Question 18-148 was inadequate. Also, AREVA's response to question 18-148 does not address how the requirements for each high-level function are identified or how functional requirements analysis will be verified, i.e., that all the high-level functions necessary for the achievement of safe operation are identified and that all requirements of each high-level function are identified.

The staff requests for the applicant to explain how the requirements for each high-level function are identified or how functional requirements analysis will be verified, i.e., that all the high-level functions necessary for the achievement of safe operation are identified and that all requirements of each high-level function are identified.

Response to Question 18-219:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised as described in the response to Question 18-215. Additional detail has been added to Section 4.1 of the plan to address the above question.

FSAR Impact:

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

Question 18-220:**Follow-up to RAI 374, Question 18-160**

In response to RAI 374, Question 18-160, dated May, 17, 2010, the applicant indicated that the EPR Plant-level FRA Work Plan explains how the plant-level and system-level FRAs are performed concurrently. AREVA's response continues by stating that the gap analysis is a reconciliation process for the end point of the plant-level function process and the start of the system-level function process. The response also provides a figure to graphically depict the gap analysis process and a procedure for doing the analysis

The staff finds that the applicant's response does not explain how the plant-level and system-level FRAs are performed, concurrently. The procedure included in the applicant's response indicates that, system process functions are derived from [emphasis added] the Plant-level FRA (PFRA). Subsequently, the applicant compares the system process functions to plant-level functions to establish appropriate relationships between the two. The process described appears to occur serially and it does not seem possible for it to occur concurrently. For example, it is unclear how can system-level functions be identified concurrently with identifying higher-level plant-level functions on which the system-level functions are dependent upon. The staff requests for the applicant to provide a description for how the two FRAs are performed, concurrently.

Response to Question 18-220:

The AREVA NP U.S. EPR Functional Requirements Analysis and Function Allocation Implementation Plan has been revised as described in the response to Question 18-215. Additional detail has been added to Section 3.0 of the plan to explain how the plant and system level FRAs are performed concurrently.

FSAR Impact:

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

Question 18-221:

On November 17, 2009, the staff issued RAI 328, Question 18-67 which focused on scenario assignment and crew/participant training and selection. With respect to the applicant's proprietary response to this RAI on March 4, 2010, the staff requests that the first 3 full paragraphs (not the bulleted information) on page 88 be incorporated by the applicant into the V&V IP.

Response to Question 18-221:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-222:

NUREG-0711 11.4.2.1 states:

- (3) Information Sources—The inventory should be based on the best available information sources. Equipment lists, design specifications, and drawings describe HSI components. 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 applicant's FSAR section 18.10.3.1 states that the HSI inventory will be created by 'filtering certain portions of the I&C input/output database.

The staff requests for the applicant to clarify what is meant by 'filtering' a database. This FSAR section also states that accuracy of the HSI inventory will be confirmed by comparing the HSI design specifications to predecessor designs. Please specify why the predecessor design is a best source of information regarding the HSIs in the current design given that there may be design differences between the two. In addition, the staff notes that within the applicant's response to RAI LETTER 240 indicates that the predecessor plant information is no longer the basis for the EPR design (i.e., removed from Section 18.1.5.1 of the FSAR interim markup). Therefore, the staff also requests for the applicant to clarify which predecessor plant information will be used for this comparison. In addition, please update the FSAR accordingly.

Response to Question 18-222:

Note that U.S. EPR FSAR Section 18.10.3.1 has been renumbered to 18.10.3.2 due to other changes.

Information from the design of previous EPRs is not used as a source of information or for comparison. Design documents are used as a source for V&V inventory and characterization. The U.S. EPR FSAR Tier 2, Section 18.10.3.2 will be revised as follows:

“The HSI inventory and characterization activity describes HSI components and related equipment associated with personnel tasks that are within the scope of the HSI design to be verified. The complete inventory is created from the HSI task support requirements determined during task analysis. The accuracy of the inventory is confirmed by comparing it to sources such as system description documents, design specifications, equipments lists, and process and instrumentation drawings. The inventory includes aspects of the HSI that are used for interface management such as navigation and display retrieval in addition to those that control the plant.”

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 18.10.3.2 will be revised as described in the response and indicated on the enclosed markup.

Question 18-223:

NUREG-0711 11.4.2.2.2 states:

- (1) **Criteria Identification**—The criteria for Task Support Verification which come from task analyses of HSI requirements for performance of personnel tasks that are selected from operational conditions should be defined.

The criteria for Task Support Verification are the HSI requirements identified by task analysis. The staff notes that section 18.10.3.2 of the FSAR discusses HSI Task Support Verification (TSV). This section of the FSAR states that a dynamic TSV is performed when the HSI and simulator designs have evolved to the point that the simulator represents the complete HSI inventory. The staff requests for the applicant to clarify what a 'dynamic' TSV is. In addition, please clarify if there is also a 'static' TSV and define it accordingly. The staff also notes that section 18.10.3.2 of the FSAR states that the HRA results are an input to the TSV. Please specify what aspects of the HRA results will be used in TSV.

Response to Question 18-223:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-225:

Section 4.2.3.5 of the V&V IP states that HSIs 'may' be evaluated with checklists based on the HSI style guide or NUREG-0700. The staff requests for the applicant to specify which methods will be used to evaluate the HSIs.

Response to Question 18-225:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-226:

NUREG-0711 11.4.3.2.5.2 states:

- (2) Plant Performance Measurement—Plant performance measures representing functions, systems, components, and HSI use should be obtained.

Section 3.6.4.7 of the V&V IP R.2 indicates that simulator logs and a chronometer will be used to collect system performance measures, and then compared to recommendations from guidelines. It further states that this level of evaluation will be deferred until the simulator is installed at the plant site. The staff requests for the applicant to clarify the intent of these statements. In addition, specify if validation of plant measures will be deferred until the ISV simulator is installed at the plant site. Section 3.6.4.2 states that identification of operator error and error rates will not be performed during simulator evaluation. The staff notes that at other points in the V&V IP Rev. 2, error rates and types are indicated as performance measures. The staff requests for the applicant to specify how and when error rates and identification of errors will be performed.

Response to Question 18-226:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-227:

NUREG-0711 section 11.4.3.2.5.2 states:

- (1) A hierarchal set of performance measures should be used which includes measures of the performance of the plant and personnel (i.e., personnel tasks, situation awareness, cognitive workload, and anthropometric/physiological factors). Some of these measures could be used as "pass/fail" criteria for validation and the others to better understand personnel performance and to facilitate the analysis of performance errors. The applicant should identify which are in each category.

Section 4.3.2.2 of the V&V IP R.2 states that an acceptance criterion is that 'required actions' are completed within the required time. The staff requests for the applicant to specify how 'required actions' are defined. In addition, specify if 'required actions' include risk-important human actions.

Response to Question 18-227:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-228:

NUREG-0711 11.4.3.2.5.3 states:

- (1) Criteria should be established for the performance measures used in the evaluations. The specific criteria that are used for decisions as to whether the design is validated or not should be specified and distinguished from those being used to better understand the results.

Section 4.6 of the V&V IP discusses the acceptance criteria for the Plant level measures. These are defined primarily in terms of operator response times. The staff requests for the applicant to clarify that the response of the plant will also be examined.

Response to Question 18-228:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-229:

NUREG-0711 11.4.3.6.2.5 states:

- (1) If possible, participants who will operate the integrated system in the validation tests should not be used in the pilot study. If the pilot study must be conducted using the validation test participants, then:
 - the scenarios used for the pilot study should be different from those used in the validation tests, and
 - care should be given to provide reasonable assurance that the participants do not become so familiar with the data collection process that it may result in response bias.

Section 4.5.1.3 of the V&V IP R.2 states that personnel used during the pilot testing are not to the same personnel as used in the integrated validation tests. The staff notes that this section goes on to state that if a pilot test participant is used in integrated validation tests that certain steps will be taken. The staff requests for the applicant to clarify if participants, used in the pilot testing, will be allowed to participant in the integrated validation tests.

Response to Question 18-229:

A revision to the AREVA NP U.S. EPR Human Factors Verification and Validation (V&V) Implementation Plan will be included in the response to RAI Batch 421 and will address this question.

FSAR Impact:

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

Question 18-230:

NUREG-0711 11.4.2.3.2 states:

- (1) **Criteria Identification**—The criteria for this verification are the HFE guidelines. The selection of guidelines used in the review depends upon the characteristics of the HSI components included in the scope of the review, as defined in the HSI characterization. It also depends upon whether the applicant has developed a style guide (design-specific HFE guideline document). When a style guide is used by the applicant, its acceptability should be reviewed by the staff. The procedures involved are described in (NUREG-0711) Section 8.4.5. The HFE guidelines contained in NUREG-0700 may be used to support the staff's review of the guidance contained in an applicant's style guide. When an NRC reviewed style guide has been used, it can provide the criteria for HFE design verification.

When no style guide is available, the guidelines in NUREG-0700 can be used for the HFE design verification. However, since not all of these guidelines will be applicable to each review, the selection of guidelines should be based on the characteristics of the HSI components being evaluated. A subset of guidelines appropriate to the specific design implementation should be identified based on the HSI characterization.

In FSAR Section 18.10.3.3, the applicant states that design requirements are derived from a style guide and NUREG-6393, "Integrated System Validation: Methodology and Review Criteria." The staff requests for the applicant to specify how NUREG-6393 will be applied to determine design requirements.

Response to Question 18-230:

Note that U.S. EPR FSAR Section 18.10.3.3 has been renumbered to 18.10.3.4 due to other changes.

NUREG-6393 "Integrated System Validation: Methodology and Review Criteria" was referenced inadvertently in U.S. EPR FSAR, Section 18.10.3.4. NUREG-6393 does not provide design requirements and therefore the reference to NUREG-6393 in U.S. EPR FSAR Tier 2, Section 18.10.3.4 will be removed.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 18.10.3.4 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

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 this implementation plan is to establish methods, criteria and guidance for functional requirements analysis (FRA) and function allocation (FA) for the U.S. EPR plant design. The FRA identifies those functions that must be performed to satisfy plant safety and power generation objectives. This plan also describes how those defined functions are allocated among systems and trains, to automatic, group-level, and component-level control to meet regulatory requirements. The plan also uses FA to ~~avoid exceeding~~ capitalize on human abilities and promote situational awareness. (References 1 and 2).

RAI 433, Q 18-215



RAI 433, Q 18-215



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

FRA is divided into plant functions and system functions as described in the FRA/FA implementation plan (Reference 3). The plant-level FRA (PFRA) starts with plant-level safety (and power generation goals), continues to safety functions (and power generating functions), and ends with defined system functions. The system-level FRA (SFRA) begins with system functions, continues to train/subsystem functions and ends with component functions and support requirements. Both PFRA and SFRA consider system interdependence, interaction, diversity, and defense-in-depth. The plant-level and system-level FRA can be performed concurrently.

- Evaluation of all mode dependencies.

Plant function documentation is reviewed through the completion of the functional analysis, which includes operating modes as documented in Chapter 16. PRA and HRA analysis combined with OE documentation is used in various steps of the process. Updates and additions to the FRA are implemented during task analysis through the same process.

RAI 433, Q 18-215



The FRA report ~~included with the U.S. EPR V&V documentation~~ lists the functions that were considered in-scope for meeting plant safety objectives. The FRA report also includes details of the differences between functional requirements for the predecessor EPRs and the U.S. EPR for the ‘safety functions’, as well as the technical justification and design basis for each difference.

18.3.3 Functional Allocation Methodology and Results Summary

In the U.S. EPR design process, control of plant process functions is assigned and allocated to humans, automation, or a combination of human and automation using a set of automation criteria. U.S. EPR plant process functions and certain control functions are allocated to closed-loop automatic control based on these automation criteria. Generally, functions automated in predecessor PWRs and in the OL3 EPR design are automated in the U.S. EPR design. Functions that are not automated are assigned to operators, either in the MCR or at LCSs. Any changes in automation are weighed against the total responsibilities of the operator to monitor automatic functions and to assume manual control during an automation system failure.

In addition to tabularizing system and component functions, each applicable system description document lists the type of control to which that function is allocated and the design basis for the allocation. A description of the personnel role with respect to functions and interfacing with automation is provided in the HFE Program Management Plan (Reference 5) concept of operations (see Section 18.7.2).

A specific objective of the V&V is to validate that the automation design decisions have resulted in an interface that permits accomplishment of the safety functions within human capabilities and identifies as human engineering discrepancies (HEDs) any ineffective function allocation observed. This V&V approach verifies that the FA uses human strengths and avoids human limitations (Reference 2).

The FA report includes ~~esd in the V&V documentation:~~ ← RAI 433, Q 18-215

- List of allocated functions for U.S. EPR
- List of differences and similarities between predecessor EPR and the U.S. EPR.
- Explains the technical justification for each difference in functional automation.

18.3.4 Changes to Functional Analysis or Allocation

As the U.S. EPR design evolves, functions may be re-allocated in an iterative manner in response to developing design specifics, operating experience, and the outcome of analyses and industry research. As described in Section 18.12, changes and modifications to the initial HSI configuration are required to be evaluated for impact to FRA or FA design documentation. The complete set of automation criteria and other design documentation previously described are considered as part of any proposed change or modification. See Reference 3.

18.3.5 References

1. NUREG-0711, "Human Factors Engineering Program Review Model," Revision 2, U.S. Nuclear Regulatory Commission, 2004.
2. NUREG-0800, Chapter 18, "Human Factors Engineering," Revision 2, U.S. Nuclear Regulatory Commission, 2004.
3. U.S. EPR Functional Requirements and Functional Allocation Implementation Plan, AREVA NP Inc., 20092010. ← RAI 433, Q 18-215
4. NUREG-0696, "Functional Criteria for Emergency Response Facilities," U.S. Nuclear Regulatory Commission, 1981.
5. U.S. EPR HFE Program Management Plan, AREVA NP Inc., 20092010.

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RAI 433, Q 18-215

- ISV that is familiar and well-structured scenarios (i.e., textbook design basis accidents).

18.10.3.2 HSI Inventory and Characterization

RAI 433 Q 18-222

The HSI inventory and characterization activity describes HSI components and related equipment associated with personnel tasks that are within the scope of the HSI design to be verified. The complete inventory is created from the HSI task support requirements determined during task analysis. ~~by filtering certain portions of the instrumentation and controls (I&C) input/output (I/O) database which receives information from~~ The accuracy of the inventory is confirmed by comparing it to sources such as system description documents, design specifications, equipments lists, and process and instrumentation drawings. ~~The accuracy of the inventory is confirmed by comparing it with similar data from predecessor designs and HSI elements described in the design specifications for the HSIs.~~ The inventory includes aspects of the HSI that are used for interface management such as navigation and display retrieval in addition to those that control the plant.

The inventory provides an accurate and complete description of the HSI components and includes the following information:

- A unique component identification code, which includes the associated plant system and subsystem.
- Associated personnel function/subfunction.
- The type of component.
- Component characteristics such as:
 - Display functionality.
 - Control functionality.
 - User-system interactions and dialog types.
 - Location within the display screen hierarchy.
 - Physical location.
 - Associated operator response time for critical human tasks.

The HSI inventory identifies aspects needed to verify that the interface meets its requirements. The focus is on characterizing the HSI and not the technical features of the devices that comprise the HSI. Photographs or copies of ~~HSI process information and control system (PICS) and safety information and control system (SICS)~~ screens and samples of ~~SICS~~ hardwired components are included in the inventory.

18.10.3.4 Design Verification

RAI 433, Q 18-230

The HFE DV evaluates the final design against the design requirements and the design specifications. ~~Design requirements are derived from the style guide (see Section 18.7.6.1) and NUREG-6393 (Reference 2).~~ HFE guidelines in the style guide cover the following aspects of HSI design.

- Global features – room layout panel configuration (e.g., anthropometrics, and ergonomics), work environment (e.g., lighting, space, air conditions, and sound levels) and inter-personnel communication that support users of HSI (e.g., equipment functionality, and ease of use).
- Standardization features – HSI characteristics and conventions (e.g., coding conventions, display formatting, navigation, and alarm hierarchy) are those features that are designed using HFE guidelines applied across individual control and display elements. For example, the display labeling is standardized based on the style guide.
- Detailed features – HSI features not addressed by general HFE guidelines.

The design verifiers define the criteria for the verification and capture them in a checklist of the relevant style guide requirements. Final design documentation such as panel drawings or mockups and screen shots are also used. The designers justify and document instances where the design deviates from the specifications or established practices. HSI design specifications capture performance requirements, and those requirements define the performance measures for the DV.

The DV consists of comparing the characteristics of the HSI components with the design requirements. An HED is generated when an HSI component does not conform to the operational requirements as defined in the ~~validated procedure guidelines (i.e., derived in TA)~~, HFE design specifications, or the style guide.

HEDs are also identified for:

- Failure to meet crew-identified functionality in addition to that specified by system designers.
- Poor integration with the rest of the HSI.
- Poor integration with procedures and training.
- Failure to meet guidance in the HSI style guide and the HSI Design Implementation Plan (Reference 3).

HEDs are documented and evaluated to determine the extent of the condition. For example, if the elements of a particular display ~~screen~~ are not in compliance with the required color coding scheme, other similar displays ~~screens~~ are evaluated to establish that there are no generic implications. HEDs identified during DV do not always