ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Tuesday, April 09, 2013 4:41 PM
To: Snyder, Amy
Cc: Ford, Tanya; DELANO Karen (AREVA); LEIGHLITER John (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); WILLS Tiffany (AREVA); HONMA George (EXTERNAL AREVA); NOXON David (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 336, FSAR Ch. 18, Supplement 2
Attachments: RAI 336 Supplement 2 Response US EPR DC.pdf

Amy,

AREVA NP Inc. provided a response to the 19 questions associated with RAI 336 on March 4, 2010. Supplement 1 was sent on March 18, 2010 to provide the U.S. EPR Human Factors Procedure Implementation Plan.

The attached file, "RAI 336 Supplement 2 Response US EPR DC.pdf," provides a technically correct and complete revised final response to Question 18-084 to provide clarification on the use of computer and paper-based procedures. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the revised final response to RAI 336 Question 18-84.

The following table indicates the respective pages in the response document, "RAI 336 Supplement 2 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 336 — 18-84	2	3

This concludes the formal AREVA NP response to RAI 336, and there are no questions from this RAI for which AREVA NP has not provided responses.

The following implementation plans will also be revised to reflect the changes in the use of computer and paper-based procedures.

- U.S. EPR HFE Program Management Plan.
- U.S. EPR Human System Interface Design Implementation Plan.

The revised proprietary implementation plans will be sent under a separate cover letter.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: BRYAN Martin (EXT)
Sent: Thursday, March 18, 2010 5:25 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC);

PANNELL George L (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 336, FSAR Ch. 18, Supplement 1

Getachew,

AREVA NP Inc. provided responses tothe 19 questions of RAI No. 336 on March 4, 2010. This submittal fulfills the commitment made in the response to RAI No. 336, Question 18-79, 18-82, 18-83, 18-85, 18-87 and RAI No. 328 Supplement 3, Question 18-56.

The proprietary and non-proprietary versions of "U.S. EPR™ HUMAN FACTORS PROCEDURE IMPLEMENTATION PLAN, 118-9104936-001" are submitted via AREVA NP Inc. letter, "Submittal of Human Factors Procedures Implementation Plan, U.S. EPR Design Certification Application RAI No. 336, Supplement 1," NRC 10:020, dated March 18, 2010. An affidavit to support withholding of information from public disclosure, per 10CFR2.390(b), is provided as an enclosure to that letter.

Sincerely,

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan@areva.com

From: BRYAN Martin (EXT)
Sent: Thursday, March 04, 2010 7:49 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); PANNELL George L (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 336, FSAR Ch. 18

Getachew,

The proprietary and non-proprietary versions of the response to RAI No. 336 are submitted via AREVA NP Inc. letter, “Response to U.S. EPR Design Certification Application RAI No. 336,“ NRC 10:014, dated March 4, 2010. The enclosure to that letter provides technically correct and complete responses to 19 of the 19 questions of RAI No. 336. An affidavit to support withholding of information from public disclosure, per 10CFR2.390(b), is provided as an enclosure to that letter.

The following table indicates the respective page(s) in the response document that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 336 — 18-71	2	6
RAI 336 — 18-72	7	9
RAI 336 — 18-73	10	16
RAI 336 — 18-74	17	17
RAI 336 — 18-75	18	28
RAI 336 — 18-76	29	30

RAI 336 — 18-77	31	31
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RAI 336 — 18-79	34	34
RAI 336 — 18-80	35	36
RAI 336 — 18-81	37	37
RAI 336 — 18-82	38	39
RAI 336 — 18-83	40	40
RAI 336 — 18-84	41	42
RAI 336 — 18-85	43	43
RAI 336 — 18-86	44	44
RAI 336 — 18-87	45	45
RAI 336 — 18-88	46	46
RAI 336 — 18-89	47	47

This concludes the formal AREVA NP response to RAI 336, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, February 02, 2010 11:12 AM
To: ZZ-DL-A-USEPR-DL
Cc: Keefe, Molly; Walker, Jacqwan; Marble, Julie; Junge, Michael; Steckel, James; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 336 (4016, 4043), FSAR Ch. 18

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on December 5, 2009, and discussed with your staff on January 14, 2010. No changes were made to the draft RAI 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: 4383

Mail Envelope Properties (554210743EFE354B8D5741BEB695E6561128AF)

Subject: Response to U.S. EPR Design Certification Application RAI No. 336, FSAR Ch. 18, Supplement 2
Sent Date: 4/9/2013 4:41:05 PM
Received Date: 4/9/2013 4:41:11 PM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

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Files	**Size**	**Date & Time**
MESSAGE	5897	4/9/2013 4:41:11 PM
RAI 336 Supplement 2 Response US EPR DC.pdf	182422	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 336, Supplement 2

02/02/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 18 - Human Factors Engineering
Application Sections 18.5 and 18.8

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

Question 18-84:

Describe how the transition from electronic to paper procedures will be conducted.

Will an analysis for the loss of the electronic procedures be conducted? If so, describe the strategy/process.

Response to Question 18-84:

This response supersedes the previous response submitted to RAI 336, Question 18-84 sent on March 4, 2010.

Failures of the Process Information and Control System (PICS) computer-based procedures (CBP) system are analyzed as a part of task analysis (TA). Specific control room related activities to be analyzed in the TA, include the following:

- The transition from PICS to the Safety Information and Control System (SICS).
- The transfer from computer-based to paper-based procedures.

Validation that integrated system performance is tolerant of individual human system interface (HSI) feature failures (including the CBP system) is conducted as a part of integrated system validation (ISV) during human factors engineering (HFE) verification and validation (V&V) as described in the U.S. EPR V&V Implementation Plan.

The CBP system is integral to the PICS. There is no postulated independent failure mode for the CBP system leaving the PICS system operable. A loss of CBP is therefore, by definition, a loss of PICS and operations will need to transition from PICS to SICS. SICS operations are conducted using hard copy paper-based procedures (PBPs) that are readily available in the control rooms. These PBPs are provided for those operations that can be conducted from the SICS including:

- Continuing normal operations for a short period of time until the PICS is recovered or it is determined that the plant must be shut down.
- Conducting a shutdown of the plant using available equipment to either hot standby, or cooling down to hot or cold shutdown conditions.
- Conducting any abnormal or emergency operations required by plant conditions.

Due to differences in the inventory of systems, controls, and indicators available on the SICS from those on the PICS, details of these PBPs will differ from the corresponding CBP used on PICS. The operational approach as well as the format, terminology, and syntax of the PBPs shall be as consistent to the corresponding CBPs as possible.

U.S. EPR FSAR Tier 2, Section 18.7.4.6, Computer-Based Procedures will be revised to describe the use of computer and paper based procedures as described above.

The following implementation plans will also be revised to reflect the changes in the use of computer and paper based procedures.

- U.S. EPR HFE Program Management Plan.

- U.S. EPR Human System Interface Design Implementation Plan.

The revised proprietary implementation plans will be sent under a separate cover letter.

U.S. EPR FSAR Tier 2, Chapter 18 and Table 1.6-1 references will be revised to reflect the revised technical reports.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 1.6-1 will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR FSAR Tier 2, Sections 18.1, 18.2, 18.3, 18.5, 18.6, 18.7, 18.10, 18.11, and 18.12 will be revised as described in the response and indicated in the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.6-1—Reports Referenced
Sheet 3 of 5

Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
[*ANP-10309P ANP-10309NP Revision 4*	*U.S. EPR Protection System Technical Report*]*	5/12	4.6, 7.1, 7.2, and 7.3
[*ANP-10310P Revision 1*	*Methodology for 100% Combinatorial Testing of the U.S. EPR Priority Module Technical Report*]*	3/11	7.1
ANP-10314	The Operating Strategies for Severe Accidents Methodology for the U.S. EPR Technical Report	7/10	19.2
[*ANP-10315P Revision 1*	*U.S. EPR Protection System Surveillance Testing and Teleperm XS Self-Monitoring Technical Report*]*	6/11	7.1,7.3
ANP-10317	Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures	5/11	19.2.7.4
ANP-10318P	Pipe Rupture External Loading Effects on U.S. EPR Essential Structures, Systems, and Components Technical Report	3/11	3.6.2
ANP-10322P	Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner	6/12	6.2.5
[ANP-10324P	*U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program]**	1/13	18.6
[ANP-10327P	*U.S. EPR HFE Program Management Plan]**	4/13	18
[ANP-10328P	*U.S. EPR Human System Interface Design Implementation Plan]**	4/13	18
BAW-10132-A	Analytical Methods Description – Reactor Coolant System Hydrodynamic Loadings During a Loss-of-Coolant Accident	7/20/79	App. 3C
BAW-10133P-A BAW-10133-A Revision 1, Addendum 1 and 2	Mark-C Fuel Assembly LOCA-Seismic Analysis	10/30/00	4.2

The detailed design phase involves performing design support and configuration measures. Support measures such as calculations, selection and suitability reviews, and design reviews (as described in Section 4.5.1 of the U.S. EPR HFE Program Management Plan (Reference 2)) are used to validate the design and maintain or manage the design configuration. HFE design evaluation activities are conducted throughout basic and detailed design. Verification and validation (V&V) activities are performed after the iterative design/evaluation process in order to develop a design that meets requirements.

The construction and operation phase involves acceptance testing before and after installation, verifying configuration management for design documentation (see Section 18.11), and monitoring system and operator performance throughout the life of the plant (see Section 18.12).

18.1.5.2 Relationship Between HFE and Other Engineering Disciplines

Reference 3 requires that the HFE and Control Room Design Team follow the same design processes as other engineering disciplines. Section 4.0 of the U.S. EPR HFE Program Management Plan (Reference 2) describes the relationship between HFE program design documentation and general design documentation.

18.1.5.3 HFE Program Element Documentation

The U.S. EPR HFE program is described in Section 18.1. Section 2.0 of the U.S. EPR HFE Program Management Plan (Reference 2) describes the general HFE requirements, standards, and specifications utilized in the design of the U.S. EPR. Section 18.10 of this FSAR and Section 6.3 of the U.S. EPR HFE Program Management Plan (Reference 2) describe the uses of HFE facilities such as mockups and simulators as well as methods and tools employed for the various testing and validation techniques.

Sections 18.2 through 18.12 provide information on the types of documents generated as part of the U.S. EPR HFE program.

18.1.6 References

1. [*NUREG-0711, "Human Factors Engineering Program Review Model," Revision 2, U.S. Nuclear Regulatory Commission, 2004.*]*

2. *ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*]* ~~U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2010.~~

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

The multi-disciplinary composition, qualifications and experience level of the HFE and Control Room Design Team provides reasonable assurance that operating experience and the results of research relevant to safety are identified, reviewed and analyzed and that the lessons learned are incorporated into the HSI design.

18.2.3 Evaluation of Results

After an OER issue has been entered into the appropriate tracking database, it is evaluated by a cognizant human factors engineer for applicability. The evaluation includes determining if any lessons learned from the issue have already been incorporated into the design.

Upon completion of the evaluation, the human factors engineer updates the tracking database with appropriate information. Each issue that results in a design change will follow the design change process described in Section 4.5.1 of the Human Factors Engineering Program Management Plan (Reference 2). When the issue has been incorporated into the design, it is closed out in the tracking database. The resolution will remain available for engineers to view.

OER results are a summary of the data captured and analyzed in the tracking database and the source materials that were evaluated using the methodology described in the implementation plan. The results summary also includes information on how selected issues were captured, maintained, evaluated, and incorporated in the final design.

18.2.4 References

1. [*U.S. EPR Human Factors Operating Experience Review Implementation Plan, AREVA NP Inc., 2010.*]*

2. *ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*]~~U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2010.~~

Next File

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., 2010.*]*

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., 2010.~~ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.]**

Next File

- Functional allocation (FA) decisions, Section 18.3, are evaluated to achieve maximized performance without placing excessive demands upon the operators, and to determine the monitoring tasks required of operators when functions are automated.

- Task analysis (TA), Section 18.4, provides input to the MCR staffing levels by including workload analysis as part of the overall TA process. The objective is to verify that the control room HSI adequately supports operator performance. Workload analysis must carefully consider assumed roles and responsibilities and qualification requirements of operators.

- Human reliability analyses (HRA), Section 18.6, provides input to the consideration of staffing levels on plant safety and reliability. In particular, risk-significant or time critical human actions (HA) are examined during the TA to determine the need for reassignment, changes to operator roles, or the need to change the number of operators required.

- The role of the operator is an important consideration in the HSI design process. Section 18.7 addresses the engineering process of optimizing coordinated operator actions, the demand on operators during the use of control elements and display elements concurrently, and the design of effective support.

18.5.2 Staffing and Qualifications Analysis Methodology

To obtain an optimum staffing level, the initial staffing assumption (Reference 1) is iterated as a result of task analysis. Initially, tasks are assigned to crew members based on operating experience and on established roles and responsibilities as noted in Reference 1. The process then builds on these assumptions. Changes in team roles and responsibilities result from the adjustments to individual crew member responsibilities. Finally, individual team member qualification requirements evolve with changes in team and individual roles.

18.5.3 Results

The staffing and qualification analysis is summarized within task analysis (Reference 2) and includes an evaluation of the number and qualifications of personnel needed to operate and test the U.S. EPR based on the HSI design features for normal, abnormal, and emergency conditions.

18.5.4 References

1. [~~*U.S EPR HFE Program Management Plan, AREVA NP Inc., 2010.*~~*ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*

2. *U.S. EPR Task Analysis Implementation Plan, AREVA NP Inc., 2011.*]*

Next File

18.6.4 References

1. [~~*U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program, AREVA NP Inc., 2012.*~~*ANP-10324P, Revision 0, U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program, AREVA NP Inc., January 2013.*]*

2. NUREG-0711, "Human Factors Engineering Program Review Model," Revision 2, U.S, Nuclear Regulatory Commission, February 2004.

Next File

functions, and responsibilities of the integrated operating team and are designed so that operators, technicians, and maintenance staff function as an integrated team.

18.7.2.3 Personnel Supervision of Plant Automation

In the event of incidents or accidents, functions are automated when analysis shows that immediate action is required sooner than the human response time. Operator action is not required for the first 30 minutes following a design basis event. The operator monitors the automatic operation of the control systems, intervening only in the event of malfunctions of the automatic control system during the initial stages, or to optimize plant parameters or configuration. When the situation is stabilized, the operator function then shifts back to active control. When feasible during abnormal or emergency situations, when conditions are stabilized or under control, the SM, CRS, and RO physically reviews the appropriate procedure(s) to make sure that all steps were accurately performed.

The role of plant automation and how operators interact with it is described in the concept of operations. The U.S. EPR Human System Interface Design Implementation Plan (Reference 1) specifies how the automation criteria and the role of operators as supervisors of automation are translated into the design guidance for the HSI.

18.7.2.4 Use of Main Control Room

Use of the MCR during normal operations, during operational occurrences such as loss of PICS or ~~electronic operating procedures~~computer-based procedures (CBP), and during emergency or accident scenarios is described in Section 2.2.2.2 of the EPR HFE Program Management Plan (Reference 2).

18.7.2.5 Crew Member Coordination Methods

The following sections describe how the operations staff interacts within the MCR and other areas. Also included are descriptions detailing how MCR operators communicate and interact with the NLOs and other personnel such as maintenance technicians, engineers, and emergency support staff. A description of the security measures used to control access to control rooms and to the HSI is also provided.

18.7.2.5.1 Forms of Communication and Expected Use

MCR operator communication is essential for the safe operation of the plant. The RO or other MCR operators are required to communicate with operations staff such as NLOs, technicians, engineers, and emergency support staff regarding periodic maintenance, equipment repairs, and abnormal operating conditions. The design of the HSI considers task loading for each individual operator as well as the time it takes to communicate with others while performing those tasks. To reduce the burden on the operator and validate the minimum staffing requirement assumptions, training the

The TSC is part of an integrated operations area which is normally in use during power operations. When the TSC is activated during an emergency, all other uses of the integrated operations area are suspended. The emergency coordinator assumes responsibility for controlling access to the TSC when it is activated.

I&CSC

The I&CSC is not continuously occupied. It is staffed by I&C engineers and technicians, I&C system administrators, and trained and authorized personnel designated to operate specialized systems such as the loose parts, vibration monitoring, leakage monitoring, and the Aeroball and PowerTrax core monitoring systems. Several forms of communication are provided in the I&CSC allowing operators immediate communication with the technicians. Access to the I&CSC is controlled by the CRS.

18.7.3 Functional Requirements Specification

As described in Section 4.5 of the EPR HFE Program Management Plan (Reference 2), design documents are produced for each of the control rooms (i.e., MCR, TSC, RSS, I&CSC) and HSIs (i.e., PICS and SICS) to track requirements and design specifications. These design documents capture the functional requirements as well as the HFE requirements and provide a uniform philosophy and design consistency among HSIs, including screen style and layout guide, hierarchy of and navigation between screens, alarm system operation, ~~electronic procedure system~~CBP, plant information system, and hard-wired control integration in panels and workstations.

Section 18.7.4.3 describes how the inventory of alarms, displays, and controls needed to operate the U.S. EPR is determined.

18.7.4 HSI Concept Design

The U.S. EPR implements a modern I&C design based on experience gained internationally in new plant designs and retrofits in existing plants with digital I&C equipment. The HSI concepts are further based on predecessor designs and utilize similar control of system functions and I&C concepts. The concepts for the HSI design for the U.S. EPR are described in Section 7.5, Section 2.2.1.2 of the EPR HFE Program Management Plan (Reference 2), and Section 5.1.2 of the U.S. EPR Human System Interface Design Implementation Plan (Reference 1).

18.7.4.1 Safety Parameter Display System

The parameters required to be displayed as part of the SPDS are made available on the PICS and SICS. For more details refer to Section 7.5.

The methodology for selecting the minimum inventory for the RSS is described in the U.S. EPR HSI Design Implementation Plan (Reference 1).

18.7.4.6 Computer-Based Procedures

~~Operating procedures can be 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 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.~~

Operating procedures can be implemented in a screen-based format on the Process Information and Control System (PICS) that provides access to process information by direct links. These computer based procedures (CBP) also provide access to related information and direct the operator to the appropriate control screens. Refer to Section 6.2.9 of the U.S. EPR Human Factors Program Management Plan (Reference 1) for further details on the development of CBPs.

Safety Information and Control System (SICS) paper-based procedures are provided in the control rooms in the event that a failure of the PICS occurs. Paper-based procedures contain similar guidance and format as the CBPs. Paper-based operating procedures are provided in the main control room (MCR), remote shutdown station (RSS), and the Technical Support Center (TSC). Aside from differences in how CBPs and paper-based procedures are used (e.g., the navigation and layout) as well as the availability of live data, paper-based procedures shall be as consistent to the CBPs as possible. Adequate space is provided in close vicinity to the workstations in the MCR and RSS for operators to lay out paper-based procedures, when required.

18.7.5 Guidance for Local Control Station Design

A style guide provided by the HFE and Control Room Design Team is used in the design of HSI features. It also provides guidance on such issues as general plant layout design, equipment accessibility requirements, coding and labeling, and environmental issues such as lighting, acoustics, personnel protection equipment, and ambient

18.7.7 HSI Verification and Validation (Tests and Evaluations)

Verification and validation (V&V) (see Section 18.10) of the HSI design is performed so that the as-built HSIs:

- Are complete and operable.
- Conform to standard HFE principles and requirements.
- Are free of safety issues and human performance issues.
- Implement the design accurately in the final design output documentation.

Testing and evaluation is conducted throughout the HSI design at various stages of development so that the complex HSI design functions properly before the design process is resolved and validation occurs (see Figure 18.1-2).

Activities such as concept testing, mock-up activities, trade-off evaluations, and performance-based tests are utilized at various stages of the design. The criteria used to decide which type of testing or evaluation technique is applicable are described in the U.S. EPR Human Factors Verification and Validation Implementation Plan (Reference 3).

18.7.8 HSI Design Results and Documentation

As described in Section 4.5 of EPR HFE Program Management Plan (Reference 2), the HSI designs are documented using specific design control process requirements. The various configuration management, design change controls, design verification, and design quality control tools are also described in Reference 1.

18.7.9 References

1. ANP-10266NPA, Revision 0, "AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR," AREVA NP Inc., December 2008.

2. [~~*U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2010.*~~*ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*]*

3. NUREG-0737, "Clarification of TMI Action Plan Requirements," U.S. Nuclear Regulatory Commission, November 1980.

4. NUREG-0711, "Human Factors Engineering Program Review Model," Rev. 2, U.S. Nuclear Regulatory Commission, February 2004.

5. ANP-10304, Revision 5, "U.S. EPR Diversity and Defense-in-Depth Assessment Technical Report," AREVA NP Inc., May 2012.

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

7. NUREG/CR-6633, "Advanced Information Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

8. NUREG/CR-6634, "Computer-Based Procedure Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

9. NUREG/CR-6635, "Soft Controls: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

10. NUREG/CR-6636, "Maintainability of Digital Systems: Technical Basis and Human Factors Review Guidance," U.S. Nuclear Regulatory Commission, March 2000.

11. NUREG-0696, "Functional Criteria for Emergency Response Facilities," U.S. Nuclear Regulatory Commission, February 1981.

12. NUREG-0835, "Human Factors Acceptance Criteria for the Safety Parameter Display System," U.S. Nuclear Regulatory Commission, October 1981.

13. NUREG-1342, "A Status Report Regarding Industry Implementation of Safety Parameter Display Systems," U.S. Nuclear Regulatory Commission, April 1989.

14. [*U.S. EPR Human Factors Operating Experience Review Implementation Plan, AREVA NP Inc., 2010.*

1. ~~*U.S. EPR Human System Interface Design Implementation Plan, AREVA NP Inc., 2010.*~~*ANP-10328P, Revision 0, "U.S. EPR Human System Interface Design Implementation Plan Technical Report," AREVA NP Inc., April 2013.*

2. *U.S. EPR Functional Requirements Analysis and Functional Allocation Implementation Plan, AREVA NP Inc., 2010.*

3. *U.S. EPR Human Factors Verification and Validation Implementation Plan, AREVA NP Inc., 2011.*]*

Table 18.7-1—Table Deleted

Table 18.7-2—Table Deleted

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- Demonstrates that the design enables plant personnel to successfully perform their task to achieve plant safety and other operation goals.

- Provides results of V&V activities and conclusions from those activities.

18.10.4 References

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

2. NUREG-6393, "Integrated System Validation: Methodology and Review Criteria," U.S. Nuclear Regulatory Commission, September 1995.

3. [~~*U.S. EPR Human System Interface Design Implementation Plan, AREVA NP Inc., 2010.*~~*ANP-10328P, Revision 0, "U.S. EPR Human System Interface Design Implementation Plan Technical Report," AREVA NP Inc., April 2013.*

4. *U.S. EPR Human Factors Verification and Validation Implementation Plan, AREVA NP Inc., 2011.*]*

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18.11.4 Results Summary

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

18.11.5 References

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

2. [~~*U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2010.*~~*ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*]*

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

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

5. [*U.S. EPR Human Factors Engineering (HFE) Design Implementation Plan, AREVA NP Inc., 2010.*]*

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18.12.3 Results Summary

HPM is continued throughout the life of the plant. It is expected that monitoring programs remain in place for the life of the plant. Reports summarizing human performance-related issues, resolution of those issues, implementation status, and operating experience results are maintained for trending purposes. Operating conditions determine the necessary frequency of these summary reports.

A U.S. EPR operator maintains an HPM program which meets the intent given in this section. Documentation of HPM summarizes the following:

- Baseline human performance criteria established during V&V.
- HPM implementation strategy.
- Any trends in human performance.
- Performance indicators.
- Human performance-related issues, resolution, implementation status, and operating results.
- Specific human performance issues that can be applied to the standard U.S. EPR plant.

18.12.4 References

1. NUREG-0711, "Human Factors Engineering Program Review Model," U.S. Nuclear Regulatory Commission, 2004.
2. [~~*U.S. EPR HFE Program Management Plan, AREVA NP Inc., 2010.*~~*ANP-10327P, Revision 0, "U.S. EPR HFE Program Management Plan Technical Report," AREVA NP Inc., April 2013.*
3. *U.S. EPR Human Performance Monitoring Implementation Plan, AREVA NP Inc., 2010.*]*