

## **18.0 HUMAN FACTORS ENGINEERING**

### **18.1 Introduction**

This section summarizes the information in Chapter 18 on the Advanced Boiling-Water Reactor (ABWR) design control document (DCD).

Section 18.1 of the South Texas Project (STP) combined license (COL) Final Safety Analysis Report (FSAR) incorporates by reference, with no departures or supplements, Section 18.1, "Introduction," of the certified ABWR DCD, Revision 4, which is referenced in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix A. U.S. Nuclear Regulatory Commission (NRC) staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the design goals and bases have been resolved.

### **18.2 Design Goals and Design Bases**

The primary goal for human-system interface (HSI) designs is to facilitate safe, efficient, and reliable operator performance during all phases of normal plant operation, abnormal events, and accident conditions. This section outlines the specific design bases adopted to achieve this goal.

Section 18.2 of the STP COL FSAR incorporates by reference, with no departures or supplements, Section 18.2, "Design Goals and Design Bases," of the certified ABWR DCD, Revision 4, which is referenced in 10 CFR Part 52, Appendix A. NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the design goals and bases have been resolved.

### **18.3 Planning, Development, and Design**

This section of the FSAR provides a program plan for integrating the design of the control and instrumentation systems and HSI elements of the ABWR. The plan presents formal decision analysis procedures to facilitate the selection of design features that satisfy top level requirements and goals of individual systems and of the overall plant. Also included is a comprehensive design approach with provisions for task analyses and human factors evaluations.

Section 18.3 of the STP COL FSAR incorporates by reference, with no departures or supplements, Section 18.3, "Planning, Development, and Design" of the certified ABWR DCD, Revision 4, which is referenced in 10 CFR Part 52, Appendix A. NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the design goals and bases have been resolved.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

## **18.4 Control Room Standard Design Features**

### **18.4.1 Introduction**

This section of the FSAR describes the standard design features for the control room HSI. The COL applicant proposes DCD departures to update the Instrumentation and Control (I&C) technology associated with the ABWR design.

### **18.4.2 Summary of Application**

Section 18.4 of the STP COL FSAR incorporates by reference Section 18.4 of the certified ABWR DCD Revision 4, which is referenced in 10 CFR Part 52, Appendix A.

In addition, in STP COL FSAR Section 18.4, the applicant provides the following:

#### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

The applicant proposes a Tier 1 departure from the ABWR DCD that

- Eliminates obsolete data communication technology
- Eliminates unnecessary inadvertent actuation prevention logic and equipment
- Clarifies digital controls nomenclature and systems
- Revises the implementation architecture to use configurable logic devices for the neutron monitoring system (NMS) and the reactor trip and isolation system
- Revises the testing and surveillance descriptions for the NMS, the reactor trip and isolation system, and the emergency safety features logic and control system

#### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 7.5-1 Post-Accident Monitoring (Drywell Pressure)

The applicant has proposed the following Tier 2 departure from the ABWR DCD. Post Accident Monitoring design requirements were updated to include drywell and wetwell related indications. Wetwell pressure has been added to the list of safety parameter display system (SPDS) indications made available on the control room large display panel. Other changes were made to improve consistency between Regulatory Guide (RG) 1.97, Technical Specifications, the DCD, and the COL application. As the applicant states in the departure description, these changes provide a closer adherence to RG 1.97.

#### Tier 2 Departure Not Requiring Prior NRC Approval.

- STD DEP 18.4-1 Main Generator Synchronization Control Relocation

The applicant proposes a Tier 2 departure from the ABWR DCD that relocates the main generator synchronization to the main control room (MCR) panel. This change provides

additional space on the main control console for more critical tasks and allows for manual synchronization of the main generator by the control room operator, or automatic synchronization by the power generation control system (PGCS).

### 18.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against Human Factors Engineering (HFE) program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

In addition, in accordance with Section VIII, Processes for Changes and Departures, of Appendix A to Part 52-- Design Certification Rule for the ABWR Design, the applicant identified Tier 2 departure(s) that do not require prior Commission approval. These departures are subject to the requirements of Section VIII, which are similar to the requirements in 10 CFR 50.59.

### 18.4.4 Technical Evaluation

As documented in NUREG–1503, the staff reviewed and approved Section 18.4 of the certified ABWR DCD. NRC staff reviewed Section 18.4 of the STP Units 3 and 4 COL FSAR. The staff also checked the referenced ABWR DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to control room standard design features.

The staff reviewed the information in the STP COL FSAR:

#### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This Tier 1 departure is described in detail in the STP COL application Part 7, “Departures Report.” In summary, the departure contains five primary changes associated with updating the ABWR design I&C to current technology:

- Elimination of obsolete data communication
- Elimination of unnecessary inadvertent actuation prevention logic and equipment
- Clarification of digital controls nomenclature and systems
- Implementation architecture changes caused by the final selection of platforms
- Testing and surveillance changes for safety system logic and control

This departure was evaluated in Chapter 7 of this SER.

This Tier 1 departure resulted in two changes in Chapter 18. Both fall within the category of “Clarification of digital controls nomenclature and systems.” The first change replaces “Plant process computer system” with “Plant computer functions.” This change does not impact the

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

HFE Program. Either terminology could be used to identify the HSI (computer/Video Display Units [VDUs]), but neither identifies a specific HSI design. The replacement terminology more accurately describes the technology expected to be used. The second change explains that there are two sets of VDUs; one set is non-safety-related and receives input from the “Plant computer functions.” The other set is safety-related and receives input from processors that are independent of the “Plant computer functions.” This change clarifies the function and qualification of each set of VDUs and the independence between the two sets. The change does not introduce any new element of HFE design.

However, the FSAR description of this departure appears to be in error. Section 18.4.2.1(3) indicates there are two sets of VDUs, one for non-safety-related applications and one for safety-related applications. The text indicates both sets are entirely independent of the plant computer functions. According to paragraph 18.4.2.4 only the SR VDUs are independent of the plant computer functions. The staff issued RAI 18-4, and the applicant submitted a response (letter U7-C-STP-NRC-090197) on November 10, 2009. The response corrected FSAR subsection 18.4.2.1(3) and committed to including this correction in the next FSAR revision. This is **Confirmatory item 18-4**

*In summary, this departure updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement*

*Tier 2 Departure Requiring Prior NRC Approval.*

- STD DEP 7.5-1 Post-Accident Monitoring (Drywell Pressure)

This departure was evaluated in Chapter 7 of this SER.

The impact of this departure on Chapter 18 is that wetwell pressure has been added to the list of SPDS indications made available on the control room large display panel. As the applicant states in the departure description, this change provides closer adherence to RG 1.97 (Revision 4). RG 1.97 categorizes drywell and wetwell pressure readings as Type A variables. The variables are used by the operator to determine whether to manually initiate drywell or wetwell sprays to protect primary containment from exceeding pressure or temperature limits. This change is consistent with HFE Program guidance in that it improves the operator’s ability to manage operational challenges. And more specifically, the change assures reactor safety by directly supporting the operator’s decision to implement manual actions associated with protecting the containment structure.

*Tier 2 Departure Not Requiring Prior NRC Approval*

- STD DEP 18.4-1 Main Generator Synchronization Control Relocation

The Main Generator Synchronization Control has been relocated from the main control console to the MCR panel. As the applicant states in the departure description, this change allocates space on the main control console for more critical tasks and allows for manual synchronization of the main generator by the control room operator, or automatic synchronization by the PGCS. The applicant’s evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII item B.5 determined that this departure did not require prior NRC approval. The NRC staff finds it reasonable that the departure does not require prior NRC approval. The applicant’s process for evaluating departures and other changes to the DCD are subject to NRC inspections.

#### 18.4.5 Post Combined License Activities

There are no post COL activities related to this section.

#### 18.4.6 Conclusion

NRC staff reviewed the COL application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to control room standard design features. With the exception of **Confirmatory Item 18-4**, no outstanding information is expected to be addressed in the COL FSAR related to this section. As a result of this confirmatory item, the staff is unable to finalize the conclusions for this section relating to control room standard design features in accordance with NRC requirements.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the control room standard design features that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information presented in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 3.4-1 was evaluated against HFE program criteria and was determined to be consistent with that guidance. The departure updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement.
- STD DEP 7.5-1 was evaluated against the HFE program criteria and was determined to be consistent with that guidance. This departure identifies drywell and wetwell pressure as type A variables and adds wetwell pressure to the SPDS indication on the control room large display panel. This change is an improvement in reactor safety, because it directly supports the operator's decision to implement manual actions associated with protecting the containment structure.
- In addition the applicant identified STD DEP 18.4-1 describing the synchronization circuit relocation. The staff finds it reasonable that this departure does not need prior NRC approval. The applicant provided sufficient information for satisfying 10 CFR Part 52, Appendix A, Section VIII.B.5.

In general, the changes associated with these departures are consistent with what one would expect from the iterative HFE design process described in the DCD. Technology is being updated and improvements in the human system interface are being applied. These changes in combination with the Design Certification, which is included by reference, provide reasonable assurance that this section will effectively support HFE design development. The staff's review confirmed that the applicant has adequately addressed the Tier 1 and Tier 2 departures in accordance with Section 18 of NUREG-0800.

## **18.5 Remote Shutdown System**

The remote shutdown system (RSS) provides a means to safely shut down the plant from outside the MCR. The RSS enables control of the plant systems that is needed to bring the plant to a hot shutdown, with the subsequent capability of attaining a cold shutdown in the event that the control room becomes uninhabitable.

Section 18.5 of the STP COL FSAR incorporates by reference, with no departures or supplements, Section 18.5, "Remote Shutdown System," of the certified ABWR DCD Revision 4, which is referenced in 10 CFR Part 52, Appendix A. NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the design goals and bases have been resolved.

## **18.6 Systems Integration**

### **18.6.1 Introduction**

This section of the FSAR describes how the operator interfaces with the safety-related systems through (1) dedicated hardware switches for system initiation and logic reset; (2) hardware switches for system mode changes; (3) safety-related VDUs for individual safety equipment control, status display, and monitoring; (4) non-safety-related VDUs for additional safety system monitoring; and (5) the large fixed-position display for plant overview information.

For non-safety-related systems, operational control is accomplished using on-screen control via the non-safety VDUs. The hardware switches for non-safety-related equipment on the main control console communicate with the non-safety-related systems logic units through hardwired transmission lines.

### **18.6.2 Summary of Application**

Section 18.6 of the STP COL FSAR incorporates by reference Section 18.6 of the certified ABWR DCD Revision 4, which is referenced in 10 CFR Part 52, Appendix A.

In addition, in STP COL FSAR Section 18.6, the applicant provides the following:

#### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

The applicant proposes a Tier 1 departure from the ABWR DCD that

- Eliminates obsolete data communication technology
- Eliminates unnecessary inadvertent actuation prevention logic and equipment
- Clarifies digital controls nomenclature and systems

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

- Revises the implementation architecture to use configurable logic devices for the NMS and the reactor trip and isolation system
- Revises the testing and surveillance descriptions for the NMS, the reactor trip and isolation system, and the emergency safety features logic and control system

### 18.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

### 18.6.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 18.6 of the certified ABWR DCD. The staff reviewed Section 18.6 of the STP Units 3 and 4 COL FSAR. The staff also checked the referenced ABWR DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to systems integration.

The staff reviewed the information in the STP COL FSAR:

#### Tier 1 Departure

- STD DEP T1 3.4-1                      Safety-Related I&C Architecture

This Tier 1 departure is described in detail in STP COL application Part 7, “Departures Report.” In summary, this departure contains five primary changes associated with updating the ABWR design I&C to current technology:

- Elimination of obsolete data communication
- Elimination of unnecessary inadvertent actuation prevention logic and equipment
- Clarification of digital controls nomenclature and systems
- Implementation of architecture changes caused by the final selection of platforms
- Implementation of testing and surveillance changes for the safety system logic and control

This departure was evaluated in Chapter 7 of this SER.

The impact of this Tier 1 departure on this section is limited to:

- Deleting references to the “Multiplexing System,” an obsolete data communication technology, and replacing that terminology with “Communication Function”
- Replacing “Plant Process Computer System” with “Plant Computer Functions”

<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

The first change eliminates an obsolete data communication system and replaces it with a functional description. This change is consistent with the current practice in the I&C and HFE areas. Because of rapidly changing technology, functional descriptions are used instead of specific design commitments. Specific designs are identified as part of the ITAAC resolution. The second change is limited to clarifying the digital control nomenclature. Either term could be used to identify the HSI (computer/VDUs), but neither term identifies a specific HSI design.

In summary, this departure updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement. These changes do not affect the HFE program.

### **18.6.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **18.6.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to systems integration, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 3.4-1 updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and systems. This change does not introduce additional HSIs or any specific HFE design requirement. Because the HFE program is not affected by these changes, there continues to be reasonable assurance that that this section will effectively support HFE design development.

The staff's review confirmed that the applicant has adequately addressed the Tier 1 departure in accordance with Section 18 of NUREG-0800.

## **18.7 Detailed Design of the Operator Interface System**

The standard design features of the ABWR MCR HSI provide the framework for the detailed equipment hardware and software designs that will be developed following the design and implementation process described in Appendix 18E of the ABWR DCD. This process is composed of eight major elements that include:

HFE Design Team  
HFE Program and Implementation Plans  
System Functional Requirements Analysis



Allocation of Functions  
Task Analysis  
HSI Design  
Procedure Development  
Human Factors Verification and Validation (V&V)

Section 18.7 of the STP Units 3 and 4 COL FSAR incorporates by reference, with no departures or supplements, Section 18.7, “Detailed Design of the Operator Interface System,” of the certified ABWR DCD Revision 4, which is referenced in 10 CFR Part 52, Appendix A. NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Detailed Design of the Operator Interface System” have been resolved.

## **18.8      COL License Information**

### **18.8.1      Introduction**

This section of the FSAR describes evaluations/information that COL applicants referencing the ABWR DCD are responsible for providing.

### **18.8.2      Summary of Application**

Section 18.8 of the STP Units 3 and COL FSAR incorporates by reference Section 18.8 of the certified ABWR DCD Revision 4.

In addition, the applicant provides the following in STP COL FSAR Section 18.8:

#### Tier 1 Departure

- STD DEP T1 3.4-1                      Safety-Related I&C Architecture

The applicant proposes a Tier 1 departure from the ABWR DCD that

- Eliminates obsolete data communication technology
- Eliminates unnecessary inadvertent actuation prevention logic and equipment
- Clarifies digital controls nomenclature and systems
- Revises the implementation architecture to use configurable logic devices for the neutron monitoring system (NMS) and the reactor trip and isolation system
- Revises the testing and surveillance descriptions for the NMS, the reactor trip and isolation system, and the emergency safety features logic and control system

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<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

COL License Information Item

- STP COL License Information Item 18.1 HSI Design Implementation Process

This COL license information item discusses the HSI design implementation process.

- STP COL License Information Item 18.2 Number of Operators Needing Controls Access

This COL license information item discusses the (1) number of operators who need access to the controls on the main control panel, (2) confirmation of the adequacy of the control room staffing arrangement, and (3) the roles and responsibilities of the Shift Supervisor/Manager and the Unit Supervisor.

- STP COL License Information Item 18.3 Automation Strategies and Their Effect on Operator Reliability

This COL license information item discusses an evaluation of automation strategies and the confirmation of automation design.

- STP COL License Information Item 18.4 SPDS Integration With Related Emergency Response Capabilities

This COL license information item discusses (1) functions of the operating staff that are necessary to recognize and cope with rare events; (2) combining the results of the review with accepted human factors principles to select SPDS parameters, data display, and functions; and (3) designing, building, and installing the SPDS and training its users.

- STP COL License Information Item 18.5 Standard Design Features Design Validation

This COL license information item discusses the validation of the MCR standard design features.

- STP COL License Information Item 18.6 Remote Shutdown System Design Evaluation

This COL license information item discusses the reliability and design adequacy of the remote shutdown system (RSS).

- STP COL License Information Item 18.7 Local Valve Position Indication

This COL license information item discusses valve position indication (VPI) requirements.

- STP COL License Information Item 18.8 Operator Training

This COL license information item discusses the operator training program.

- STP COL License Information Item 18.9 Safety System Status Monitoring

This COL license information item discusses the implementation of safety system monitoring requirements.

- STP COL License Information Item 18.10 PGCS Malfunction

This COL license information item discusses malfunctions of the Power Generation Control function.

- STP COL License Information Item 18.11 Local Control Stations

This COL license information item discusses operations at local control stations that are critical to plant safety.

- STP COL License Information Item 18.12 As-Built Evaluation of MCR and RSS

This COL license information item discusses the verification of as-built configurations for the MCR and the RSS.

- STP COL License Information Item 18.13 Accident Monitoring Instrumentation

This COL license information item discusses accident monitoring instrumentation requirements.

- STP COL License Information Item 18.14 In-Core Cooling Instrumentation

This COL license information item discusses reactor pressure vessel (RPV) level instrumentation.

- STP COL License Information Item 18.15 Performance of Critical Tasks

This COL license information item discusses HSIs for critical tasks.

- STP COL License Information Item 18.16 Plant Status and Post-Accident Monitoring

This COL license information item discusses how plant status and post-accident monitoring requirements were addressed in NUREG–1503.

### **18.8.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

### **18.8.4 Technical Evaluation**

As documented in NUREG–1503, NRC staff reviewed and approved Section 18.8 of the certified ABWR DCD. The staff reviewed Section 18.8 of the STP COL FSAR. The staff also checked the referenced DCD to ensure that the combination of information in the COL FSAR

and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to COL license information.

The staff reviewed the information in the STP COL FSAR:

Tier 1 Departure

- STD DEP T1 3.4-1                      Safety-Related I&C Architecture

This departure was evaluated in Chapter 7 of this SER.

The impact of this Tier 1 departure on this section is limited to:

- Deleting references to the "Multiplexing System," an obsolete data communication technology, and replacing the terminology with "Communication Function."
- Replacing "Process Computer System" with "Plant Computer Functions."

The first change eliminates an obsolete data communication system and replaces it with a functional description. This change is consistent with the current practice in the I&C and HFE areas. Because of rapidly changing technology, functional descriptions are used instead of specific design commitments. Specific designs are identified as part of the ITAAC resolution. The second change is limited to clarifying the digital control nomenclature. These changes do not affect the HFE Program. Either term could be used to identify the HSI (computer/VDUs), but neither term identifies a specific HSI design.

*In summary, this departure updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement. These changes do not affect the HFE program*

COL License Information Items

For each subsection of Section 18.8, the applicant provides supplemental information describing how DCD COL license information items are addressed. In general, the COL license information items are addressed within the scope of existing ITAAC. These items can be closed because they are redundant to the ITAAC. Specific evaluation results are provided below.

- STP COL License Information Item 18.1                      HSI Design Implementation Process

In STP FSAR Section 18.8.1, the applicant states that the HSI design implementation process is conducted in accordance with Appendix 18E, "ABWR Human System Interface Design Implementation Process." The ITAAC listed in Tier 1, Table 3.1 are specifically designed to track implementation of Appendix 18E, which provides acceptance criteria for the implementation plans described in the ITAAC. NRC staff reviewed these ITAAC and confirmed

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

that they cover the scope of COL License Information Item 18.1. COL License Information Item 18.1 is closed because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.2                      Number of Operators Needing Controls Access

In STP FSAR Section 18.8.2, the applicant states that the number of operators needing access to the controls on the main control panel is determined in accordance with Tier 1, Table 3.1, ITAAC 3.a(3)(c) related to personnel skills and ITAAC 4.a related to task analysis. Confirmation of the adequacy of the control room staffing arrangement is performed in accordance with Tier 1, Table 3.1, ITAAC 6.a(4)(b) related to control room staffing. The staff reviewed these ITAAC and confirmed they cover the scope of the COL License Information Item. This COL License Information Item is closed because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.3                      Automation Strategies and Their Effect on Operator Reliability

In STP FSAR Section 18.8.3, the applicant states that the evaluation of automation strategies and the confirmation of automation design are performed in accordance with Table 18E-1 and Tier 1, Table 3.1, ITAAC 1.b. The staff determined that these references do not provide specific directions for automation. Therefore, the staff issued **RAI 18-1**, and the applicant submitted a response (letter U7-C-STP-NRC-090084) on July 23, 2009. The applicant indicates that the automation strategies will be addressed in accordance with ITAAC 1.b and ITAAC Item 3.a. The combination of acceptance criteria from Table 18E-1 for both ITAAC 1.b and 3.a provides a complete set of criteria making those two ITAAC redundant to this COL information item. The applicant indicates that FSAR Section 18.8.3 will be revised accordingly to include a reference to ITAAC 3.a. Hence, this COL information item is closed and is now **Confirmatory Item 18-1**.

- STP COL License Information Item 18.4                      SPDS Integration with Related Emergency Response Capabilities

In STP FSAR Section 18.8.4, the applicant states:

1. Applying insights from probabilistic risk assessment and human reliability analysis is performed in accordance with Tier 1, Table 3.1, ITAAC 4 related to task analyses.
2. Selection of SPDS parameters, data display, and functions, including incorporation of the SPDS function as part of the plant status summary information on the large display panel, is performed in accordance with Tier 1, Table 3.1, ITAAC 5 related to HSI design.
3. SPDS training is an integral part of control room operator training and identification of training needs is performed in accordance with Tier 1, Table 3.1, ITAAC 1.b(3) related to training.

The staff reviewed the ITAAC related to this COL license information item and confirmed that they cover the scope of this item. COL License Information Item 18.4 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.5                      Standard Design Features Design Validation

In STP FSAR Section 18.8.5, the applicant states that design validation is performed in accordance with Tier 1, Table 3.1, ITAAC 6. The staff reviewed this ITAAC and confirmed that it covers the scope of the COL License Information Item 18.5. COL License Information Item 18.5 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.6                      Remote Shutdown System Design Evaluation

In STP FSAR Section 18.8.6, the applicant states that the evaluation of reliability and the confirmation of design adequacy of the RSS are performed in accordance with Tier 1, Table 3.1, ITAAC 1.b(3) related to training, ITAAC 6.a(2)(a) related to validating equipment hardware- and software-driven functions, and ITAAC 6.a(6) related to performance measures.

COL License Information Item 18.6 states that "digital versus analog design approaches" for the RSS will be evaluated. The staff understands this to be a pre-design/design activity versus a V&V activity. However, ITAAC 6 only addresses V&V activities and the ITAAC 1 reference only addresses training. Therefore, the staff issued **RAI 18-2**, and the applicant submitted a response (letter U7-C-STP-NRC-090084) on July 23, 2009. The applicant describes the RSS HFE design approach, which includes the following elements:

- The RSS design will be in accordance with ABWR DCD Tier 2 Sections 7.4.1.4, 7.4.2.4, and 18.5. These sections are all incorporated by reference into the STP Units 3 and 4 COL FSAR, with no departures that affect the RSS design.
- The RSS HSI will be defined during the Functional Requirements Analysis and Allocation of Function, Task Analysis, and HSI Design activities. These analyses will include the identification of controls, displays, and alarms, in accordance with accepted human factors practices. The identified information and control requirements will be incorporated into the HFE design, in accordance with Tier1, Table 3.1, ITAAC Item 5.a(2) related to the HSI design.
- Both the MCR and the RSS will be designed in accordance with the STP Units 3 and 4 HFE Program plan, which requires the development and application of an HSI Requirements Document and an HSI Guidelines Document to ensure consistency in the presentation of both interfaces. This consistency will minimize the potential for human error during the operator's transition from the mostly digital MCR interface to the analog RSS interface. The design activity is performed in accordance with Tier 1, Table 3.1, ITAAC Item 5.a(2)

In the RAI response, the applicant also points out that the MCR will continue to have dedicated hard switches, controls, and indicators. Operators will become familiar with the use of dedicated devices in both the MCR and RSS, thus reducing the extent of the cognitive transition from the MCR interface to the RSS interface, and reducing the potential for human error introduced as a result of the transition. Appropriate training and V&V activities will be identified to ensure the adequacy of the RSS interface design.

The staff found this plan acceptable. By including ITAAC 5.a(2) in this COL information item response, the applicant ensures that the RSS interface design development follows the same design process used for the control room. This process is consistent with current HFE design

guidelines and thus provides reasonable assurance that the RSS will include a HFE design that will minimize operator error or confusion if the RSS must be used. This process provides a satisfactory way to address the original issue of whether an analog (vice digital) design should be used. The referenced ITAAC provide sufficient tracking for completing the design. The

applicant indicates that FSAR Section 18.8.6 will be revised accordingly to include a reference to ITAAC 5.a (2). Hence, this COL information item is closed and is now **Confirmatory Item 18-2**.

- STP COL License Information Item 18.7                      Local Valve Position Indication

In STP FSAR Section 18.8.7, the applicant states that “power-operated valves and manually operated valves are required to have a positive, mechanical indication of the valve's overall position which can be determined by direct observation at the valve without instruments or power.” This statement applies to three classes of valves described in the ABWR DCD: power operated valves, large manual valves, and small manual valves (less than 5 centimeters) that are important to a safe plant operation.

Operating experience indicates that existing designs for small valves do not always have positive, mechanical indications as part of their design. Instead, administrative measures are used to control the position. Therefore, the staff issued **RAI 18-3**, and the applicant submitted response (letter U7-C-STP-NRC-090084) on July 23, 2009. The applicant clarifies that a local VPI is only necessary for those valves that are determined, after an evaluation, to require a local VPI. For small valves that are important to a safe plant operation but do not require positive mechanical indications, the administrative controls described in FSAR Subsection 13.5.3.4.1 (“Administrative Procedures,”) provide the appropriate measures to control valve positions.

The staff found this position acceptable because:

- an evaluation will ensure design basis information is captured for local VPI and
- operating experience demonstrates that administrative controls are generally effective for controlling valve positions.

The applicant indicates that the FSAR description will be revised to include this clarification. Additionally, the applicant also indicates that FSAR Section 18.8.7 will be updated accordingly. The applicant notes the need to address local valve indications and identifies the method to do so. Therefore, this COL information item is closed and is now **Confirmatory Item 18-3**.

- STP COL License Information Item 18.8                      Operator Training

In STP FSAR Section 18.8.8, the applicant states that the identification of personnel training needs is performed in accordance with Tier 1, Table 3.1, ITAAC 1.b(3) related to training. The staff reviewed this ITAAC and confirmed that it covers the scope of COL License Information Item 18.8. COL License Information Item 18.8 is closed because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.9                      Safety System Status Monitoring
- STP COL License Information Item 18.13                    Accident Monitoring Instrumentation
- STP COL License Information Item 18.14                    In-Core Cooling Instrumentation
- STP COL License Information Item 18.16                    Plant Status and Post-Accident Monitoring

The four COL License Information Items listed above all ensure that the proper instrumentation is available and inclusion of the instrumentation in the main control room does not create a potential for human error. ABWR DCD Appendix 18E, “ABWR Human-System Interface Design Implementation Process,” provides specific requirements for identifying functions and tasks that operators perform, which in turn establish the basis for the HSI design. The design is then demonstrated via a verification and validation process.

In STP FSAR Sections 18.8.9, 18.8.13, 18.8.14, and 18.8.16, the applicant states that the HSI design implementation process is conducted in accordance with Appendix 18E. This reference is appropriate, because the material applies directly to the subject of the COL license information items. The ITAAC listed in Tier 1, Table 3.1 are specifically designed to track the implementation of Appendix 18E, which provides acceptance criteria for the Implementation plans described in the ITAAC. The staff reviewed these ITAAC and confirmed that they cover the scope of the COL license information items. These COL license information items are closed, because they are redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.10                    PGCS Malfunction

In STP FSAR Section 18.8.10, the applicant states that this malfunction is evaluated in accordance with Tier 1, Table 3.1, ITAAC 6.a(5)(related to operational conditions and upsets), and ITAAC 6.a(6) (related to performance measures). The staff reviewed these ITAAC and confirmed that they cover the scope of the COL license information items. COL License Information Item 18.10 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.11                    Local Control Stations

In STP FSAR Section 18.8.11, the applicant states that the evaluation of operations at local control stations critical to plant safety is performed in accordance with Tier 1, Table 3.1, ITAAC 2.a(3) (related to critical functions), ITAAC 4.a(3) (related to critical tasks), and ITAAC 6.a(4)(a) (related to function and task achievement). The staff reviewed these ITAAC and confirmed that they cover the scope of COL License Information Item 18.11. COL License Information Item 18.11 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

- STP COL License Information Item 18.12                    As-Built Evaluation of MCR and RSS

In STP FSAR Section 18.8.12, the applicant states that the as-built configurations of the MCR and the RSS are verified for conformance with the validated configurations. The verification is performed in accordance with Tier 1, Table 3.1, ITAAC 7, and the results are documented in a report. The staff reviewed this ITAAC and confirmed that it covers the scope of COL License Information Item 18.12. This COL License Information Item is closed, because it is redundant to existing ABWR DCD HFE ITAAC.



- STP COL License Information Item 18.15, “Performance of Critical Tasks”

In STP FSAR Section 18.8.15, the applicant states that the HSI evaluation for timely performance of critical tasks is performed in accordance with Tier 1, Table 3.1, ITAAC 2.a(3) (related to critical functions), ITAAC 4.a(3) (related to critical tasks), and ITAAC 6.a(4)(a) (related to function and task achievement). The staff reviewed these ITAAC and confirmed that they cover the scope of COL License Information Item 18.15. COL License Information Item 18.15 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

### **18.8.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **18.8.6 Conclusion**

NRC staff reviewed the COL application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information relating to COL information items. With the exceptions of **Confirmatory Items 18-1, 18-2, and 18-3**, no outstanding information is expected to be addressed in the COL FSAR related to COL license information. As a result of these confirmatory items, the staff is unable to finalize the conclusions for this section relating to COL license information in accordance with NRC requirements.

The staff’s finding related to information incorporated by reference is in NUREG–1503. The staff’s review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to COL information items that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 Part CFR 52, Appendix A. The staff’s conclusion is based on the following:

- STD DEP T1 3.4-1 updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and systems. This change does not introduce additional HSIs or any specific HFE design requirement. Because the HFE program is not affected by these changes, there continues to be reasonable assurance that this appendix will effectively support HFE design development.
- The COL action items are redundant to the ITAACs and therefore can be closed. The ITAACs provide reasonable assurance that implementation plans and HFE design will be developed in accordance with the Design Certification.

The staff’s review confirmed that the applicant has adequately addressed the Tier 1 departures in accordance with Section 18 of NUREG–0800.

## **18.9 Appendices 18A and 18B (Material related to Emergency Procedure Guidelines)**

### **18.9.1 Introduction**

Appendix 18A, “Emergency Procedure Guidelines” and Appendix 18B, “Difference between BWROG EPG Revision 4 and ABWR EPG,” contain Emergency Procedure Guidelines (EPGs) and bases material for the ABWR design.

### **18.9.2 Summary of Application**

Appendices 18A and 18B of the STP Units 3 and 4 COL FSAR Revision 2 incorporates by reference Appendices 18A and 18B of the certified ABWR DCD Revision 4.

In addition, in STP COL FSAR Appendices 18A and 18B, the applicant provides the following:

#### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

10 CFR 50.44, “Combustible gas control for nuclear power reactors,” was amended after the issuance of the design certification for the ABWR. The amended 10 CFR 50.44 eliminates the requirements for hydrogen control systems to mitigate a design-basis loss-of-coolant accident (LOCA) hydrogen release. As a result of this change, the use of the containment hydrogen and oxygen monitoring instrumentation in the mitigation of a design-basis LOCA is also eliminated.

This departure reflects the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.

### **18.9.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

### **18.9.4 Technical Evaluation**

As documented in NUREG–1503, the staff reviewed and approved Appendices 18A and 18B of the certified ABWR DCD. NRC staff reviewed Appendices 18A and 18B of the STP COL FSAR. The staff also checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendices 18A and 18B.

The staff reviewed the information in the STP COL FSAR:

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure was evaluated in Chapter 6 of this SER.

This Tier 1 departure is described in detail in the STP COL application Part 7, "Departures Report." In summary, the departure deletes all references to the "Flammability Gas Control System" in the EPG. The EPGS material contained in these appendices was determined to have been appropriately updated to reflect this departure. There are no other HFE review criteria are applicable to this departure.

#### **18.9.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **18.9.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to Appendices 18A and 18B, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 2.14-1 updates EPG information for changes in the plant configuration. Because the HFE program is not affected by these changes, there continues to be reasonable assurance that the EPGs continue to contain the necessary information needed to support HFE Design development.

The staff's review confirmed that the applicant has adequately addressed the Tier 1 departures in accordance with Section 18 of NUREG-0800.

### **18.10 Appendix 18C Operator Interface Equipment Characterization**

#### **18.10.1 Introduction**

This appendix describes an operator interface system that meets the control room standard design features described in DCD Section 4.

#### **18.10.2 Summary of Application**

Appendix 18C of the STP Units 3 and 4 COL FSAR incorporates by reference Appendix 18C of the certified ABWR DCD Revision 4.

In addition, in COL FSAR Appendix 18C, the applicant provides the following:

### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

The applicant proposes a Tier 1 departure from the ABWR DCD that

- Eliminates obsolete data communication technology
- Eliminates unnecessary inadvertent actuation prevention logic and equipment
- Clarifies digital controls nomenclature and systems
- Revises the implementation architecture to use configurable logic devices for the NMS and the reactor trip and isolation system
- Revises the testing and surveillance descriptions for the NMS, the reactor trip and isolation system, and the emergency safety features logic and control system

#### **18.10.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

#### **18.10.4 Technical Evaluation**

As documented in NUREG–1503, NRC staff reviewed and approved Appendix C of the certified ABWR DCD. The staff reviewed Appendix 18C of the STP COL FSAR. The staff also checked the referenced ABWR DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18C.

The staff reviewed the information in the STP COL FSAR:

### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure was evaluated in Chapter 7 of this SER.

The impact of this Tier 1 departure on this section is limited to:

- Deleting references to the “Multiplexing System,” an obsolete data communication technology, and replacing that terminology with “Communication Function.”

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

- Replacing “Process Computer system” with “Plant Computer Functions.”

The first change eliminates an obsolete data communication system and replaces it with a functional description. This change is consistent with the current practice in the I&C and HFE areas. Because of rapidly changing technology, functional descriptions are used instead of specific design commitments. Specific designs are identified as part of the ITAAC resolution. The second change is limited to clarifying the digital control nomenclature. These changes do not affect the HFE Program. Either term could be used to identify the HSI (computer/VDUs), but neither term identifies a specific HSI design.

In summary, this departure updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement. These changes do not affect the HFE program.

#### **18.10.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **18.10.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information relating to Appendix 18C, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff’s finding related to information incorporated by reference is in NUREG–1503. The staff’s review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff’s conclusion is based on the following:

- STD DEP T1 3.4-1 updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and systems. This change does not introduce additional HSIs or any specific HFE design requirement. Because the HFE program is not affected by these changes, there continues to be reasonable assurance that this appendix will effectively support HFE design development.

The staff’s review confirmed that the applicant has adequately addressed the Tier 1 departures in accordance with Section 18 of NUREG–0800.

#### **18.11 Appendix 18D Emergency Procedures Guidelines—Input Data and Calculation Results**

The EPGs in Appendix 18A contain various limits for emergency plant operations. These operation limit calculations are based on specific plant design parameters. This appendix contains the plant parameter values used to calculate operation limits and the results of these calculations.

Appendix 18D of the STP Units 3 and 4 COL FSAR incorporates by reference, with no departures or supplements, Appendix 18D of the certified ABWR DCD Revision 4, which is referenced in 10 CFR Part 52, Appendix A. NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Emergency Procedures Guidelines—Input Data and Calculation Results" have been resolved.

## **18.12 Appendix 18E ABWR Human-System Interface Design Implementation Process**

### **18.12.1 Introduction**

Appendix 18E describes the process for conducting and evaluating the MCR and RSS HSI design through the application of accepted HFE practices and principles.

### **18.12.2 Summary of Application**

Appendix 18E of the STP Units 3 and 4 COL FSAR incorporates by reference Appendix 18E of the certified ABWR DCD, Revision 4.

In addition, the applicant provides the following departure in STP COL FSAR Appendix 18E:

#### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

The applicant proposes a Tier 1 departure from the ABWR DCD that

- Eliminates obsolete data communication technology
- Eliminates unnecessary inadvertent actuation prevention logic and equipment
- Clarifies digital controls nomenclature and systems
- Revises the implementation architecture to use configurable logic devices for the neutron monitoring system and the reactor trip and isolation system
- Revises the testing and surveillance descriptions for the NMS, the reactor trip and isolation system, and the emergency safety features logic and control system

#### Tier 2\* Departure

- STD DEP 1.8-1 Tier 2\* Codes, Standards, and Regulatory Guide Edition Change

The applicant proposes to delete U.S. Military (Mil) Standard (Std) 1478, "Task Performance Analysis" from a list of 9 references in Table 1.8-21 of the DCD, as sources for information pertaining to methods and criteria for performing task analyses.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

### 18.12.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

### 18.12.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 18E of the certified ABWR DCD. The staff reviewed Appendix 18E of the STP COL FSAR. The staff also checked the referenced DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18E.

The staff reviewed the information in the STP COL FSAR:

#### Tier 1 Departure

- STD DEP T1 3.4-1                      Safety-Related I&C Architecture

This departure was evaluated in Chapter 7 of this SER.

The impact of this Tier 1 departure on this section is limited to:

- Deleting references to the “Multiplexing System,” an obsolete data communication technology, and replacing that terminology with “Communication Function.”

This change eliminates an obsolete data communication system and replaces it with a functional description. This change is consistent with the current practice in the I&C and HFE areas. Because of rapidly changing technology, functional descriptions are used instead of specific design commitments. Specific designs are identified as part of the ITAAC resolution.

#### Tier 2\* Departure

- STD DEP 1.8-1                      Tier 2\* Codes, Standards, and Regulatory Guide Edition Change

The DCD provides a general list of documents related to task analyses that constitutes a resource for accepted HFE practices and principles. The deletion of any specific reference does not impact the ability to determine these practices and principles. The list is sufficiently large to provide a diverse set of inputs for consideration in designing the task analysis. The Mil Std is also not directly associated with any acceptance criteria. The deletion of the Mil Std from the list is acceptable.

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### **18.12.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **18.12.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to Appendix 18E, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 3.4-1 updates the safety-related I&C architecture to current technologies and clarifies the digital controls nomenclature and systems. This change does not introduce additional HSIs or any specific HFE design requirement. Because the HFE program is not affected by these changes, there continues to be reasonable assurance that this appendix will effectively support HFE design development.
- STD DEP 1.8-1 contains the deletion of Mil Std 1478 from the list of task analysis source references. This change does not challenge the task analysis process approved in the DCD.

The staff's review confirmed that the applicant has adequately addressed the Tier 1 and Tier 2\* departures, in accordance with Section 18 of NUREG-0800.

## **18.13 Appendix 18F Emergency Operation Information and Controls**

### **18.13.1 Introduction**

Appendix 18F, "Emergency Operation Information and Controls," contains the results of an analysis of information and control needs of the main control room operators. The analysis is based on the operation strategies in the ABWR EPGs and significant operator actions determined by the Probabilistic Risk Assessment. It constitutes the minimum inventory of controls, displays, and alarms that are needed to safely shut down the reactor and maintain it in safe shutdown.

### **18.13.2 Summary of Application**

Appendix 18F of the STP Units 3 and 4 COL FSAR incorporates by reference Appendix 18F of the certified ABWR DCD Revision 4.

In addition, the applicant provides the following departure in STP COL FSAR Appendix 18F:



### Tier 1 Departures

STD DEP T1 2.3-1

Deletion of main steamline isolation valve (MSIV) Closure and Scram on High Radiation

The MSIV closure and scram were removed because they were not specifically credited in any ABWR safety analysis. Their removal increases operating reliability by eliminating spurious trips caused by minor variations in the Nitrogen-16 (N-16) flow.

This departure reflects the elimination of the automatic trip function. The main steamline radiation indication and alarm is still available as part of the minimum inventory.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

10 CFR 50.44, "Combustible gas control for nuclear power reactors," was amended after the issuance of the design certification for the ABWR. The amended 10 CFR 50.44 eliminates the requirements for hydrogen control systems to mitigate a design-basis LOCA hydrogen release. As a result of this change, the use of the containment hydrogen and oxygen monitoring instrumentation in the mitigation of a design-basis LOCA is also eliminated.

This departure reflects the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.

#### **18.13.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, "Standard Review Plan," Chapter 18 and NUREG-0711, "Human Factors Engineering Program Review Model."

#### **18.13.4 Technical Evaluation**

As documented in NUREG-1503, NRC staff reviewed and approved Section 18F of the certified ABWR DCD. The staff reviewed Appendix 18F of the STP COL FSAR. The staff also checked

the referenced DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18F.

The staff reviewed the information in the STP COL FSAR:

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 1 Departure

- STD DEP T1 2.3-1 Deletion of MSIV Closure and Scram on High Radiation

This departure was evaluated in Chapter 11 of this SER.

This Tier 1 departure is described in detail in STP COL application Part 7, "Departures Report." In summary, the departure (as it affects Chapter 18) deletes a reference to the automatic MSIV closure and trip on high steamline radiation from the minimum inventory. This departure updates the minimum inventory list to reflect the removal of automatic MSIV closure and trip on high steamline radiation. The main steamline radiation indication and alarm is still available as part of the minimum inventory. No specific HFE review criteria are applicable to this departure.

- STD DEP T1 2.14-1 Deletion of the Flammability Gas Control System

This departure was evaluated in Chapter 6 of this SER.

This Tier 1 departure is described in detail in STP COL application Part 7, "Departures Report." In summary, the departure (as it affects Chapter 18) deletes all references to the "Flammability Gas Control System" from the EPGs. This departure updates the EPGs to reflect to the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release. No specific HFE review criteria are applicable to this departure.

#### **18.13.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **18.13.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to Appendix 18F, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 2.3-1 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. This departure updates the minimum inventory list to reflect the removal of automatic MSIV closure and trip on high steamline radiation.
- STD DEP T1 2.14-1 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. This departure updates the EPGs to

reflect to the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.

The staff's review confirmed that the applicant has adequately addressed the Tier 1 departures, in accordance with Section 18 of NUREG-0800.

## **18.14 Appendix 18G Design Development and Validation Testing**

### **18.14.1 Introduction**

Appendix 18G, "Design Development and Validation Testing," contains descriptions of the studies, evaluations, and validation testing performed during the fabrication and testing of prototype control room HSI equipment designs. The results of this development program form the basis for the ABWR control room HSI design.

### **18.14.2 Summary of Application**

Appendix 18G of the STP Units 3 and 4 COL FSAR incorporates by reference Appendix 18G of the certified ABWR DCD Revision 4.

In addition, in COL FSAR Appendix 18G, the applicant provides the following:

#### **Supplement**

The applicant has added a paragraph explaining that the information in this appendix provides a historical description of activities that occurred between 1986 and 1992. The information may not reflect the current design, which is controlled by DCD Sections 18.7 and 18.8.1 and Appendix 18E.

### **18.14.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1503.

There is no regulation applicable to the supplement.

### **18.14.4 Technical Evaluation**

As documented in NUREG-1503, NRC staff reviewed and approved Section 18G of the certified ABWR DCD. The staff also reviewed Section 18G of the STP COL FSAR. The staff checked the referenced DCD to ensure that the combination of information in the COL FSAR

and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18G.

The staff reviewed the supplement that explains the applicability of Appendix 18G. The supplement correctly states that design development and validation testing are part of the HSI

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

design process controlled by Sections 18.7 and 18.8.1 and Appendix 18E of the referenced ABWR DCD. Appendix 18G only provides historical documentation.

#### **18.14.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **18.14.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to Appendix 18G, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff concluded that the supplement contains no information that is subject to regulation.

### **18.15 Appendix 18H Supporting Analysis for Emergency Operation Information and Controls**

#### **18.15.1 Introduction**

Appendix 18H, "Supporting Analysis for Emergency Operation Information and Controls," contains the supporting analysis of information and control needs of the main control room operators. This information was used to develop the Minimum Inventory listed in Appendix 18F.

#### **18.15.2 Summary of Application**

Appendix 18H of the STP Units 3 and 4 COL FSAR incorporates by reference Appendix 18H of the certified ABWR DCD Revision 4.

In addition, in COL FSAR Appendix 18H, the applicant provides the following:

##### Tier 1 Departures

- STD DEP T1 2.3-1                      Deletion of MSIV Closure and Scram on High Radiation

The MSIV closure and scram were removed because they were not specifically credited in any ABWR safety analysis. Their removal increases operating reliability by eliminating spurious trips caused by minor variations in the N-16 flow.

As applied to this section, the departure reflects the exclusion of the automatic trip function from the supporting analysis of control room information and control needs. The main steamline radiation indication and alarm is still available as part of the minimum inventory.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

10 CFR 50.44, “Combustible gas control for nuclear power reactors,” was amended after the issuance of the design certification for the ABWR. The amended 10 CFR 50.44 eliminates the requirements for hydrogen control systems to mitigate a design-basis LOCA hydrogen release. As a result of this change, the use of the containment hydrogen and oxygen monitoring instrumentation in the mitigation of a design-basis LOCA is also eliminated.

As applied to this section, this departure reflects the exclusion of equipment needed to mitigate a design-basis LOCA hydrogen release from the supporting analysis of control room information and control needs.

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 10.4-5 Condensate and Feedwater System

Technical Specification 3.3.4.2 Bases is changed to show that there are four feedwater pumps that require four feedwater pump adjustable speed drives (ASDs). The referenced ABWR DCD specifies two feedwater pump ASDs.

**18.15.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG–1503.

Departures taken in the COL application were assessed against HFE program guidance contained in NUREG-0800, “Standard Review Plan,” Chapter 18 and NUREG-0711, “Human Factors Engineering Program Review Model.”

**18.15.4 Technical Evaluation**

As documented in NUREG–1503, NRC staff reviewed and approved Section 18H of the certified ABWR DCD. The staff reviewed Section 18H of the STP COL FSAR. The staff also checked the referenced DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18H.

The staff reviewed the information in the STP COL FSAR:

Tier 1 Departure

- STD DEP T1 2.3-1 Deletion of MSIV Closure and Scram on High Radiation

This departure was evaluated in Chapter 11 of this SER.

This Tier 1 departure is described in detail in STP COL application Part 7, “Departures Report.” In summary, the departure (as it affects Chapter 18) excludes references to the DCD tables that

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

list the functions associated with the high steamline radiation automatic trip function. This departure updates the minimum inventory list to reflect the removal of automatic MSIV closure and trip on high steamline radiation. The main steamline radiation indication and alarm is still available as part of the minimum inventory. No specific HFE review criteria are applicable to this departure

- STD DEP T1 2.14-1                      Hydrogen Recombiner Requirements Elimination

This departure was evaluated in Chapter 6 of this SER.

This Tier 1 departure is described in detail in STP COL application Part 7, "Departures Report." In summary, the departure (as it affects Chapter 18) excludes references to the DCD tables that list functions associated with the "Flammability Gas Control System." This departure updates the EPGs to reflect to the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release. No specific HFE review criteria are applicable to this departure.

*Tier 2 Departures requiring Prior NRC approval*

- STD DEP 10.4-5                      Condensate and Feedwater System

With respect to Chapter 18, this departure added information explaining that condensate booster pumps have been added to the condensate and feedwater system design. This change in system configuration does not affect any of the HFE processes described in Chapter 18 of the DCD.

**18.15.5 Post Combined License Activities**

There are no post COL activities related to this section.

**18.15.6 Conclusion**

NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to Appendix 18H, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to systems integration that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference into 10 CFR Part 52, Appendix A. The staff's conclusion is based on the following:

- STD DEP T1 2.3-1 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. This departure updates the minimum inventory list to reflect the removal of automatic MSIV closure and trip on high steamline radiation.

- STD DEP T1 2.14-1 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. The departure updates the EPGs to reflect to the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.
- STD DEP 10.4-5 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. This departure updates the condensate feedwater system design to reflect the addition of condensate booster pumps.

The staff's review confirmed that the applicant has adequately addressed the Tier 1 departures, in accordance with Section 18 of NUREG-0800.