18.0 HUMAN FACTORS ENGINEERING

18.1 Introduction

This section of the Final Safety Analysis Report (FSAR) summarizes the information in Chapter 18 regarding the Advanced Boiling-Water Reactor (ABWR) design control document (DCD).

Section 18.1 of the South Texas Project (STP), Units 3 and 4, combined license (COL) FSAR Revision 12, incorporates by reference Section 18.1, "Introduction," of the certified ABWR DCD Revision 4, referenced in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor," with no departures or supplements. The 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.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR 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, Units 3 and 4, COL FSAR, Revision 12, incorporates by reference Section 18.2, "Design Goals and Design Bases," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR 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 provided 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, Units 3 and 4, COL FSAR, Revision 12, incorporates by reference Section 18.3, "Planning, Development, and Design," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to

[1] 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.

this section remains for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the planning, development, and design have been resolved.

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 proposed 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, "Control Room Standard Design Features," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Section 18.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 18.4, the applicant provided the following:

Tier 1 Departure

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

The applicant proposed 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 engineered safety features (ESF) logic and control system.

Tier 2 Departure Requiring Prior NRC Approval

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

The applicant revises post-accident monitoring design parameters to include drywell- and wetwell-related indications. Wetwell pressure has been added to the list of safety parameter display system (SPDS) indications and made available on the control room large display panel. Other changes were made to improve the consistency between Regulatory Guide (RG) 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plant," and the

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

technical specifications (TS); the DCD; and the COL application (COLA). 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 proposed a Tier 2 departure from the ABWR DCD that relocates the main generator synchronization to the main control room (MCR) panel. This change provided 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 (PGC) system (PGCS).

18.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling-Water Reactor Design," (July 1994) (final safety evaluation report related to the ABWR DCD). In addition, the relevant requirements of the Commission regulations for the control room standard design features, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, (LWR Edition)," the Standard Review Plan.

Departures taken in the COLA were assessed against the Human Factors Engineering (HFE) Program guidance in Chapter 18 of NUREG–0800 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 U.S. Advanced Boiling Water Reactor," the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures affecting TS require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59, "Changes, tests, and experiments."

18.4.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 18.4, "Control Room Standard Design Features," of the certified ABWR DCD. The NRC staff reviewed Section 18.4 of the STP, Units 3 and 4, COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.[1] The NRC 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.

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

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is described in detail in the COLA, Part 7, "Departures Report." In summary, the departure contains five primary changes associated with updating the ABWR I&C design 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 is evaluated in Chapter 7 of this SER.

This departure results in two changes in Chapter 18, which 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 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 second 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 HFE design element.

However, the FSAR description of this departure appears to be in error. FSAR Subsection 18.4.2.1(3) indicates that there are two sets of VDUs, one for non-safety-related applications and one for safety-related applications. The text indicates that both sets are entirely independent of the plant computer functions. According to FSAR Subsection 18.4.2.4, only the safety-related VDUs are independent of the plant computer functions. The NRC staff issued Request for Additional Information (RAI) 18-4 requesting the applicant provide clarification on the operation of the two sets of VDUs being entirely independent of the plant computer functions, . In its response to RAI 18-4, dated November 10, 2009 (ML093170222), the applicant corrected FSAR Subsection 18.4.2.1(3) and committed to include this correction in the next FSAR revision. The NRC staff verified that the applicant has incorporated this change in the COLA, Revision 4. Therefore, this RAI is closed.

In summary, this departure updated 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 is evaluated in Chapter 7 of this SER.

The impact of this departure on Chapter 18 is to add wetwell pressure to the list of SPDS indications made available on the control room large display panel (LDP). As the applicant stated in the departure description, this change provided a 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 the primary containment from exceeding pressure or temperature limits. This change is consistent with the HFE Program guidance in that it improves the operator's ability to manage operational challenges.

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 stated in the departure description, this change allocates space on the main control console for more critical tasks and allows for: (1) manual synchronization of the main generator by the control room operator, or (2) automatic synchronization by the PGCS. The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. Within the review scope of this section, the NRC staff determined it to be reasonable that the departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is 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

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC staff reviewed the COLA and checked the referenced DCD. The NRC staff's review confirmed that the applicant has addressed the required information relating to control room standard design features, 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 10 CFR 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 NRC staff compared the information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review confirmed that the applicant has adequately addressed the Tier 1 departure in accordance with Chapter 18 of NUREG–0800 and confirmed that the applicant has adequately addressed the Departure STD DEP 7.5-1 in Chapter 7 of this SER. The NRC staff determined that Tier 2 departure 18.4-1 were properly characterized as not requiring prior NRC approval per 10 CFR Part 52 Appendix A, Section VIII.B.5.

The NRC staff concluded that the relevant information presented in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion is based on the following:

- Departure STD DEP T1 3.4-1 was evaluated against the HFE Program criteria and was determined to be consistent with that guidance. The departure updated the safety-

related I&C architecture to current technologies and provided clarification of the digital controls nomenclature and system interfaces. This change does not introduce additional HSIs or any specific HFE design requirement.

- Departure 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 LPD. 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 identifies Departure STD DEP 18.4-1 describing the synchronization circuit relocation. The NRC staff determined it to be reasonable that this departure does not need prior NRC approval. The applicant provided sufficient information to satisfy 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 HSI are being applied. The combination of these changes with the design certification (DC) that is included by reference provided reasonable assurance that this section will effectively support the HFE design development.

18.5 Remote Shutdown System

The remote shutdown system (RSS) provided a means to safely shut down the plant from outside of the MCR. The RSS enables the 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, "Remote Shutdown System," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Section 18.5 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the RSS 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.

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

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, "Systems Integration," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Section 18.6 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 18.6, the applicant provided the following:

Tier 1 Departure

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

The applicant proposed 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 ESF logic and control system.

18.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for system integration, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 departure. This departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4.

18.6.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 18.6 of the certified ABWR DCD. The NRC staff reviewed Section 18.6 of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC staff's review

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

confirmed that the information in the application and the information incorporated by reference address the required information relating to systems integration.

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is described in detail in the COLA, Part 7, "Departures Report." In summary, this departure contains five primary changes associated with updating the ABWR I&C design 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 is evaluated in Chapter 7 of this SER.

The impact of this 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."

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 inspections, tests, analyses, and acceptance criteria (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 updated the safety-related I&C architecture to current technologies and clarified 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

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC 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. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR 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 NRC staff compared the information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review confirmed that the applicant has adequately addressed the Tier 1 departure in accordance with Chapter 18 of NUREG–0800.

The NRC 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 NRC staff's conclusion is based on the following:

- Departure STD DEP T1 3.4-1 updated 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 section will effectively support the HFE design development.

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 Revision 12, incorporates by reference Section 18.7, "Detailed Design of the Operator Interface System," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR 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.

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

18.8 COL License Information

18.8.1 Introduction

This section of the FSAR describes evaluations and information that are the responsibility of COL applicants referencing the ABWR DCD.

18.8.2 Summary of Application

Section 18.8, "COL License Information," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Section 18.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Section 18.8, the applicant provided the following:

Tier 1 Departure

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

The applicant proposed 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 ESF logic and control system.

COL License Information Items

- COL License Information Item 18.1 HSI Design Implementation Process

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

- 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.

- 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.

- 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.

- 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.

- COL License Information Item 18.6 Remote Shutdown System Design Evaluation

This COL license information item discusses the reliability and design adequacy of the RSS.

- COL License Information Item 18.7 Local Valve Position Indication

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

- COL License Information Item 18.8 Operator Training

This COL license information item discusses the operator training program.

- COL License Information Item 18.9 Safety System Status Monitoring

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

- COL License Information Item 18.10 PGCS Malfunction

This COL license information item discusses malfunctions of the PGC function.

- 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.

- 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.

- COL License Information Item 18.13 Accident Monitoring Instrumentation

This COL license information item discusses accident monitoring instrumentation requirements.

- COL License Information Item 18.14 In-Core Cooling Instrumentation

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

- COL License Information Item 18.15 Performance of Critical Tasks

This COL license information item discusses HSIs for critical tasks.

- 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 are addressed in NUREG–1503.

18.8.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the HFE Program, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 departure. This departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4.

18.8.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 18.8 of the certified ABWR DCD. The NRC staff reviewed Section 18.8 of the STP, Units 3 and 4, COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC 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 NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is 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 current practices 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.

[1] 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 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 updated 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 provided 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.

- COL License Information Item 18.1 HSI Design Implementation Process

In STP, Units 3 and 4, FSAR Section 18.8.1, the applicant stated that the HSI design implementation process is conducted in accordance with Appendix 18E, "ABWR Human System Interface Design Implementation Process." The ITAAC listed in DCD Tier 1, Table 3.1 are specifically designed to track implementation of Appendix 18E, which provided acceptance criteria for the implementation plans described in the ITAAC. The NRC staff reviewed these ITAAC and confirmed 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.

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

In STP, Units 3 and 4, FSAR Section 18.8.2, the applicant stated that the number of operators needing access to the controls on the main control panel is determined in accordance with DCD Tier 1, Table 3.1, ITAAC Item 3.a(3)(c) related to personnel skills and ITAAC Item 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 Item 6.a(4)(b), which relates to control room staffing. The NRC staff reviewed these ITAAC and confirmed they covered the scope of COL License Information Item 18.2. COL License Information Item 18.2 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

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

In STP, Units 3 and 4, FSAR Section 18.8.3, the applicant stated that the evaluation of automation strategies and the confirmation of automation design are performed in accordance with Table 18E-1 and DCD Tier 1, Table 3.1, ITAAC Item 1.b. The NRC staff determined that these references do not provide specific directions for automation therefore, the NRC staff issued RAI 18-1. In its response to RAI 18-1, dated July 23, 2009 (ML092080081), the applicant indicated that the automation strategies would be addressed in accordance with ITAAC Items 1.b and 3.a. The combination of acceptance criteria from Table 18E-1 for both ITAAC Items 1.b and 3.a provided a complete set of criteria that makes those two ITAAC redundant to this COL information item. The applicant's response indicates that FSAR Section 18.8.3 will be revised accordingly to include a reference to ITAAC Item 3.a. The NRC staff considers the response

acceptable and RAI 18-1 is resolved and closed. The NRC staff verified that the applicant had incorporated this change in COL FSAR Revision 4. Therefore, COL License Information Item 18.3 is closed.

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

In STP, Units 3 and 4, FSAR Section 18.8.4, the applicant stated:

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

- COL License Information Item 18.5 Standard Design Features Design Validation

In STP, Units 3 and 4, FSAR Section 18.8.5, the applicant stated that design validation is performed in accordance with DCD Tier 1, Table 3.1, ITAAC Item 6. The NRC staff reviewed this ITAAC and confirmed that it covered the scope of COL License Information Item 18.5. COL License Information Item 18.5 is closed, because it is redundant to existing ABWR DCD HFE ITAAC.

- COL License Information Item 18.6 Remote Shutdown System Design Evaluation

In STP, Units 3 and 4, FSAR Section 18.8.6, the applicant stated that the evaluation of reliability and the confirmation of design adequacy of the RSS are performed in accordance with DCD Tier 1, Table 3.1, "Human Factors Engineering," ITAAC Item 1.b(3), which relates to training; ITAAC Item 6.a(2)(a), which relates to validating equipment hardware- and software-driven functions; and ITAAC Item 6.a(6), which relates to performance measures.

COL License Information Item 18.6 stated that "digital versus analog design approaches" for the RSS will be evaluated. The NRC staff understood this to be a pre-design or design activity versus a V&V activity. However, ITAAC Item 6 only addresses V&V activities, and the ITAAC Item 1 reference only addresses training, therefore, the NRC staff issued RAI 18-2. In its response to RAI 18-2, dated July 23, 2009 (ML092080081), the applicant described the RSS HFE design approach, which includes the following elements:

- The RSS design will be in accordance with ABWR DCD Tier 2, Subsections 7.4.1.4, "Remote Shutdown System," and 7.4.2.4, "Remote Shutdown System-Instrumentation

and Controls," and Section 18.5, "Remote Shutdown System." They 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, the 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 Tier 1, Table 3.1, ITAAC Item 5.a(2), which relates 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 will be performed in accordance with Tier 1, Table 3.1, ITAAC Item 5.a(2).

The applicant's RAI response 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 the 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 NRC staff determined this plan to be acceptable. By including ITAAC Item 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 provided reasonable assurance that the RSS will include an HFE design that will minimize operator error or confusion if the RSS must be used. This process provided a satisfactory way to address the original issue of whether an analog (versus a 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 Item 5.a (2). The NRC staff considers the response to be acceptable and RAI 18-2 is resolved and closed. The NRC staff verified that the applicant incorporated this change in COL FSAR Revision 4. Therefore, COL License Information Item 18.6 is closed.

- COL License Information Item 18.7 Local Valve Position Indication

In STP, Units 3 and 4, FSAR Section 18.8.7, the applicant stated 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 [2 inches]) 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 NRC staff issued RAI 18-3. In its response, dated July 23, 2009 (ML092080081), the applicant clarified 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 NRC staff determined this position to be acceptable for the following reasons:

An evaluation will ensure that design-basis information is captured for a local VPI.

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, "Local Valve Position Indication," will be updated accordingly. The applicant notes the need to address local valve indications and identifies the method to do so. The NRC staff considers the response to be acceptable and RAI 18-3 is resolved and closed. The NRC staff verified the applicant incorporated this change in COL FSAR Revision 4. Therefore, COL License Information Item 18.7 is closed.

- COL License Information Item 18.8 Operator Training

In STP, Units 3 and 4, FSAR Section 18.8.8, the applicant stated that the identification of personnel training needs is performed in accordance with DCD Tier 1, Table 3.1, ITAAC Item 1.b(3), which relates to training. The NRC staff reviewed this ITAAC and confirmed that it covered 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.

- COL License Information Item 18.9 Safety System Status Monitoring
- COL License Information Item 18.13 Accident Monitoring Instrumentation
- COL License Information Item 18.14 In-Core Cooling Instrumentation
- 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 the inclusion of the instrumentation in the MCR does not create a potential for human error. ABWR DCD Appendix 18E, "ABWR Human-System Interface Design Implementation Process," provided 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 V&V process.

In STP, Units 3 and 4, FSAR Sections 18.8.9, "Safety System Status Monitoring," 18.8.13, "Accident Monitoring Instrumentation," 18.8.14, "In-Core Cooling Instrumentation," and 18.8.16, "Plant Status and Post Accident Monitoring," the applicant stated that the HSI design implementation process is conducted in accordance with Appendix 18E, "ABWR Human-System Interface Design Implementation Process." This reference is appropriate, because the material applies directly to the subject of the COL license information items. The ITAAC listed in

DCD Tier 1, Table 3.1 are specifically designed to track the implementation of Appendix 18E, which provided acceptance criteria for the implementation plans described in the ITAAC. The NRC staff reviewed these ITAAC and confirmed that they covered 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.

- COL License Information Item 18.10 PGCS Malfunction

In STP, Units 3 and 4, FSAR Section 18.8.10, "PGCS Malfunction," the applicant stated that this malfunction is evaluated in accordance with DCD Tier 1, Table 3.1, ITAAC Item 6.a(5), which relates to operational conditions and upsets; and ITAAC Item 6.a(6), which relates to performance measures. The NRC staff reviewed these ITAAC and confirmed that they covered 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.

- COL License Information Item 18.11 Local Control Stations

In STP, Units 3 and 4, FSAR Section 18.8.11, "Local Control Stations," the applicant stated that the evaluation of operations at local control stations critical to plant safety is performed in accordance with DCD Tier 1, Table 3.1, ITAAC Item 2.a(3), which relates to critical functions; ITAAC Item 4.a(3), which relates to critical tasks; and ITAAC Item 6.a(4)(a), which relates to function and task achievement. The NRC staff reviewed these ITAAC and confirmed that they covered 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.

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

In STP, Units 3 and 4, FSAR Section 18.8.12, "As-Built Evaluation of MCR and RSS," the applicant stated 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 DCD Tier 1, Table 3.1, ITAAC Item 7, and the results are documented in a report. The NRC staff reviewed this ITAAC and confirmed that it covered 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.

- COL License Information Item 18.15 Performance of Critical Tasks

In STP, Units 3 and 4, FSAR Section 18.8.15, "Performance of Critical Tasks," the applicant stated that the HSI evaluation for the timely performance of critical tasks is performed in accordance with DCD Tier 1, Table 3.1, ITAAC Item 2.a(3), which relates to critical functions; ITAAC Item 4.a(3), which relates to critical tasks; and ITAAC Item 6.a(4)(a), which relates to function and task achievement. The NRC staff reviewed these ITAAC and confirmed that they covered 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

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the COLA and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to COL information items, and no outstanding information was expected to be addressed in the COL FSAR related to COL license information. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR 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.

The NRC staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review concluded that the applicant has adequately addressed COL License Information Items 18.1 through 18.16, and the Tier 1 departure in accordance with Chapter 18, "Human Factors Engineering," of NUREG-0800.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion is based on the following:

- Departure STD DEP T1 3.4-1 updated 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 license information items are redundant to the ITAAC and therefore can be closed. The ITAAC provide reasonable assurance that implementation plans and HFE design will be developed in accordance with the DC.

18.9 Appendix 18A Emergency Procedure Guidelines and Appendix 18B Difference between BWROG EPG Revision 4 and ABWR EPG

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 12, incorporates by reference Appendices 18A and 18B of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Appendices 18A and 18B, the applicant provided 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 containment hydrogen and the oxygen monitoring instrumentation used in the mitigation of a design-basis LOCA are 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. In addition, the relevant requirements of the Commission regulations for the HFE, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 departure. This departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4.

18.9.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendices 18A and 18B of the certified ABWR DCD. The NRC staff reviewed Appendices 18A and 18B of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the ABWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and the information incorporated by reference addressed the required information relating to Appendices 18A and 18B.

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure is evaluated in Chapter 6 of this SER.

This departure is described in detail in the COLA, Part 7, "Departures Report." In summary, the departure deletes all references to the "Flammability Gas Control System" in the EPG. The NRC staff determined that the EPG material in these appendices have been appropriately updated to reflect this departure. There are no other HFE review criteria that are applicable to this departure.

[1] 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.

18.9.5 Post Combined License Activities

There are no post COL activities related to this section.

18.9.6 Conclusion

The NRC staff's finding related to the information incorporated by reference is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC 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 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the Appendix 18A, "Emergency Procedure Guidelines," and Appendix18B, "Difference Between BWROG EPG Revision 4 and ABWR EPG," that were incorporated by reference have been resolved.

The NRC staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review concluded that the applicant adequately addressed the Tier 1 departure in accordance with Chapter 18 of NUREG–0800.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion is based on the following:

- Departure STD DEP T1 2.14-1 updated the 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 will continue to contain the necessary information needed to support the HFE design development.

18.10 Appendix 18C Operator Interface Equipment Characterization

18.10.1 Introduction

This FSAR appendix describes an operator interface system that meets the control room standard design features described in DCD Tier 2, Section 18.4.

18.10.2 Summary of Application

Appendix 18C of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 18C of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

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

Tier 1 Departure

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

The applicant proposed 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 engineered safety features logic and control system.

18.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the HFE, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 departure. This departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4.

18.10.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix C of the certified ABWR DCD. The NRC staff reviewed Appendix 18C, "Operator Interface Equipment Characterization," of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and the information incorporated by reference addressed the required information relating to Appendix 18C.

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is evaluated in Chapter 7, "Instrumentation and Control Systems," 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 "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 current practices in the I&C and HFE

[1] 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.

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 updated the safety-related I&C architecture to current technologies and clarified 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

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC 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. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the operator interface equipment characterization that were incorporated by reference have been resolved.

The NRC staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review concluded that the applicant has adequately addressed the Tier 1 departure in accordance with Chapter 18 of NUREG–0800.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion is based on the following:

- Departure STD DEP T1 3.4-1 updated the safety-related I&C architecture to current technologies and clarified 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 the HFE design development.

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

The EPGs in Appendix 18A, "Emergency Procedure Guidelines," 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, "Emergency Procedures Guidelines-Input Data and Calculation results," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 18D of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures

or supplements. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The NRC staff's review confirmed that there is no outstanding issue related to this section. Pursuant to10 CFR 52.63(a)(5) and 10 CFR 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

This FSAR appendix 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, ABWR Human-System Interface Design Implementation Process," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 18E of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Appendix 18E, the applicant provided the following:

Tier 1 Departure

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

The applicant proposed 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 ESF logic and control system.

Tier 2 Departure*

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

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

[1] 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. In addition, the relevant requirements of the Commission regulations for the HFE, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 and one Tier 2* departure. The Tier 1 departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. The Tier 2* departure requires prior NRC approval and is subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.6.

18.12.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix 18E of the certified ABWR DCD. The NRC staff reviewed Appendix 18E of the STP, Units 3 and 4, COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC staff's review confirmed that the information in the application and the information incorporated by reference addressed the required information relating to Appendix 18E.

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is 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 Changes

The DCD provided 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

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

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 deleted Mil Std 1478 is also not directly associated with any acceptance criteria. The deletion of the Mil Std from the list is acceptable.

18.12.5 Post Combined License Activities

There are no post COL activities related to this section.

18.12.6 Conclusion

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC 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. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the ABWR HSI design implementation process that were incorporated by reference have been resolved.

The NRC staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review concluded that the applicant has adequately addressed the Tier 1 and Tier 2* departures in accordance with Chapter 18 of NUREG–0800.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion is based on the following:

- Departure STD DEP T1 3.4-1 updated 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 the HFE design development.

- Departure 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.

18.13 Appendix 18F Emergency Operation Information and Controls

18.13.1 Introduction

This FSAR appendix contains the results of an analysis of information and control needs of the MCR 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, "Emergency Operation Information and Controls," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix18F of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Appendix 18F, the applicant provided the following:

Tier 1 Departures

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

The main steamline isolation valve (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 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. In addition, the relevant requirements of the Commission regulations for the HFE, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies Tier 1 departures. These departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4.

18.13.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 18F of the certified ABWR DCD. The NRC staff reviewed Appendix 18F of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC staff's review

[1] 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.

confirmed that the information in the application and the information incorporated by reference address the required information relating to Appendix 18F.

The NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departures

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

This departure is evaluated in Chapter 11 of this SER.

This departure is described in detail in the COLA, 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 updated the minimum inventory list to reflect the removal of the 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 is evaluated in Chapter 6, "General," of this SER.

This departure is described in detail in the COLA, 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 updated the EPGs to reflect to the elimination of the requirement to maintain the 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

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant has addressed the required information, 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 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the emergency operation information and controls that were incorporated by reference have been resolved.

In addition, the NRC staff compared the information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review confirmed that the applicant has adequately addressed the Tier 1 departures in accordance with Chapter 18 of NUREG–0800.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion was based on the following:

- Departure 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 updated the minimum inventory list to reflect the removal of the automatic MSIV closure and trip on high steamline radiation.

- Departure STD DEP T1 2.14-1 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to the HFE Program guidance. This departure updated the EPGs to reflect to the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.

18.14 Appendix 18G Design Development and Validation Testing

18.14.1 Introduction

This FSAR appendix contains descriptions of the studies, evaluations, and validation tests 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, "Design Development and Validation Testing," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 18G of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

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

Supplemental Information

The applicant provided additional text explaining that the information in the referenced ABWR DCD provided a historical description of activities that occurred between 1986 and 1992. The applicant adds that this information may not reflect the current design, which is controlled by DCD Tier 2, Sections 18.7, "Detailed Design of the Operator Interface System," and 18.8.1, "HIS Design Implementation Process," 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 this supplement.

18.14.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix 18G of the certified ABWR DCD. The NRC staff reviewed Appendix 18G of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The NRC staff's review

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

confirmed that the information in the application and the information incorporated by reference addressed the required information relating to Appendix 18G.

The NRC staff reviewed the following information in the COL FSAR:

Supplemental Information

The NRC staff reviewed the supplemental information that explains the applicability of Appendix 18G. The NRC staff agreed with the applicant's statement that design development and validation testing are part of the HSI design process controlled by Sections 18.7 and 18.8.1 and Appendix 18E of the referenced ABWR DCD. Appendix 18G only provided historical documentation.

18.14.5 Post Combined License Activities

There are no post COL activities related to this section.

18.14.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant has addressed the required information, 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 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the design development and validation testing that were incorporated by reference have been resolved.

In addition, the NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC 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

This FSAR appendix contains the supporting analysis of information and control needs of the MCR operators. This information was used to develop the minimum inventory listed in Appendix 18F.

18.15.2 Summary of Application

Appendix 18H, "Supporting Analysis for Emergency Operation Information and Controls," of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 18H of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Appendix 18H, the applicant provided 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 was amended after the issuance of the DC 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

TS 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. In addition, the relevant requirements of the Commission regulations for the HFE, and the associated acceptance criteria, are in Chapter 18 of NUREG–0800 and NUREG–0711.

In accordance with Section VIII, “Processes for Changes and Departures,” of “Appendix A to Part 52-Design Certification Rule for the U.S. Advanced Boiling Water Reactor,” the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures affecting TS require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4.

18.15.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix 18H of the certified ABWR DCD. The NRC staff reviewed Appendix 18H of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents

the complete scope of information relating to this review topic.[1] The NRC 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 NRC staff reviewed the following information in the COL FSAR:

Tier 1 Departure

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

This departure is evaluated in Chapter 11 of this SER.

This departure is described in detail in COLA, Part 7. In summary, the departure (as it affects Chapter 18) excludes references to the DCD tables that list the functions associated with the high steamline radiation automatic trip function. This departure updated 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 is evaluated in Chapter 6 of this SER.

This departure is described in detail in COLA, Part 7. 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 updated the EPGs to reflect 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

TS 3.3.4.2, "Feedwater Pump and Main Turbine trip Instrumentation," bases is changed to show that there are four feedwater pumps that require four feedwater pump ASDs. The referenced ABWR DCD specifies two feedwater pump ASDs. This change in system configuration does not affect any of the HFE processes described in Chapter 18 of the DCD. The new configuration is evaluated for its impact on operator performance as part of ITAAC Item 4 (task analysis) from DCD Tier 1, ITAAC Table 3.1.

18.15.5 Post Combined License Activities

There are no post COL activities related to this section.

18.15.6 Conclusion

The NRC staff's finding related to information incorporated by reference, is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's

[1] 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.

review confirmed that the applicant has addressed the required information, 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 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the supporting analysis for emergency operation information and controls that were incorporated by reference have been resolved.

In addition, the NRC staff compared the information in the COLA to the relevant NRC regulations, the guidance in Chapter 18 of NUREG–0800. The NRC staff's review confirmed that the applicant has adequately addressed the Tier 1 departures in accordance with Chapter 18 of NUREG–0800, and confirmed that the applicant has adequately addressed the Departure STD DEP 10.4-5 in Chapter 6 of this SER.

The NRC staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements defined in the ABWR DCD. The NRC staff's conclusion was based on the following:

- Departure 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 updated the minimum inventory list to reflect the removal of the automatic MSIV closure and trip on high steamline radiation.

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

- Departure STD DEP 10.4-5 was evaluated against the required exemption criteria. The evaluation is satisfactory with respect to HFE Program guidance. This departure updated the TS bases to reflect a different feedwater system configuration. Four feedwater pump ASDs are used instead of two.