

4.0 REACTOR

This chapter of the application describes the reactor assembly, which consists of the reactor pressure vessel (RPV), pressure containing appurtenances that include control rod drive (CRD) housings, in-core instrumentation housing, and the head vent and spray assembly. The RPV includes the reactor internal pump (RIP) casing and flow restrictors in each of the steam outlet nozzles and the shroud support and pump deck that form the partition between the RIP suction and discharge.

4.1 Summary Description

The major reactor internal components are the core (fuel, channels, control blades, CRDs and instrumentation); the core support structure (including the shroud, top guide, and core plate); the shroud head and steam separator assembly; the steam dryer assembly; the feedwater spargers; RIPs; and the core flooding spargers. Except for the Zircaloy in the reactor core, these reactor internals are stainless steel or other corrosion-resistant alloys. The fuel assemblies (including fuel rods and channel), control blades, shroud head and steam separator assembly, and steam dryers and in-core instrumentation dry tubes are removable when the reactor vessel is opened for refueling or maintenance.

Section 4.1 of the South Texas Project (STP) combined license (COL) Final Safety Analysis Report (FSAR) incorporates by reference, with no departures or supplements, Section 4.1, "Summary Description," of Revision 4 of the certified Advanced Boiling-Water Reactor (ABWR) Design Control Document (DCD), Revision 4, which is, itself incorporated by referenced into 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 remained remains for review¹. The staff's review confirmed that there is no outstanding issue related to this subsection. 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.

4.2 Fuel System Design

4.2.1 Introduction

This section of the application addresses the thermal, mechanical, and materials design of the fuel system. The fuel system consists of arrays (assemblies or bundles) of fuel rods including fuel pellets, insulator pellets, springs, tubular cladding, end closures, hydrogen getters, and fill gas; burnable poison rods that include components similar to those in fuel rods; spacer grids and springs; end plates; channel boxes; and reactivity control rods. This section discusses the fuel system design and reactivity control elements of the control rods that extend from the coupling interface of the CRD mechanism into the core.

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.

4.2.2 Summary of Application

Section 4.2 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.2 of the certified ABWR DCD Revision 4 referenced in 10 CFR Part 52, Appendix A, with two administrative departures.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

In FSAR Subsection 4C.3.4 the administrative departure changes the following text in Section 4C.3.4 of the ABWR DCD from:

Scram time insertion performance and control rod drop times affect the total reactivity inserted into the core.

to the following text in Section 4C.3.4 in the STP Units 3 and 4 COL:

Scram time insertion performance affects the total reactivity inserted into the core.

In FSAR Subsection 4D the administrative departure changes Design Criterion 8 (page 4D-7 of the DCD) from,

For a super prompt critical reactivity insertion accident originating from any operating condition, the net prompt reactivity feedback due to prompt heating of the moderator and fuel is negative.

to the following text on page 4D-5 in the STP Units 3 and 4 COL FSAR:

A negative moderator temperature coefficient shall be maintained above hot standby.

4.2.3 Regulatory Basis

The regulatory basis for 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) (FSER related to the ABWR DCD).

4.2.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 4.2 of the certified ABWR DCD. NRC staff reviewed Section 4.2 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.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to fuel system design.

The staff reviewed the information in the COL FSAR:

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.

Appendix 4B Fuel Licensing Acceptance Criteria

Appendix 4B of the ABWR DCD contains the fuel licensing acceptance criteria for evaluating fuel designs and for determining the applicability of generic analyses to these designs. This is supplementary information supporting the Fuel System Design discussed in ABWR DCD Section 4.2. The staff reviewed and approved Appendix 4B as documented in NUREG-1503.

The COL applicant incorporates by reference Appendix 4B of the certified ABWR DCD referenced in Appendix A to 10 CFR Part 52. No departures from the certified design are identified. The applicant has submitted the applicable proprietary information as required by Section IV.A.3 of the ABWR Design Certification Rule.

Any change to the criteria in Appendix 4B requires prior NRC review and approval.

Appendix 4C Control Rod Licensing Acceptance Criteria

Appendix 4C of the ABWR DCD contains the control rod licensing acceptance criteria for evaluating new control rod designs. This is supplementary information supporting the Fuel System Design discussed in ABWR DCD Section 4.2. The staff reviewed and approved Appendix 4C as documented in NUREG-1503.

The applicant incorporates by reference Appendix 4C of the certified ABWR DCD referenced in Appendix A to 10 CFR Part 52 with one administrative departure. This administrative departure changes the text in Section 4C.3.4, "Reactivity," of the ABWR DCD to agree with the terminology used in the technical specifications. Therefore, this departure is acceptable.

Any change to the criteria in Appendix 4C requires prior NRC review and approval.

Appendix 4D Reference Fuel Design Compliance with Acceptance Criteria

Appendix 4D of the ABWR DCD contains the fuel design compliance with the fuel licensing acceptance criteria (from Appendix 4B). This supplementary information supports the Fuel System Design discussed in ABWR DCD Section 4.2. The staff reviewed and approved Appendix 4D as documented in NUREG-1503.

The applicant incorporates by reference Appendix 4D of the certified ABWR DCD referenced in Appendix A to 10 CFR Part 52 with one administrative departure. The updated Design Criterion 8 in the STP Units 3 and 4 FSAR imposes a more stringent requirement than the criterion approved by NRC staff for the ABWR DCD. Therefore, this administrative departure is acceptable.

4.2.5 Post Combined License Activities

There are no post COL activities related to this section.

4.2.6 Conclusion

The NRC 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 fuel system design that were incorporated by reference have been resolved and all administrative departures are acceptable.

4.3 Nuclear Design

4.3.1 Introduction

This section of the application addresses whether the nuclear design of the fuel assemblies, control systems, and reactor core is carried out to aid in confirming that fuel design limits will not be exceeded during normal operation or anticipated operational occurrences, including stability, and that postulated reactivity events will not (1) violate specified acceptable fuel design limits; (2) cause significant damage to the reactor coolant pressure boundary; or (3) impair the capability to cool the core.

4.3.2 Summary of Application

Section 4.3 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.3 of the certified ABWR DCD Revision 4, with no departures. In addition, in COL FSAR Section 4.3, the applicant provides the following:

COL License Information Item

- COL License Information Item 4.1 Thermal Hydraulic Stability

This COL license information item addresses the use of an approved stability compliance methodology if the fuel design is changed. The applicant states that the DCD fuel design remains unchanged.

4.3.3 Regulatory Basis

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

The regulatory basis for reviewing the COL license information item is in Section 4.3 of NUREG–0800.

4.3.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 4.3 of the certified ABWR DCD. NRC staff reviewed Section 4.3 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.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to nuclear design.

The staff reviewed the information in the COL FSAR:

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.

COL License Information Item

- COL License Information Item 4.1 Thermal Hydraulic Stability

NRC staff's current review of this application includes COL License Information Item 4.1. Specific information provided by the applicant to address COL License Information Item 4.1 includes a statement in the DCD indicating that if a different fuel design is chosen by the COL applicant, the methodology used to demonstrate compliance with acceptable thermal hydraulic stability criteria will be one that has been approved by the NRC. This methodology is discussed in DCD Subsection 4.3.2.6.2

In response to COL License Information Item 4.1, the applicant states that the fuel design has not changed. Thus this COL License Information Item is resolved.

The staff has issued RAI 04.03-2 requesting that the applicant explain the inconsistencies in the typical loading patterns for Figure 4.3-2 within their application and the generic ABWR DCD. RAI 04.03-2 will remain open until applicant has responded.

Appendix 4A Typical Control Rod Patterns and Associated Power Distribution for ABWR

Appendix 4A of the ABWR DCD contains a typical simulation of an equilibrium cycle core. This appendix is supplementary information supporting the nuclear design discussed in ABWR DCD Section 4.3.

The COL applicant incorporates by reference Appendix 4A of the certified ABWR DCD referenced in Appendix A to 10 CFR Part 52. No departures from the certified design are identified.

The staff issued RAI 04.03-1 requesting that the applicant provide an explanation for the inconsistencies between the STP 3/4 COL application and the generic ABWR DCD within Appendix 4A for the maximum linear heat generation rate (MLHGR) values and the Integrated Power per Bundle values. The COL applicant responded in letter U7-C-STP-NRC-090063 dated June 25, 2009. The staff does not agree with the applicant that "there have been no changes to the figures from what was previously approved and is not subject to re-review." This issue remains open under RAI 04.03-3 (Open Item 04.03-1).

4.3.5 Post Combined License Activities

There are no post COL activities related to this section.

4.3.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's finding related to information incorporated by reference is in NUREG-1503. However, as a result of the open items the staff is unable to finalize its conclusions on Section 4.3 - Nuclear Design in accordance with the requirements of 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1.

4.4 Thermal Hydraulic Design

4.4.1 Introduction

This section of the application addresses the thermal and hydraulic design of the core and the reactor coolant system (RCS). The contents of this section verify that the core thermal-hydraulic designs (1) use acceptable analytical methods, (2) are equivalent to or are a justified extrapolation from proven designs, (3) provide acceptable margins of safety from conditions that would lead to fuel damage during normal reactor operation and anticipated operational occurrences, and (4) are not susceptible to thermal-hydraulic instability.

4.4.2 Summary of Application

Section 4.4 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.4 of the certified ABWR DCD Revision 4. In addition, in COL FSAR Section 4.4, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

In FSAR Subsection 4.4.3.1.3, “Reactor Coolant System Geometric Data,” a reference to “recirculation loops of the Reactor Coolant System” was deleted.

In FSAR Subsection 4.4.3.5.2, “MCPR Operating Limit Computational,” “v CPR” was changed to “ Δ CPR.”

COL License Information Items

- COL License Information Item 4.2 Power/Flow Operating Map

This COL license information item states that the “specific power/flow operating map to be used at the plant will be prepared and provided as an amendment to the FSAR in accordance with 10 CFR 50.71(e), at least one year prior to fuel load. This operating map will be used in the final fuel analysis for the initial core loading to determine the analysis domain” and provides a commitment to this effect. (COM 4.4-1)”

- COL License Information Item 4.3 Thermal Limits

This COL license information item states that the “results of the analysis to determine the thermal limits will be provided as an amendment to the FSAR in accordance with 10 CFR 50.71(e), at least one year prior to fuel load. This analysis will reflect the final fuel design for the initial core loading” and provides a commitment to this effect. (COM 4.4-2)”

4.4.3 Regulatory Basis

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

The regulatory basis for reviewing the COL license information item is in Section 4.4 of NUREG–0800.

4.4.4 Technical Evaluation

As documented in NUREG-1503, NRC staff reviewed and approved Section 4.4 of the certified ABWR DCD.

The staff reviewed Section 4.4 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 appropriately represents the complete scope of information relating to this review topic.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to thermal hydraulic design.

In the staff SER (ADAMS Accession Number ML05146018) related to NRC GL2004-02, Nuclear Energy Institute (NEI) Guidance Report-NEI 04-07, "PWR Sump Performance Evaluation Methods", the following recommendation was identified: Licensees should consider flow blockage associated with fuel supports and debris filter, and their effects on fuel rod temperature. Flow paths between downcomer and lower plenum should be evaluated for long term cooling degradation resulting from flow interruption from plugging.

Section 9 of the staff Safety Evaluation Report (SER) conclusion provides guidance on the evaluation of entrained debris downstream of the sump causing downstream blockage. Because NEI 04-07 provides limited guidance on how downstream effects should be evaluated, the staff provides alternative guidance with regard to downstream blockage. As such, in RAI 06.02.02-2, the staff requested that STP describe how they will address the downstream effects identified in RG 1.82 Rev.3.

In response to RAI 06.02.02-2, STP Nuclear Operating Company (STPNOC) in their letter dated September 28, 2009 (U7-C-STP-NRC-090141) agreed to a COL license condition to submit an evaluation as part of the license amendment confirming that the fuel for the initial fuel load satisfies the downstream effects of containment debris on the reactor fuel. The acceptance criteria specified in the response was not sufficient and the staff issued RAI 04.04-3 requesting that the COL applicant provides verifiable criteria for the fuel testing, revise FSAR Section 4.4 to include the details of the acceptance criteria, and confirm that the protective coatings debris characteristics for fuel assembly tests will be consistent with the NRC guidance for operating pressurized-water reactors (PWRs).

The staff is waiting for the Applicant's response- Open Item 04.04-1.

The staff also reviewed the information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

The NRC staff's review found the applicant's editorial and administrative changes acceptable. However, the staff identified an inconsistency between the DCD and the FSAR and issued RAI 2355 (RAI 04.04-1).

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 COL applicant responded to the RAI in a letter (U7-C-STP-NRC-090063) dated June 25, 2009. The applicant agrees in the response that there is a typographical error and FSAR Subsection No. 4.4.3.5.2 will be changed to Subsection 4.4.5.5.2 to be consistent with the DCD. This change will be incorporated into the next revision of the COL FSAR. This is a confirmatory item 04.04-1.

COL License Information Items

- COL License Information Item 4.2 Power/Flow Operating Map
- COL License Information Item 4.3 Thermal Limits

The applicant stated in the FSAR that specific information related to COL License Information Items 4.2 and 4.3 will be provided at least 1 year before fuel loading, and will include plant-specific power/flow operating maps and thermal limits, respectively, for the core loading at STP Units 3 and 4. However, NRC staff found this response unacceptable and issued RAI 04.04-2 requesting that the applicant provides a method of resolution that will allow the NRC to reach a safety conclusion on each COL License Information Item.

The applicant submitted the response to RAI 04.04-2 in letter U7-C-STP-NRC-090210 dated November 19, 2009. The applicant stated that no departures are taken from the fuel design licensing basis that is described in the ABWR DCD, including the core loading map used for the transient and accident response analysis in DCD Figure 4.3-1 and the control rod strategy in DCD Table 4A-1.

Since the certified DCD Subsections 4.4.3.3.1 and Figures 4.4-1, 4.4.2 include the power/flow map for the core being licensed, the COL License Information item 4.2 is satisfied and is considered closed. Also, the certified DCD Section 4.4.3.3.1 includes the results of the necessary thermal limits analyses required for the core being licensed, therefore, the COL License Information item 4.4-1 is satisfied and is considered closed.

4.4.5 Post Combined License Activities

There are no post COL activities related to this section.

4.4.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's finding related to information incorporated by reference is in NUREG-1503. However, as a result of an open items the staff is unable to finalize its conclusions on Section 4.4 –Thermal Hydraulic Design in accordance with the requirements of 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1.

4.5 Reactor Materials

4.5.1 Control Rod Drive Structural Materials

4.5.1.1 *Introduction*

This FSAR section addresses information related to the materials selection, processing, fabrication, and cleaning and cleanliness controls applied to CRD structural components.

Materials selected for CRD structural components must provide adequate performance throughout the design life of the plant (or the component).

4.5.1.2 Summary of Application

Section 4.5.1 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.5.1 of the certified ABWR DCD, Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 4.5.1, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 4.5.1 Reactor Materials

This departure addresses the additional materials specifications and grades for some components and updates descriptions of operational experience. The applicant also modifies the CRD materials list to allow for the use of alternative materials specifications (for non-reactor coolant pressure boundary components) from those listed in COL FSAR Subsection 4.5.1.1, as long as the materials are equivalent. The applicant considers materials with similar chemical composition, mechanical properties, and operating experience to be equivalent.

COL License Information Item

- COL License Information Item 4.4 CRD Inspection Program

The applicant provides supplemental information in COL FSAR Subsection 4.5.3.1 describing the CRD inspection program, which addresses the inspection needs identified in ABWR DCD Subsection 4.5.3.1.

4.5.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1503. In addition, the relevant requirements of NRC regulations and the associated acceptance criteria for CRD structural materials and inspection programs are listed in Section 4.5.1 of NUREG-0800 (SRP). The regulatory basis of COL Information Item 4.4 is 10 CFR 50.55a and GDC 26.

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 a Tier 2 departure. This departure is subject to the requirements of Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59.

4.5.1.4 Technical Evaluation

As documented in NUREG-1503, the staff reviewed and approved Section 4.5.1 of the certified ABWR DCD. NRC staff reviewed Section 4.5.1 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.¹ The staff's review confirmed that the information in the application

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.

and the information incorporated by reference address the required information relating to control rod drive structural materials.

The staff reviewed the information in the COL FSAR:

COL License Information Item

- COL License Information Item 4.4 CRD Inspection Program

The applicant provides additional information in COL FSAR Subsection 4.5.3.1 addressing COL License Information Item 4.4. The applicant states the following:

The CRD condition and integrity are monitored by a routine visual inspection of a selected sample of CRDs during each outage period. The number and selection process for the CRDs is based on vendor recommendations and included in the preventive maintenance program. CRD performance is monitored under the provisions of the Maintenance Rule, and this monitoring coupled with the CRD inspections detects incipient defects before they become serious enough to cause operating problems. The CRD nozzle and bolting are included in the inservice inspection program. CRD bolting is accessible for inservice examinations during normally scheduled CRD maintenance.

ABWR DCD Subsection 4.5.3.1 states the following:

The CRD inspection program shall include provisions to detect incipient defects before they become serious enough to cause operating problems. The CRD nozzle and bolting are included in the inservice inspection program (Table 5.2-8, System Number B11/B12). CRD bolting is accessible for inservice examinations during normally scheduled CRD maintenance.

NRC staff found that the supplemental information provided by the applicant, as stated above, appropriately addresses ABWR DCD COL Information Item 4.4. The inclusion of the CRD nozzle and bolting in the inservice inspection program satisfies the requirements of 10 CFR 50.55a. Additional information related to the applicant's inservice inspection program is located in FSER Section 5.2.4. The applicant's CRD inspection program will contain provisions to ensure that incipient defects will be detected before they become an operational concern thus meeting the requirements of GDC 26.

4.5.1.5 *Post Combined License Activities*

There are no post COL activities related to this section.

4.5.1.6 *Conclusion*

The NRC 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 CRD structural materials that were incorporated by reference have been resolved. In addition, the applicant identified STD DEP 4.5.1 in COL Section 4.5.1.1. The staff finds it reasonable that this departure is adequately characterized as not needing prior NRC approval.

In conclusion, the applicant has provided sufficient information for satisfying 10 CFR Part 52, Appendix A, Section VIII.B.5.

The staff reviewed COL Information Item 4.4 and finds that it meets the applicable requirements of 10 CFR 50.55a and general design criteria (GDC) 26.

4.5.2 Reactor Internal Materials

4.5.2.1 Introduction

ABWR design certification document (DCD) Section 4.5.2 addresses information related to materials selection and component design, fabrication, and inspection to ensure the structural integrity of internal and core support structures during reactor operation. Materials selected for reactor internals and structural components must perform adequately throughout the design life of the plant (or component).

4.5.2.2 Summary of Application

Section 4.5.2 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.5.2 of the ABWR DCD, Revision 4, referenced in 10 CFR Part 52, Appendix A .

In addition, the applicant provided the following:

Tier 2 Departure not Requiring prior NRC Approval

- STD DEP 4.5-1 Reactor Materials

The applicant provided STD SEP 4.5-1 to revise text and provide additional information to ABWR DCD Section 4.5.2.1, “Materials Specifications”; Section 4.5.2.2, “Controls on Welding”; Section 4.5.2.3, “Non-Destructive Examination of Wrought Seamless Tubular”; Section 4.5.2.4, “Fabrication and Processing of Austenitic Stainless Steel – Regulatory Guide Conformance”; and Section 4.5.2.5, “Other Materials.”

STP Units 3 and 4 COL FSAR Section 4.5.2 does not contain any COL information items related to ABWR DCD Section 4.5.2.

4.5.2.3 Regulatory Basis

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

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 a Tier 2 departure. This departure is subject to the requirements of Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59.

4.5.2.4 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.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to reactor internal material.

4.5.2.5 Post Combined License Activities

There are no post COL activities related to this section.

4.5.2.6 Conclusion

The NRC 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 reactor internal materials that were incorporated by reference have been resolved. In addition, the applicant identified STD DEP 4.5-1 in COL Section 4.5.2. The staff finds it reasonable that this departure is adequately characterized as not needing prior NRC approval. In conclusion, the applicant has provided sufficient information for satisfying 10 CFR Part 52, Appendix A, Section VIII.B.5.

4.6 Functional Design of Control Rod Drive System

4.6.1 Introduction

This section of the application addresses the functional performance of the CRD system (CRDS) to confirm that the system can affect a safe shutdown, respond within acceptable limits during anticipated operational occurrences, and prevent or mitigate the consequences of postulated accidents.

4.6.2 Summary of Application

Section 4.6 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 4.6 of the certified ABWR DCD Revision 4, with departures. In addition, in COL FSAR Section 4.6, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 4.6-1 Fine motion control rod drive (FMCRD) Friction Test Equipment

This departure changes the description of the FMCRD friction test equipment.

- STP DEP 7.7-1 RPV Water Level Instrumentation

This departure "clarifies that the source of water for purging of the instrument lines in the Nuclear Boiler System (NBS) is the CRD hydraulic system (CRDHS). It further clarifies that for the RPV level instruments; this purging is only performed on instrument lines with condensing chambers."

In addition, in COL FSAR Section 4.6 the applicant provides the following:

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.

COL License Information Item

- COL License Information Item 4.5 CRD and FMCDR Installation and Verification During Maintenance

This COL license information item provides information regarding CRD and FMCDR installation and verification.

4.6.3 Regulatory Basis

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

In accordance with Section VIII, “Processes for Changes and Departures,” of 10 CFR Part 52, Appendix A, the applicant identifies Tier 2 departures. 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.

The regulatory basis for the review of the COL license information items is in Section 4.6 of NUREG–0800.

4.6.4 Technical Evaluation

As documented in NUREG–1503, the staff reviewed and approved Section 4.6.4 of the certified ABWR DCD. NRC staff reviewed Section 4.6.4 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.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to functional design of control rod drive system.

The staff reviewed the information in the COL FSAR:

COL License Information Item

- COL License Information Item 4.5 CRD and FMCDR Installation and Verification During Maintenance

This COL License Information Item requests that the applicant develop procedures to ensure that maintenance procedures have provisions to prohibit coincident removal of the CRD blade and drive of the same assembly. In addition, the COL applicant shall develop contingency procedures to provide core and spent fuel cooling capability and mitigative actions during CRD replacement with fuel in the vessel.

Specific information provided by the applicant to address COL License Information Item 4.5 should include programs and procedures to address issues that could arise during maintenance. The applicant should provide the time frame when the administrative procedures will be available before fuel load. These procedures ensure that maintenance procedures have

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.

provisions to prohibit a coincident removal of the CRD blade and drive of the same assembly. In addition, the applicant should provide the time frame when the contingency procedures will be available for the staff to review. These procedures provide the core- and spent-fuel cooling capability and mitigating actions during CRD replacement with fuel in the vessel.

NRC staff issued RAI 04.06-1 to address (1) the time frame for the availability of COL License Information Item 4.5 for the staff to review, and (2) the revision of Subsection 13.5.3.4.2 to assure that the specific procedures will be developed as required by COL License Information Item 4.5.

The applicant responded to RAI 04.06-1 in a letter (U7-C-STP-NRC-090049) dated May 26, 2009, which includes the following statement:

The incorporation of the COL License Information Item 4.5 into plant maintenance procedures is adequately addressed by the STP 3&4 Quality Assurance Program Description (QAPD) and FSAR Subsection 13.5.3.4.2 item (8) combined with FSAR Table 1.9-1.

However, to provide additional assurance that the subject of the RAI is incorporated, the applicant revised the first paragraph of COL application Section 13.5 to include the following:

The procedures that are identified in or required by the COL License Information Items in ABWR DCD, Tier 2, Table 1.9-1, will be incorporated into the plant procedures according to the following supplements, as applicable.

The staff confirmed that the FSAR revision is acceptable and RAI 04.06-1 is therefore resolved.

In Subsection 4.6.1.2.3, "Hydraulic Control Units," Standard Departure 4.6-1 deletes the phrase "a small pump and associated" to read, "The test fixture contains hydraulic controls to pressurize the underside of the hollow piston."

The staff noted that the revised description was editorially incorrect, but the intent was understandable. The staff issued RAI 04.06-2 requesting the applicant to clarify the intended description of the special test fixture and to revise the FSAR narrative accordingly. In the response to RAI 04.06-2, (letter U7-C-STP-NRC-090060, dated June 22, 2009), the applicant provides an explanation for Standard Departure 4.6-1 without clarifying the narrative. However, because there is no impact on the design that would affect plant operation, and the intent of the statement is understandable, the staff accepted the response and concluded that RAI 2364 is resolved.

In Subsection 4.6.1.2.4.1, the applicant states that "Approximately 4 L/min purge flow is provided to the NBS reference leg instrument lines." From the description and the data in the FSAR, the staff was unable to confirm the validity of the 4 L/min purge flow. Therefore, the staff issued RAI 04.06-3 requesting the applicant to provide the basis (e.g., assumptions, boundary conditions, references) for this value.

In response to RAI 04.06-3, (letter U7-C-STP-NRC-090060 dated June 22, 2009), the applicant includes a discussion and references a report (GENE-637-019-0893, "Analysis Guidelines for Backfill Modification of RPV Water Level Instrumentation," Revision 0) that provides the method used in the purge flow calculation. The applicant also notes that the flow rate in the referenced report is incorrectly transcribed into the COL FSAR, Subsection 4.6.1.2.4.1(4). The value stated

in the referenced report is 4 lb/hour (0.03 L/min). Therefore, COL FSAR will be modified to correct this error.

The staff noted that the correction had not been added in the COL FSAR Revision 3. As a follow up, the staff issued RAI 04.06-4 requesting the applicant to provide the referenced report to complete the evaluation. Therefore, this issue remains open. [Open Item OI 4.6-1]

4.6.5 Post Combined License Activities

There are no post COL activities related to this section.

4.6.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's finding related to information incorporated by reference is in NUREG-1503. However, as a result of open item 4.6-1 the staff is unable to finalize its conclusions on Section 4.6 – Functional Design of Control Rod Drive System in accordance with the requirements of 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1. In addition, the applicant identified STD DEP 4.6-1 and STD 7.7-1 in COL Section 4.6. The staff finds it reasonable that this departure is adequately characterized as not needing prior NRC approval. In conclusion, the applicant has provided sufficient information for satisfying 10 CFR Part 52, Appendix A, Section VIII.B.5.