

12.0 RADIATION PROTECTION

This chapter provides information on radiation protection methods and estimated occupational radiation exposures to operation and construction personnel during normal operations and anticipated operational occurrences (AOOs). In particular, AOOs may include refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection; and calibration. Specifically, this Final Safety Analysis Report (FSAR) chapter provides information on facility and equipment design, planning and procedures programs, and techniques and practices employed by the applicant to meet the radiation protection standards in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20. In addition, it provides information on how techniques and practices are consistent with the practices in the appropriate regulatory guides (RGs) that are used to implement the U.S. Nuclear Regulatory Commission's (NRC's) regulations. Finally, this chapter provides updated information that supplements the Advanced Boiling-Water Reactor (ABWR) design control document (DCD) with a site-specific assessment of doses to members of the public from anticipated routine liquid and airborne effluent releases.

12.1 Ensuring That Occupational Radiation Exposures Are As Low As Is Reasonably Achievable

12.1.1 Introduction

This FSAR section addresses administrative programs and procedures. In conjunction with facility design, they ensure that the occupational radiation exposure to personnel will be kept as low as is reasonably achievable (ALARA).

12.1.2 Summary of Application

Section 12.1 of the South Texas Project (STP) Units 3 and 4 combined license (COL) FSAR incorporates by reference Section 12.1 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures. In addition, in COL FSAR Section 12.1, the applicant provides the following:

COL License Information Items

- COL License Information Item 12.1 Regulatory Guide 8.10

The applicant references Nuclear Energy Institute (NEI) 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program Description," to address conformance with RG 8.10. In COL FSAR Section 12.1.4 the applicant references Section 12.5S of the COL FSAR which contains the commitment to NEI 07-03A.

- COL License Information Item 12.2 Regulatory Guide 1.8

The applicant references NEI 07-03A to address conformance with RG 1.8. In COL FSAR Section 12.1.4 the applicant references Section 12.5S of the COL FSAR which contains the commitment to NEI 07-03A.

- COL License Information Item 12.3 Occupational Radiation Exposures

The applicant references NEI 07–03A to address criteria and conditions for implementing various operating procedures and techniques to ensure that occupational exposures are ALARA, by using the guidance of NUREG–1736. In COL FSAR Section 12.1.4 the applicant references Section 12.5S of the COL FSAR which contains the commitment to NEI 07–03A.

- COL License Information Item 12.4 Regulatory Guide 8.8

The applicant references NEI 07–03A to address conformance with RG 8.8. In COL FSAR Section 12.1.4 the applicant references Section 12.5S of the COL FSAR which contains the commitment to NEI 07–03A.

12.1.3 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,” (July 1994). In addition, the relevant requirements of the Commission’s regulations for ensuring that occupational radiation exposures are ALARA and the associated acceptance criteria are in Section 12.1 of NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” (the Standard Review Plan [SRP]).

The regulatory basis for accepting that occupational radiation exposure to personnel will be kept ALARA is based on meeting the requirements of 10 CFR 20.1101. Specifically, that there is a policy formulated in accordance with the ALARA provisions of 10 CFR 20.1101(b) to ensure that occupational radiation exposure will be ALARA.

In addition, the information that follows describes the regulatory bases for accepting the resolution of the STD COL license information items.

COL License Information Item 12.1 is based on meeting the requirements of 10 CFR Part 20, “Standards for Protection against Radiation,” and the guidance of RG 8.10 (Revision 1), “Operating Philosophy for Maintaining Occupational Radiation Exposures ALARA.”

COL License Information Item 12.2 is based on meeting the requirements of 10 CFR Part 20 and the guidance of RG 1.8, Revision 3, “Qualification and Training of Personnel for Nuclear Power Plants.”

COL License Information item 12.3 is based on meeting the requirements of 10 CFR Part 20 and the guidance of RG 1.70, Revision 3, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, LWR.”

COL License Information Item 12.4 is based on meeting the requirements of 10 CFR Part 20 and the guidance of RG 8.8, Revision 3, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.”

Moreover, COL license information items in Section 12.1 are based on following the guidance of RGs 1.8, 8.2, 8.7, 8.9, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38 and the guidance in NEI 07–03A (Revision 0), “Generic FSAR Template Guidance for Radiation Protection Program Description.”

12.1.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed the approved Section 12.1 of the certified ABWR DCD. The staff reviewed Section 12.1 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 information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic¹. The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to ensuring that occupational radiation exposures are ALARA.

The staff reviewed the information in the STP COL FSAR:

COL License Information Item

- COL License Information Item 12.1 Regulatory Guide 8.10

The applicant provides additional information in FSAR Subsection 12.1.4.1 to address the resolution of DCD COL License Information Item 12.1, which states:

Compliance with Regulatory Guide 8.10 shall be demonstrated by the COL applicant.

This COL License Information Item is addressed in NEI 07–03A which is referenced in Section 12.5S of the FSAR. NRC staff completed the review and safety evaluation of NEI 07-03 in “Safety Evaluation Regarding the Nuclear Energy Institute Technical Report 07–03, ‘Generic FSAR Template Guidance for Radiation Protection Program Description’ Revision 7,” as documented below and available in the Agencywide Documents Access and Management System (ADAMS) as accession number ML090510379.

The staff reviewed the final version of NEI 07–03 with respect to compliance with RG 8.10. NEI 07–03 states that plant management will establish a written policy on radiation protection that is consistent with the guidance in RG 8.10 and that the responsibilities of the Radiation Protection Manager will be consistent with the guidance in RG 8.10 and will include establishing, implementing, and enforcing the Radiation Protection (RP) Program. In addition, management is committed to assuring that each individual working at the facility understands and accepts responsibility for following radiation protection procedures and instructions provided by radiation protection staff, and for maintaining his or her dose ALARA. The staff found that for COL applications, NEI 07–03, Revision 7, provides an acceptable template for assuring that the RP Program meets applicable NRC regulations and conforms to applicable NRC guidance as documented in the staff’s safety evaluation (SE) (ML090510379). NEI published the final accepted version in May 2009 as NEI 07–03A (Revision 0), (ML091490684).

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 staff issued Request for Additional Information (RAI) **RAI 12.05-4** requesting the applicant to update the FSAR to reference the final accepted version of NEI 07-03. In the response to RAI 12.05-4 dated August 20, 2009 (ML092360170), the applicant proposed to include the accepted version of NEI 07-03, in a future COL application revision. NRC staff verified that NEI 07-03A was referenced in COL FSAR Revision 4, Section 12.5S. The staff finds this acceptable. Accordingly, RAI 12.05-4 is closed.

- COL License Information Item 12.2 Regulatory Guide 1.8

The applicant provides additional information in FSAR Subsection 12.1.4.2 to address the resolution of DCD COL License Information Item 12.2, which states:

Compliance with Regulatory Guide 1.8 shall be demonstrated by the COL applicant.

This COL License Information Item is addressed in NEI 07-03A, which is referenced in Section 12.5S of the FSAR.

As discussed above, the staff found that for COL applications, NEI 07-03A provides an acceptable template for assuring that the RP program meets applicable NRC regulations and conforms with applicable guidance including RG 1.8. This RG states that American National Standards Institute (ANSI)/American Nuclear Society (ANS) 3.1-1993, with certain additions, exceptions, and clarifications delineated in the RG, provides acceptable criteria for the selection; qualification; and training of personnel for nuclear power plants. NEI 07-03A states that the radiation protection manager, radiation protection technicians, and radiation protection supervisory and technical staff will be trained and qualified in accordance with the guidance in RG 1.8. As discussed in RAI 12.05-4 above, the staff requested the applicant to update the FSAR to reference the final accepted version of NEI 07-03. The applicant's response to RAI 12.05-4 commits to include the accepted version of NEI 07-03 in a future COL FSAR application revision. NRC staff verified that NEI 07-03A, was referenced in COL FSAR Revision 4, Section 12.5S. Accordingly, RAI 12.05-4 is closed.

- COL License Information Item 12.3 Occupational Radiation Exposures

The applicant provides additional information in FSAR Subsection 12.1.4.3 to address the resolution of DCD COL License Information Item 12.3, which states:

COL applicants will provide, to the level of detail provided in Regulatory Guide 1.70, the criteria and/or conditions under which various operating procedures and techniques shall be provided to ensure that occupational radiation exposures ALARA are implemented.

NRC staff reviewed the applicant's response to COL License Information Item 12.3 related to criteria and conditions under which various operating procedures and techniques will be implemented to ensure that occupational radiation exposures are ALARA using the guidance in NUREG-1736, to the level of detail described in RG 1.206. The staff also reviewed the applicant's response to ensure that the applicant has committed to follow the guidance in the following RGs: 8.2, 8.7, 8.9, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38. Many of the criteria and conditions in COL License Information Item 12.3 are addressed in FSAR Subsection 12.1.4.3 and in NEI 07-03A which is referenced in Section 12.5S of the FSAR.

NEI 07-03A addresses various operating procedures and techniques used in dose-related activities found in typical nuclear plants. These activities include refueling, in-service inspections, radwaste handling, spent fuel handling, normal operations, routine maintenance, sampling, and calibration. The template allows COL applicants to modify procedures based on design and site-specific information. The staff reviewed the categories listed in the template for coverage of the ABWR activities. Based on the review, the staff determined that NEI 07-03A does not fully describe all elements of an ALARA program. NEI 07-08A, "Generic FSAR Template Guidance for Ensuring That Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)," supplements the ALARA program description in NEI 07-03A with information that describes the roles and responsibilities of management and staff, training requirements, and key elements of an effective ALARA program. The staff found that for COL applications, NEI 07-08, Revision 3, provides an acceptable template for assuring that the ALARA program meets applicable NRC regulations and guidance provided it is used in conjunction with NEI 07-03A, Revision 0, as documented in the staff's SE (ML091130034). NEI published the final accepted version in October 2009 as NEI 07-08A (Revision 0), (ML093220178).

The applicant's description of the ALARA program did not reference NEI 07-08. The staff issued **RAI 12.01-1** requesting the applicant to provide additional information concerning the review and possible incorporation of NEI 07-08 into the FSAR. The applicant's response to RAI 12.01-1 dated August 12, 2009 (ML092260582) commits to incorporate by reference the accepted version of NEI 07-08 in a future COL FSAR application revision. The staff found the proposed COL FSAR revision acceptable because NEI 07-08 presents the functional elements of an ALARA program that, if met, demonstrate compliance with 10 CFR 20.1101. The applicant included reference to NEI 07-08 in COL FSAR, Revision 4, Section 12.5S (letter U7 C STP NRC 100222 dated October 5, 2010), but did not reference the accepted version (NEI 07-08A) of this NEI template. The applicant committed to include the accepted version of NEI 07-08 in the next COL revision. Accordingly, RAI 12.01-1 is being tracked as **Confirmatory Item 12.01-1**.

- COL License Information Item 12.4 Regulatory Guide 8.8

The applicant provides additional information in Subsection 12.1.4.4 to address the resolution of COL License Information Item 12.4, which states:

Compliance with Regulatory Guide 8.8 shall be demonstrated by the COL applicant.

The FSAR states that COL License Information Item 12.4 is addressed by the site-specific information in Subsection 12.1.4.4. FSAR Subsection 12.1.4.4 references the conformance of the design with RG 8.8 as documented in Sections 12.1 and 12.3 of the ABWR DCD, and identifies FSAR Sections 12.1, 12.3, 12.4, and 12.5 as addressing the operational portions of the objectives of RG 8.8. FSAR Subsection 12.5.3.1 states that the Operational Radiation Protection Program is described in FSAR Section 12.5S. NEI 07-03A, with site-specific supplements, is incorporated by reference as the basis for the Operational Radiation Protection Program in Section 12.5S of the FSAR. As discussed above, the staff found that for COL applications, NEI 07-03A, Revision 0, provides an acceptable template for assuring that the RP program meets applicable NRC regulations and conforms with applicable guidance including RG 8.8. NEI 07-03A and the supplemental information in FSAR Section 12.5S address the operational portions of RG 8.8 that are not addressed in the ABWR DCD, including a description

of the plant organization, personnel, and personnel responsibilities; facilities (to the extent that they are not described in the DCD); instrumentation; and equipment. The template also includes a description of radiation protection procedures sufficient to provide adequate control over the receipt, possession, use, transfer, and disposal of byproduct, source, and special nuclear materials. These procedures also assure compliance with the applicable requirements in 10 CFR Parts 19, 20, 50, 70, and 71. The procedures described in this template include procedures for radiation protection training, access control of radiation areas, methods to maintain exposures ALARA, personnel monitoring, respiratory protection, and contamination control. As discussed in RAI 12.05-4 above, the staff requested that the applicant update the FSAR to reference NEI 07-03A. The applicant's response to this RAI commits to add NEI 07-03A, Revision 0, to a future revision of the COL application. NRC staff verified that NEI 07-03A was referenced in COL FSAR Revision 4, Section 12.5S. Accordingly, RAI 12.05-4 is closed.

Additionally, the applicant's FSAR is based on evidence that the ABWR design, methods, approach, and interactions are in accordance with the ALARA provisions of 10 CFR 20.1101(b) and RG 8.8 (Regulatory Position C.2) and will incorporate measures for reducing the need for time spent in radiation areas; measures to improve accessibility to components requiring periodic maintenance or in-service inspection; measures to reduce the production, distribution, and retention of activated corrosion products throughout the primary system; measures for assuring that occupational radiation exposure during decommissioning will be ALARA; reviews of the design by competent radiation protection personnel; instructions to designers and engineers regarding the ALARA design; experience gained from operating plants and past designs; and the continuation of facility design reviews. The objective of the plant radiation protection design is to maintain individual doses and total person-Sievert (person-rem) doses to plant workers (including construction workers) and to members of the general public ALARA, and to maintain individual doses within the limits of 10 CFR Part 20. The staff's review considered all plant sources of direct radiation and airborne radioactive contamination within restricted areas.

By incorporating by reference, NEI 07-03A, Revision 0 and NEI 07-08A, Revision 0, the applicant provides a management commitment to ensure that STP Units 3 and 4 will be designed, constructed, and operated in a manner consistent with the above criteria and that facility management will review radiation exposure trends periodically to determine major changes in problem areas and to note the worker groups that are accumulating the highest exposures. The facility staff will use this information to recommend design modifications or changes in plant procedures. This practice, as described in STP COL FSAR Section 12.1 and the associated NEI generic templates, conforms to those practices described in RGs 8.8 and 8.10. This management commitment is discussed further in SER Section 12.5.

12.1.5 Post Combined License Activities

There are no post COL activities related to this section.

12.1.6 Conclusion

The NRC staff's finding relating to information incorporated by reference is in NUREG-1503. NRC staff reviewed the application and checked the referenced DCD. NRC staff's review confirmed that, with the exception of confirmatory item 12.01-1, 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues related to ensuring that occupational radiation exposures are ALARA that were incorporated by reference have been resolved.

The staff concludes that the Radiation Protection and ALARA programs sufficiently describe the programmatic elements and operational objectives to enable the staff to make a reasonable assurance finding of acceptability for the issuance of a COL, followed by a verification of the implementation of site- and plant-specific program elements, through the inspection process before fuel load.

Listed below is a summary of the areas reviewed in Section 12.1 of the STP 3 and 4 COL FSAR upon which the staff based their conclusions:

- The staff evaluated the applicant's supplemental information in this section to address the ALARA program at the site. The applicant's supplemental information incorporates by reference NEI Templates 07-03A and 07-08A. These templates describe an ALARA program which meets the ALARA provisions of 10 CFR 20.1101(b), the training requirements of 10 CFR 19.12, and the guidance provided in RGs 8.8 and 8.10. These templates meet the acceptance criteria defined in Section 12.1 of NUREG-0800 and, therefore, the staff finds that the information contained in these templates adequately describes an acceptable ALARA program.
- The applicant has adequately addressed COL License Information Items 12.1, 12.2, and 12.4 regarding design and operational considerations for the plant's radiation protection program, and has committed to update COL FSAR Section 12.5S to address COL License Information Item 12.3 in a future COL revision. The applicant's proposed resolution to these COL license information items is to reference the information contained in NEI 07-03A and NEI 07-08A, which incorporate the guidance in RGs 1.8, 8.8, and 8.10 and contain a commitment to provide operating procedures and techniques to ensure that occupational radiation exposures are ALARA. On this basis, the staff found that the information in these templates is acceptable and resolves these COL license information items.
- The staff concluded that the ALARA policy, design, and implementation considerations are acceptable because the applicant meets the training requirements of 10 CFR 19.12, the ALARA provisions of 10 CFR 20.1101(b), and the guidance in RG 8.8, Regulatory Position C.2, and RG 8.10, Regulatory Position C.1.

The staff concluded that the relevant information in the STP 3 and 4 COL FSAR Section 12.1 is acceptable and meets the requirements defined in the ABWR DCD, which is incorporated by reference. In conclusion, the COL applicant has provided sufficient information for satisfying the NUREG-0800 acceptance criteria and, as a result, Section 12.1 of the FSAR is acceptable.

12.2 RADIATION SOURCES (Related To RG 1.206, Section 12.2, "Radiation Sources")

12.2.1 Introduction

This section of the FSAR addresses the issues related to contained radiation sources and airborne radioactive material sources during normal operations, AOOs, and accident conditions affecting the in-plant radiation protection program.

This section of the Safety Evaluation Report (SER) also addresses doses to members of the public from radioactive effluent releases. All liquid effluent releases are conducted and monitored through the liquid waste management system (LWMS) for processed liquids generated during the operation of the LWMS, the gaseous waste management system (GWMS), and the solid waste management system (SWMS). Airborne releases from the operation of the LWMS, GWMS, SWMS, and the ventilation exhaust systems servicing radiologically controlled areas where process equipment is located, are monitored, and discharged through the main plant vent stack.

12.2.2 Summary of Application

Section 12.2 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 12.2 of the certified ABWR DCD, (Revision 4), referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 12.2, the applicant provides the following information:

Tier 1 Departure Requiring Prior NRC Approval

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

The referenced ABWR DCD Section 2.15.13 states that the exterior walls of the RW/B below grade and the basement are classified as Seismic Category I. This departure revises the seismic category of the RW/B substructure from Seismic Category I to nonseismic.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 5.4-1 Reactor Water Cleanup System

The flow capacity of the two pumps and two filter demineralizers in the reactor water cleanup system (CUW) is doubled from 1 percent of rated feedwater flow to 2 percent. The proposed change improves cleanup water system reliability by providing a backup pump and filter demineralizer capability to handle 100 percent of the CUW flow and filtering requirements. This departure revises Table 12.2-9 to include the source term for both CUW System demineralizers.

- STD DEP 11.2-1 Liquid Radwaste Process Equipment

This section of the referenced ABWR DCD, including all subsections, figures, and tables (except for piping and instrumentation diagrams), is completely replaced due to a departure in the design of the liquid radioactive waste system. The departure includes the use of mobile technology and deletes the forced-circulation concentrator system and other permanently installed liquid radwaste processing equipment.

- STD DEP 11.4-1 Radioactive Solid Waste Update

The applicant completely replaces Tier 2, Section 11.4 of the certified ABWR DCD, including all subsections, figures, and tables. This standard departure in the design of the SWMS deletes the solidification, incineration, and compacting processes included in the ABWR DCD. Thus, no part of ABWR DCD Section 11.4 is incorporated by reference.

Administrative Departure

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (i.e., misspellings, incorrect references, table headings, etc.). The applicant identifies an Administrative Departure in this section with respect to an incorrect table reference.

COL License Information Item

- COL License Information Item 12.5 Compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I

In Section 12.2.3, the applicant provides site-specific information on gaseous and liquid releases to address compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

Supplemental Information

Contained Sources

RG 1.206 Subsection C.I.12.2.1, “Contained Sources,” states that “the applicant should describe the sources of radiation, during normal plant operations and accident conditions, that are the bases for the radiation protection design” and that the “sources should be described in the manner needed for input to the shield design calculation.”

The COL applicant states that the information in Section 12.2.1 of the ABWR DCD is incorporated by reference, including all subsections and tables, with supplements to address the departures discussed above.

12.2.3 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 “Radiation Sources” and the associated acceptance criteria are in Section 12.2 of NUREG–0800.

COL License Information Item 12.5 relates to compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I and is based on meeting the requirements of these documents and the guidelines in RG 1.70, (Revision 3). In addition, the regulatory basis for accepting the resolution to COL License Information Item 12.5 is in 10 CFR 20.1201, as it relates to limiting occupational radiation doses.

The regulatory basis for accepting the supplementary information in assessing doses to members of the public associated with liquid and gaseous effluent releases in unrestricted areas is established in 10 CFR 20.1301(e); 10 CFR 20.1302; 10 CFR 50.34a and 50.36a; 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 60 and 64; to 10 CFR Part 50, Appendix I, Sections II.A, II.B1, II.C, and II.D; 10 CFR 52.80(a) and Generic Letter 89-01. SRP acceptance criteria include RGs 1.109, 1.111, 1.112, 1.113, and 1.206. Full descriptions of the applicable regulatory and acceptance criteria are in SRP Sections 11.2 to 11.5 (NUREG–0800).

The regulatory basis for accepting that radiation protection equipment and design features will ensure radiation exposure to occupational workers and members of the public will be kept ALARA, and in compliance with the limits identified in 10 CFR 20.1201 and 10 CFR 20.1301, is based on meeting the requirements of 10 CFR 20.1101. Specifically, that there is a policy formulated in accordance with the ALARA provisions of 10 CFR 20.1101(b) to ensure that occupational radiation exposure will be ALARA.

The regulatory basis for accepting that the facility design and procedures for operation will minimize contamination of the facility and the environment and the generation of radioactive waste, to the extent practicable, and facilitate the eventual decommissioning of the facility is established in 10 CFR 20.1406.

In addition, in accordance with Section VIII, "Process 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 requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Section VIII,B.5, which are similar to the requirements in 10 CFR 50.59.

12.2.4 Technical Evaluation

As documented in NUREG-1503, NRC staff reviewed the approved Section 12.2 of the certified ABWR DCD. The staff reviewed Section 12.2 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 topic¹. The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to radiation sources.

This particular section pertains to many aspects of the LWMS and GWMS, the effluent releases, and the regulatory limits associated with each system. Sections 11.2 and 11.3 describe the LWMS and GWMS and the design of each system. Section 12.2 includes the annual radioactive source terms that will be released from the LWMS and the GWMS and the parameters used to calculate offsite doses from these systems.

Tier 1 Departure Requiring Prior NRC Approval

The following Tier 1 Departure identified by the applicant in this section requires prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER accordingly. For more information, refer to COLA Application Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 1 departure. In addition, compliance with 10 CFR Part 52, Appendix A, Section VIII.A.4 for this Tier 1 departure will be addressed by the staff in Appendix 1-A of the staff's SER.

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.

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

This departure is identified in Section 12.2 of the STP Units 3 and 4 COL FSAR because it changes the seismic category of the RW/B substructure from Seismic Category I to nonseismic. This departure does not result in any change in radiation protection equipment and design features identified in the ABWR DCD used to ensure that occupational radiation exposures associated with operation of the Radwaste Building are ALARA. NRC staff found that this departure does not require any further evaluation as it pertains to the review scope of this section. Additional staff review and evaluation of the acceptability of this departure can be found in Section 14.3 of this SER.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 5.4-1 Reactor Water Cleanup System

The flow capacity of the two Reactor Water Cleanup System pumps and the two Reactor Water System demineralizers are doubled from 1 percent of rated feedwater flow to 2 percent of rated feedwater flow. This provides the backup pump and filter demineralizer with the capability to handle 100 percent Reactor Water Cleanup flow and filtering requirements. This departure references Table 12.2-9 indicating the radioactive source term for the Reactor Water Cleanup system demineralizers. There is no impact/review of this departure required in this section. This departure is further evaluated in SER Section 5.4.

- STD DEP 11.2-1 Liquid Radwaste Process Equipment

The applicant completely replaces this section of the referenced ABWR DCD, including all subsections, figures, and tables (except for Piping and Instrumentation Diagram IDs), due to a departure in the design of the liquid radioactive waste system. The departure includes the use of mobile technology and deletes the forced-circulation concentrator system and other permanently installed liquid radwaste processing equipment. There is no impact/review of this departure required in this section. Staff review and evaluation of this departure can be found in Section 11.2 of this SER.

- STD DEP 11.4-1 Radioactive Solid Waste Update

The applicant completely replaces Tier 2 Section 11.4 of the certified ABWR DCD, including all subsections, figures, and tables. This standard departure in the design of the SWMS deletes the solidification, incineration, and compacting processes identified in the ABWR DCD. Thus, no part of ABWR DCD Section 11.4 is incorporated by reference. There is no impact/review of this departure required in this section. Staff review and evaluation of this departure can be found in Section 11.4 of this SER.

Administrative Departures

- STD DEP Admin

Administrative departures are defined by the applicant as minor corrections such as editorial or administrative errors in the reference ABWR DCD (i.e. misspelling, incorrect references, table

headings, etc). Administrative departures do not affect the presentation of any design discussion or the qualification of any design margin. The applicant identifies an Administrative Departure in this section with respect to an incorrect table reference. NRC staff found that this administrative departure is acceptable.

In addition, in FSAR Section 12.2, the applicant provided the following:

COL License Information Item

- COL License Information Item 12.5 addresses the compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I,

The applicant provides additional information in FSAR Subsections 12.2.2.1, 12.2.2.4, and 12.2.2.5 to address the resolution of DCD COL License Information Item 12.5, which states:

The COL applicant will re-evaluate the average annual airborne releases and the average annual liquid releases to the environment for the final plant design and site parameters for conformance to 10 CFR Part 20 and 10 CFR Part 50, Appendix I.

The applicant revises information to supplement the DCD with site-specific parameters, (airborne effluent releases, liquid effluent releases and doses to members of public).for addressing DCD COL License Information Item 12.5. As discussed above in the evaluation of the Tier 2 departures affecting this FSAR section, the applicant makes major changes in the LWMS and SWMS as a result of Departures STD DEP 11.2-1 and STD DEP 11.4-1. Although the applicant does not identify Departure STD DEP 11.3-1 as affecting Section 12.2, STD DEP 11.3-1 modifies the GWMS design approved in the ABWR DCD, and that in turn affects the airborne effluent releases identified in DCD COL License Information Item 12.5.

Compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I – Liquid Effluents

Liquid Effluent Source Term Analysis

The applicant calculated the annual liquid effluent release source term shown in FSAR Tier 2, Table 12.2-22, using the methodology set forth in the BWR-GALE code, as documented in NUREG-0016. NRC staff evaluated the annual average liquid releases listed in FSAR Table 12.2-22 and issued **RAI 11.02-3** concerning the departures from the DCD in the LWMS design and that the annual average liquid release Table 12.2-22 values had not changed due to the departures taken. The applicant responded that the annual average liquid release source term is based on the GALE code methodology and takes into account the change to the radwaste system. The applicant stated that Table 12.2-22 in COLA Rev. 2 replaces Table 12.2-22 in the DCD, and the values in the table are different because of site specific calculations. **RAI 11.02-3 was closed** based on the applicant's initial response letter (U7-C-STP-NRC-090047, dated May 21, 2009). However, upon further review, the staff issued supplemental **RAI 12.02-15** requesting additional calculation information to confirm the annual average liquid release source term presented in the STP FSAR Table 12.2-22.

The applicant responded (letter U7-C-STP-NRC-100058, dated March 24, 2010) that review of their GALE code input indicated that the complete input/output file information used for calculating the annual average liquid release source term were non-retrievable. The applicant

supplied information from the ABWR DCD and STP COLA to develop GALE code input parameters and to calculate the GALE code output values in response to RAI 12.02-15. However, the applicant revised the GALE code output values for liquid annual average effluent releases based on capacity factors, ABWR reactor water I-131 concentration, and the annual flow in the circulating water system. The applicant calculated the 10 CFR Part 20, Appendix B note 4 unity rule value to be less than one and to be in compliance with Appendix B note 4, using the adjusted annual average liquid release source term values. The applicant also stated that the calculated adjusted values result in no significant effect on the annual average liquid release values that are in FSAR Table 12.2-22 and result in no changes to the FSAR, and that, therefore, the applicant is in compliance with 10 CFR Part 20, 10 CFR Part 50, and GDC 60.

The staff performed an independent evaluation of the applicant's GALE86 Code annual average liquid release input and output data. This independent evaluation verified the applicant's results for the GALE86 Code annual average liquid release output presented in their response letter (U7-C-STP-NRC-100058, dated March 24, 2010). Compliance with 10 CFR Part 20, 10 CFR Part 50 and GDC 60 are evaluated later in this section. **RAI 12.02-15 is closed.**

The staff also issued **RAI 12.02-11** requesting revision of the source terms calculated in the backwash receiving tank in the LWMS. In their response to question 12.02-11, the applicant provided revised LWMS tables with revised and corrected radionuclides and concentrations that the staff found acceptable and **RAI 12.02-11 is closed.**

10 CFR Part 20 Liquid Compliance

The initial staff review of the STP COL did not identify COL liquid effluent information from the applicant to address compliance with 10 CFR Part 20. The staff issued **RAI 12.02-2** and the applicant's response included concentration comparisons to 10 CFR Part 20, however, not all values the applicant submitted were correct. Thus, the staff issued **RAI 12.02-9**, which is a supplemental question to **RAI 12.02-2**, concerning demonstrating compliance with the annual average liquid release concentrations to meet the 10 CFR Part 20, Appendix B "unity" concentration limit identified in note 4, of 10 CFR Part 20, Appendix B. The applicant provided revised tables with the liquid effluent unity calculation included in the **RAI 12.02-9** response.

An additional request, **RAI 12.02-10**, was issued to the applicant for clarification or corrections to FSAR Table 12.2-22 listing the liquid radionuclides and concentrations. The staff has determined that based on the changes made to the concentrations of radioactive materials in liquid effluents in unrestricted areas currently listed in Table 12.2-22, these values will be a small fraction of the limits specified in Table 2, Column 2, of Appendix B to 10 CFR Part 20 and therefore these values meet the 10 CFR Part 20, Appendix B "unity" concentration limit. **RAI 12.02-2, RAI 12.02-9 and 12.02-10 are closed.** The responses to these RAIs also address COL License Information Item 12.5 concerning 10 CFR Part 20 compliance.

10 CFR Part 50, Appendix I Liquid Dose Compliance

Staff review identified that the tables, input parameters and resulting doses for evaluation and verification of annual liquid effluent doses to the environment from STP 3 & 4 were not included in the COL application. The staff issued a series of RAIs requesting details of the liquid effluent data and associated effluent dose information from the applicant, and requested that the effluent information be incorporated into the FSAR. In response to **RAI 11.02-2 and RAI 12.02-8**, the applicant stated that the liquid effluent data requested is presented in the STP Environmental

Report (ER). **RAI 11.02-2 and 12.02-8 are closed**, as the applicant did not supply the requested information in the FSAR. Until the applicant submitted a supplemental response to **RAI 12.02-7** (letter U7-C-STP-NRC-090196, dated November 9, 2009) that did provide the requested information concerning the liquid effluent data and associated liquid effluent doses and stated that this information will be incorporated into the FSAR.

The supplemental response to RAI 12.02-7 provided a description of the required model assumptions and input parameters needed to run LADTAP II computer codes and justification for excluding potential exposure pathways. Using radiological exposure models based on RG 1.109 and the LADTAP II computer program (NUREG/CR-4013, "LADTAP II - Technical Reference and User Guide," April 1986), the applicant calculated the estimated public doses to a hypothetical maximum exposed individual (MEI) and to the population within 50 miles (80 km) from the postulated liquid effluents discharged.

The staff further evaluated the provided information and found that the applicant calculated offsite liquid releases from the Main Coolant Reservoir (MCR) using the procedure described in the Offsite Dose Calculation Manual (ODCM) for STP Units 1 and 2. This procedure calculates a release fraction for each radionuclide and assumes a significant amount of sedimentation of all radionuclides except tritium and the complete holdup by soil for cesium leakage into Little Robbins Slough. The staff was unable to verify the applicant's initial source term assumptions. Therefore, the staff used the fully mixed impoundment model recommended by RG 1.113 to calculate offsite releases. This is a bounding approach because the fully mixed impoundment model assumes no loss by sedimentation and soil holdup.

Table 12.2-1 lists the important parameters used by the staff for the LADTAP computer code calculations. The staff considered leakage from the MCR to the adjacent Little Robbins Slough and calculated the flow to the slough from the MCR as one effluent discharge rate. The staff also used the effluent discharge rate from MCR/Spillway and blowdown to the Colorado River of 16.5 cubic feet per second (cfs). The values utilized are listed in Table 12.2-1. Otherwise, the staff used the applicant's site specific values in its dose estimation.

Table 12.2-1 – Important LADTAP Parameter Values Used by the Staff*

Parameter	Staff's Value	Basis
Annual radionuclide release (Ci/yr)	GALE86 Source Term	RG 1.112, RG 1.109, and NUREG 0016.
Effluent discharge rate (cfs)	3.8/16.5	Calculated seepage rate from MCR/Spillway and blowdown.
Impoundment Model	Fully Mixed Impoundment	RG 1.113
Dilution Flow (cfs)	18.3/600	Little Robbins Slough and Colorado River
Dilution Factors	4.82/36.36	Ratio of the discharge rates.

* Staff used Applicant and LADTAPII default values for parameters not listed in the table.

Table 12.2-2 compares the applicant's results to the staff's and the 10 CFR Part 50, Appendix I liquid dose criteria. Table 12.2-2 shows that both the applicant and staff results are well below the Appendix I criteria. The NRC staff has provided bounding assessments concluding that the applicant has demonstrated its capability to comply with the liquid effluent regulatory requirements in 10 CFR Part 20 and Appendix I, to 10 CFR Part 50.

Table 12.2-2 - Comparison of Liquid Maximum Individual Doses (mrem/yr)

Organ/Body	Application*	NRC Staff's Analysis	10 CFR Part 50, Appendix I, Section II.A
Bone	1.15 E-03**	1.43 E-00**	10
Total Body	2.63 E-04**	9.36 E-01**	3
Thyroid	2.03 E-04	1.27 E-02	10

** Taken from FSAR Table 12.2-29

** Doses used for compliance to Appendix I Section II.A

Table 12.2-3 lists the population doses calculated by the applicant and compares them to the staff's results. The table shows that the assumptions and parameters used by the applicant resulted in lower doses for the total body and thyroid when compared to the NRC staff's bounding independent assessment.

The calculated annual population doses listed in FSAR Table 12.2-3 are 0.003 person-rem to the total body, and 0.003 person-rem to the thyroid. The applicant uses the population doses in the cost-benefit analysis previously described in Chapter 11 of this SER. The staff also calculated the annual population doses using the GALE86 source term and the parameters described in Table 12.2-1 above to perform an independent cost-benefit analysis previously described in Chapter 11 of this SER.

Table 12.2-3 - Comparison of Liquid Population Doses (person-rem/yr)

Organ/Body	Application*	NRC Staff's Analysis
Total Body	0.003	0.403
Thyroid	0.003	0.112

* Taken from FSAR Table 11.2-8

10 CFR 20.1301(e) (40 CFR 190) Liquid and Gaseous Effluent Dose Compliance

10 CFR 20.1301(e) requires that NRC-licensed facilities comply with the EPA generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ. Meeting the requirements of 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and N-16 sky shine from boiling-water reactor (BWR) turbine buildings. The EPA standards apply to the entire site or facility, whether it has single or multiple units.

NRC staff reviewed Section 12.2 of the COL application for compliance with 10 CFR 20.1301(e) and general radiation protection standard 40 CFR Part 190 of the U.S. Environmental Protection Agency (EPA) because the staff was unable to determine whether the applicant is in compliance with this regulation, the staff issued **RAI 11.02-4** requesting the applicant to provide additional information. The applicant's response letter (U7-C-STP-NRC-090125, dated September 3, 2009), stated that the (ER) provided the "bases and assumptions" for compliance with 10 CFR 20.1301(e) and 40 CFR Part 190, but the applicant did not incorporate the necessary ER information into the FSAR. **RAI 11.02-4** was closed as unresolved and supplemented by RAI 12.02-12 which requested that the applicant provide additional bases and assumptions used to show compliance with 10 CFR 20.1301(e) and 40 CFR Part 190, and incorporate the information into the FSAR.

The applicant's supplemental response to **RAI 12.02-7** (letter U7-C-STP-NRC-090196, dated November 9, 2009), provided liquid and gaseous effluent site data, effluent dose calculations and appropriate results tables including the 10 CFR 20.1301(e) and 40 CFR Part 190 table. **RAI 12.02-17** was issued by the staff concerning the liquid effluent dose calculations for STP 3 and 4 in the 10 CFR 20.1301(e) and 40 CFR Part 190 table. The first response to RAI 12.02-17 stated that the initial information provided was correct. After further discussion with the applicant, the 10 CFR 20.1301(e) and 40 CFR Part 190 table liquid dose calculation data was revised (U7-C-STP-NRC-100111, dated May 17, 2010), in a response provided for RAI 12.02-17. Table 12.2-4 below lists the calculated 40 CFR 190 values provided by the applicant. The staff reviewed the revised applicant response calculations including liquid and gaseous effluent doses. The staff independently verified the applicant's calculations and determined that the applicant complies with the 10 CFR Part 20.1301(e) and 40 CFR Part 190 requirements.

Table 12.2-4 - Comparison of Maximum Individual Doses to 40 CFR 190 (mrem/yr)

Organ/Body	Application*	NRC Staff Analysis	40 CFR 190
Total Body	5.71	8.03	25
Thyroid	4.55	9.52	75
Bone	1.94	10.2	25

* Taken from FSAR Table 12.2-30

The staff also independently performed liquid, gaseous and total maximum individual doses as described in NRC guidance. The staff values also verified that the requirements of 10 CFR 20.1301(e) were met. **RAI 12.02-7, RAI 12.02-12 and RAI 12.02-17 are closed.**

Based on the above information the NRC has determined that the applicant has complied with the public liquid effluent dose requirements of 10 CFR Part 20 and the design objectives in 10 CFR Part 50, Appendix I and complied with COL License Information Item 12.5.

Compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I – Gaseous Effluents

Gaseous Effluent Source Term

NRC staff evaluated the annual gaseous effluent source term data listed in FSAR Table 12.2-20 as the source term for calculating the annual gaseous effluent doses utilizing the GASPARE code. The applicant calculated and provided an annual gaseous effluent source term shown in DCD Table 12.2-20 and FSAR Tier 2, Table 12.2-20, stating that they used the methodology set forth in the BWR-GALE86 code (NUREG-0016) to calculate the values in this table as documented in FSAR Section 12.2.2. However, in review of the source term in FSAR Table 12.2-20 and the gaseous waste management system (GWMS) Departure 11.3-1 and the associated changes made, the staff issued **RAI 12.02-16** requesting information to independently confirm the calculated annual gaseous effluent source term values in FSAR

Table 12.2-20. The applicant responded (letter U7-C-STP-NRC-100058, dated March 24, 2010) that review of their GALE86 code input, used to create the annual gaseous effluent source term, indicated that the complete input/output file information for the gaseous effluent source term in Table 12.2-20 were “non-retrievable”. The applicant used the information in the ABWR DCD and STP FSAR to develop GALE86 code input parameters and to calculate GALE86 code gaseous source term output values. The applicant then adjusted the new GALE86 code gaseous source term output values based on 1) the ABWR capacity factor ratio to the capacity factor included in the GALE86 Code program, 2) the ABWR DCD reactor coolant system (RCS) water I-131 concentration ratio to the I-131 RCS concentration generated by the GALE86 Code, and 3) the ABWR DCD noble gas production rate in the RCS and its ratio to the noble gas production rate in the RCS, generated by the GALE86 Code. This adjustment of the GALE86 output results in the accepted NRC methodology is permitted by RG 1.112, as long as the applicant provides the basis for all parameters used in the evaluation that differ from, or are not contained in, the referenced NUREG-series reports to reconcile any differences between the applicant and NRC staff evaluations. The applicant provided a revised gaseous source term table in the response to the RAI, but did not revise Table 12.2-20 in the FSAR.

The staff evaluated the response to **RAI 12.02-16** and issued supplemental **RAI 12.02-19** requesting the applicant evaluate the calculated GALE86 source term table values calculated for the I-131 liquid annual release in curies per year and the Xe-133 and Xe-135 gaseous annual releases in curies per year. The NRC staff also requested the applicant to justify the iodine-131 and noble gas factors used by the applicant to revise the gaseous source term output file table values generated by the GALE86 code. The applicant’s response (letter U7-C-STP-NRC-100119, dated May 27, 2010) corrected the I-131 liquid and Xe-133 and Xe-135 gaseous GALE86 output source term values and made additional corrections to the applicant’s calculated gaseous effluent source term in their initial response to RAI 12.02-16. The applicant did not incorporate their gaseous effluent source term table values provided in their response into the FSAR Table 12.2-20. In the response to RAI 12.02-19 the applicant also compared their revised gaseous source term concentrations to 10 CFR Part 20, Appendix B concentrations to calculate the 10 CFR Part 20 unity rule ratio compliance. The applicant added the individual radionuclide ratio values and calculated the sum and determined the unity ratio was less than one. This indicated compliance with the 10 CFR Part 20 unity calculations on the revised adjusted gaseous effluent source term table of values (see the 10 CFR Part 20 Compliance section).

The applicant stated that the newly calculated adjusted source term table values did not result in significant effect on the gaseous effluent values that are in FSAR Table 12.2-20 and results in no changes to the FSAR, and that STP is in compliance with 10 CFR Part 20, 10 CFR Part 50, Appendix I and GDC 60.

The staff evaluated the applicant’s FSAR Table 12.2-20 source term and the applicants’ revised GALE86 source term response. The DCD and FSAR source terms (Tables 12.2-20) could not be verified by the applicant due to non-retrievable information. However, the DCD was previously reviewed, approved and accepted by the NRC. Therefore, the GALE86 code source term input and output values provided by the applicant were verified by the staff to evaluate and compare to the FSAR Table 12.2-20 values. The input parameter values were entered into the GALE86 Code. The GALE86 gaseous output source term table results generated by the staff agreed with the applicant output table values. Based on the calculated GALE86 source term table agreement **RAI 12.02-16 is closed.**

The staff evaluated the applicants' modification of the GALE86 gaseous effluent source term table output. The change in table values were based on modifying the GALE86 source term output table by 1) the ABWR capacity factor ratio to the capacity factor included in the GALE86 Code program, 2) the ABWR DCD reactor coolant system (RCS) water I-131 concentration ratio to the I-131 RCS concentration generated by the GALE86 Code, and 3) the ABWR DCD noble gas production rate in the RCS and its ratio to the noble gas production rate in the RCS, generated by the GALE86 Code. The staff verified GALE86 source term table values for noble gases and iodines were modified by one or more of these three factors and generated an additional source term table provided to the staff. The staff reviewed and verified the new table of values based on the changes from the applied ratios. The staff values and the applicant's values were in agreement. **RAI 12.02-19 is closed.**

The staff review of the FSAR source term, the GALE86 source term and the adjusted GALE86 source term table have been reviewed and verified. Each of these source term tables complies with the 10 CFR Part 20 unity fraction requirement. The total curie values of all three source term tables are fairly similar. However, the gaseous effluent doses for each of these source terms are dependent on the individual radionuclide values in each table. The following section of this review determines effluent gaseous dose compliance with 10 CFR Part 50, Appendix I and GDC 60.

10 CFR Part 50, Appendix I Gaseous Doses

Staff review identified that the input parameters and methodology for calculating the resulting gaseous effluent doses listed in FSAR Table 12.2-21 were not included in the COL application for evaluation and verification. The staff review of FSAR Table 12.2-21 led to issuing **RAI 12.02-7** to obtain the detailed information to validate and verify the calculated doses cited in FSAR Section 12.2.2.4 with respect to the dose objectives of 10 CFR Part 50 and 10 CFR Part 20.1301(e). The applicant responded (letter U7-C-STP-NRC-090155, dated September 22, 2009) stating the information requested was provided in the ER in response to a previous environmental RAI. However, after the applicant reviewed a supplemental **RAI 12.02-8**, the applicant re-evaluated their position and provided the requested information as a supplemental response to **RAI 12.02-7**. The applicant responded (letter U7-C-STP-NRC-090196, dated November 9, 2009) by transferring gaseous effluent information contained in the STP ER to the FSAR. The applicant moved effluent dose input parameters into FSAR Section 12.2.

The applicant also provided a description of all model assumptions and input parameters needed to run the GASPARII computer code. Using radiological exposure models based on RG 1.109 and the GASPAR II computer program (NUREG/CR-4653, "GASPAR II - Technical Reference and User Guide," March 1987), the applicant calculated the estimated doses to the public and to the population within 50 miles (80 km) from the postulated gaseous effluents discharged.

The applicant also provided justification for excluding potential gaseous effluent exposure pathways. The pathways evaluated by the applicant were based on information provided in the ER. The applicant referred to the ER stating that the cow and goat milk ingestion pathways were not viable because there are no milk animals located within 5 miles of the plant. The staff evaluated the information provided by the applicant and verified the gaseous dose calculations, using the FSAR annual gaseous effluent source term in FSAR Table 12.2-20, in accordance with NRC guidelines. As stated in the source term section above, the staff issued **RAI 12.02-16** requesting documentation verifying the annual gaseous effluent source term in Table 12.2-20 used to calculate the gaseous effluent doses. The applicant responded to **RAI 12.02-16** by supplying the STP GALE86 input and output information which included a table with a new GALE86 Code gaseous effluent source term and an adjusted GALE86 Code source term. Staff evaluation determined that the GALE86 source term was in agreement with the NRC calculations, but the new applicant adjusted GALE86 Code source term table provided had incorrect values for some radionuclides based on the derivation described by the applicant. The NRC also requested additional justification for gaseous effluent source term adjustment factors and issued **RAI 12.02-19** requesting these items be evaluated. The applicant response provided corrections to the new adjusted source term table. The data in the gaseous effluent adjusted source term table in the **RAI 12.02-19** response were verified by the staff in accordance with the derivation described by the applicant and the adjustment factors were evaluated and found to be acceptable.

The staff used the applicant's gaseous effluent source term data presented in the RAI 12.02-19 response to perform gaseous effluent dose calculations in accordance with RG 1.109 and the GASPARII computer program. These dose calculations were performed on three sets of gaseous effluent source terms. These source terms include:

- 1) The initial source term presented in the FSAR in Table 12.2-20, which is based on "non-retrievable" information, according to the applicant,
- 2) The GALE86 Code gaseous effluent source term calculated in accordance with approved NRC methodology (NUREG-0016) using applicant provided information in RAI 12.02-16 response, and
- 3) The adjusted GALE86 gaseous effluent source term developed by the applicant in response to **RAI 12.02-19**.

The NRC to applicant gaseous effluent dose comparison, and the NRC evaluation of the GALE86 and GALE86 adjusted gaseous effluent doses is described in Table 12.2-8 of this SER, and discussed below and compared to the 10 CFR Part 50, Appendix I dose criteria.

Staff review also identified gaseous effluent RAIs for the applicant to address 10 CFR Part 20 and 10 CFR Part 50, Appendix I compliance. **RAI 12.02-1** requested proper reference to gaseous effluent dispersion factors used for routine gaseous effluent releases. The applicant has provided updated dispersion parameters and an updated Table 2.3S-27 addressing this issue. The FSAR has been revised to include the revised information used in the effluent dose evaluations. **RAI 12.02-1 is closed.**

RAI 11.03-6 requested that the applicant provide finalized dispersion factors used to calculate gaseous effluent doses from each plant. The applicant responded (letter U7-C-STP-NRC-090132, dated September 9, 2009), and provided dispersion factors that were

reviewed and accepted by the staff. These dispersion factors were used to calculate the airborne concentrations in FSAR Table 12.2-20. The staff reviewed and accepted the annual average χ/Q and D/Q values (dispersion factors) addressed in FSAR Subsection 2.3S.5, "Long-Term Atmospheric Dispersion Estimates for Routine Releases." **RAI 11.03-6 is closed.**

Table 12.2-7 below shows the comparison of the effluent dose modeling assumptions between the applicant's and the NRC staff's analyses. FSAR Table 2.3S-27 includes the applicant's gaseous pathway dispersion parameters for routine releases found in FSAR Table 12.2-8 and used as input to the GASPARII dose calculation model, including the X/Q dispersion parameter and the D/Q deposition parameter for the receptor locations determined by the applicant for the maximum exposed individuals.

Table 12.2-7 - Comparison of Gaseous Receptor Locations

Receptor	Location	X/Q (sec/m ³)	D/Q (m ⁻²)
<u>Plume</u>			
• Application	Overall Max. Point, 0.69 miles, NNW	8.1 E-06	6.4 E-08
• NRC	Overall Max. Point, 0.69 miles, NNW	8.1 E-06	6.4 E-08
<u>Deposition and Inhalation</u>			
• Application	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09
• NRC	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09
<u>Vegetable Garden</u>			
• Application	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09
• NRC	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09
<u>Pasture for Livestock</u>			
• Application	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09*
• Application	Max. Residence, 3.03 miles, NNW	6.2 E-07	1.8 E-09*
• NRC	Max. Residence, 2.18 miles, WSW	6.2 E-07	1.5 E-09*
• NRC	Max. Residence, 3.03 miles, NNW	6.2 E-07	1.8 E-09*

* X/Q higher at 2.18 miles WSW, D/Q higher at 3.03 miles NNW
Values from FSAR Table 2.3S-27

The applicant calculated all FSAR gaseous pathway doses to the site boundary, except the Maximum Organ Dose, which was evaluated at 3.03 miles NNW, using the FSAR Table 12.2-20 source term. The results for the worst-case location at the site boundary indicates a gamma annual air dose of 3.3 millirad (mrad), and a beta annual air dose of 4.8 mrad; a total annual body dose of 3.2 millirem (mrem) and an annual skin dose of 7.25 mrem. The FSAR also lists the maximum annual organ dose (thyroid) of 2.19 mrem for the child. These doses are all within NRC regulatory limits.

The NRC staff performed independent dose assessments following NRC guidelines and using the GASPAR II computer code and the annual gaseous effluent data from the STP FSAR, the GALE86 code, the adjusted GALE86 source term described above and then compared all staff results to the applicant's results and the Appendix I dose criteria. Table 12.2-8 below shows the comparison of different MEI location doses between the applicant's and the NRC staff's analyses. The applicant utilizes their initial gaseous effluent dose assessment based on the gaseous effluent source term in FSAR Table 12.2-20. The applicant provided two additional source terms in their RAI responses noted above. The applicant did not provide dose calculations for these two additional source terms, but did state that their adjusted GALE86 gaseous source term resulted in no significant effect on the airborne effluent values presently given in FSAR Table 12.2-20.

The staff's gaseous effluent dose calculations performed in accordance with the NRC accepted process and the applicant site specific values using the FSAR Table 12.2-20 source term output results in a site boundary gamma annual air dose of 3.3 millirad (mrad), and a beta annual air dose of 4.28 mrad and a dose to the total body and skin, at the location of the highest dose offsite (evaluated at a location that is anticipated to be occupied during plant lifetime or evaluated with respect to such potential land and water usage and food pathways, as could actually exist during the term of plant operation), of 0.167 mrem, and 0.462 respectively. The total body dose at the site boundary from the GALE source term was 3.20 mrem and an annual skin dose of 7.25 mrem. The maximum annual organ dose (thyroid) was 2.19 mrem, for the child at 3.03 miles NNW.

The staff's gaseous effluent dose calculation performed in accordance with the NRC accepted process and the applicant site specific values using the GALE86 source term output results in a site boundary gamma annual air dose of 7.7 millirad (mrad), and a beta annual air dose of 9.1 mrad; a dose to the total body and skin, at the location of the highest dose offsite, evaluated at a location that is anticipated to be occupied during plant lifetime or evaluated with respect to such potential land and water usage and food pathways as could actually exist during the term of plant operation of 0.396 mrem, and 1.07 respectively. The total body dose at the site boundary from the GALE source term was 5.17 mrem and an annual skin dose of 14.0 mrem. The maximum annual organ dose (thyroid) was 2.0 mrem, for the child at 3.03 miles NNW.

The staff's gaseous effluent dose calculation performed in accordance with the NRC accepted process and the applicant site specific values, using the applicant adjusted GALE86 source term output results in a site boundary gamma annual air dose of 2.65 millirad (mrad), and a beta annual air dose of 3.07 mrad; a dose to the total body and skin, at the location of the highest dose offsite, evaluated at a location that is anticipated to be occupied during plant lifetime or evaluated with respect to such potential land and water usage and food pathways as could actually exist during the term of plant operation of 0.135 mrem, and 0.367 respectively. The total body dose at the site boundary from the GALE source term was 1.77 mrem and an annual skin dose of 4.80 mrem. The maximum annual organ dose (thyroid) was 2.36 mrem, for

the child at 3.03 miles NNW. Table 12.2-8 shows a comparison of the maximum annual individual doses.

This calculated gaseous effluent dose comparison indicates how the gaseous effluent doses were derived. The FSAR effluent doses adequately address the design criteria in 10 CFR Part 50, Appendix I (see Table 12.2-8), and envelope the gaseous effluent dose calculations performed in accordance with the NRC methodology using the GALE Code for calculating the effluent source term, and the GASPAR Code to calculate the associated doses to the environment.

Table 12.2-8 - Comparison of Gaseous Maximum Annual Individual Doses

Description	Based on FSAR Source term in Application	Based on NRC Staff GALE86 Source Term	Based on Applicant GALE86 Adjusted Source Term	10 CFR Part 50, Appendix I, Section II.B and II.C Limits
<u>Noble Gases</u>				
• Gamma Dose (mrad) <u>Site Boundary</u>	3.30 *	7.70	2.65	10
Beta Dose (mrad) <u>Site Boundary</u>	4.28 *	9.10	3.07	20
• Total Body (mrem) <u>At MEI</u>	0.167 **	0.396 **	0.135 **	5
• <u>Site Boundary</u>	3.20 *	5.17	1.77	N/A
• Skin (mrem) <u>At MEI</u>	0.462 **	1.07 **	0.367 **	15
• <u>Site Boundary</u>	7.25 *	14.0	4.8	N/A
<u>Radioiodines and Particulates (mrem)</u>				
• Maximum Organ ***	2.19*	2.0	2.36	15

* From FSAR Table 12.2-29

** These doses indicate the accepted NRC methodology dose evaluated at the Maximum Exposed Individual (MEI) location (2.18 miles WSW) that is anticipated to be occupied during plant lifetime or evaluated with respect to such potential land and water usage and food pathways as could actually exist during the term of plant operation per RG 1.109 Table 1, page 1.109-10. The doses at the site boundary are shown as comparisons to the doses reported at the MEI.

*** Dose for the child thyroid @ 3.03 miles NNW

Population Dose Evaluation – Gaseous Effluents

Table 12.2-9 lists the population doses calculated by the applicant as compared to the staff's results. The applicant's calculated annual population doses from STP Units 3 and 4 are 0.58 person-rem to the total body, and 2.38 person-rem to the thyroid. The table shows that the assumptions and parameters used by the applicant resulted in lower doses for the total body and a higher dose for the thyroid when compared to the NRC staff's bounding independent assessment. The applicant uses the population doses from both STP Units 3 and 4 in the cost-benefit analysis located in Chapter 11, Table 11.3-6 of this SER. The NRC guidance, RG 1.110, for this calculation references population doses per reactor, rather than multiple reactors. Therefore, the NRC population doses used in Chapter 11 are per reactor.

Table 12.2-9 - Comparison of Gaseous Population Doses (person-rem/yr)

Organ/Body	Application*	NRC Staff's Analysis **
Total Body	0.58	0.746
Thyroid	2.38	0.924

* Taken from RAI Response 12.02-7 for both STP 3 and 4 reactors

** NRC population doses are per reactor.

10 CFR Part 20 Gaseous

The initial staff review did not find COL gaseous effluent information provided by the applicant that addressed compliance with 10 CFR Part 20 Appendix B "unity" concentration limit. The staff issued **RAI 12.02-3** requesting that the applicant provide information demonstrating compliance with gaseous annual effluent release concentrations meeting the 10 CFR Part 20, Appendix B "unity" concentration limit identified in note 4, of 10 CFR Part 20, Appendix B. The applicant provided revised tables with the unity calculation included in the **RAI 12.02-3** response. In addition, the applicant also clarified and corrected Table 12.2-20 that lists the radionuclides and 10 CFR Part 20 concentrations. The staff has determined the FSAR and DCD gaseous source terms are similar. The staff has determined that based on the changes made to the concentrations of radioactive materials in gaseous effluents in unrestricted areas currently listed in Table 12.2-20, these values will be a small fraction of the limits specified in Table 2, Column 1, of Appendix B to 10 CFR Part 20 and therefore meet the 10 CFR Part 20, Appendix B "unity" concentration limit. The applicant will modify the FSAR to address RAI 12.02-3 in the next COL FSAR revision. **RAI 12.02-3 is being tracked as Confirmatory Item 12.02-3.**

Compliance with GDC 60

The staff reviewed STP COL Section 11.3, the GWMS, for compliance with Technical Rationale Section 5 of the Standard Review Plan (SRP) Section 11.3. "Gaseous Waste Management System," which states, "Compliance with GDC 60 requires that design provisions be included in

the nuclear power unit to control releases of radioactive materials in gaseous effluents to the environment during normal plant operation, including anticipated operational occurrences.” Part of the design to control the releases of radioactive materials in gaseous effluents is the influence of the meteorological dispersion parameters in the region of the nuclear power plant. In the response to **RAI 12.02-1** the applicant addressed changes to the X/Q and D/Q dispersion factors used to calculate releases of gaseous effluents to the environment. After reviewing the information provided, the staff issued **RAI 11.03-6** requesting that design of the GWMS and the releases of gaseous effluents to the environment be re-evaluated based on the changes to the dispersion factors. The applicant has re-evaluated the dispersion factors for STP and responded by revising Table 2.3S-27 listing the final dispersion factors determined to be used for routine gaseous effluent releases. **RAI 12.02-1 and RAI 11.03-6 are closed.**

This section of section 12.2 addresses COL License Information Item 11.2

Supplemental Information

RG 1.206 Part C.I.12.2.1, “Contained Sources,” states that “the applicant should describe the sources of radiation, during normal plant operations and accident conditions, that are the bases for the radiation protection design” and that the “sources should be described in the manner needed for input to the shield design calculation.”

NRC staff issued **RAIs 12.02-4 and 12.02-5** requesting the applicant to provide additional information concerning radiation source and shield design for the skid-mounted, low conductivity waste (LCW) and high conductivity waste (HCW) filter/demineralizer systems that will be utilized in the STP Units 3 and 4 RW/B. The applicant’s responses to RAI 12.02-4 dated August 20, 2009 (ML092930209) and RAI 12.02-5 dated October 12, 2009 (ML092890082) state that the equipment has not been specified at this time, but the design specifications for the equipment will include shielding requirements to ensure that external dose rates from the equipment remain within the dose rate ranges for the zone designations identified in the ABWR DCD and in COL application Figure 12.3-39. In response to RAI 12.02-4, the applicant provided a conservative calculation of the radiation source term information for the HCW and LCW skids, which will be added to the FSAR as Tables 12.2-13b and 12.2.13f in a future COL FSAR revision. Because the equipment has not been specified, the calculation assumes a ‘typical’ filter/demineralizer skid model and operating assumptions. In order to provide the most conservative source term estimate, the model assumes a 100 percent removal efficiency of the input streams and operation for a 1-year time period. Based on a review of the information provided in the response, and a commitment from the applicant to include the estimated HCW and LCW source term information in the FSAR, the staff found this response and the methodology acceptable. Therefore, RAI 12.02-5 is resolved. NRC staff verified that the proposed source information was included in COL FSAR Revision 4. Accordingly, Question 12.02-4 is closed.

RG 1.206, Subsection C.I.12.2.1 also states that the applicant should describe any required radiation sources containing byproduct, source, and special nuclear material that may warrant shielding design considerations and may provide a listing of isotope, quantity, form, and use of all sources that exceed 3.7 E+9 Bq (100 millicuries). The staff issued **RAI 12.02-6** requesting the applicant to include additional information and to list in FSAR Section 12.2 any radiation sources containing byproduct, source, and special nuclear material that exceed 3.7 E+9 Bq (100 millicuries), including isotope, quantity, form, and use of all sources. The applicant’s response to RAI 12.02-6, dated August 20, 2009 (ML092930209), states that ABWR

Subsection 12.2.1.2.9, "Other Radioactive Sources," was incorporated by reference and no additional radiation sources were identified for STP Units 3 and 4. Since the COL applicant will have to use additional radioactive sources not described in the ABWR DCD for the purpose of calibration of radiation protection instruments, the staff found the applicant's response to RAI 12.02-6 to be insufficient. Accordingly, RAI 12.02-6 is closed as unresolved and the staff issued **RAI 12.02-13** requesting the applicant to provide additional information about any radiation sources containing byproduct, source, and special nuclear material that exceed $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries) and that may be required to perform STP Units 3 and 4 radiation detection instrumentation calibration activities. The applicant's response to RAI 12.02-13 dated December 21, 2009 (ML093580193), references the response to RAI 01-15, dated December 21, 2009 (ML093450355), which discusses the appropriateness of the licensee's compliance with 10 CFR Parts 30, 40, and 70, and the program elements that will ensure necessary controls to allow receipt of byproduct and source material. In Revision 4 to the COL FSAR, the applicant revised Subsection 12.2.1.2.9.6, to state that sources greater than $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries) required for dosimetry and portable instrument calibration will be located in the Meteorology Laboratory and will be licensed under Units 1 and 2. This revised FSAR subsection also states that all other sources are expected to be less than $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries). Because the applicant provided the requested information about radiation sources containing byproduct, source, and special nuclear material, RAI 12.02-13 is closed.

COL FSAR Section 12.2 Tables 12.2-5a, "Radiation Sources-Radiation Sources," and 12.2-5b, "Radiation Sources-Source Geometry," provide a reference to the radiation source term tables (the individual tables in the DCD containing the detailed source term information for each radiation source) and the source term geometry information for all of the radiation sources found in the ABWR except for the sources for the reactor pressure vessel. During its review of Tables 12.2-5a and 12.2-5b, the staff noted that these tables reference the source term tables and provide the geometry information for all of the sources listed in these tables except for the source listed " (i.e., for the spent fuel assemblies located in the spent fuel pool). For this source, Tables 12.2-5a and 12.2-5b stated that this information would be provided by "Applicant". Even though Tables 12.2-5a and 12.2-5b stated that the "Spent Fuel Storage" source term would be provided by the applicant in the ABWR DCD, the ABWR DCD contained no COL information item or notations stating that it was the responsibility of the COL applicant to determine a "Spent Fuel Storage" source term to be included in the COL application. In addition, the staff found that the ABWR DCD did not adequately describe the spent fuel storage radiation source term and geometry to allow for verification of the shield design calculations for this source term required in Tier 1 ITAAC 3.2a. The staff issued **RAI 12.02-14** requesting the applicant to revise Tables 12.2-5a and 12.2-5b of the STP Units 3 and 4 FSAR to list a radiation source term reference table and include geometry information for the "Spent Fuel Storage" source. The applicant's response to RAI 12.02-14, dated January 4, 2010, (ML100060693) stated that design activity for the new STP 3 and 4 fuel and spent fuel storage facilities was still in progress and the applicant would develop design drawings showing the geometry of the Spent Fuel Storage facility and provide these in a proposed future COL revision to STP FSAR Table 12.2-5a and Table 12.2-5b. The applicant also stated that, at the conclusion of the spent fuel storage design activities, the source terms, geometry, and dose calculations will be made available for NRC staff review. After several teleconference calls with the applicant and further staff discussions, the staff determined that additional information to resolve the staff's concerns associated with the spent fuel sources. Consequently, staff issued **RAI 12.02-20** requesting the applicant to also include the radiation source term for corrosion and fission products contained in the spent fuel pool water in Table 12.2-5a and Table 12.2-5b in the STP Units 3 and 4 FSAR. RAI 12.02-20 also requested the applicant to modify the STP FSAR to specify the expected dose rates to the refueling operator during spent fuel movement, in accordance with ANSI/ANS-

57.1-1992. The applicant's response to RAI 12.02-20, dated January 3, 2011, (ML110050390) provided the requested information, but in reviewing the response, the staff noted a very large discrepancy between the applicant's calculated dose rate to the refueling operator during fuel movement and the corresponding dose rate based on the staff's confirmatory calculation, (which utilized the information included in DCD Table 12.2-3b "Gamma Ray Source Energy Spectra - Post-Operation Gamma Sources in the Core"). In order to evaluate the reasons for this discrepancy and to review the applicant's source term calculations for RAI 12.02-20, the staff held an audit with applicant on January 13, 2011. The purpose of the audit (ML110871600) was for the applicant to provide their source term calculations for the bundles in the spent fuel pool and the maximum raised fuel assembly to the staff, and for the staff to obtain information on how the information in DCD Table 12.2-3b was used by the applicant. After evaluating the source term data in DCD Table 12.2-3b, the applicant stated that the spent fuel dose rates calculated using the data contained in DCD Table 12.2-3b would be low by a factor of one million ($10E6$) and that this large discrepancy was likely the result of a unit's error in Table 12.2-3b. The applicant stated that the data in DCD Table 12.2-3b should have units of J/MW-s instead of pJ/W-s. Using the units of J/MW-s would result in the values of the DCD Table 12.2-3b being a million times larger than the source term values that are currently in the table. The applicant stated, and staff later confirmed, that increasing the magnitude of the data in the table by a factor of a million would make the table's data consistent with the source term data for operating BWRs. The applicant later identified a unit's error in DCD Table 12.2-3c "Gamma Ray Source Energy Spectra – Gamma Ray Sources External to the Core During Operation" which also resulted in the data in this table being a factor of a million times too low. The units in Table 12.2-3c should be $pJ/cm^3/s/W_t$ instead of $pJ/cm^3/s/MW_t$. Staff asked the applicant to make a departure to correct the unit errors associated with the tables in the DCD. The staff also asked the applicant to provide the requested spent fuel pool information, including the dose rates from 1) the fuel in the core, post-operation, 2) the fuel in a fully loaded spent fuel pool, 3) the radionuclides in the water in the pool itself, and 4) the maximum raised fuel assembly in the spent fuel pool.

In lieu of changing the units in DCD Tables 12.2-3b and 12.2-3c, the applicant proposed a departure to add a footnote at the bottom of each of these tables, stating that the information in Tables 12.2-3b and 12.2-3c shall not be used by the applicant for detailed facility design, including shielding design and evaluation of equipment qualification, operational procedures, or as a basis for any changes to the FSAR. In the applicant's response, dated May 5, 2011 (ML11129A057, the applicant stated that, although the unit's error in Tables 12.2-3b and 12.2-3c resulted in the data in these tables being low by a factor of a million, the applicant stated that source terms of the appropriate magnitude were used in the design of the ABWR facility, including shielding design, and equipment qualification. The applicant also provided several examples which supported this conclusion that correct units were used in the DCD in calculating the doses around the reactor vessel, for shielding in containment and building walls, and in equipment qualification. Staff determined from these examples, and from the staff's own analysis, that appropriate source term information appears to have been used in the plant shielding design and in evaluating equipment qualification. Therefore, since correct source term information appears to have been used in the design, and the applicant has committed not to use the data in Tables 12.2-3b and 12.2-3c in order to prevent the use of the information with incorrect units, staff finds this departure acceptable. In addition to this departure, the staff will issue a license condition that will prohibit the licensee from using the information in Tables 12.2-3b and 12.2-3c until the licensee revises the information in these tables and the apparent errors in the units are corrected (as authorized by Section VIII.B.5 of Appendix A, to 10 CFR Part 52). Finally, in the applicant's response to RAI 12.02.20, dated April 26, 2011, (ML11119A076), the applicant provided new spent fuel pool information, including a proposed new appendix "12B

Spent Fuel Pool Geometry and Dose Rate Calculation”, to the COL FSAR. Information to be added to the FSAR includes new spent fuel geometry information, source term information for spent fuel in the core, spent fuel in the spent fuel pool, and for the maximum raised fuel assembly, and the source term for the radionuclides contained in the spent fuel pool water. In their response, the applicant also specified that estimated dose rates from the maximum raised fuel assembly would be 1.2 mrem/hr to an operator on the refueling machine trolley platform. This estimated dose rate is below the criteria of 2.5 mrem/hr from an irradiated fuel unit specified in ANSI/ANS-57.1-1992. The staff finds these proposed FSAR revisions acceptable. Accordingly, RAI 12.02-20 is being tracked as **Confirmatory Item 12.02-20**.

Based on the staff’s review of additional information provided in response to a series of RAIs generated during the Chapter 11 review (RAIs 11.02-07, 11.02-08, and 11.02-09) concerning the condensate storage tank (CST) the staff issued **RAI 12.02-18**. In this RAI, the staff requested that additional information be included in the STP FSAR concerning; 1) identification of the CST and associated radiation levels (Zone C designation) on radiation zone maps, 2) design features of the CST containment dike and underground piping trenches, 3) identification of the CST as a radiation source in Section 12.2, 4) inclusion of CST source geometry and shielding information in Section 12.2, and 5) provision of additional information about radiation protection controls for the CST and other radioactive materials and tanks that may be located outdoors. In the response to RAI 12.02-18, dated May 17, 2010 (ML101390226), the applicant provided information about the CST location, the CST piping routing information (piping located in trenches with capability to identify and collect piping leakage), and the design information (material, height, and outside wall thickness) about the dike that will surround the CST. The response also refers to the response to RAI 11.02-7 for CST source term information. However, in the response to the staff’s request to include this information in the appropriate sections of the STP FSAR, the applicant cited finality related to the CST because ABWR DCD Tier 2, Section 9.2.9 “Makeup Water Condensate System” provides some details on the CST, which is incorporated by reference in the COL application, with no departures. Therefore, the applicant stated that, “No COLA revision is required as a result of this RAI response”. The staff subsequently issued **RAI 12.02-21** requesting the applicant to include CST operating procedure and source term information in the COL FSAR, in accordance with the guidance in RG 1.206. In response to RAI 12.02-21, dated October 27, 2010, (ML103070081) the applicant proposed to modify the COL FSAR to include a description of the CST source term information, operating procedures, containment dike and underground piping information in the next COL FSAR revision. The staff’s review found these proposed FSAR revisions acceptable, and this item is being tracked as **Confirmatory Item 12.02-21**.

12.2.5 Post Combined License Activities

The staff proposed a license condition that would prohibit the applicant from using the information in Tables 12.2-3b and 12.2-3c, until the licensee revises the information in these tables and the apparent errors in the units are corrected (as authorized by Section VIII.B.5 of Appendix A, to 10 CFR Part 52), as described above.

12.2.6 Conclusion

The staff evaluated the information the applicant provided in this section to address radiation sources and airborne radioactive material sources at the site. In addition, the staff has compared the additional COL information within the application to the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 12.2, and other NRC regulatory guides

and concludes that the applicant is in compliance with the NRC regulations. Specifically, the staff finds that the relevant requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I have been met regarding contained radiation sources and airborne radioactive material sources.

COL License Information Item 12.5, regarding airborne radioactive material releases to the environment, is adequately addressed by the applicant and considered closed. Based on its evaluation, the staff has determined that the additional information, identified in the Technical Evaluation Section above adequately addresses the radiation sources associated with South Texas Nuclear Plant, Units 3 and 4.

In conclusion, as a result of the technical evaluation above, with the exception of **Confirmatory Items 12.02-3, 12.02-20 and 12.02-21**, the staff can finalize its conclusions concerning radiation sources and airborne radioactive material sources in accordance with the requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I

- As demonstrated in FSAR Section 12.2 using site-specific conditions, the applicant meets the requirements of Section II.A of Appendix I to 10 CFR Part 50 with respect to design objectives, by including a LWMS that is capable of maintaining releases of radioactive materials in liquid effluents. Therefore, the calculated individual doses in an unrestricted area from all exposure pathways are less than 3 mrem to the total body and less than 10 mrem to any organ.
- The applicant meets the requirements of 10 CFR 20.1301 and 10 CFR 20.1302, as demonstrated in FSAR Section 12.2 using site-specific conditions. The staff determined that the concentrations of radioactive materials in liquid effluents in unrestricted areas will be within the limits specified in Table 2 Column 2 of Appendix B to 10 CFR Part 20.
- The staff reviewed the sources of radiation and radioactivity and associated doses to members of the public. The staff concluded that annual doses from all sources of radioactivity and radiation from the site (using site-specific conditions), including liquid and gaseous effluents and external radiation exposures from buildings and storage tanks, will not exceed the EPA generally applicable environmental radiation standard 40 CFR Part 190, as implemented under 10 CFR 20.1301(e) and demonstrated in FSAR Section 12.2 using site-specific conditions.
- The applicant meets the requirements of GDC 60 and 61 with respect to controlling releases of radioactive materials into the environment, by assuring that the GWMS design includes the equipment to monitor and control releases of radioactive materials in gaseous and particulate effluents. As demonstrated in FSAR Subsection 12.2.2.2.2 using site-specific conditions, the applicant meets the requirements of Sections II.B and II.C of Appendix I to 10 CFR Part 50 design objectives. By maintaining releases of radioactive materials in gaseous effluents, the calculated individual doses in an unrestricted area from all exposure pathways are less than 0.05 mSv (5 mrem) to the total body; less than 0.15 mSv (15 mrem) to the skin; and less than 0.15 mSv (15 mrem) to any organ from releases of radioiodines, tritium, carbon-14, and radioactive materials in particulate form. In addition, the calculated air doses from gaseous effluents at the exclusion area boundary will be less than 0.01 cGy (10 millirads) for gamma radiation and less than 0.02 cGy (20 millirads) for beta radiation.

- The applicant meets the requirements of 10 CFR 20.1301 and 10 CFR 20.1302, as demonstrated in FSAR Subsection 12.2.2.2.2 using site-specific conditions. The staff determined that the concentrations of radioactive materials in gaseous effluents in unrestricted areas will be within the limits specified in Table 2 (Column 1) of Appendix B to 10 CFR Part 20.

The staff reviewed the sources of radiation and radioactivity and associated doses to members of the public. The review concluded that annual doses from all sources of radioactivity and radiation from the site (using site-specific conditions), including gaseous and liquid effluents and external radiation exposures from buildings and storage tanks, will not exceed the EPA generally applicable environmental radiation standard 40 CFR Part 190 implemented under 10 CFR 20.1301(e), as demonstrated in FSAR Section 12.2 using site-specific conditions.

12.3 Radiation Protection (Related to RG 1.206, Section C.I.12.3, “Radiation Protection Design Features”)

Section 12.3, “Radiation Protection Design Features,” and Section 12.4, “Dose Assessment,” are treated as separate sections in the SER, the COL FSAR, and in the ABWR DCD. However, these two sections are listed as a single section (Section 12.3-12.4, “Radiation Protection Design Features,”) in both RG 1.206 and NUREG–0800.

12.3.1 Introduction

This section of the FSAR addresses the issues related to radiation protection equipment and design features used to ensure that occupational radiation exposures are ALARA. The discussion takes into account design dose rates, AOOs, and accident conditions. These issues include facility design features, shielding, ventilation, area radiation and airborne radioactivity monitoring instrumentation, dose assessment, and inspections, tests, analyses, and acceptance criteria (ITAAC).

12.3.2 Summary of Application

Section 12.3 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 12.3 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. .

In addition, in COL FSAR Section 12.3 the applicant provides the following:

Tier 1 Departures

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

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

Elimination of hydrogen recombiners.

Reclassification of containment hydrogen and oxygen-monitoring instrumentation from safety-related Category 1 to nonsafety-related Category 2 or Category 3.

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

This departure updates instrumentation and control (I&C) system, and can be grouped into five primary changes:

- Elimination of obsolete data communication technology
- Elimination of unnecessary inadvertent actuation prevention logic and equipment
- Clarifications of digital controls nomenclature and systems
- Final selection of platforms that changed the implementation architecture
- Testing and surveillance changes for Safety System Logic and Control (SSLC)

Tier 2* Departure

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

This departure identifies Tier 2* items in Table 1.8-20 and Table 1.8-21 that are being updated to more current revisions/editions. Those Tier 2 items that are explicitly revised in the COL application or those that require changes due to changes in the Tier 2* items are also included.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 1.2-2 Turbine Building

This departure addresses the turbine building redesign to accommodate replacing the turbine generator, resizing the condenser, and replacing the medium voltage electrical system with a dual voltage design requiring equipment relocation into the turbine building.

- STD DEP 3.8-1 Resizing the Radwaste Building

Due to process changes to the radioactive waste treatment systems described in Departures STD DEP 11.2-1 and 11.4-1, the dimensions and layout have changed from those in the DCD.

- STP DEP 9.4-1 Service Building HVAC System

This departure revises the outside inlet air monitoring instrumentation design of the service building heating, ventilating, and air conditioning (HVAC) system by removing the provisions for toxic gas monitors and the Technical Support Center (TSC) alarm for high toxic gas concentrations.

- STD DEP 11.5-1 Process and Effluent Radiation Monitoring and Sampling System

This departure includes numerous changes to the process and effluent radiation monitoring and sampling system that include additional alarm functions, removing recorders, radiation monitor readout units, and modifying channel ranges.

- STD DEP 12.3-1 Cobalt Content in Stainless Steel

This departure revises the requirements for the material specification for the stainless steel component exposed to reactor coolant, with a specific reference to the cobalt content in the stainless materials. A graded approach to cobalt concentrations was taken by using various grades of low-cobalt stainless steel, with the material in the core receiving the least amount of cobalt. The cobalt concentrations are allowed to increase with the distance from the core. The overall cobalt limit for all reactor vessel material is 0.05 weight (wt) percent.

- STD DEP 12.3-2 Deletion of CUW Backwash Tank Vent Charcoal Filter

This departure corrects the text description of the backwash tank vent system by deleting the reference to a charcoal filter on that vent system, which does not exist in the design.

- STD DEP 12.3-3 Steam Tunnel Blowout Panels

This departure removes the Section 12.3 discussion concerning blowout panels and relief and release pathways associated with the steam tunnel, which conflicts with the description in Section 3.8.4 and Subsection 3.12.1.3. This departure also adds the phrase "or equivalent" in Subsection 12.3.1.4.4, which describes the use of lead-loaded silicone foam for sealing penetrations and allows for the use of new or better products.

- STD DEP 12.3-4 Alarm Capability for Area Radiation Monitors (ARMs)

This departure revises the FSAR to add alarm capability to certain ARMs and adds five additional monitors to the reactor building.

Administrative Departure

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (i.e., misspellings, incorrect references, table headings, etc.). Administrative departures do not affect the presentation of any design discussion or the qualification of any design margin.

COL License Information Items

- COL License Information Item 12.6 Airborne Radionuclide Concentration Calculation

COL License Information Item 12.6 addresses the calculation of the expected airborne radionuclide concentrations to verify the adequacy of the ventilation system before fuel loading.

- COL License Information Item 12.7 Operational Considerations

COL License Information Item 12.7 addresses operational considerations for airborne radiation monitoring, such as the procedures for operations and the calibration of the monitors, as well as the placement of the portable monitors. COL License Information Item 12.7 also includes ARM alarm setpoints.

- COL License Information Item 12.8 Requirements of 10 CFR 70.24

COL License Information Item 12.8 addresses information demonstrating that the plant meets the criticality accident monitoring requirements of 10 CFR 70.24.

- COL License Information Item 12.3.7.4 Material Selection

COL License Information Item 12.3.7.4 (DCD Tier 2) addresses the material selection. (This COL License Information Item is not included in DCD Table 1.9-1.)

Supplemental Information

- Radiation Exposure to Construction Workers During Plant Construction

The applicant includes the evaluation of doses to construction workers in FSAR Section 12.3.8.

10 CFR 20.1406 Minimization of Contamination to Facilitate Decommissioning

12.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1503. In addition, the acceptance criteria for "Radiation Protection" are in Section 12.3-12.4 of NUREG-0800.

The regulatory basis for accepting that radiation protection equipment and design features will ensure radiation exposure to occupational workers and members of the public will be kept ALARA, and in compliance with the limits identified in 10 CFR 20.1201 and 10 CFR 20.1301, is based on meeting the requirements of 10 CFR 20.1101. Specifically, that there is a policy formulated in accordance with the ALARA provisions of 10 CFR 20.1101(b) to ensure that occupational radiation exposure will be ALARA.

The regulatory basis for accepting that the facility design and procedures for operation will, in accordance with 10 CFR 20.1406, minimize contamination of the facility and the environment and the generation of radioactive waste, to the extent practicable, and facilitate the eventual decommissioning of the facility.

In addition, the regulatory bases for accepting the resolution of the STD COL information items are:

- COL License Information Item 12.6 is based on meeting the applicable requirements of 10 CFR Part 20 by following the guidance of RG 8.8.
- COL License Information Item 12.7 is based on meeting the applicable requirements of 10 CFR Part 20 by following the guidance of RG 8.2 and RG 8.8.
- COL License Information Item 12.8 is based on meeting the applicable requirements of 10 CFR Part 50 and 10 CFR Part 70.
- COL License Information Item 12.3.7.4 is based on meeting the applicable requirements of 10 CFR Part 20 by following the guidance of RG 8.8.

Moreover, the STD COL license information items are based on following the guidance of 10 CFR 20, 30, 31, 32, 33, 34, 40, 50, and 70 and NEI 07–03A, Revision 0, “Generic FSAR Template Guidance for Radiation Protection Program Description.”

In addition, in accordance with Section VIII, “Process 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, Tier 2* and Tier 2 departures. Tier 1 and Tier 2* departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Sections VIII.A.4 and VIII.B.6, respectively. 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.

12.3.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 12.3 of the certified ABWR DCD. The staff reviewed Section 12.3 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 radiation protection.

The staff reviewed the information in the STP COL FSAR:

Tier 1 Departures

The following Tier 1 Departures identified by the applicant in this section require prior NRC approval and the full scope of their technical impact may be evaluated in the other sections of this SER accordingly. For additional information, refer to COL application Part 07, Section 5.0 for a listing of all FSAR sections affected by these Tier 1 departures. In addition, compliance

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.

with 10 CFR Part 52, Appendix A, Section VIII.A.4 for this Tier 1 departure will be addressed by the staff in Appendix 1-A of the staff's SER.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

STD DEP T1 2.14-1 is identified in Section 12.3 of the STP Units 3 and 4 COL FSAR because revisions of Reactor Building Zone Maps and Figures 12.3-5, 12.3-10, 12.3-16, and 12.3-21 were required to reflect the elimination of the Hydrogen Recombiners.

The staff found that this departure does not result in any change in radiation protection equipment and design features identified in the ABWR DCD that are used to ensure that occupational radiation exposures are ALARA. NRC staff found that this departure does not require any further evaluation as it pertains to the review scope of this section. Additional staff review and evaluation of the acceptability of this departure can be found in Section 16.4.9.11 of this SER.

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

This departure is identified in this section due to changes in the data communication technology that will be used in STP Units 3 and 4. The proposed data communication system separates safety-related and non-safety-related data communication. Process and Effluent Radiation Monitoring instrumentation is part of the non-safety instrumentation that is affected by the data communication system changes.

The staff found that this departure does not result in any change in radiation protection equipment and design features identified in the ABWR DCD that are used to ensure that occupational radiation exposures are ALARA. NRC staff found that this departure does not require any further evaluation as it pertains to the review scope of this section. Additional staff review and evaluation of the acceptability of this departure can be found in Subsections 16.4.1.1 and 16.4.6.1 of this SER.

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

This departure is not identified by the applicant as affecting FSAR Chapter 12. However, the departure was reviewed by the staff for applicability to Chapter 12 because it addresses changes in radiation monitoring instrumentation. This departure deletes the main steam line tunnel radiation monitor closure of the main steam isolation valves (MSIV) and SCRAM trip function, because the function is not credited in the ABWR safety analysis. Also, operational experience indicates spurious reactor trips due to the function. The departure retains the indication of main steam line tunnel radiation levels and alarm functionality.

This departure does not result in any change in radiation protection equipment and design features identified in the ABWR DCD that are used to ensure that occupational radiation exposures are ALARA. Additionally, the staff review and evaluation of the acceptability of this departure can be found in Subsection 16.4.6.1 and Section 11.5 of this SER.

Tier 2* Departure

The following Tier 2* Departure identified by the applicant in this section requires prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER accordingly. For more information, please refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2* departure.

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

This departure updates the referenced regulatory guides in the DCD to the most recent version of guides that are applicable to the STP Units 3 and 4 COL application. For this section, this departure updates RG 1.143 to Revision 2. The staff found this departure acceptable based on the applicant's utilization of the most recent regulatory guidance for the design changes made to the radwaste building and radwaste systems. With respect to the impact of the departure on this section, the acceptability of this departure is limited to RG 1.143, Revision 2.

This departure does not result in any change in radiation protection equipment and design features identified in the ABWR DCD that are used to ensure that occupational radiation exposures are ALARA. NRC staff found that this departure does not require any further evaluation as it pertains to the review scope of this section and is acceptable.

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 Departures not requiring prior NRC approval identified by the applicant in this section may also be evaluated in the other sections of this SER accordingly. For more information, please refer to COL application Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

- STD DEP 1.2-2 Turbine Building
- STD DEP 3.8-1 Resizing the Radwaste Building
- STP DEP 9.4-1 Service Building HVAC System
- STD DEP 11.5-1 Process and Effluent Radiation Monitoring and Sampling System
- STD DEP 12.3-1 Cobalt Content in Stainless Steel
- STD DEP 12.3-2 Deletion of CUW Backwash Tank Vent Charcoal Filter
- STD DEP 12.3-3 Steam Tunnel Blowout Panels
- STD DEP 12.3-4 Alarm Capability for Area Radiation Monitors (ARMs)

Administrative Departure

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (i.e., misspellings, incorrect references, table headings, etc.). The applicant identifies an Administrative Departure in this section with respect to an incorrect table reference. NRC staff found that this administrative departure does not affect the presentation of any design discussion or qualification of design margin and is acceptable.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 determined that these departures do not require prior NRC approval. Within the review scope of this section, the staff found it reasonable that these departures do not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

Compliance with 10 CFR Part 20 for Tier 2 Departures Not Requiring Prior NRC Approval

Although the applicant has identified the following Tier 2 Departures as Not Requiring Prior NRC Approval, NRC staff found it necessary to evaluate these departures within the scope of compliance with the requirements of 10 CFR Part 20 in order to make a determination of reasonable assurance that the departures did not result in any changes to radiation protection equipment and design features identified in the ABWR DCD that ensure occupational and public radiation exposures are ALARA, and that STP 3 and 4 will be constructed and operated in compliance with the Part 20 requirements.

STD DEP 1.2-2 Turbine Building

This departure reflects the turbine building redesign to accommodate replacing the turbine generator, resizing the condenser, and relocating electrical system equipment into the turbine building. This redesign resulted in the need to revise the Turbine Building Radiation Area Zone maps and Figures 12.3-49 through 12.3-53, 12.3-55, 12.3-68 through 12.3.73, and 12.3-75 through 12.3-77. The revised drawings indicate the location changes of the turbine building area radiation monitors. Table 12.3-7, "Area Radiation Monitors Turbine Building," was revised to indicate the location changes. However, the applicant did not provide the bases or the methodology for the monitor locations and sensitivity ranges selected. The staff issued **RAI 12.03-12.04-6** requesting the applicant to provide additional information concerning the relocation of the turbine building ARMs. The applicant's response to this RAI dated August 26, 2009 (ML092430136), states that the revised ARM locations and sensitivity ranges are consistent with the basis in the ABWR DCD and no additional information should be added to the FSAR. Further evaluation of the revised turbine building ARM locations and sensitivity ranges by the staff concluded that the locations and sensitivity ranges are consistent with the NRC-approved design and location criteria specified in the ABWR DCD. Based on the above discussion, the staff found this departure reasonable regarding compliance with the requirements of 10 CFR Part 20. Accordingly, RAI 12.03-12.04-6 is closed.

in the ABWR DCD for RCS alloy cobalt content. In addition, the applicant will monitor and reduce, to the extent practicable, the cobalt inventory in the reactor coolant system. Reducing the amount of cobalt in the reactor coolant system in this manner conforms to the guidance in RG 8.8 for maintaining occupational radiation exposures ALARA. Therefore, the staff found this departure reasonable regarding compliance with the requirements of 10 CFR Part 20.

- STD DEP 12.3-2 Deletion of CUW Backwash Tank Vent Charcoal Filter

Section 12.3.1.4.1 of the ABWR DCD provides a description of the Reactor Water Cleanup (CUW) System and states that the backwash tank vent for this system is fitted with a charcoal filter canister on the backwash tank vent to reduce emissions of radioiodines into the plant atmosphere. STD DEP 12.3-2 deleted the statement in Section 12.3.1.4.1 which referenced the use of this charcoal filter canister on the CUW backwash tank vent line. In COLA, Revisions 2 and 3, the applicant stated that the intent of the design was for the CUW backwash tank to be vented to the reactor building HVAC exhaust. NRC staff issued **RAI 12.03-12.04-7** requesting the applicant to provide additional information concerning venting the CUW backwash tank directly into the reactor building HVAC exhaust and the possibility of contaminating the HVAC system. In the applicant's response to this RAI, dated August 26, 2009 (ML092430136), the applicant stated that the design of the CUW system at STP Units 3 and 4 will include a charcoal filter canister on the backwash tank vent line. In their response to this RAI, the applicant also proposed a future COL FSAR revision that will delete departure STD DEP 12.3-2 and restore the deleted text contained in Section 12.3.1.4.1 of the ABWR DCD. The staff found the applicant's proposed response to RAI 12.03-12.04-7 acceptable. However, the staff noted that the applicant did not propose to include the equivalent information concerning the CUW backwash tank vent line charcoal filter in any other applicable system-related FSAR subsections which addressed the CUW System. Therefore, the staff issued **RAI 12.03-12.04-12** requesting the applicant to provide additional information pertaining to the CUW backwash tank vent line charcoal filter in the applicable FSAR sections.

In the response to RAI 12.03-12.04-12, dated December 21, 2009 (ML093580191), the applicant proposed to add a description of the charcoal filter to STP FSAR Subsection 11.4.2.2.2, "Spent Resins and Sludges," in a future revision of the COL application. The staff found the proposed COL revision acceptable. NRC staff verified that the proposed FSAR revisions concerning the CUW backwash tank vent filter, including the deletion of STD DEP 12.3-2, were included in COL FSAR, Revision 4. Accordingly, RAIs 12.03-12.04-7 and 12.03-12.04-12 are closed.

- STD DEP 12.3-3 Steam Tunnel Blowout Panels

This departure removes the design description and discussion in this section concerning blowout panels and relief and release pathways associated with the steam tunnel. The information is inaccurate and not needed in Section 12.3. Evaluation of the main steam tunnel, safety-related tunnels, and nonsafety-related tunnels containing non-safety-related equipment is in Sections 3.4 and 3.8 of this SER. This departure also adds the phrase "or equivalent" to the last sentence in Subsection 12.3.1.4.4, which describes the use of lead-loaded silicone foam for sealing penetrations to allow the use of new or better products. NRC staff issued **RAI 12.03-12.04-5** requesting additional information from the applicant concerning the radiation shielding criteria associated with the lead-loaded silicone foam for sealing penetrations. The applicant's response to this RAI, dated August 26, 2009 (ML092430136), identifies the location

in the ABWR DCD indicating that the radiation shielding properties of lead-loaded silicone foam for sealing penetrations will have a density equivalent to that of concrete. Based on the additional information provided in the applicant's response to RAI 12.03-12.04-5, the staff found Departure STD DEP 12.3-3 reasonable regarding compliance with the requirements of 10 CFR Part 20 in keeping occupational radiation exposures ALARA. Accordingly, RAI 12.03-12.04-5 is closed.

- STD DEP 12.3-4 Alarm Capability for Area Radiation Monitors (ARMs)

This departure adds local alarm capability to certain ARMs and adds five ARMs to locations within the reactor building. The applicant states that the departure represents a favorable change by providing additional alarm capability to ARMs in the reactor building, the radwaste building, and the turbine building. The departure adds additional ARMs in the reactor building beyond those identified in the DCD. NRC staff reviewed this section and determined that there is no change in the design or function of the ARMs. By providing additional notification to plant personnel concerning changes in radiological conditions and keeping occupational radiation exposures ALARA, this departure represents a radiation safety improvement. Therefore, the staff found this departure reasonable regarding compliance with the requirements of 10 CFR Part 20.

COL License Information Items

- COL License Information Item 12.6 Airborne Radionuclide Concentration Calculation

NRC staff reviewed COL License Information Item 12.6 regarding the Airborne Radionuclide Concentration Calculation included in Section 12.A.1 of the STP COL FSAR.

The applicant provides additional information in Subsection 12.3.7.2 to address the resolution of DCD COL License Information Item 12.6, which states:

The COL applicant will provide the calculations of the expected concentrations of the airborne radionuclide for the requisitioned ABWR plant design.

In Subsection 12.3.7.1 of the COL FSAR, the applicant states:

Calculations of the expected airborne radionuclide concentrations will be performed, as part of the plant inspections, tests, analyses and acceptance criteria (ITAAC Tier 1, Table 3.2b), to verify the adequacy of the ventilation system prior to fuel load.

As discussed in Section 12.2.1 of NUREG-1503, almost all airborne radioactivity within the plant results from equipment leakage. Since leakage of contaminated fluids from equipment could not be quantified, Design Acceptance Criteria (DAC) were included in Table 3.2b of the ABWR DCD Tier 1 ITAAC to calculate the airborne source term in each room and operating area of the plant prior to fuel load. The purpose of the analysis is to identify the plant areas that may require additional airborne radioactivity monitoring. Because the confirmatory calculations can only be performed after construction, the calculations may be inspected by NRC staff, when they become available, as part of the ITAAC inspection program. Based on the above discussion and existing ITAAC to complete the calculations to determine additional airborne

radioactivity monitoring requirements, the staff found that the applicant has adequately addressed COL License Information Item 12.6.

- COL License Information Item 12.7 Operational Considerations

The applicant provides additional information in Subsection 12.3.7.2 to address the resolution of DCD COL License Information Item 12.7, which states:

Area radiation monitoring operational considerations, such as monitor alarm setpoints, listed in Regulation Guide 1.70 are the COL applicant's responsibility. Airborne radiation monitoring operational considerations such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors, are also the COL applicant's responsibility.

NRC staff reviewed COL License Information Item 12.7 regarding ARM operational considerations included in Section 12.5S of the STP COL FSAR. The COL applicant states that ARM alarm setpoints are established based on design background radiation levels, which are then confirmed during the Startup Test Program. ARM system preoperational tests are included in ABWR DCD Subsection 14.2.12.1.24, which is incorporated by reference in COL FSAR Section 14.2. Preoperational testing will check for proper calibration of the detectors; proper functioning of alarms (local and remote, audible and visual); and protective features including alarm setpoints as well as the proper response to various loss of power conditions. The staff issued **RAI 12.03-12.04-4** requesting the applicant to provide additional information on the calibration methods and frequency that will be used for the STP Units 3 and 4 fixed area and airborne monitors. The applicant's response to this RAI dated August 26, 2009 (ML092430136), references the ARM preoperational testing in Subsection 14.2.12.1.24 of the ABWR DCD and states that calibration procedures for preoperational testing will be in accordance with ANSI/ANS-HPSSC-6.8.1-1981, "Location And Design Criteria For Area Radiation Monitoring Systems for Light Water Nuclear Reactors" and the vendor's instructions. However, the response does not entirely address COL License Information Item 12.7, because calibration methods and frequency of fixed area and airborne monitors are not discussed in the response. Therefore, the staff found the applicant's response to be incomplete and considered RAI 12.03-12.04-4 to be unresolved. Accordingly, the staff issued **RAI 12.03-12.04-13** requesting that the applicant provide additional information concerning the ARM and airborne monitor calibration methods and frequencies that will be utilized during operations of STP Units 3 and 4. This RAI was tracked as an open item in the SER with open items.

The applicant's response to RAI 12.03-12.04-13 dated January 4, 2010 (ML100060693), and the revised response dated June 1, 2010 (ML101550063), reference the ARM preoperational testing in Subsection 14.2.12.1.24 of the ABWR DCD and states that calibration procedures for preoperational testing will be in accordance with ANSI/ANS-HPSSC-6.8.1-1981, national consensus standards and guidance, and the vendor's instructions. The response also states that calibration of the safety-related area monitors will be performed at least once every 18 months or during the refueling outage if the detector is not readily accessible. The applicant proposed a future COL FSAR revision to COL Subsection 12.3.7.2 for clarification. Based on the additional information provided in the applicant's response to RAI 12.03-12.04-13, the staff found that COL License Information Item 12.7 has been fully addressed. However, this item is being tracked as **Confirmatory Item 12.03-12.04-13** until the applicant revises the STP FSAR to include the additional information necessary to adequately resolve COL License Information Item 12.7.

The staff reviewed COL License Information Item 12.7 regarding airborne radiation monitoring operational considerations included in Section 12.5S of the STP COL FSAR. The COL applicant states that the airborne radioactivity monitors are classified as non-safety-related. Although airborne radioactivity monitors are classified as nonsafety-related, as discussed below the applicant must show compliance with 10 CFR 20.1501.

The COL applicant states that operational considerations and portable monitor placement are discussed in FSAR Section 12.5S. FSAR Section 12.5S references NEI 07–03A. NEI 07–03A describes various monitoring instruments that will be maintained and used at the facility, including the following:

- High- and low-volume air samplers used to take grab samples to assess airborne radioactivity concentrations to determine respiratory protection measures
- Continuous air monitors to observe trends in airborne radioactivity concentrations and to alert personnel of sudden changes in airborne radioactivity concentrations
- Portable air sampling and analysis system to determine airborne radioiodine concentrations during and following an accident
- Portable sampling and onsite analysis capability to assess airborne radio-halogens and particulates released during and following an accident

Subsection 12.5.4.1 of NEI 07–03A describes the operational considerations of these monitors. The template states that airborne radioactivity levels are surveyed by using continuous air monitors and by taking grab samples using portable high- and low-volume air samplers. The continuous air monitor alarm setpoints are set at a fraction of the concentration values in 10 CFR Part 2, Appendix B, Table 1 (Column 3) for radionuclides expected to be encountered.

Subsection 12.5.4.1 of NEI 07–03A also describes calibration frequency and requirements for operating procedures for airborne monitors. The template states that continuous air monitors will have daily operational checks to test function or response. All monitors used to perform surveys are calibrated before initial use, after maintenance or repairs that might affect the calibration, and at least annually. In addition, emergency and special-use monitors will have operational checks on a regular schedule, as specified in written procedures.

Subsection 12.5.3.2 of NEI 07–03A states that continuous air monitors equipped with local alarm capability are used in occupied areas where needed to alert personnel to sudden changes in airborne radioactivity concentrations. This section also states that radiation monitoring instrumentation and equipment will provide the appropriate detection capabilities, ranges, sensitivities, and accuracies required for the types and levels of radiation anticipated in the plant and in the environs during routine operations; major outages; abnormal occurrences; and postulated accident conditions. The staff issued RAI 12.03-12.04-4 and RAI 12.03-12.04-13 requesting the applicant to provide additional information on the calibration methods and frequency that will be used for the STP Units 3 and 4 fixed area and airborne monitors. As previously discussed, RAI 12.03-12.04-4 was closed as unresolved and RAI 12.03-12.04-13 is being tracked as **Confirmatory Item 12.03-12.04-13**.

- COL License Information Item 12.8 Requirements of 10 CFR 70.24

The applicant provides additional information in Subsection 12.3.7.3 to address the resolution of COL License Information Item 12.8, which states:

COL applicants will provide information showing that their plant meets the requirements of 10 CFR 70.24 or request an exemption from this 10 CFR 70.24 requirement.

NRC staff reviewed COL License Information Item 12.8 regarding criticality accident monitoring requirements of 10 CFR 70.24 included in Subsection 12.3.7.3 of the COL FSAR. The COL applicant commits (COM 12.3-1) to provide information demonstrating that the plant meets the criticality accident monitoring requirements of 10 CFR 70.24. The applicant has indicated that they will submit the information as an amendment to the FSAR in accordance with 10 CFR 50.71(e) or will request an exemption from this 10 CFR 70.24 requirement at least 6 months before fuel loading. The staff notes that an exemption from the criticality accident monitoring requirements of 10 CFR 70.24 would require that the applicant comply with the criticality accident monitoring requirements of 10 CFR 50.68 (b) in lieu of the requirements of 10 CFR 70.24. Accordingly, the staff issued **RAI 12.03-12.04-15** requesting the applicant to demonstrate compliance with either the criticality accident monitoring requirements of 10 CFR 70.24, or request and receive an exemption from the 10 CFR 70.24 requirements. This RAI was tracked as an open item in the SER with open items.

In the response to this RAI dated February 25, 2010 (ML100610277), the applicant states that in lieu of demonstrating compliance with 10 CFR 70.24, STP 3 and 4 will comply with the requirements of 10 CFR 50.68, paragraph (b) as allowed by 10 CFR 50.68, paragraph (a). The applicant also provided a supplemental response to RAI 12.03-12.04-15 dated July 8, 2010 (ML101930503), at staff's request, identifying the radiation monitor locations and providing monitor maintenance and operating procedures. The staff finds this methodology acceptable to address COL License Information Item 12.8, and therefore, RAI 12.03-12.04-15 is resolved. NRC staff verified that COL FSAR, Revision 4, revised COL Information Item 12.8 to include compliance with 10 CFR 50.68 (b). Therefore RAI 12.03-12.04-15 is closed.

- COL License Information Item 12.3.7.4 Material Selection

The applicant provides additional information in Subsection 12.3.1.1.2 to address the resolution of COL License Information Item 12.3.7.4, which states:

The COL applicant shall address state-of-the-art developments in material selection options for maintaining exposure ALARA.

NRC staff reviewed the applicant's response to COL License Information Item 12.3.7.4 regarding material selection for maintaining exposure ALARA. Based on the information provided and the discussion below, the staff found that the applicant has adequately addressed COL License Information Item 12.3.7.4.

The applicant states that a graded approach will be used to reduce the levels of cobalt in the primary systems, as discussed in FSAR Subsection 12.3.1.1.2.

The following additional information addressing the use of state-of-the-art developments for maintaining exposure ALARA in the COL FSAR were identified by the staff:

Radiation Shielding Computer Codes

During an audit of the radwaste system departures completed by NRC staff during the review of Chapter 11 as documented in the Staff's audit report dated October 16, 2009 (ML092510426), the staff raised a concern about the radiation shielding computer codes being used to verify the STP 3 and 4 radwaste system design changes. As a result, the staff issued **RAI 12.03-12.04-10** requesting the applicant to provide additional information about any radiation shielding computer codes being used to verify STP Units 3 and 4 radiation shielding that is not identified in the ABWR DCD. The applicant's initial and supplemental response to RAI 12.03-12.04-10 dated October 26, 2009 (ML093030296), and December 9, 2009 (ML093480068), identify several radiation shielding computer codes used to verify the STP 3 and 4 radwaste system design changes that are not identified in the ABWR DCD. The applicant provided supplemental information about how the radiation shielding computer codes are being used and proposed including the information in the COL FSAR in a future COL application revision. Based on the review of the applicant's information, and the applicant's commitment to include the supplemental computer code information in the FSAR, the staff found this response acceptable. Accordingly, RAI 12.03-12.04-10 is resolved. NRC staff verified that COL FSAR, Revision 4 includes the proposed additional information about radiation shielding codes, therefore RAI 12.03-12.04-10 is closed.

Zinc Injection

The applicant states that FSAR Section 9.3, "Process Auxiliaries," incorporates by reference the information in ABWR DCD Section 9.3. Section 9.3.11 of the ABWR DCD states that "provisions are made to permit installation of a system for adding a zinc solution to the feedwater." The COL FSAR does not discuss zinc injection. One of the benefits of utilizing a zinc injection system to inject depleted zinc oxide in the feedwater is to suppress cobalt plate-out on reactor building piping. Minimizing the plate-out of radioactive cobalt on reactor building piping can lead to potentially lower dose rates in the vicinity of this piping and result in correspondingly lower doses to personnel in this portion of the plant. NRC staff issued **RAI 01-11** requesting the applicant to provide additional information as to whether or not the zinc injection system will be utilized in STP Units 3 and 4. The applicant's response to this RAI dated August 12, 2009 (ML092260197) confirms that a zinc injection system will not be installed in STP Units 3 and 4. However, piping connections to allow for the future installation and operation of a zinc injection system will be installed, with the possibility that operational experience could indicate that a zinc injection system would be beneficial. The staff found the provision to allow for the future use of zinc injection acceptable based on the applicant's commitment to maintain the worker dose ALARA in FSAR Section 12.1 and on the contingencies to implement zinc injection in the future. The safety-related evaluation of the acceptability of the applicant's response to RAI 01-11 is included in Section 9.3.11 of this SER.

Supplemental Information

- Radiation Exposure to Construction Workers During Plant Construction

The applicant includes an evaluation and discussion of the different phases of construction for the two-unit site and the doses associated with the operation of STP Units 1 and 2 and the

preoperational testing of Unit 3 during the construction of Unit 4. Additionally, the applicant states in FSAR Section 12.3.8 that, (1) the STP Units 3 and 4 site will be continually monitored during the construction period; (2) appropriate actions will be taken to ensure that doses to the construction workers remain ALARA, and (3) the Operational Radiation Protection Program will be in place while Unit 3 is operating with Unit 4 still under construction to provide oversight to ensure that doses to construction workers remain ALARA during the construction period.

RG 1.206, Subsection C.I.12.3.5 directs an applicant to provide (a) estimates of annual doses to construction workers in a new unit construction area, as a result of radiation from onsite sources from the existing operating plant(s); and (b) bases, models, assumptions, and input data for these estimates. The applicant provided a description of the potential sources of exposure to construction workers and comparisons of the annual calculated construction worker doses to the limits in 10 CFR 20.1301 and 40 CFR 190.10 for members of the public. However, the COL FSAR does not contain the bases, models, and assumptions used to calculate construction worker doses. The staff issued **RAI 12.03-12.04-9** requesting the applicant to provide additional information concerning construction worker doses. The applicant's response to this RAI dated September 3, 2009 (ML092510039) includes a summary of construction activities and bases for dose calculations; a table containing the calculated person-Sievert dose for each unit; and references Sections 3.9S, 3.10S, and 4.5 of the Environmental Report in Part 3 of the COL application, for additional information. The staff found the applicant's response to RAI 12.03-12.04-9 to be incomplete. Accordingly, RAI 12.03-12.04-9 was closed as unresolved. The staff issued supplemental **RAI 12.03-12.04-14** requesting the applicant to provide additional information in the FSAR concerning the bases, models, assumptions, and input data used in the assessment and calculation of construction worker doses, and to clarify if construction workers will be considered member of the public or occupational workers during construction of STP 3 and 4. This RAI was tracked as an open item in the SER with open items.

The applicant's supplemental response to RAI 12.03-12.04-14 dated May 17, 2010 (ML101390226), which replaces the original response dated January 4, 2010 (100060693), clarifies that construction workers will be considered to be members of the public in the context of 10 CFR Part 20, Subpart D, and proposes a future COL FSAR revision to FSAR Section 12.3.8 which summarizes the bases, assumptions, and methods used to calculate the STP 3 and 4 construction worker dose. The staff found the applicant's response acceptable and RAI 12.03-12.04-14 is resolved. Verification of the proposed changes in a future FSAR revision is being tracked as **Confirmatory Item 12.03-12.04-14**.

- 10 CFR 20.1406 Minimization of Contamination to Facilitate Decommissioning

STP Units 3 and 4 utilize the certified ABWR design per 10 CFR Part 52, Appendix A. In accordance with 10 CFR 20.1406(a), the COL applicant is responsible for documenting in the application how the facility design and procedures for operation (1) will minimize, to the extent practicable, contamination of the facility and the environment; (2) will facilitate eventual decommissioning; and (3) will minimize, to the extent practicable, the generation of radioactive waste. NRC staff reviewed STP Units 3 and 4 COL FSAR Chapters 9, 11 and 12 in order to determine whether the applicant adequately describes how the facility design and procedures for operation will comply with the requirements of 10 CFR 20.1406(a).

In FSAR Subsection 11.2.1.2.4, the applicant provides information on compliance of the radwaste system design features with 10 CFR 20.1406 for minimizing contamination to facilitate decommissioning. The applicant also references NEI 07-03A in FSAR Section 12.5S.

NEI 07-03A identifies some of the programmatic considerations for implementing 10 CFR 20.1406(a). However, the COL application, the ABWR DCD, and NEI 07-03A do not address operational programs to the level of detail that is described in RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning." The COL application does not contain any discussion about or take any credit for approved ABWR facility design features that may address compliance with 10 CFR 20.1406. To determine conformance with the guidance in RG 4.21, the staff issued **RAI 12.03-12.04-3**. The applicant's response to this RAI dated August 26, 2009 (ML092430071), states that 10 CFR 20.1406 was issued after the ABWR Design Certification Rule in 1997, and 10 CFR 20.1406(b) is not applicable to the ABWR DCD. The applicant also provides a discussion of how the STP Units 3 and 4 radwaste system departures address the requirements of 10 CFR 20.1406, noting that NEI 08-08A, "Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," provides guidance in developing operational programs to address 10 CFR 20.1406. The applicant also states that the NEI 08-08A guidance will be used, to the extent practicable, in the development of STP Units 3 and 4 programs and procedures. The applicant's response also states that all piping will be located in pipe tunnels or in accessible surface trenches, and FSAR Subsection 11.2.1.2.4 will be revised to clarify that there will be no piping buried directly in the ground. The staff found the response incomplete in that the applicant does not fully commit to using NEI 08-08A or fully describe the operational programs and procedures to address 10 CFR 20.1406. Accordingly, RAI 12.03-12.04-3 was closed as unresolved. The staff issued supplemental **RAI 12.03-12.04-11** requesting the applicant to provide additional information concerning (1) operational programs and operating procedures that STP Units 3 and 4 will utilize to address the requirements of 10 CFR 20.1406; and (2) clarifying whether only the radwaste system piping or all piping will be located in tunnels or in accessible surface trenches. This RAI was tracked as an open item in the SER with open items.

The applicant's response to supplemental RAI 12.03-12.04-11 dated June 30, 2010 (ML101830417), incorporates a proposed FSAR revision referencing NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination" to address the operational aspects of compliance with 10 CFR 20.1406. The response also proposes incorporating a summary of ABWR design features that address compliance with 10 CFR 20.1406, and clarifies that all below grade piping carrying radioactive fluids will be located in tunnels, in a future FSAR revision. NRC staff verified that COL FSAR, Revision 4 includes the proposed additional information, concerning the applicant's compliance with 10 CFR 20.1406; therefore RAI 12.03-12.04-11 is closed.

The staff issued additional RAIs related to 10 CFR 20.1406 compliance while reviewing ventilation systems in Chapter 9 (**RAI 09.04.01-1**) and radioactive waste systems in Chapter 11 (**RAI 11.03-4** and **RAI 11.02-8**). As discussed in the staff's evaluations in SER Chapters 9 and 11, the staff found the applicant's responses to these three RAIs to be acceptable. Additional discussions of the staff's review of these RAIs are in Chapters 9 and 11 and Section 12.2 of this SER.

12.3.5 Post Combined License Activities

- COM 12.3-1 10 CFR 50.68(b) in lieu of 10 CFR 70.24

This commitment states that in lieu of meeting the criticality accident monitoring requirements of 10 CFR 70.24, the applicant will meet the requirements of 10 CFR 50.68(b), as provided for in 10 CFR 70.24(d)(1). The staff finds this method acceptable, to satisfy COL License Information Item 12.8 and RAI 12.03-12.04-15, as discussed above.

12.3.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1503. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and with the exception of **Confirmatory Items 12.03-12.04-13 and 12.03-12.04-14**, no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to radiation protection that were incorporated by reference have been resolved.

The staff has compared the application to the relevant NRC regulations, acceptance criteria defined in NUREG-0800 Section 12.3, and other applicable NRC regulatory guides, and concluded that the applicant complies with the NRC regulations. The applicant has adequately addressed COL License Information Items 12.6, 12.7, 12.8, and 12.3.7.4 (DCD Tier 2), regarding the radiation protection design features, and these COL items can be considered resolved. The applicant has provided sufficient information to support issuance of a license.

12.4 Dose Assessment

12.4.1 Introduction

This section of the FSAR addresses the issues related to estimating the annual personnel doses associated with operations, normal maintenance, radwaste handling, refueling, in-service inspection, and special maintenance (e.g., maintenance that goes beyond routine scheduled maintenance such as the modification of equipment to upgrade the plant, or repairs to failed components).

12.4.2 Summary of Application

Section 12.4 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 12.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 12.4, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

This departure contains numerous design revisions of Fuel Storage and Handling Equipment, including clarifying spent fuel storage rack minimum storage capacity, updating the corresponding COL license information item, adding a stand-alone section describing new fuel storage, and adding supplemental and clarifying information throughout Section 9.1 of the FSAR.

- STD DEP 11.2-1

Liquid Radwaste Process Equipment

The applicant completely replaces (except for piping and instrumentation diagrams) Tier 2, Section 11.2 of the certified ABWR DCD, including all subsections, figures, and tables. This departure includes the use of mobile technology and deletes the forced-circulation concentrator system and other permanently installed liquid radwaste processing equipment, as identified in Departure STD DEP 11.2-1. Thus, no part of ABWR DCD Section 11.2 is incorporated by reference. This departure resulted in a complete revision of Section 12.4.3, “Radwaste Building Dose,” of the ABWR DCD.

Administrative Departure

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (i.e., misspellings, incorrect references, table headings, etc.). Administrative departures do not affect the presentation of any design discussion or the qualification of any design margin. This administrative departure modifies a table heading for FSAR Table 12.4-1.

Supplemental Information

- Occupational Dose

The applicant revises the basic ABWR DCD information in FSAR Sections 12.4.1, 12.4.2, 12.4.3, and 12.4.5 for occupational exposure dose calculations in the drywell, in the reactor building, and in the radwaste building; and during “Work at Power.” The changes are due to revised dose estimates based on a reduction in the number of work hours due to equipment modifications.

12.4.3 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 “Dose Assessment” and the associated acceptance criteria are in Section 12.3-12.4 of NUREG–0800.

The regulatory basis for accepting that radiation protection equipment and design features will ensure radiation exposure to occupational workers and members of the public will be kept ALARA, and in compliance with the limits identified in 10 CFR 20.1201 and 10 CFR 20.1301, is based on meeting the requirements of 10 CFR 20.1101. Specifically, that there is a policy formulated in accordance with the ALARA provisions of 10 CFR 20.1101(b) to ensure that occupational radiation exposure will be ALARA.

The regulatory basis for accepting that the facility design and procedures for operation will minimize contamination of the facility and the environment, minimize generation of radioactive waste, to the extent practicable, and facilitate the eventual decommissioning of the facility, is based on meeting the requirements of 10 CFR 20.1406.

reasonable that these departures do not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

Compliance with 10 CFR Part 20 for Tier 2 Departures Not Requiring Prior NRC Approval

The applicant has identified the following Tier 2 departures as not requiring prior NRC approval. NRC staff found it necessary to evaluate these departures within the scope of compliance with the requirements of 10 CFR Part 20. This was performed to make a determination of reasonable assurance that the identified departures do not result in any changes to radiation protection equipment and design features identified in the ABWR DCD, that the occupational and public radiation exposures are ALARA, and that the STP 3 and 4 will be constructed and operated in compliance with the Part 20 requirements.

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

In a departure from Section 12.4.2, "Reactor Building Dose," of the ABWR DCD, the applicant changes the nomenclature from "automated refueling bridge" to "automated refueling machine;" deletes a reference to the "enclosed automation center;" and includes a reference to FSAR Subsection 9.1.4.2.7.1 for the description of the refueling machine. The estimates of person-hours and effective dose rate for refueling activities remains unchanged at 4,000 hours and 2 micro-Gray per hour (0.2 millirem/hr). However, in FSAR Section 12.5S.2.4, the applicant states that the normal radiation level on the refueling bridge is expected to be less than 5 millirem (mrem)/h.

NRC staff issued **RAI 12.03-12.04-1** requesting the applicant to provide additional information concerning dose calculations for refueling activities and to correct the units used for exposure rates. The applicant's response to the RAI dated August 12, 2009 (ML092260582) clarifies that the effective dose rate for refueling operations will be less than 2 $\mu\text{Gy/h}$ (2 micro-Sievert per hour [$\mu\text{Sv/h}$]) and proposes a future FSAR revision that will change the units from $\mu\text{Gy/h}$ to $\mu\text{Sv/h}$, as applicable throughout Chapter 12. Based on the additional information from the applicant and the proposed FSAR revision, the staff found this departure reasonable regarding compliance with the requirements of 10 CFR 20. NRC staff verified that COL FSAR, Revision 4 includes the proposed change of dose rate units from $\mu\text{Gy/h}$ to $\mu\text{Sv/h}$ throughout Chapter 12. Therefore RAI 12.03-12.04-1 is closed.

- STD DEP 11.2-1 Liquid Radwaste Process Equipment

In a departure from Section 12.4.3, "Radwaste Building Dose," of the ABWR DCD, the applicant replaces Section 12.4.3 of the ABWR DCD. The applicant provides a general description of the radwaste processes and work activities that would result in occupational exposure to workers. FSAR Table 12.4-1 includes an estimate of the total hours and average exposure rate for the performance of operations and maintenance in the radwaste building. The number of hours is reduced by more than a factor of four from 4,200 hours to 1,000 hours. However, the FSAR does not contain any information concerning the bases, models, and assumptions used to calculate the revised radwaste building dose. NRC staff issued **RAI 12.03-12.04-2** requesting the applicant to provide additional information concerning radwaste building dose calculations. The applicant's response to this RAI dated August 12, 2009 provides additional information concerning the bases for the reduced radwaste building operating hours. The applicant also proposed a future FSAR revision summarizing the bases and adding an additional industry reference. Based on the additional information from the applicant and the proposed FSAR

revision, the staff found this departure reasonable regarding compliance with the requirements of 10 CFR Part 20. NRC staff verified that COL FSAR, Revision 4 includes the proposed changes to the radwaste building dose calculation bases and the industry reference. Therefore RAI 12.03-12.04-2 is closed.

Supplemental Information

- Occupational Dose

In Section 12.4, the applicant revised the occupational dose rate and estimated occupancy time information for the radwaste building to address Departure STD DEP 11.2-1. Based on the information in Table 12.4-1, "Projected Annual Radiation Exposure," the revised per unit annual estimated radiation exposure is reduced by approximately 8 percent—from the ABWR DCD estimate of 989 person-mSv/year to 909 person-mSv/year (90.9 person-rem/yr). This corresponds to an approximate 39 percent reduction in the average annual radiation exposure when compared to the average annual BWR radiation exposure of 1.51 person-Sv/yr (151 person-rem/yr), in NUREG-0713 Volume 31, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," 2009. The reduction in the annual estimated exposure is based entirely on reduced exposure estimates for operating the radwaste building.

12.4.5 Post Combined License Activities

There are no post COL activities related to this section.

12.4.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1503. NRC staff reviewed the application and checked the referenced DCD. The 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. The staff finds that the revised dose assessment performed for the Radwaste Building dose complies with the guidelines in RG 1.70 and RG 8.19, as well as the criteria in the applicable portions of Section 12.3-12.4 of the SRP pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to dose assessment that were incorporated by reference have been resolved.

In addition, the staff concluded that the relevant information in the COL FSAR is acceptable and meets the requirements 10 CFR Part 20. The staff based its conclusion on the following:

- The applicant identifies Departure STD DEP 9.1-1, which describes updates of fuel storage and handling equipment. The staff found it reasonable that the departure does not require prior NRC approval.
- The applicant identifies Departure STD DEP 11.2-1, which describes the replacement of Tier 2, Section 11.4.3, "Radwaste Building Dose," of the certified ABWR DCD. The staff found it reasonable that the departure does not require prior NRC approval.
- The applicant identifies Administrative Departures for this section. The staff found that these administrative departures do not affect the presentation of any design discussion or

the qualification of any design margin. The staff found it reasonable that the departure does not require prior NRC approval.

12.5 Operational Radiation Protection Program

12.5.1 Introduction

This FSAR section addresses the Operational RP Program, which is designed to maintain occupational and public doses below regulatory limits and ALARA. The Operational RP Program is designed with the following objectives:

- Providing the capability for administrative control of the activities of plant personnel to maintain personnel exposure to radiation and to radioactive materials ALARA within the guidelines of 10 CFR Part 20.
- Providing the capability for administrative control of effluent releases from the plant to maintain the releases ALARA and within the limits of 10 CFR Part 20 and the plant Technical Specifications.

12.5.2 Summary of Application

Section 12.5 of the STP Units 3 and 4 COL FSAR incorporates by reference Section 12.5 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures. In addition, in COL FSAR Section 12.5 the applicant provides the following:

COL License Information Items

- COL License Information Item 12.9 Radiation Protection Program

This COL license information item requires the applicant to provide a description of the operational Radiation Protection Program. The applicant references FSAR Section 12.5S, which in turn references NEI 07-03A, as a means to address the needs of this DCD COL license information item.

- COL License Information Item 12.10 Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR 50 and NUREG-0737 Item III.D.3.3

COL License Information Item 12.10 requires the applicant to describe portable instruments to measure radioiodine concentrations under accident conditions. The applicant is responsible to provide portable instruments to measure radioiodine concentrations in compliance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the guidance in NUREG-0737, Item III.D.3.3. In FSAR Subsection 12.5.3.2, the applicant identifies the number of instruments currently available, and states that personnel have been trained and procedures have been developed to measure radioiodine concentrations.

Supplemental Information

- Access Control

The applicant identifies Very High Radiation Areas (VHRAs) in the facility and provides information concerning the physical and administrative controls to be used for accessing the areas.

12.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission’s regulations for the “Operational Radiation Protection Program,” and the associated acceptance criteria, are in Section 12.5 of NUREG–0800.

COL License Information Item 12.9 is based on meeting the requirements of 10 CFR Part 20 and the guidelines in RG 1.70, Revision 3. Moreover, COL License Information Item 12.9 is also satisfied based on following the guidance of RGs 1.8, 1.97, 8.2, 8.8, and 8.10.

COL License Information Item 12.10 is based on meeting the requirements of the above mentioned documents. Moreover, COL License Information Item 12.10 is also satisfied based on following the guidance of RGs 1.8, 1.33, 8.2, 8.7, 8.8, and 8.10.

12.5.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed and approved Section 12.5 of the certified ABWR DCD. The staff reviewed Section 12.5 and 12.5S 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 the Operational RP Program.

In addition, the staff reviewed the applicant’s proposed resolution to the following COL license information items included under Section 12.5 of the STP COL. In the review, the staff used the applicable sections in the SRP (NUREG–0800) and in RG 1.206 as guidance.

The staff reviewed the information in the STP COL FSAR:

COL License Information Items

- COL License Information Item 12.9 Radiation Protection Program

The applicant provides additional information in FSAR Subsection 12.5.3.1 to address the resolution of DCD COL License Information Item 12.9, which states:

COL applicants will provide, to the level of detail required by Regulatory Guide 1.70, the implementation of a radiation protection program for operational considerations.

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.

FSAR Subsection 12.5.3.1 states that this COL license information item is addressed in FSAR Section 12.5S. Section 12.5S incorporates by reference NEI 07-03A, with site-specific supplements included in the section, as the Operational RP Program. NRC staff completed the review of NEI 07-03 and the safety evaluation on NEI 07-03 was issued in March 2009 (ML090510379). NEI 07-03A thoroughly describes the Operational RP Program, including radiation protection facilities, monitoring instrumentation, and equipment to be included in the program.

The generic RP Program Description in NEI 07-03A commits an applicant to NRC regulatory requirements and guidance and to acceptance criteria listed in RG 1.206 and Section 12.5 of NUREG-0800. The staff reviewed NEI 07-03A with respect to the operating philosophy for maintaining occupational radiation exposures ALARA, that the management of the licensed facility should be committed to maintaining exposures ALARA, and the personnel responsible for radiation protection should be continually vigilant for means to reduce exposures. NEI 07-03A states that the plant management will establish a written policy on radiation protection that is consistent with the guidance in RG 8.10. The radiation protection responsibilities of the Radiation Protection Manager will be consistent with the guidance in RG 8.10 and will include establishing, implementing, and enforcing the RP Program. In addition, management is committed to assuring that each individual working at the facility understands and accepts the responsibility to follow radiation protection procedures and instructions provided by radiation protection staff and to maintain his or her dose ALARA.

The RP Program components described in the template include a radiochemistry laboratory, personnel and equipment decontamination facilities, an access control facility, radiation protection offices, portable instrument calibration and respirator facilities, storage and issue areas for contaminated tools and equipment, a machine shop for activated/contaminated components and equipment, a radioactive materials storage area, a facility for dosimetry processing and bioassay, and a laundry facility. The ABWR DCD provides additional information for the personnel decontamination area, radiation protection offices, and a portable instrument calibration facility that is consistent with the template. Equipment to be used for radiation protection purposes includes portable radiation survey instruments, personnel monitoring equipment, fixed and portable area and airborne radioactivity monitors, laboratory equipment, air samplers, respiratory protective equipment, and protective clothing.

The applicant provides implementation schedules and milestones to address Operational Program #10, which is associated with the RP Program as required by 10 CFR 20.1101. In Table 13.4S-1 of the STP Units 3 and 4 FSAR, the applicant lists four milestones for implementation of the various portions of the Radiation Protection Program:

- (1) before the initial receipt of byproduct, source, or special nuclear materials
- (2) before fuel receipt onsite
- (3) before fuel loading
- (4) before the first shipment of radioactive waste

The RP Program is composed of a number of elements that are described in NEI 07-03A. Because these elements were not specifically mentioned in FSAR Table 13.4S-1, the staff issued **RAI 12.05-2** requesting the applicant to ascertain at which implementation milestone each program element will be implemented. The applicant's response to RAI 12.05-2 dated August 20, 2009 (ML092360170), states that the corresponding Operational RP Program and supporting procedures, as described in Section 12.5 of NEI 07-03A, will be in place before the

milestones identified in FSAR Table 13.4S-1. The staff found this response acceptable, and RAI 12.05-2 is closed.

The staff issued **RAI 12.05-3** requesting the applicant to provide additional information concerning specific procedures to be developed before each radiation protection milestone. The applicant's response to this RAI dated August 20, 2009 stated that the corresponding Operational RP Programs and supporting procedures, as described in NEI 07-03A, will be in place before the milestones identified in FSAR Table 13.4S-1. The staff found this response acceptable and RAI 12.05-3 is closed.

The staff found that the applicant has adequately described the Operational RP Program, plant health physics equipment, instrumentation, and facilities to resolve COL License Information Item 12.9. This conclusion is based on the applicant's commitment to use NEI 07-03A to develop the Operational RP Program and supporting procedures, and to have the program elements in place before the milestones identified in FSAR Table 13.4S-1.

- COL License Information Item 12.10 Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR Part 50 and NUREG-0737 Item III.D.3.3

The applicant provides additional information in FSAR Subsection 12.5.3.2 to address the resolution of DCD COL License Information Item 12.10, which states:

COL applicants will provide the portable instruments in operating reactors that accurately measure radio-iodine concentrations in plant areas under accident conditions and will provide training and procedures on the use of these instruments in compliance with Paragraph 50.34 (f) (xxvii) of 10 CFR Part 50 and NUREG-0737 Item III.D.3.3.

In addition to COL License Information Item 12.10, equivalent information is required to be provided per COM 1A-3 included in FSAR Section 1A3.3.

In COL FSAR Subsection 12.5.3.2, the applicant states the number of instruments currently available, that personnel were trained to operate the equipment, and that procedures had been developed to measure radioiodine concentrations. NRC staff issued **RAI 12.05-6** requesting the applicant to explain the statement that equipment, procedures, and trained personnel were already available, when the STP Units 3 and 4 RP Program is not yet in place, and equipment acquisition has not yet occurred. This RAI was tracked as an open item in the SER with open items.

In the response to RAI 12.05-6 dated February 8, 2010 (ML100470590), the applicant clarifies that the information included in the FSAR reflects the equipment and programs currently in place for STP Units 1 and 2 and acknowledges that additional equipment will need to be purchased to support four unit operations. The applicant proposes a future COL FSAR revision to address COL License Information Item 12.10 stating that the STP Health Physics Program, procedures, and training curriculum will be expanded and modified as necessary to meet the requirements for all operating units, that additional air sampling equipment will be shared among the four units, and that additional sampling equipment will be procured as needed. The staff found the applicant's response acceptable and RAI 12.05-6 is resolved. NRC staff verified that COL FSAR, Revision 4, includes the proposed changes to address COL Information Item 12.10. Therefore, RAI 12.05-6 is closed.

Section 12.5S of the COL FSAR references NEI 07-03A. The staff completed the review and issued the SE on NEI 07-03, as documented above. In order to address this COL license information item, the licensee must show compliance with 10 CFR 50.34(f)(2)(xxvii) and Item III.D.3.3 of NUREG-0737. 10 CFR 50.34(f)(2)(xxvii) (as supplemented by the criteria in Item III.D.3.3 of NUREG-0737) requires the licensee to provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident. NEI 07-03A discusses procedures to be used to collect and analyze samples to detect and measure radioiodine. This template states that radiation protection technicians will be trained and qualified under a program established in accordance with 10 CFR 50.120. This training, along with the procedures on radiological surveillance described in NEI 07-03A, will ensure that the radiation protection technicians will have the capability of determining the airborne iodine concentrations in areas within the facility, where personnel may be present during an accident and for a broad range of routine conditions. Milestone 1.c. of NEI 07-03A ensures that an adequate number of instruments will be available to provide appropriate detection capabilities and to conduct radiation surveys in accordance with 10 CFR 20.1501 and 10 CFR 20.1502, including the capability to determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

The staff's review finds that the applicant has provided an adequate description of both the portable instruments that accurately measure radioiodine concentrations in plant areas under accident conditions and the training and procedures provided on the use of these instruments. The staff finds that this information demonstrates the applicant's compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR Part 50 and NUREG-0737 Item III.D.3.3, and COL License Information Item 12.10.

Supplemental Information

- Access Control

The COL applicant identified three VHRA in COL Subsection 12.5S.4.4 that require additional administrative controls for access. The applicant also references plant layout drawings located in FSAR Section 12.3. In addition, FSAR Section 12.5S references NEI 07-03A. Subsection 12.5.4.4 of NEI 07-03A describes access control to ensure compliance with 10 CFR 20.1902, 10 CFR 20.1903, 10 CFR 20.1601, and 10 CFR 20.1602. Subsection 12.5.4.4 of NEI 07-03A identifies additional site-specific information to be included in the COL FSAR:

- (1) anticipated frequency of accessing each VHRA
- (2) detailed drawings for each VHRA that indicate physical barriers

The COL FSAR did not contain information about anticipated frequency of access or detailed drawings that provided sufficient information to fully assess the physical barriers. The staff issued **RAI 12.05-1** requesting the applicant to provide additional information about VHRA access control. The applicant's response to this RAI dated August 12, 2009 (ML092260582) provides generic information concerning expected VHRA access control, describes physical barriers to preclude personnel access, and references NEI 07-03A. According to NEI 07-03A, access control guidelines will be consistent with the guidelines of RG 8.38, "Control of Access to High and Very High Radiation Areas in Nuclear Power Plants." However, the applicant did not propose an FSAR revision to include the information in the COL application. Accordingly, the

staff considered RAI 12.05-1 closed as unresolved. The staff issued **RAI 12.05-5** requesting the applicant to provide additional information. This RAI was tracked as an open item in the SER with open items.

In the response to RAI 12.05-5 dated December 21, 2010 (ML093580194), the applicant proposes a future COL FSAR revision to FSAR Subsection 12.5S.4.4, "Access Control," identifying the access frequencies and barriers or programmatic controls that will be in place to preclude access to very high radiation areas. The staff found the applicant's response acceptable, therefore RAI 12.05-5 is resolved. NRC staff verified that COL FSAR, Revision 4, includes the proposed changes about VHRA barriers and access controls. Therefore RAI 12.05-5 is closed.

The staff's review of this section noted that illustrative examples of facility vital area access paths, identification of source locations, and associated mission doses for post-accident access are not included in the COL FSAR or the ABWR DCD. The staff issued **RAI 12.03-12.04-8** requesting the applicant to provide additional information about postaccident vital area access paths and mission doses. The applicant's response to this RAI dated August 26, 2009 (ML092430136) reiterates that the information is in NUREG-1503 Volume 1, Section 12.2.2, Subsection 12.3.5.1, Section 12.3.6, and Subsection 14.3.3.2 concerning plant shielding DAC. The applicant also referenced the ABWR DCD Tier 1, ITAAC, Table 3.2a, "Plant Shielding Design." ABWR DCD Tier 1, ITAAC, Table 3.2a is incorporated by reference in the STP Units 3 and 4 FSAR. This table identifies the confirmatory shielding analyses and evaluations that must be completed to verify that the final plant design provides radiation shielding commensurate with the occupancy requirements for routine and AOO conditions, as well as permits plant personnel to perform required safety functions in vital areas of the plant, including access and egress of the areas under accident conditions. Based on the applicant's response, and on additional staff review of the radiation zone maps, postaccident access information, and Tier 1, Table 3.2a DAC in NUREG-1503, the staff found that the applicant has adequately addressed postaccident vital area access. Accordingly, RAI 12.03-12.04-8 is closed.

12.5.5 Post Combined License Activities

There are no post COL activities related to this section. The applicant's commitments are captured under the operational programs listed under item 10 of table 13.4S-1 of the FSAR.

12.5.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1503. NRC staff reviewed the application and checked the referenced DCD. The 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the Operational RP Program that were incorporated by reference have been resolved.

The staff's review concludes that the Operational RP Program is sufficiently described and that the programmatic elements and operational objectives are included to enable a reasonable assurance finding of acceptability for the issuance of a COL, followed by a verification of the implementation of site- and plant-specific program elements as license conditions, through the inspection process before fuel load.

This conclusion is based on the following:

- The applicant has adequately addressed COL License Information Items 12.9 and 12.10 regarding design and operational considerations for the plant's radiation protection program. The applicant's proposed resolution to these COL license information items is to reference the information contained in NEI 07-03A, which incorporates the guidance in RG 8.10 and contains a commitment to provide operating procedures and techniques to ensure that occupational radiation exposures are ALARA. On this basis, the staff found that the information in this template is acceptable and resolves these COL license information items.
- The staff concluded that the ALARA policy, design, and implementation considerations are acceptable because the applicant meets the training requirements of 10 CFR 19.12, the ALARA provisions of 10 CFR 20.1101(b), and the guidance in RG 8.8, Regulatory Position C.2, and RG 8.10, Regulatory Position C.1.