

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 (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection (ISI); and calibration), and anticipated operational occurrences (AOOs) (occurrences such as loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss of offsite power). Specifically, this 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, "Standards for protection against radiation," and to be consistent with the guidance given in the appropriate regulatory guides (RGs), where the practices set forth in such guides are used to implement the U.S. Nuclear Regulatory Commission (NRC) 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 Final Safety Analysis Report (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, Revision 12, incorporates by reference Section 12.1 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor," with no departures. In addition, in 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, Revision 1-R, "Operating Philosophy for Maintaining Occupational Radiation Exposures ALARA." In FSAR Section 12.1.4, the applicant references FSAR Section 12.5S, 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, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants." In FSAR Section 12.1.4, the applicant references FSAR Section 12.5S, which contains the commitment to NEI 07-03A.

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, “Consolidated Guidance: 10 CFR Part 20 — Standards for Protection Against Radiation.” In FSAR Section 12.1.4, the applicant references FSAR Section 12.5S, which contains the commitment to NEI 07–03A.

The applicant references NEI 07–03A, to address conformance with RG 8.8, Revision 3, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be ALARA.” In FSAR Section 12.1.4, the applicant references FSAR Section 12.5S, 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 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, (LWR Edition)” (the Standard Review Plan [SRP]).

In particular, the regulatory basis for accepting that occupational radiation exposure to personnel will be kept ALARA is in 10 CFR 20.1101, “Radiation Protection Programs.” Specifically, that a policy is 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 Edition).”

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 ALARA.”

Moreover, COL license information items in Section 12.1 are based on following the guidance in:

- RG 8.2, “Guide for Administrative Practices in Radiation Monitoring,”

- RG 8.7, Revision 2, “Instructions for Record Keeping and Recording Occupational Radiation Exposure Data,”
- RG 8.9, Revision 1, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program,”
- RG 8.13, Revision 3, “Instruction Concerning Prenatal Radiation Exposure,”
- RG 8.15, Revision 1, “Acceptable Programs for Respiratory Protection,”
- RG 8.27, “Radiation Protection Training for Personnel at Light-Water Cooled Nuclear Power Plants,”
- RG 8.28, “Audible-Alarm Dosimeters,”
- RG 8.29, Revision 1, “Instructions Concerning Risks from Occupational Radiation Exposure,”
- RG 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,”
- RG 8.35, “Planned Special Exposures,”
- RG 8.36, “Radiation Dose to the Embryo/Fetus,”
- RG 8.38, Revision 1, “Control of Access to High and Very High Radiation Areas in Nuclear Power Plants,” and
- NEI 07–03A, “Generic FSAR Template Guidance for Radiation Protection Program Description.”

12.1.4 Technical Evaluation

As documented in NUREG–1503, the 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:

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.

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. The 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 at accession number ML090510379.

The staff reviewed the final version of NEI 07-03 with respect to conformance 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, (ML091490684).

The staff issued Request for Additional Information (RAI) 12.05-4, requesting that the applicant update the FSAR to reference the final accepted version of NEI 07-03. In its 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. The staff verified that NEI 07-03A was referenced in FSAR Revision 4, Section 12.5S. Therefore, RAI 12.05-4 is resolved and 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 FSAR Section 12.5S.

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. RG 1.8 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 the resolution of RAI 12.05-4 above, the staff verified that NEI 07-03A was referenced in FSAR Revision 4, Section 12.5S. Therefore, this COL license information item is adequately addressed.

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.

The 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, "Combined License Applications for Nuclear Power Plants (LWR Edition)." 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 FSAR Section 12.5S.

NEI 07-03A addresses various operating procedures and techniques used in dose-related activities found in typical nuclear plants. These activities include refueling, ISIs, radwaste handling, spent fuel handling, normal operations, routine maintenance, sampling, and calibration. NEI 07-13A allows COL applicants to modify procedures based on design and site-specific information. The staff reviewed the categories listed in NEI 07-03A 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, as documented in the staff's SE (ML091130034). NEI published the final accepted version in October 2009, as NEI 07-08A, (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. In its response to RAI 12.01-1, dated August 12, 2009 (ML092260582), the applicant committed 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 a reference to NEI 07-08 in COL FSAR Revision 4, Section 12.5S, 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. The staff verified that the accepted version of NEI 07-08 was referenced in COL FSAR Revision 6. Therefore, RAI 12.01-1 is resolved and closed.

The applicant provides additional information in FSAR 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 FSAR Section 12.5S. 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 8.8. NEI 07-03A 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 Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations"; Part 20; Part 50, "Domestic Licensing of Production and Utilization Facilities"; Part 70, "Domestic Licensing of Special Nuclear Material"; and Part 71, "Packaging and Transportation of Radioactive Material." The procedures described in NEI 07-03A 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 the resolution of RAI 12.05-4 above, the staff verified that NEI 07-03A is referenced in COL FSAR Revision 6, Section 12.5S.

In addition to referencing NEI 07-03A, the applicant includes supplemental information in FSAR Section 12.5S, which addresses the operational portions of RG 8.8 that are not addressed in the ABWR DCD and applicant specific information supplementing NEI 07-03A, including a description of the plant organization and personnel responsibilities, procedures, and access controls to very high radiation areas. This site specific information relevant to NEI 07-03A is discussed in more detail in the following paragraphs:

Regarding plant organizational structure and responsibilities, the only difference from NEI 07-03A is that the plant manager may delegate authority to the ALARA committee, which is consistent with the intent of a good radiation protection program and ensuring radiation exposure is ALARA and is acceptable.

The information on procedures includes specific information on refueling procedures and dose control. The site specific information on refueling procedures is essentially equivalent to the information provided in NEI 07-03A except that the applicant indicates that radiation levels on the refueling bridge is expected to be less than 5 mrem/hour. However, as indicated by the applicant in response to RAI 12.3-12.4-1 (ML092260582) the 5 mrem/hour value is a dose rate zone designation and does not represent the expected dose to an operator during refueling operations. Additional information in FSAR Section 12.4.2 and Appendix 12B of Chapter 12 (including supporting calculations), indicate that dose rates will be less than 2.5 mrem/hour, which is

acceptable. Additional information relevant to refueling can be found in Sections 12.4, Appendix 12B, and Chapter 9 of the FSAR and additional staff evaluation of refueling procedures and equipment can be found in Section 12.4 and Chapter 9 of this SER (see Section 12.4 of this SER for additional information related to RAI 12.3-12.4-1).

Plant specific information relevant to dose control only includes a plant specific definition of "significant exposure." In accordance with NEI 07-03A, radiation protection will assure that procedures and methods for operation, maintenance, repair, surveillance, refueling, and activities involving significant exposures are reviewed prior to initial use and periodically thereafter to assure measures are considered to minimize occupational and public radiation exposure. The applicant defines "significant exposures" to be those that may result from entering an area greater than 10 R/hour or where an individual is likely to receive greater than 500 mrem. Since NUREG 0713, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities," Volume 35, indicates that the annual exposure to an average worker is approximately 120 mrem/year and since the annual limit for a radiation worker is 5 rem/year, the staff finds it acceptable to consider a potential for exposure of greater than 500 mrem a reasonable criteria for significant exposure.

NEI 07-03A indicates that the COL applicant should provide site specific information identifying very high radiation areas and describing access controls and limitations to these areas. This site specific information is discussed in Section 12.5 of this SER.

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 Regulatory Position C.2 of RG 8.8 and will incorporate measures for reducing the need for time spent in radiation areas; measures to improve accessibility to components requiring periodic maintenance or ISI; 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 (ML091490684) and NEI 07-08A (ML093220178), and providing the additional information in FSAR Section 12.5S, as discussed above, the applicant provided 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. These NEI documents have been approved by the NRC and the NRC SEs are in Appendix A of each of these NEI guidance documents. The facility staff will use this information to recommend design modifications or changes in plant procedures. This practice, as described in 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 Section 12.5 of this safety evaluation report (SER).

12.1.5 Post Combined License Activities

There are no post COL activities related to this section.

12.1.6 Conclusion

The staff's finding relating to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information. Therefore, no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52 Appendix A Section VI.B.1, all nuclear safety issues related to ensuring that occupational radiation exposures are ALARA that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.1 of NUREG-0800, and other NRC RGs. The staff's review concluded 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, Units 3 and 4, COL FSAR upon which the staff based its 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, "Instruction to workers," 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, 12.3, and 12.4, regarding design and operational considerations for the plant's RP Program. The applicant resolved these COL license information items by referencing 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 Regulatory Position C.2 of RG 8.8, and Regulatory Position C.1 of RG 8.10.

The staff concluded that the relevant information in the STP, Units 3 and 4, COL FSAR Section 12.1 adequately addresses the COL information items in the ABWR DCD, which is incorporated by reference. In conclusion, the COL applicant has provided sufficient information for satisfying

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.

STD DEP 12.2-1 Footnote to DCD Tables 12.2-3b and 12.2-3c

The applicant added a footnote to ABWR DCD Table 12.2-3b, "Gamma Ray Source Energy Spectra – Post – Operation Gamma Sources in the Core," and Table 12.2-3c, "Gamma Ray Source Energy Spectra – Gamma Ray Sources External to the Core During Operation," stating that the information provided in these tables shall not be used for detailed facility design or as the basis for any changes to the FSAR. This departure was made because the information in these two tables was discovered to be inaccurate.

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 identified 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 FSAR 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, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

Supplemental Information

Contained Sources

RG 1.206, Regulatory Position 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 regulations 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, "Occupational dose limits for adults," 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, "Compliance with dose limits for individual members of the public"; 10 CFR 50.34a and 50.36a; 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criteria (GDC) 60, "Control of releases of radioactive materials to the environment," and 64, "Monitoring radioactivity releases"; 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, "Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications." Full descriptions of the applicable regulatory and acceptance criteria are in SRP Sections 11.2 through 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, "Dose limits for individual members of the public," is in 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 in 10 CFR 20.1406, "Minimization of contamination."

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, Appendix A, Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59, "Changes, tests, and experiments."

12.2.4 Technical Evaluation

As documented in NUREG-1503, the 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.

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 scope of this section, the staff finds it reasonable that the departure does not require NRC approval. See SER Section 11.2 and the evaluation of COL Information Item 12.5 below, for further discussions related to this departure.

STD DEP 11.4-1

Radioactive Solid Waste Update

The applicant completely replaced 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. Section 12.2.1.2.6.4 and Tables 12.2-15a to 12.2-15l are updated to reflect the new system. There is no additional impact of this departure on this section. Within the scope of this section, the staff finds it reasonable that the departure does not require NRC approval. See SER Section 11.4 for further discussions related to this departure.

STD DEP 12.2-1

Gamma Ray Source Energy Spectra Tables

The applicant added a footnote to ABWR DCD Table 12.2-3b, "Gamma Ray Source Energy Spectra – Post – Operation Gamma Sources in the Core," and Table 12.2-3c, "Gamma Ray Source Energy Spectra – Gamma Ray Sources External to the Core During Operation," stating that the information provided in these tables shall not be used for detailed facility design or as the basis for any changes to the FSAR. This departure was made in conjunction with RAIs 12.2-14 and 12.2-20, as the response to RAI 12.2-20 and FSAR Appendix 12B, provides spent fuel pool source term information that would be inconsistent with the fuel source term information that could be derived from DCD Tables 12.2-3b and 12.2-3c, had they been used by the applicant. The information in DCD Tables 12.2-3b and 12.2-3c was discovered to be inaccurate and the use of the information in these tables could potentially result in inaccurate shielding design for fuel. Chapter 12 Appendix B of the STP, Units 3 and 4, FSAR provides, in part, site specific post operation core source term information which can be used as a supplement to ABWR DCD Table 12.2-3b. Within the scope of this section, the staff finds it reasonable that the departure does not require NRC approval. Additional discussion of this departure can be found in the "Supplemental Information" section of this SER section.

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 correcting an incorrect table reference. Within the scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval.

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

COL License Information Item

COL License Information Item 12.5

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, 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, this departure 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. These departures affect the input parameters for calculating the average annual airborne releases and the average annual liquid releases, and therefore, affect the response to COL Information Item 12.5. The following is a summary of the staff's evaluation of the applicant's response to this COL item, including how the departures affect the response to the COL item. Additional discussion is also in Sections 11.2, 11.3, and 11.4, "Solid Waste Management System," of this SER.

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

Liquid Effluent Source Term Analysis

COL Information Item 12.5 states that the applicant will re-evaluate the average annual liquid releases to the environment. The applicant calculated the annual liquid effluent release source term shown in FSAR Tier 2, Table 12.2-22, "Annual Average Liquid releases," using the methodology set forth in the BWR-GALE code (GALE 86 Code), as documented in NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR)." The staff evaluated the annual average liquid releases listed in FSAR Table 12.2-22 and issued RAI 11.02-3 concerning (1) the use of the BWR-GALE (which is a different methodology from the one used in the DCD for the LWMS design) and (2) that the annual average liquid release values in FSAR Table 12.2-22 had not changed due to the departures taken. In its response to this RAI, dated May 21, 2009 (ML091460243), the applicant stated that the annual average liquid release source term is based on the GALE 86 Code methodology and takes into account the change to the radwaste system. The applicant stated that FSAR Table 12.2-22 in COL application Revision 2 replaces Table 12.2-22 in the DCD, and the values in the FSAR table are different because of site specific calculations. RAI 11.02-3 was closed based on this response. However, upon further review of COL Information Item 12.5, the staff issued supplemental RAI 12.02-15 requesting additional calculation information to confirm the annual average liquid release source term presented in the FSAR Table 12.2-22.

In its response to RAI 12.02-15, dated March 24, 2010 (ML100880056), the applicant stated that its review of the GALE 86 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 provided information from the ABWR DCD and STP COL application that was used to develop GALE 86 Code input parameters and to calculate the GALE 86 Code output values in response to RAI 12.02-15. The information shows that the applicant has revised the GALE 86 Code output values for liquid annual average effluent releases based on the plant capacity factor, ABWR reactor water iodine-131 (I-131) concentration, and the annual flow in the circulating water system. In addition, the applicant calculated the demonstrated

compliance with the unity rule in footnote 4 to Table 2, "Effluent Concentrations," of Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," to 10 CFR Part 20, using the adjusted annual average liquid release source term values. The applicant 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. Therefore, the applicant stated that it is in compliance with 10 CFR Part 20, 10 CFR Part 50, and GDC 60, "Control of releases of radioactive materials to the environment."

In order to ensure that the applicant's response to COL Information Item 12.5 was adequate, the staff performed an independent evaluation of the applicant's GALE 86 Code annual average liquid release input and output data. This independent evaluation verified the applicant's results for the GALE 86 Code annual average liquid release output presented in the applicant's response dated March 24, 2010 (ML100880056). Compliance with 10 CFR Part 20, 10 CFR Part 50 and GDC 60 are evaluated later in this section. Therefore, RAI 12.02-15 is resolved and closed.

In addition, during an audit of the radwaste system departures completed by the staff during the review of Chapter 11 as documented in the staff's audit report dated October 16, 2009 (ML092510426), STP engineers indicated that FSAR Table 12.2-15L, "Solid Radwaste Component Inventories LW Backwash Receiving Tank" was inaccurate. Therefore, the staff issued RAI 12.02-11, requesting a revision of the source terms calculated in the backwash receiving tank in the LWMS. In its response to RAI 12.02-11, dated October 29, 2009 (ML093640053), the applicant provided revised LWMS tables with revised and corrected radionuclides and concentrations that the staff found acceptable. The staff confirmed that Revision 4 of the FSAR incorporated the proposed FSAR changes. Therefore, RAI 12.02-11 is resolved and closed.

10 CFR Part 20 Liquid Compliance

COL Information Item 12.5 states that the applicant will re-evaluate the average annual liquid releases to the environment for the final plant design and site parameters for conformance with 10 CFR Part 20. The staff issued RAI 12.02-2, requesting this information because the initial review of the STP COL application showed that the applicant did not provide liquid effluent compliance with 10 CFR Part 20. In its response to RAI 12.02-2, dated April 23, 2009 (ML091170081), the applicant included a comparison of liquid effluent concentrations 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 unity rule concentration limit identified in footnote 4 to Table 2 in Appendix B of 10 CFR Part 20. In its response to RAI 12.02-9, dated October 12 2009 (MI092890095), the applicant provided revised tables with the liquid effluent unity calculation.

The staff issued RAI 12.02-10, requesting the applicant to provide clarifications or corrections to FSAR Table 12.2-22 listing the liquid radionuclides and concentrations. In its response to RAI 12.02-10, dated October 12, 2009 (ML0928900821), the applicant included a revised FSAR Table 12.2-22 with a corrected list of liquid radionuclides and corrected liquid effluent concentrations. The applicant also revised the 10 CFR 20, Appendix B "unity" rule calculation. 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 meet the 10 CFR Part 20, Appendix B unity rule. Staff confirmed that the proposed FSAR changes were incorporated into the FSAR. Therefore, RAI 12.02-2, RAI 12.02-9 and 12.02-10 are resolved and 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

COL Information Item 12.5 states that the applicant will re-evaluate the average annual liquid releases to the environment for the final plant design and site parameters for conformance with 10 CFR Part 50, Appendix I. The staff's review identified that the tables, input parameters and resulting doses for evaluation and verification of annual liquid effluent doses to the environment from STP, Units 3 and 4, were not included in the COL application. The staff issued a series of RAIs requesting that the applicant provide details of the liquid effluent data and associated effluent dose information, and that the effluent information be incorporated into the FSAR. In its responses to RAI 11.02-2, dated April 27, 2009 (ML091260746); and RAI 12.02-8, dated October 29, 2009 (ML093640053), the applicant stated that the liquid effluent data requested is presented in the STP Environmental Report (ER). Because the applicant did not supply the requested information in the FSAR, this response was not acceptable. The applicant subsequently submitted a supplemental response to RAI 12.02-7, in a letter dated November 9, 2009 (ML093170676), and provided 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 staff confirmed that Revision 4 of the FSAR incorporated the proposed FSAR changes. Therefore, RAIs 11.02-2, 12.02-7, and 12.02-8 are resolved and closed.

The supplemental response to RAI 12.02-7, provides a description of the required model assumptions and input parameters needed to run LADTAP II computer code (NUREG/CR-1276, "User's Manual for LADTAP II – A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents," issued March 1980), and justification for excluding potential exposure pathways. 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 using radiological exposure models based on RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I," and the LADTAP II computer code. The staff further evaluated the applicant's information and found that the applicant calculated offsite liquid releases from the main cooling reservoir using the procedure described in the offsite dose calculation manual 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, Revision 1, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," to calculate offsite releases. This is a bounding approach because the fully mixed impoundment model assumes no loss by sedimentation and soil holdup.

SER Table 12.2-1 (below) lists the important parameters used by the staff for the LADTAP II computer code calculations. The staff considered leakage from the main cooling reservoir to the adjacent Little Robbins Slough and calculated the flow to the slough from the main cooling reservoir as one effluent discharge rate. The staff also used the effluent discharge rate from the main cooling reservoir spillway and blowdown to the Colorado River of 0.47 cubic meters per

second (m³/s) (16.5 cubic feet per second [cfs]). The values utilized are listed in SER 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)	GALE 86 Source Term	RG 1.112, RG 1.109, and NUREG-0016.
Effluent discharge rate (cfs)	3.8/16.5	Calculated seepage rate from main cooling reservoir/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 this table.

Key: Ci/yr=curries/year, cfs =cubic-feet per second

SER Table 12.2-2 provides a comparison of the applicant's and the staff's dose estimates to the liquid dose criteria in 10 CFR Part 50, Appendix I. Table 12.2-2 shows both the applicant's and staff's results are well below the Appendix I criteria. The 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 Effluent Maximum Individual Doses (mrem/yr)

Organ, or Total 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 10 CFR Part 50, Appendix I Section II.A

SER 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 the staff's bounding independent assessment.

The calculated annual population doses listed in SER 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 GALE 86 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 Effluent Population Doses (person-rem/yr)		
Organ or Total 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

COL Information Item 12.5 states that the applicant will re-evaluate the average annual liquid releases to the environment for the final plant design and site parameters for conformance with 10 CFR Part 20. 10 CFR 20.1301(e) requires that NRC-licensed facilities comply with the U.S. Environmental Protection Agency (EPA) applicable environmental radiation standards of 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Plants." The EPA annual dose limits are 0.25 millisievert (mSv) (25 milli-radiation equivalent man [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 nitrogen-16 (N-16) sky shine from BWR turbine buildings. The EPA standards apply to the entire site or facility, whether it has single or multiple units.

The staff reviewed Section 12.2 of the COL application for compliance with 10 CFR 20.1301(e) and the applicable radiation protection standard of 40 CFR Part 190. 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. In its response to RAI 11.02-4, dated September 3, 2009 (ML092510039), the applicant 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. The staff closed RAI 11.02-4 as unresolved and issued 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.

In its supplemental response to RAI 12.02-7, dated November 9, 2009 (ML093170676), the applicant provided liquid and gaseous effluent site data, effluent dose calculations and appropriate dose results comparisons to dose limits in 10 CFR 20.1301(e) and 40 CFR Part 190. The staff issued RAI 12.02-17, concerning the liquid effluent dose calculations for STP, Units 3 and 4, and the comparison to dose limits in the 10 CFR 20.1301(e) and 40 CFR Part 190. In its first response to RAI 12.02-17, dated February 25, 2010 (ML100610277), the applicant stated that the initial information provided in response to RAI 12.02-7 was correct. After further discussion with the applicant, the applicant provided a revised response to RAI 12.02-17, dated May 17, 2010 (ML101390226), to include revised 10 CFR 20.1301(e) and 40 CFR Part 190 liquid effluent dose calculation data. SER Table 12.2-4 lists the calculated 40 CFR 190 values provided by the applicant. The staff reviewed the revised applicant's response calculations including liquid and gaseous effluent doses. The staff independently verified the applicant's calculations and determined that the applicant complied 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 or Total 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 the NRC guidance. The staff values also verified that the requirements of 10 CFR 20.1301(e) were met. The staff confirmed that the proposed changes were incorporated into the FSAR. Therefore, RAI 12.02-7, RAI 12.02-12 and RAI 12.02-17 are resolved and closed.

Based on the above information, the staff 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 has adequately addressed 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

COL Information Item 12.5 states that the applicant will re-evaluate the average annual airborne releases to the environment. The staff evaluated the annual gaseous effluent source term data listed in FSAR Table 12.2-20, "Airborne Concentrations," as the source term for calculating the annual gaseous effluent doses utilizing the GASPARD II code (NUREG/CR-5643, "GASPARD II – Technical Reference and User Guide," issued March 1989). The applicant calculated and provided an annual gaseous effluent source term shown in DCD Tier 2 Table 12.2-20 and FSAR Tier 2, Table 12.2-20, stating that they used the methodology set forth in the GALE 86

Code (NUREG-0016) to calculate the values in FSAR Table 12.2-22, as documented in FSAR Section 12.2.2. During the review of the response to COL Information Item 12.5 for gaseous effluents, the staff determined that the source term in FSAR Table 12.2-20 and the GWMS Departure STP DEP 11.3-1 and its associated changes described in the departure report (Revision 5, Part 7 of the application), did not contain enough information to resolve COL Information Item 12.5. Therefore, the staff issued RAI 12.02-16, requesting that the applicant provide additional information to enable the staff to independently confirm the calculated annual gaseous effluent source term values in FSAR Table 12.2-20. In its response to RAI 12.02-16, dated March 24, 2010 (ML100880056), the applicant stated that a review of the GALE 86 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 performed a new analysis using the information in the ABWR DCD and STP FSAR to develop GALE 86 Code input parameters and to calculate GALE 86 Code gaseous source term output values. The applicant then adjusted the new GALE 86 Code gaseous source term output values based on: 1) the ABWR capacity factor ratio to the capacity factor included in the GALE 86 Code program, 2) the ABWR DCD reactor coolant system (RCS) water I-131 concentration ratio to the I-131 RCS concentration generated by the GALE 86 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 GALE 86 Code.

The staff reviewed and evaluated the applicant’s response to RAI 12.02-16. This adjustment of the GALE 86 output results in the accepted NRC methodology is permitted by RG 1.112, Revision 1, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors,” 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 the staff evaluations. The staff noted that the applicant provided a revised gaseous source term table in the response to RAI 12.02-16, but did not revise Table 12.2-20 in the FSAR.

The staff issued supplemental RAI 12.02-19, requesting the applicant to evaluate the calculated GALE 86 source term table values calculated for the I-131 liquid annual release in curies per year and the xenon (Xe)-133 and Xe-135 gaseous annual releases in curies per year. The staff also requested the applicant to justify the I-131 and noble gas factors used by the applicant to revise the gaseous source term output file table values generated by the GALE 86 Code. In its response to RAI 12.02-19, dated May 27, 2010 (ML101530608), the applicant corrected the I-131 liquid and Xe-133 and Xe-135 gaseous GALE 86 output source term values and made additional corrections to the calculated gaseous effluent source term provided in the response to RAI 12.02-16. In its response to RAI 12.02-19, the applicant also compared its revised gaseous source term concentrations to 10 CFR Part 20 Appendix B concentrations to demonstrate compliance with the 10 CFR Part 20 unity rule concentration limit. The applicant stated that this shows compliance with the 10 CFR Part 20 unity calculations based on the revised adjusted gaseous effluent source term table of values (see subsection “10 CFR Part 20 Gaseous” in this SER).

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 resulted 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 GALE 86 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 GALE 86 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 GALE 86 Code. The staff generated the GALE 86 gaseous output source term table and found the results to be in agreement with the applicant output table values. Therefore, RAI 12.02-16 is resolved and closed.

The staff evaluated the applicants' modification of the GALE 86 gaseous effluent source term table output. The change in table values was based on modifying the GALE 86 source term output table by: 1) the ABWR capacity factor ratio to the capacity factor included in the GALE 86 Code program, 2) the ABWR DCD RCS water I-131 concentration ratio to the I-131 RCS concentration generated by the GALE 86 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 GALE 86 Code. The staff verified that GALE 86 source term table values for noble gases and radioiodine isotopes were modified by one or more of these three factors. The applicant generated an additional source term table and 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. Therefore, RAI 12.02-19 is resolved and closed.

The staff reviewed and verified the FSAR source term, the GALE 86 source term, and the adjusted GALE 86 source term tables. Each of these source term tables complies with the 10 CFR Part 20 unity rule 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 gaseous effluent dose compliance with 10 CFR Part 50, Appendix I and GDC 60.

10 CFR Part 50, Appendix I Gaseous Doses

COL Information Item 12.5 states that the applicant will re-evaluate the average annual airborne releases to the environment for the final plant design and site parameters for conformance with 10 CFR Part 50, Appendix I. The staff's 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's 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). In its response to RAI 12.02-7, dated September 22, 2009 (ML092680018), the applicant stated that the information requested was provided in the ER in response to a previous environmental RAI. However, after the applicant reviewed supplemental RAI 12.02-8, the applicant re-evaluated its position and provided the requested information as a supplemental response to RAI 12.02-7. In its supplemental response to RAI 12.02-7, dated November 9, 2009 (ML093170676), the applicant transferred the gaseous effluent information contained in the ER, into FSAR Section 12.2. The staff confirmed that the proposed changes were incorporated into the FSAR.

The applicant also provided a description of all model assumptions and input parameters needed to run the GASPARI computer code. Using radiological exposure models based on RG 1.109 Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," and the GASPARI computer code, the applicant calculated the estimated doses to the nearest member

of the public and to the general population within 80 kilometers (km) (50 miles [mi]) 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 are not viable, because there are no cows or goats located within 8 km (5 mi) of the plant. The staff evaluated the applicant's information 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. In its response to RAI 12.02-16 (ML100880056), dated March 24, 2010, the applicant supplied the STP GALE 86 input and output information which included a table with a new GALE 86 Code gaseous effluent source term and an adjusted GALE 86 Code source term. The staff's evaluation determined that the applicant's GALE 86 source term was in agreement with the NRC calculations, but the new applicant's adjusted GALE 86 Code source term table had incorrect values for some radionuclides. The staff issued RAI 12.02-19, which requested additional justification for gaseous effluent source term adjustment factors used. In its response to RAI 12.02-19 (ML101530608), dated May 27, 2010, the applicant provided corrections to the new adjusted GALE 86 source term table. The staff reviewed and verified the data in the gaseous effluent adjusted GALE 86 source term table in the RAI 12.02-19 response in conjunction with the applicant's description of derivation of the adjustment factors, and found them 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 GASPARI computer code. 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 GALE 86 Code gaseous effluent source term calculated in accordance with an approved NRC methodology (NUREG-0016) using applicant provided information in the RAI 12.02-16 response, and
- 3) The adjusted GALE 86 Code gaseous effluent source term developed by the applicant in response to RAI 12.02-19.

SER Table 12.2-6 (below) provides a comparison of the applicant's gaseous effluent dose and the NRC evaluation of the GALE 86 and adjusted GALE 86 gaseous effluent doses to the dose criteria in 10 CFR Part 50, Appendix I.

The staff's review also identified gaseous effluent RAIs for the applicant to address 10 CFR Part 20 and 10 CFR Part 50, Appendix I compliance. In RAI 12.02-1, the staff requested proper reference to gaseous effluent dispersion factors used for routine gaseous effluent releases. The applicant provided updated dispersion parameters and an updated Table 2.3S-27, "XOQDOQ- Predicted Maximum X/Q and (D/Q) Values at Receptors of Interest," addressing this issue. The FSAR has been revised to include the revised information used in the effluent dose evaluations. Therefore, RAI 12.02-1 is resolved and closed.

In RAI 11.03-6, the staff requested that the applicant provide finalized dispersion factors used to calculate gaseous effluent doses from each plant. In its response to this RAI dated September 9, 2009 (ML092530686), the applicant 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 dispersion factors, χ/Q and D/Q values, addressed in FSAR Subsection 2.3S.5, "Long-Term Atmospheric Dispersion Estimates for Routine Releases." Therefore, RAI 11.03-6 is resolved and closed.

SER Table 12.2-5 below shows the comparison of the effluent dose modeling assumptions between the applicant's and the the staff's analyses. FSAR Table 2.3S-27 includes the applicant's gaseous pathway dispersion parameters for routine releases and used as input to the GASPARI 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 12.2-5 - Comparison of Gaseous Receptor Locations

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

In order to verify the adequacy of the applicant's response to COL Information Item 12.5, the staff performed independent dose assessments following NRC guidelines and using the GASPARD II computer code and the annual gaseous effluent data from: 1) FSAR Table 12.2-20 source term; 2) the GALE 86 source term; and 3) the adjusted GALE 86 source term described above and then compared all results to the applicant's results and the Appendix I dose criteria. SER Table 12.2-6 shows the comparison of different MEI location doses between the applicant's and the staff's analyses. The applicant utilized its 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 its adjusted GALE 86 gaseous source term resulted in no significant effect on the airborne effluent values presently given in FSAR Table 12.2-20.

FSAR Table 12.2-20 Source Term

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 resulted in (1) a site boundary gamma annual air dose of 3.3 mrad; (2) a beta annual air dose of 4.28 mrad; and (3) 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 FSAR Table 12.2-20 source term was 3.20 mrem and the annual skin dose was 7.25 mrem. The maximum annual organ dose (thyroid) was 2.19 mrem, for the child at 3.03 miles NNW.

GALE 86 Source Term

The staff's gaseous effluent dose calculation performed in accordance with the NRC accepted process and the applicant site specific values using the GALE 86 source term output results in a site boundary gamma annual air dose of 7.7 mrad; a beta annual air dose of 9.1 mrad; and a dose to the total body and skin, at the location of the highest dose offsite, of 0.396 mrem and 1.07 mrem respectively. The total body dose at the site boundary from the GALE 86 source term was 5.17 mrem and the annual skin dose was 14.0 mrem. The maximum annual organ dose (thyroid) was 2.0 mrem, for the child at 3.03 miles NNW.

Adjusted GALE 86 Source Term

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); a beta annual air dose of 3.07 mrad; and a dose to the total body and skin of 0.135 mrem and 0.367 mrem, respectively. The total body dose at the site boundary from the adjusted GALE 86 source term was 1.77 mrem and the annual skin dose was 4.80 mrem. The maximum annual

organ dose (thyroid) was 2.36 mrem, for the child at 3.03 miles NNW. Table 12.2-6 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 SER Table 12.2-6), and envelope the gaseous effluent dose calculations performed in accordance with the NRC methodology using the GALE 86 Code for calculating the effluent source term, and the GASPAR II Code to calculate the associated doses to the environment.

Table 12.2-6 - 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>				
<ul style="list-style-type: none"> • Gamma Dose (mrad) 				
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>Site Boundary</u> 	3.30 *	7.70	2.65	10
<ul style="list-style-type: none"> • Beta Dose (mrad) 				
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>Site Boundary</u> 	4.28 *	9.10	3.07	20
<ul style="list-style-type: none"> • Total Body (mrem) 				
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>At MEI</u> 	0.167 **	0.396 **	0.135 **	5
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>Site Boundary</u> 	3.20 *	5.17	1.77	N/A
<ul style="list-style-type: none"> • Skin (mrem) 				
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>At MEI</u> 	0.462 **	1.07 **	0.367 **	15
<ul style="list-style-type: none"> <li style="margin-left: 20px;"><u>Site Boundary</u> 	7.25 *	14.0	4.8	N/A
<u>Radioiodines and Particulates (mrem)</u>				
<ul style="list-style-type: none"> • 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 at 3.03 miles NNW

Population Dose Evaluation – Gaseous Effluents

COL License Information Item 12.5 states that the applicant will re-evaluate the doses from average annual liquid releases and the average annual airborne releases to the environment for the final plant design and site parameters. SER Table 12.2-7 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 staff's bounding independent assessment. The applicant used the population doses from both STP, Units 3 and 4, in the cost-benefit analysis located in Chapter 11, Table 11.3-6, "Gaseous Radwaste Augment Benefit Cost Ratio Summary," of this SER. The NRC guidance, RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," 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 12.2-7 - Comparison of Gaseous Population Doses (person-rem/yr)		
Organ, or Total 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

COL License Information Item 12.5 states that the applicant will re-evaluate the average annual airborne releases to the environment for the final plant design and site parameters for conformance with 10 CFR Part 20. The staff's initial review did not find COL gaseous effluent information in the application 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 unity rule concentration limit identified in footnote 4 to Table 2 in Appendix B of 10 CFR Part 20. In its response to RAI 12.02-3, dated July 7, 2009 (ML091900147), the applicant provided revised tables with the unity calculation included. 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 meet the 10 CFR Part 20, Appendix B unity rule. Staff confirmed that

the proposed changes were incorporated into the FSAR. Therefore, RAI 12.02-3 is resolved and closed.

Compliance with GDC 60

COL License Information Item 12.5 states that the applicant will re-evaluate the doses from average annual liquid releases and the average annual airborne releases to the environment for the final plant design and site parameters. The staff reviewed FSAR Section 11.3, the GWMS, for compliance with Technical Rationale in Section 5 of the 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 its response to RAI 12.02-1 (ML083570395), dated December 18, 2008, the applicant addressed changes to the X/Q and D/Q dispersion factors used to calculate releases of gaseous effluents to the environment and corrected the reference for site specific X/Q values in FSAR Subsection 12.2.2.1 to Table 2.3S-27 (instead of Table 2.3S.5-2). Staff confirmed that the proposed change was incorporated in FSAR Revision 3. Therefore, RAI 12.02-1 is resolved and closed.

After reviewing the information provided, the staff issued RAI 11.03-6, requesting that the design of the GWMS and the releases of gaseous effluents to the environment be re-evaluated based on the changes to the dispersion factors. In its response to RAI 11.03-6 dated September 6, 2009 (ML092530686), the applicant stated that as a result of the revisions to X/Q and D/Q dispersion factors, the airborne concentration in FSAR Table 12.2-20, and gaseous pathway dose results in Table 12.2-21, will be reported to the NRC in NINA's responses to RAI 02.03.04-5. In a supplemental response to RAI 02.03.04-5 dated September 22, 2009 (ML092680018), the applicant provided revised airborne concentrations in Table 12.2-20, using the revised X/Q values. The staff verified compliance with the Unity Rule of 10 CFR Part 20, Appendix B, based upon the revised values. Table 12.2-21 gaseous pathway doses were also revised based upon the revised X/Q and D/Q values. The staff verified compliance with the 10 CFR Part 50, Appendix I design basis dose limits. The staff confirmed that the proposed changes were incorporated into the FSAR. Therefore, RAI 11.03-6 is resolved and closed.

Supplemental Information

RG 1.206, Regulatory Position 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 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, RWB. In its responses to RAI 12.02-4, dated August 20, 2009 (ML092930209), and RAI 12.02-5, dated October 12, 2009 (ML092890082), the applicant stated that the equipment has not been specified, 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 FSAR Figure 12.3-39, "Radwaste Building, Radiation Zone Map, Normal Operation at Elevation 12300

mm.” In its 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 the applicant said would be added to the FSAR as Tables 12.2-13b, “Liquid Radwaste Component Inventories – LCW Filter/Demin Skid,” and 12.2.13f, “Liquid Radwaste Component Inventories – HCW Filter/Demin Skid,” 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 one-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. The staff verified that the proposed source information was included in COL FSAR Revision 4. Accordingly, RAIs 12.02-4 and 12.02-5 are resolved and closed.

RG 1.206, Regulatory Position 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 should provide a listing of isotope, quantity, form, and use of all sources that exceed $3.7 \text{ E}+9$ Becquerel (Bq) (100 millicuries [mCi]). The staff issued RAI 12.02-6 requesting the applicant to provide a description of and listing in FSAR Section 12.2 of any radiation sources containing byproduct, source, and special nuclear material that exceed $3.7 \text{ E}+9$ Bq (100 mCi), including isotope, quantity, form, and use of all sources. In its response to RAI 12.02-6, dated August 20, 2009 (ML092930209), the applicant stated 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 $3.7 \text{ E}+9$ Bq (100 mCi) and that may be required to perform STP, Units 3 and 4, radiation detection instrumentation calibration activities. In its response to RAI 12.02-13, dated December 21, 2009 (ML093580193), the applicant referenced its response to RAI 01-15, dated December 21, 2009 (ML093450355), which discussed the appropriateness of the licensee’s compliance with 10 CFR Part 30, “Rules Of General Applicability to Domestic Licensing of Byproduct Material”; 10 CFR Part 40, “Domestic Licensing of Source Material”; 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material”; and the program elements that will ensure necessary controls to allow receipt of byproduct and source material. Staff confirmed that in Revision 4 to the COL FSAR, the applicant revised Subsection 12.2.1.2.9.6, to state that sources greater than $3.7 \text{ E}+9$ Bq (100 mCi) required for dosimetry and portable instrument calibration will be located in the Metrological Laboratory and will be licensed under STP, Units 1 and 2. This revised FSAR subsection also states that all other sources are expected to be less than $3.7 \text{ E}+9$ Bq (100 mCi). Because the applicant provided the requested information about radiation sources containing byproduct, source, and special nuclear material, RAI 12.02-13 is resolved and closed.

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 as “Spent Fuel Storage” (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 the “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 inspections, tests, analyses, and acceptance criteria (ITAAC) Item 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.

In its response to RAI 12.02-14, dated January 4, 2010, (ML100060693), the applicant stated that the design activities for the new STP, Units 3 and 4, fuel and spent fuel storage facilities were 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 added that, at the conclusion of the spent fuel storage design activities, the source terms, geometry, and dose calculations would be made available for the staff to review. After several teleconference calls with the applicant and further staff discussions, the staff determined that additional information was needed to resolve the staff’s concerns associated with the spent fuel sources. Consequently, the staff closed RAI 12.02-14 as unresolved and 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.

In its initial response to RAI 12.02-20, dated January 3, 2011 (ML110050390), the applicant 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 to the staff, its source term calculations for the fuel bundles in the spent fuel pool and the maximum height to which a fuel assembly is raised during refueling, and for the staff to obtain additional insight 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 in DCD Table 12.2-3b were low by a factor of approximately one million ($10E6$) and that this large discrepancy was likely the result of a unit’s error in Table 12.2-3b. The applicant believed that the data in DCD Table 12.2-3b should have units of joules/megawatt-second (J/MW-s) instead of pico joules per watt – seconds (pJ/W-s). Using the units of J/MW-s would increase the source term values in DCD Table 12.2-3b by a factor of a million. The applicant stated, and the 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 similar 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 approximately a million times too low. The applicant indicated that the units in Table 12.2-3c should be pico joules per cubic centimeter per second per watt thermal ($\text{pJ}/\text{cm}^3/\text{s}/\text{W}_t$) instead of pico joules per cubic centimeter per second per megawatt thermal ($\text{pJ}/\text{cm}^3/\text{s}/\text{MW}_t$). The staff asked the applicant to make a departure to correct the information in these DCD tables.

In lieu of correcting the information in DCD Tables 12.2-3b and 12.2-3c, the applicant proposed a new departure (STD DEP 12.2-1) 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 its proposed departure response, dated May 5, 2011 (ML11129A057), the applicant stated that, although the suspected unit's error in DCD Tables 12.2-3b and 12.2-3c resulted in the data in these tables being low by a factor of a million, 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 data was used in the DCD in calculating the doses around the reactor vessel, for shielding in containment and building walls, and in equipment qualification. The 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.

In addition to the review of the departure provided for the STP COL application, during the review of General Electric-Hitachi's (GEH's) application to renew the ABWR design, the staff issued an RAI, regarding the apparent incorrect tables. In GEH's response (ML14350A843), GEH (the successor to GE Nuclear Energy, the original designer of the ABWR) reviewed the original analysis supporting ABWR DCD Table 12.2-3b and 12.2-3c. GEH confirmed that there was a unit conversion error resulting in ABWR DCD Tables 12.2-3b and 12.2-3c being a million times lower than what was provided in the actual supporting analysis, and GEH provided information supporting this conclusion. GEH also confirmed that, besides the source term data in Tables 12.2-3b and 12.2-3c, all other information in the DCD was based on the correct source term information. Since GEH's conclusions are based on the original ABWR design certification calculations and since all of the other information in the DCD appears consistent with the use of the accurate data, the staff has reasonable assurance that the table errors did not affect anything in the DCD beyond the source term information in the tables themselves.

In a series of telephone conferences with the COL applicant, the staff asked the applicant to provide additional 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 spent fuel pool itself, and 4) the maximum raised fuel assembly in the spent fuel pool. In its revised response to RAI 12.02.20, dated April 26, 2011, (ML11119A076), the applicant provided new spent fuel pool information, including a proposed new appendix (Appendix 12B, "Spent Fuel Pool Geometry and Dose Rate Calculation,") to the COL FSAR. Information to be added to the FSAR included 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 its revised response to RAI 12.02-20, 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 to an operator from a raised irradiated fuel unit specified in ANSI/ANS-57.1-1992. The staff agreed that the information provided in the response to RAI 12.02-20, supplements the information in DCD Table 12.2-3b appropriately, and therefore the source term information in DCD Table 12.2-3b does not need to be used by the COL applicant. In addition, since correct

core source term information was used in the design, the erroneous information in Table 12.2-3c has no impact on the design and does not need to be used by the COL applicant. Since correct and accurate information was used in the plant design and since the COL applicant should not need the erroneous information in DCD Tables 12.2-3b and 12.2-3c for any reason, the staff proposes a license condition that will prohibit the licensee from using, modifying, or deleting the information in DCD Tables 12.2-3b and 12.2-3c, including footnotes associated with the tables, without an amendment.

Based on all of the above information, the staff found the combination of the FSAR changes in the final response to RAI 12.02-20, and STD DEP 12.2-1, with the license condition, to be acceptable. The staff verified that the proposed FSAR changes were included in COL FSAR Revision 7. Therefore, RAI 12.02-20 is resolved and closed.

However, following the completion of this review, the applicant submitted Holtec Report No. HI-2135462, "Licensing Report for South Texas Project Units 3 and 4 ABWR Spent Fuel Racks," and incorporated Revision 1 of this document (ML13218A291) into FSAR Chapter 9, "Auxiliary Systems." During the Phase 6 SER review of FSAR Chapter 12, the staff found that some of the information in Appendix 12B, "Spent Fuel Pool Inventory and Dose Rate Calculation," was inconsistent with the information in Holtec Report. For example, Appendix 12B stated that the spent fuel pool (SFP) capacity was 2365 assemblies, while the capacity in the Holtec Report was 2380 assemblies. Also, the spent fuel pool rack arrangement drawing in chapter 12 did not match the rack design included in the Holtec Report. The staff also identified several other apparent inconsistencies between Appendix 12B and other FSAR sections. Therefore, the staff held a meeting with the applicant on January 20, 2015, to discuss these discrepancies (see ML15022A657, for the meeting summary). As a result of this meeting, NINA indicated that Westinghouse was reviewing the calculations and that it would revise Chapter 12 as appropriate.

Subsequently, the staff held another meeting with the applicant on February 3, 2015, to discuss the apparent discrepancies in more detail. At the meeting, the applicant indicated that the majority of the discrepancies were either insignificant, conservative, or irrelevant to the SFP source term and shielding calculations performed in Appendix 12B, including the calculations for the dose to the operator from a raised assembly, and that the calculations in Appendix 12B remained adequate. For example, the difference in source term as a result of assuming 2365, instead of 2380, would result in less than a one percent change to the total source term, because the extra 15 assemblies would be at least 10 years old, since all of the more recently dispatched (higher source term) assemblies were already included in the calculation. In addition, the staff notes that the Holtec Report indicates that although the physical capacity of the SFP is 2380 assemblies, the SFP will be administratively limited to 2354 assemblies. Differences in SFP rack design would make little difference to the calculations for the source term for fuel within the racks because the source term was originally modelled as a homogeneous source within the SFP rack area. Additional detail regarding the information discussed during the February 3, 2015, meeting can be found in the meeting summary (ML15062A053).

While the staff generally agreed with the applicant, that the Appendix 12B source term and shielding calculations and the dose rates calculated remained acceptable and that the issue could be resolved by making FSAR revisions (instead of revising the calculations), the staff wanted to re-review the applicant's source term and shielding calculations to ensure that the calculations remained valid with the inclusion of the Holtec report and to ensure that the calculations remained a reasonable basis for the SFP source term and associated dose rate

estimates. One specific issue the staff wanted to confirm was that the dose rate calculation for the raised assembly was based on 8.5 feet of water coverage above the active fuel region and not 8.5 feet above the top of the entire assembly. If the dose rate was calculated 8.5 feet above the top of the entire assembly, the staff was concerned that there may not be enough clearance to move an assembly above the fuel assemblies in the pool, considering the height of the assemblies seated within the storage racks, while maintaining 8.5 feet of water shielding. Therefore, the staff conducted an audit of the applicant's SFP source term and shielding calculations on February 10, 2015, and February 11, 2015.

During the audit, the staff confirmed that the dose rate from a raised assembly was calculated with 8.5 feet of water above the active fuel region. However, during the review of the calculations and discussions with the applicant regarding the calculation of the SFP source term, the staff determined that some of the information in FSAR Appendix 12B related to the maximum spent fuel assembly source term was unclear and inaccurate. Specifically, FSAR Appendix 12B indicated that 30 percent was added to the maximum assembly for conservatism, when in actuality 30 percent was added to the average first burned assembly, to represent the maximum assembly. While this did not impact the calculation results, FSAR Appendix 12B required updating to correct this discrepancy and to clarify that the dose from a raised assembly was calculated 8.5 feet above the active fuel region.

In addition, ABWR DCD, Table 12.2-5c indicates that there will be 7.4 meters of water shielding above the fuel elements seated in the spent fuel pool racks. The applicant's shielding calculations are modeled assuming 7.4 meters of water shielding above the active fuel region of the fuel assemblies seated in the racks. The staff accepts the applicant's approach of using 7.4 meters above the active fuel length for the radiation shielding calculations (as opposed to 7.4 meters above the entire assembly), because it is conservative from a radiation shielding perspective. In addition, the dose rate from the fuel in the racks results in an insignificant dose above the SFP water regardless of whether the water shielding is 7.4 meters above the active fuel region or 7.4 meters above the top of the entire fuel assembly. The dose rate calculated by the applicant at the water surface, from fuel assemblies in the racks, with 7.4 meters of water shielding above the active fuel region is approximately 0.001 micro Rem per hour.

While it is acceptable for the applicant to model the Appendix 12B related calculations with 7.4 meters of water above the active fuel region of the assembly, for the purposes of estimating radiation dose, staff notes that the assumptions used in the Appendix 12B calculations in no way obviate other FSAR requirements. For example, the ABWR DCD Technical Specification 3.7.8 LCO requirement to maintain a minimum water level of 7.0 meters over the top of irradiated assemblies seated in the spent fuel storage pool (which is incorporated by reference by the applicant), must be maintained. Likewise, the staff notes that the iodine decontamination factors assumed in the DCD section 15.7.4 fuel handling accident (FHA) analysis are based on a minimum water depth between the top of the damaged fuel rods and the fuel pool surface of 23 feet, consistent with guidance in RG 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors (Safety Guide 25)". Since DCD Section 15.7.4, "Fuel-Handling Accident," is incorporated by reference by the COL applicant, the actual minimum SFP water depth must be at least 23 feet above the top of the assumed dropped damaged fuel rods in order for the Chapter 15, "Accident and Analysis," FHA dose analysis to remain valid.

The staff notes that while the applicant's SFP source term is modeled as fuel homogeneously spread throughout the racks (the calculation does not account for the possibility of a higher

source term in certain areas of the SFP where fresh fuel assemblies are located), the calculations do contain conservatisms. For example, the applicant's calculations consider that the full core will be offloaded to the SFP in 24 hours and the calculations do not account for the water shielding that would be in place between the fuel and the radiation barriers. The Holtec report indicates a minimum distance of 22.4 inches from the racks to the SFP walls. Confirmatory calculations performed by the staff indicate that the two meters of concrete shielding provided by the SFP walls and floor (as indicated in FSAR Chapter 12) would be adequate to maintain dose rates around the SFP to within the radiation zones specified in the FSAR even if an entire recently dispatched core was placed in one area of the SFP. Therefore, the two meters of concrete shielding specified in Chapter 12, along with the current SFP rack configuration provides adequate shielding for the SFP.

As discussed in the audit report (ML15063A081), the staff determined that the discrepancies identified between Appendix 12B and other FSAR sections did not invalidate the SFP source term and shielding calculations. However, the staff identified several necessary updates to FSAR Appendix 12B (including those discussed above) in order to correct or remove, as appropriate, inconsistencies between Appendix 12B and the remainder of the FSAR and to ensure that Appendix 12B does not contain factual inaccuracies. In addition, the staff requested additional documentation for why the original differences between Appendix 12B (and associated calculations) and other FSAR sections did not invalidate the SFP source term and shielding analysis. Therefore, the applicant agreed to revise its response to RAI 12.02-20, to provide the requested information and FSAR updates. The staff found this approach acceptable.

In its revised response to RAI 12.02-20 (ML15070A009) dated March 4, 2015, the applicant corrected inconsistencies between Appendix 12B and other FSAR sections. In addition, the response and FSAR markups justify why Appendix 12B remains valid despite the differences in assumptions between Appendix 12B and other FSAR sections. As indicated in the proposed FSAR markups and alluded to above, much of the information in Appendix 12B is based on calculation assumptions and identified in Appendix 12B as "assumed" information. This information labeled as assumed information in the FSAR is for radiation source term and shielding calculation purposes and for conservatism in the calculations and does not remove any design requirements provided in the application. The staff accepts these assumptions for estimating source terms and shielding for the SFP based on the design information in the FSAR.

The staff reviewed the applicant's response and proposed FSAR markups and found them acceptable. The staff verified that the proposed FSAR changes were incorporated into FSAR Revision 12 (ML15124A559). In addition, in Revision 12, the applicant updated Appendix 12B to remove erroneous information remaining from the initial version of Appendix 12B, indicating that the calculations were based on the fuel pool being filled to maximum capacity. These changes are appropriate and acceptable. Therefore, RAI 12.02-20 is resolved and closed.

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 its 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 is located in trenches and tunnels which provide the capability to identify and collect any leakage and to transfer the water to the LWMS for processing) and the design information (material, height, and outside wall thickness) about the dike that will surround the CST. The response also referred to the response to RAI 11.02-7, for CST source term information. However, in its 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 closed RAI 12.02-18 and 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 its 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. The staff verified that the proposed information is included in COL FSAR Revision 6. Therefore, RAI 12.02-21 is resolved and closed.

In addition to the above items, the staff performed a detailed review of the applicant's conformance with RG 1.143, as it relates to the design of structures, systems, and components (SSCs) of the solid, liquid, and gaseous waste management system. This review included the design of the RWB, turbine building offgas system, and radwaste tunnel as well as the systems and components within these buildings. The design criteria of these SSCs in accordance with RG 1.143, Revision 2 are based on the amount of radioactive material within the given SSCs (including unmitigated dose calculations to workers and members of the public). A detailed summary of the staff's review of the applicant's conformance with RG 1.143 can be found in Section 3.8.4 and Chapter 11 of this SER (See the discussions related to RAIs 03.08.04-37, 03.08.04-38, and 03.08.04-39).

12.2.5 Post Combined License Activities

The staff is imposing the following license condition that would prohibit the applicant from using, modifying, or deleting the information in ABWR DCD Tier 2 Tables 12.2-3b and 12.2-3c, as described above.

"The licensee may not modify or delete the information in final safety analysis report Tables 12.2-3b or 12.2-3c, including associated footnotes, or use the information in these tables as the basis for any detailed facility design, including shielding design and evaluation of equipment qualification, operational procedures, or as the basis for any changes to the FSAR."

12.2.6 Conclusion

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

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 compared the additional information within the COL application to the relevant NRC regulations, the guidance in Section 12.2 of NUREG-0800, and other NRC RGs. The staff's review concluded that the applicant is in compliance with NRC regulations. Specifically, the staff found 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. The staff finds that the Tier 1 departure is acceptable and finds it reasonable that the Tier 2 departures do not require NRC approval.

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 STP, Units 3 and 4.

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, "Fuel storage and handling and radioactivity control," 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.

STD DEP T1 3.4-1

Safety-Related I&C Architecture

This departure updates the 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.

Tier 2* Departure

STD DEP 1.8-1 Edition Changes

Tier 2* Codes, Standards, and Regulatory Guide

This departure identifies Tier 2* items in Table 1.8-20, "NRC Regulatory Guides Applicable to ABWR," and Table 1.8-21, "Industrial Codes and Standards Applicable to ABWR," 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 Sampling System

Process and Effluent Radiation Monitoring and

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 systems and components exposed to reactor coolant, with a specific reference to the cobalt content in stainless steel 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 Filter

Deletion of CUW Backwash Tank Vent Charcoal

This departure was made to correct the text description of the CUW backwash tank vent system by deleting the reference to a charcoal filter on the vent system, which the applicant originally claimed did not exist in the ABWR design. However, the applicant later determined that its design would have a CUW Backwash Tank Vent Charcoal Filter and deleted this departure.

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 (ARMS)

Alarm Capability for Area Radiation Monitors

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

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, "Criticality accident requirements."

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, "Summary of ABWR Standard Plant COL License Information.")

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 relevant requirements of the Commission regulations for radiation protection, 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 and the 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, "Minimization of contamination."

In addition, the regulatory bases for accepting the resolution of the STD COL license 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 regulatory bases for the STD COL license information items are in 10 CFR Part 20, "Standards for Protection Against Radiation"; 10 CFR Part 40, "Domestic Licensing of Source Material"; 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"; 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material"; 10 CFR Part 30, "General Domestic Licenses for Byproduct Material"; 10 CFR Part 32, "Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material"; 10 CFR Part 33, "Specific Domestic Licenses of Broad Scope for Byproduct Material"; 10 CFR Part 34, "Licenses for Industrial Radiography and Radiation Safety Requirements for Industrial Radiographic Operations"; and in NEI 07-03A (ML091490684).

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, the 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. 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 with 10 CFR Part 52 Appendix A, Section VIII.A.4 for this Tier 1 departure is addressed by the staff in Appendix 1.11S.1 of the this SER.

STP DEP T1 2.5-1

Elimination of New Fuel Storage Racks From the New Fuel Vault

Departure STP DEP T1 2.5-1 is identified in Section 12.3 of the STP, Units 3 and 4, COL FSAR because Section 12.3.4.3 briefly described how new fuel was originally to be stored in new fuel storage racks in the new fuel vault. However, as a result of this departure the new fuel racks are being eliminated and new fuel will be stored directly in the spent fuel pool, upon receipt and inspection.

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 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. The staff found that this departure does not require any further evaluation as it pertains to the review scope of this section. Additional staff evaluation of the acceptability of this departure can be found in Chapter 9 of this SER.

STD DEP T1 2.14-1

Hydrogen Recombiner Requirements Elimination

Departure 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" in FSAR 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. The 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 Subsection 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. The 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
Radiation

Deletion of MSIV Closure and Scram on High

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 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. For more information, refer to COL application 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 RGs 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 the applicable revision of RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," to Revision 2. The staff initially found this departure acceptable based on the applicant's utilization of the most recent regulatory guidance for the design changes made to the RWB and radwaste systems.

However, as a result of staff RAIs, STP reverted back to Revision 1 of RG 1.143 for the turbine building offgas system, while referencing Revision 2 of RG 1.143 for all other relevant radwaste SSCs. The staff finds it acceptable to reference Revision 1 of RG 1.143 for the turbine building offgas system because Revision 1 of the RG is referenced in the certified ABWR DCD and the only departure relevant to the offgas system is STD DEP 11.3-1, "Gaseous Waste Management System," which did not result in changes of any significance in relation to the structural integrity of the offgas vault or the offgas system.

The staff performed a detailed review of the applicant's conformance with RG 1.143, as it relates to the adequacy of the design of SSCs of the solid, liquid, and gaseous waste management system. This review included the design of the RWB, turbine building offgas system, and radwaste tunnel as well as the systems and components within these buildings. For those SSCs classified under Revision 2 of RG 1.143, the design criteria of these SSCs are based on the amount of radioactive material within the given SSCs. A detailed summary of the staff's review of the applicant's conformance with RG 1.143 can be found in Section 3.8.4, "Other Seismic Category I Structures," and Chapter 11 of this SER (See the discussion of RAIs 03.08.04-37, 03.08.04-38, and 03.08.04-39).

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. For more information, refer to COL application Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

Although the applicant identified the following Tier 2 Departures as "Not Requiring Prior NRC Approval," the staff initially could not determine if the applicant had adequately evaluated these departures against the 10 CFR Part 52, Appendix A, Section VIII.B.5 criteria, as was discussed in the SER Chapter 11 audit report of the applicant's departure process (ML092510426). Subsequently, as discussed below, the staff has found it reasonable that these departures do not require NRC approval.

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" in FSAR 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 staff initially could not determine if the applicant had considered all of the original monitor locations and sensitivity ranges in the DCD in making the departure, and if the applicant had adequately evaluated the departure against Criterion 4 in Section VIII.B.5.(b) in Appendix A of 10 CFR Part 52, because the applicant did not provide the bases or the methodology for the monitor locations and sensitivity ranges selected. Therefore, the staff issued RAI 12.03-12.04-6, requesting the applicant to provide additional information concerning the relocation of the turbine building ARMs. In its response to this RAI, dated August 26, 2009 (ML092430136), the applicant stated 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 it reasonable that this departure meets the criteria for not requiring NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Accordingly, RAI 12.03-12.04-6 is resolved and closed.

This Tier 2 departure resulted in updated dimensions and layout of the RWB due to process changes to the radioactive waste treatment systems described in Departures STD DEP 11.2-1 and STP DEP 11.4-1. In the review of Tier 1 departure STD DEP T1 2.15-1, the staff issued RAI 03.08.04-18 requesting design information for the RWB that addresses RG 1.143, Revision 2. In its response to RAI 03.08.04-18 Revision 1, Supplement 1 (ML102350220 dated August 19, 2010), the RWB layout was revised. Neither the Tier 2 departure nor the associated revisions resulted in any change to the radiation protection equipment and/or design features identified in the ABWR DCD that are used to ensure that occupational and public radiation exposures are ALARA. However, the departure and revision made changes to the RWB layout and therefore altered the Chapter 12 radiation zone maps for the RWB. The staff noticed that the proposed FSAR changes to the RWB layout described in the applicant's response to RAI 03.08.04-18 Revision 1 Supplement 1 were incomplete. Most notably the rooms labeled "Future Liquid Radwaste Processing Skids and Laydown Area" and "High Activity Waste Storage Area," in Figure 12.3-39, did not have clearly denoted radiation zones. In a confirmatory telephone call on January 5, 2012, the staff asked the applicant to clearly indicate the radiation zones that were not labeled in the Chapter 12 radiation zone maps and update STD DEP 3.8-1 to accurately depict the changes made in the updated RWB configuration. Since the zoning for some of the rooms in RWB were not labeled, the FSAR changes as a result of the departure were incomplete (the departure did not consider all matters described in the plant specific DCD), and therefore was not in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. The applicant updated the RWB radiation zone maps and STD DEP 3.8-1 changes in COL FSAR Rev 7. Therefore, with the proposed updates, the staff finds it reasonable that the departure does not require prior NRC approval. Additional staff discussion regarding this departure can be found in Sections 3.8.4, 11.2, and 11.4 of this SER. RAIs related to the RWB modifications

and radioactive waste treatment systems are discussed under Sections 3.8.4, 11.2, and 11.4 of this SER.

STP DEP 9.4-1

Service Building HVAC System

This departure reflects the removal of the outside inlet air monitoring toxic gas monitors from the service building HVAC system and the removal of the TSC alarm for high toxic gas concentrations based on the site-specific evaluation of onsite and offsite mobile and stationary sources of toxic gases described in FSAR Section 2.2S, "Nearby Industrial, Transportation, and Military Facilities," in accordance with RG 1.78, Revision 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release." 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 and public radiation exposures are ALARA. Therefore, within the review scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval.

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 including additional alarm functions, removing recorders, radiation monitor readout units, and modification of channel ranges. With the exception of the main steam line tunnel radiation monitors, the process and effluent radiation monitoring system changes added additional alarm functionality. A second upscale alarm function was added to the monitors, which provides additional functionality for operational purposes. No safety margins are impacted by this departure. By providing additional functionality and alarm notification capability to plant personnel, this departure represents an overall improvement in the Process and Effluent Radiation Monitoring and Sampling System maintaining public radiation exposures ALARA. Therefore, within the review scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval.

STD DEP 12.3-1

Cobalt Content in Stainless Steel

This departure reflects the changes in the stainless steel cobalt content material specification for components exposed to reactor coolant. The applicant stated that a graded approach to cobalt concentrations will be taken by using various grades of low cobalt stainless steel, with the material in the core containing the lowest amount of cobalt. The cobalt concentrations are allowed to increase with distance from the core. The overall cobalt limit for all reactor vessel materials is 0.05 wt percent. The applicant also described the use of an ongoing program to monitor industry state-of-the-art developments in material selection options for maintaining exposure ALARA, including Stellite reduction efforts. The staff found the applicant's approach reasonable in that it provides more restrictive material selection criteria than the criteria included 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, within the review scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval.

Subsection 12.3.1.4.1 of the ABWR DCD provides a description of the 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. Departure STD DEP 12.3-2 deleted the statement in Subsection 12.3.1.4.1 which references the use of this charcoal filter canister on the CUW backwash tank vent line. In COL application 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. The departure removed the information related to the charcoal filter from Chapter 12 simply on the basis that information related to the charcoal filter was not included in Chapter 11 of the DCD. However, just because the design information was not included in Chapter 11 does not mean the information related to the charcoal filter can be removed from Chapter 12 by an administrative change. Therefore, the applicant's evaluation ensuring that the departure is in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 for this departure was not adequate. The staff issued RA 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 its 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 this response, the applicant also proposed a future COL FSAR revision that would delete Departure STD DEP 12.3-2 and restore the deleted text contained in Subsection 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 address 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 its 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. The staff verified that the proposed FSAR revisions concerning the CUW backwash tank vent filter, including the deletion of Departure 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 resolved and closed.

This departure removes the design description and discussion in the ABWR DCD on this section concerning blowout panels and relief and release pathways associated with the steam tunnel. The DCD information is inaccurate because the ABWR design does not require any blowout panel in the steam tunnel and is not needed in Section 12.3. Detailed discussion of this departure is in Section 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. The staff was initially unable to conclude that this aspect of the departure contained enough information for the staff to confirm that the departure considered all matters described in the DCD and was evaluated in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Therefore, the staff issued RAI 12.03-12.04-5, requesting that the applicant provide additional information concerning the

radiation shielding criteria associated with the lead-loaded silicone foam for sealing penetrations. In its response to this RAI, dated August 26, 2009 (ML092430071), the applicant identified 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 it reasonable that Departure STD DEP 12.3-3 does not require NRC approval. Accordingly, RAI 12.03-12.04-5 is resolved and 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 stated that the departure represents a favorable change by providing additional alarm capability to ARMs in the reactor building, the RWB, and the turbine building. The departure adds additional ARMs in the reactor building beyond those identified in the DCD. The 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, within the review scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval.

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 identified an Administrative Departure in this section with respect to an incorrect table reference. The 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.

COL License Information Items

COL License Information Item 12.6

Airborne Radionuclide Concentration Calculation

The 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 provided additional information in FSAR 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 FSAR Subsection 12.3.7.1, the applicant stated:

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, DAC were included in Table 3.2b, “Ventilation and Airborne Monitoring,” of the ABWR DCD Tier 1 ITAAC to calculate the airborne source term in each room and operating area of the plant before fuel loading. 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 the 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 provided additional information in FSAR 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 the information addressing COL License Information Item 12.7 regarding ARM operational considerations. The COL applicant states that the airborne radioactivity monitors are classified as nonsafety-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, and this section 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. NEI 07-03A 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 20 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. It adds 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.

In addition to referencing NEI 07-03A, the COL applicant stated 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. In its response to this RAI, dated August 26, 2009 (ML092430136), the applicant referenced the ARM preoperational testing described in Subsection 14.2.12.1.24 of the ABWR DCD and stated 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.

In its response to RAI 12.03-12.04-13, dated January 4, 2010 (ML100060693), and its revised response to this RAI, dated June 1, 2010 (ML101550063), the applicant referenced the ARM preoperational testing in Subsection 14.2.12.1.24 of the ABWR DCD and stated 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 stated 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. In addition, the applicant proposed a future revision to FSAR 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. The staff verified that the proposed information was included in COL FSAR Revision 6. Therefore, RAI 12.03-12.04-13 is resolved and closed, and COL License Information Item 12.7 has been adequately addressed.

COL License Information Item 12.8 Requirements of 10 CFR 70.24

The applicant provided 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.

The 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 committed (COM 12.3-1) to providing information demonstrating that the plant meets the criticality accident monitoring requirements of 10 CFR 70.24. The applicant indicated that it would submit the information as an amendment to the FSAR in accordance with 10 CFR 50.71(e) or would request an exemption from this 10 CFR 70.24 requirement at least six months before fuel loading. 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.

In its response to this RAI, dated February 25, 2010 (ML100610277), the applicant stated that in lieu of demonstrating compliance with 10 CFR 70.24, STP, Units 3 and 4 will comply with the requirements of 10 CFR 50.68(b) as allowed by 10 CFR 70.24(d)(1) and 10 CFR 50.68(a). The applicant also provided a supplemental response to RAI 12.03-12.04-15, dated July 8, 2010 (ML101930503), at the 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 and closed. The 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 resolved and closed.

COL License Information Item 12.3.7.4 Material Selection

The applicant provided additional information in FSAR 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.

The staff reviewed the applicant's response to COL License Information Item 12.3.7.4, regarding material selection for maintaining exposure ALARA. The applicant stated 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. Based on the information provided in the FSAR, the staff found that the applicant has adequately addressed COL License Information Item 12.3.7.4.

The following 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 the 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, Units 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. In its initial and supplemental responses to RAI 12.03-12.04-10, dated October 26, 2009 (ML093030296), and December 9, 2009 (ML093480068), respectively, the applicant identified several radiation shielding computer codes used to verify the STP, Units 3 and 4, radwaste system design changes that are not identified in the ABWR DCD. In these responses, 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 the response acceptable. The staff verified that COL FSAR, Revision 4 includes the proposed additional information about radiation shielding codes, therefore RAI 12.03-12.04-10 is resolved and closed.

Zinc Injection

The applicant stated that FSAR Section 9.3, "Process Auxiliaries," incorporates by reference the information in ABWR DCD Section 9.3. ABWR DCD Section 9.3.11 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. The 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. In its response to this RAI, dated August 12, 2009 (ML092260197), the applicant confirmed 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, if 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 included 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 STP, Unit 3, during the construction of STP, Unit 4. Additionally, in FSAR Section 12.3.8, the applicant stated 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 STP, Unit 3, is operating with STP, Unit 4, still under construction to provide oversight to ensure that doses to construction workers remain ALARA during the construction period.

RG 1.206, Regulatory Position 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 FSAR provides 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, "Standards for normal operation," for members of the public. However, the FSAR did 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. In its response to this RAI, dated September 3, 2009 (ML092510039), the applicant included a summary of construction activities and bases for dose calculations; a table containing the calculated person-sievert dose for each unit; and references to Sections 3.9S, 3.10S, and 4.5 of the ER 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, Units 3 and 4.

In its supplemental response to RAI 12.03-12.04-14, dated May 17, 2010 (ML101390226), which replaced the original response dated January 4, 2010 (ML100060693), the applicant clarified that construction workers will be considered to be members of the public in the context of 10 CFR Part 20, Subpart D, and proposed a future revision to FSAR Section 12.3.8 which summarizes the bases, assumptions, and methods used to calculate the STP, Units 3 and 4, construction worker dose. The staff found the applicant's response to be acceptable. The staff verified that the proposed information was included in COL FSAR Revision 6. Accordingly, RAI 12.03-12.04-14 is resolved and closed.

However, in January of 2015, South Texas Project Nuclear operating Company (STPNOC), the operator of STP Units 1 and 2, was issued a general license for the operation of the independent spent fuel storage installation (ISFSI) (See Federal Register, Vol. 80, No.8, January 13, 2015). This will be an additional direct radiation source to construction workers at the STP 3 and 4 site. In a letter dated July 16, 2015, (ML15201A131), NINA provided an assessment of the dose contribution to construction workers from the future ISFSI. Since the ISFSI is not yet in operation, the assessment is based on bounding dose rate calculations provided by the ISFSI vendor, which NINA modified to account for the expected loading of the ISFSI during the construction of Units 3 and 4, still conservatively assuming all fuel within the ISFSI is only cooled for 5 years. NINA then used a dose vs. distance curve (based on the location of the ISFSI, approximately 1600 feet from the center of the Unit 3 construction site and hundreds of feet away from the edge of the Units 3 and 4 construction area) to calculate the dose rate at the center of Units 3 and 4 from the ISFSI and added it to the dose contributions from other sources previously calculated, as discussed above. The calculated dose contribution from all Unit 1 and 2 sources, as well as Unit 3 sources while it is in operation during final construction of Unit 4, is well below 100 mrem/year at the center of the Unit 3 and 4 construction site. The dose contribution from the ISFSI alone was calculated as 8.7 mrem/year to Unit 3 and 1.9 mrem/year to Unit 4. The total dose to construction workers from all sources, including the

ISFSI, was calculated to be 12.8 mrem/year for Unit 3 and 19.5 mrem/year for Unit 4, including the dose from the operation of Unit 3.

Furthermore, while the applicant calculated direct dose rates at the centers of the construction site for Units 3 and 4, staff performed a qualitative assessment of dose rates at any location within the Unit 3 and 4 construction area. Staff reviewed the effluent release reports for STP Units 1 and 2 from 2010 through 2014, and the dose rates outside the Unit 1 and 2 protected area per quarter (a quarter of a year is the approximate amount of time a construction worker will be on site a year) have typically been well below 100 mrem (typically less than 20 mrem per quarter). Significantly higher dose rates were recorded in certain areas however, when Units 1 and 2 temporarily stored high activity sources outside the protected area (reactor head and control rod drive mechanisms). However, during construction of Units 3 and 4, Unit 1 and 2 will be required to ensure that they are not exposing members of the public, including construction workers, in excess of the 100 mrem/year dose limit and provide appropriate demonstration of this under 10 CFR 20.1301 and 10 CFR 20.1302. Therefore, Units 1 and 2 must ensure that temporary or transient sources do not result in construction workers exceeding regulatory limits. Regarding the dose from the ISFSI, based on the distance from the ISFSI to the construction site and data from operating ISFSIs at other reactor sites, it is highly unlikely that the dose from the ISFSI alone would result in a dose equating to a large percentage of the 100 mrem/year dose limit to a construction worker located anywhere within the Units 3 and 4 construction area. In addition, the 2014 Radioactive Effluent Release Report shows that the direct path from the ISFSI to the Units 3 and 4 construction area will likely be blocked by existing buildings, to further limit the dose.

Finally, FSAR Section 12.3.8 states that the STP 3 and 4 site will be continually monitored during the construction period and appropriate actions will be taken to ensure that doses to the construction workers remain ALARA. This also covers sources on site for the construction of Units 3 and 4.

Based on all of the above, the staff has reasonable assurance that the total effective dose equivalent to individual construction workers for Units 3 and 4 (considering dose from gaseous and liquid effluents and all direct radiation sources, including from the ISFSI) will be maintained less than 100 mrem/year and is therefore acceptable.

- 10 CFR 20.1406, "Minimization of contamination"

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. The 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 did not, and 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 did 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. In its response to this RAI, dated August 26, 2009 (ML092430071), the applicant stated 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 provided 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 stated that the NEI 08-08A guidance would be used, to the extent practicable, in the development of STP, Units 3 and 4, programs and procedures. The applicant’s response also stated that all piping would be located in pipe tunnels or in accessible surface trenches, and FSAR Subsection 11.2.1.2.4 would 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 did 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.

In its response to supplemental RAI 12.03-12.04-11, dated June 30, 2010 (ML101830417), the applicant incorporated 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 proposed incorporating a summary of ABWR design features that address compliance with 10 CFR 20.1406, and clarifying that all below grade piping carrying radioactive fluids will be located in tunnels, in a future FSAR revision. The 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 resolved and 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

The applicant identifies the following commitment to address COL License Information Item 12.8:

- Commitment (COM 12.3-1) – Provide information demonstrating that the plant meets the criticality accident monitoring requirements of 10 CFR 70.24, by meeting the requirements of 10 CFR 50.68(b) in lieu of 10 CFR 70.24.

- 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.

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, to the extent practicable, contamination of the facility and the environment; minimize, to the extent practicable, generation of radioactive waste; and facilitate the eventual decommissioning of the facility, is based on meeting the requirements of 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 identified Tier 2 departures. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52 Appendix A Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59.

12.4.4 Technical Evaluation

As documented in NUREG–1503, NRC staff reviewed the approved Section 12.4 of the certified ABWR DCD. The staff reviewed Section 12.4 of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of information in the COL FSAR and information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to dose assessment.

The staff reviewed the information in the STP COL FSAR:

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. For more information, refer

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.

to COL application Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

Although the applicant has identified the following Tier 2 Departures as “Not Requiring Prior NRC Approval,” the staff initially could not determine if the applicant had adequately evaluated these departures against the 10 CFR Part 52, Appendix A, Section VIII.B.5 criteria, as was discussed in the SER Chapter 11 audit report of the applicant’s departure process (ML092510426). Subsequently, as discussed below, the staff has found it reasonable that these departures do not require NRC approval.

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 changed the nomenclature from “automated refueling bridge” to “automated refueling machine,” deleted a reference to the “enclosed automation center,” and included 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 remained unchanged at 4,000 hours and 2 micro-Gray per hour ($\mu\text{Gy/hr}$) (0.2 millirad per hour radiation absorbed dose [mrad/hr]). However, in FSAR Section 12.5S.2.4, the applicant stated that the normal radiation level on the refueling bridge is expected to be less than 5 mrem/hr.

The use of 0.2 millirad for dose estimates was inconsistent with the 5 mrem/hour value provided in FSAR Section 12.5S.2.4. Also, the departure used the incorrect unit for dose equivalent. The correct units for dose equivalent are the Sievert (or Rem), instead of Gray (or Rad). Therefore, it was unclear to staff that the departure considered all matters in the plant-specific DCD and that the departure was in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. The 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. In its response to the RAI, dated August 12, 2009 (ML092260582), the applicant clarified that the effective dose rate for refueling operations will be less than 2 $\mu\text{Gy/hr}$ (2 micro-sievert per hour [$\mu\text{Sv/hr}$]) and proposed a future FSAR revision that would change the units from $\mu\text{Gy/hr}$ to $\mu\text{Sv/hr}$, as applicable throughout Chapter 12. The staff verified that COL FSAR, Revision 4 includes the proposed change of dose rate units from $\mu\text{Gy/hr}$ to $\mu\text{Sv/hr}$ throughout Chapter 12. Therefore, RAI 12.03-12.04-1 is resolved and closed. Based on the additional information from the applicant and the FSAR revision, the staff finds it reasonable, within the review scope of this section, that the departure does not require prior NRC approval.

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 provided a general description of the radwaste processes and work activities that would result in occupational exposure to workers. FSAR Table 12.4-1, “Projected Annual Radiation Exposure,” includes an estimate of the total hours and average exposure rate for the performance of operations and maintenance in the RWB. The number of hours is reduced by more than a factor of four from 4,200 hours to 1,000 hours. However, the FSAR and departure report did not contain any information concerning the bases, models, and assumptions used to calculate the revised RWB dose. It was unclear to the staff whether the departure met the criteria of 10 CFR Part 52, Appendix A, Section VIII.B.5 for not requiring NRC approval and whether the applicant considered all matters described in the plant-specific DCD. Therefore, the staff issued RAI 12.03-12.04-2, requesting the applicant to provide additional information concerning RWB dose calculations. In its response to this RAI, dated August 12, 2009 (ML092260582), the applicant provided additional information

concerning the bases for the reduced RWB operating hours. The applicant also proposed a future FSAR revision summarizing the bases and adding an additional industry reference. The staff verified that COL FSAR, Revision 4 includes the proposed changes to the RWB dose calculation bases and the industry reference. Therefore RAI 12.03-12.04-2 is resolved and closed. Based on the additional information from the applicant and the proposed FSAR revision, the staff finds it reasonable, within the review scope of this section, that the departure does not require prior NRC approval.

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 administrative departures do not affect the presentation of any design discussion or qualification of design margin.

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. 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.

12.4.5 Post Combined License Activities

There are no post COL activities related to this section.

12.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1503. The 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 10 CFR 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 compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.3-12.4 of NUREG-0800, and other applicable NRC RGs. The only changes to the certified design made in this section were the result of Tier 2 departures that do not require NRC approval. The NRC staff finds it reasonable that the Tier 2 departures do not require NRC approval.

12.5 Operational Radiation Protection Program

12.5.1 Introduction

This section of the FSAR 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, Revision 12, 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 RP 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 for providing portable instruments to measure radioiodine concentrations in compliance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the guidance in Item III.D.3.3 of NUREG-0737, "Clarification of TMI Action Plan Requirements." 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 RP Program, and the associated acceptance criteria, are in Section 12.5 of NUREG-0800.

The regulatory basis for reviewing COL License Information Items 12.9 and 12.10, is in 10 CFR Part 20 and 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, "Qualification and Training of Personnel for Nuclear Power Plants"; 8.2; 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable,"; 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low As Is Reasonably Achievable"; and 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants." COL License Information Item 12.10 is satisfied based on following

the guidance of RGs 1.8; 8.2; 8.7; 8.8; 8.10; and 1.33, Revision 2, “Quality Assurance Program Requirements (Operation).”

12.5.4 Technical Evaluation

As documented in NUREG–1503, the 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 addresses the required information relating to the Operational RP Program.

In addition, the staff reviewed the applicant’s proposed resolution to the COL license information items included under Section 12.5 of the STP COL FSAR and reviewed the applicant’s supplemental information. The staff used the applicable sections in 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 provided 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.

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. The 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 that 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

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.

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 provided implementation schedules and milestones to address Operational Program #10, in FSAR Table 13.4S-1, "Operational Programs Required by NRC Regulation and Program Implementation," 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 listed 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 (excluding exempt quantities),
- (2) before fuel receipt onsite,
- (3) before fuel loading, and
- (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 state at which implementation milestone each program element will be implemented. In its response to RAI 12.05-2, dated August 20, 2009 (ML092360170), the applicant stated 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 resolved and 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. In its response to this RAI, dated August 20, 2009 (ML092360170), the applicant 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 resolved and 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.

RG 1.206 indicates that there should be a license condition for the implementation of the operational RP program. Since the applicant references NEI 07-03A for the RP program, the milestones for the RP program are consistent with the milestones in NEI 07-03A and Table 13.4S-1, Item 10 of the FSAR.

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-Plant Radiation Monitoring."

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. The 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.

In its response to RAI 12.05-6, dated February 8, 2010 (ML100470590), the applicant clarified 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 proposed a future COL FSAR revision to address COL License Information Item 12.10 stating that the STP Health Physics programs, 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. The staff verified that COL FSAR, Revision 4, includes the proposed changes to address COL Information Item 12.10. Therefore, RAI 12.05-6 is resolved and 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), the guidance for which is in Item III.D.3.3 of NUREG-0737. "Clarification of TMI Action Plan Requirements," Item III.D.3.3 of NUREG-0737 states that the licensee should 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. NEI 07-03A 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 found 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 found that this information demonstrates the applicant's compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR Part 50, conforms with NUREG-0737 Item III.D.3.3, and adequately addresses COL License Information Item 12.10.

Supplemental Information

- Access Control

The COL applicant identified three VHRAs in FSAR 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, "Posting requirements," 10 CFR 20.1903, "Exceptions to posting requirements," 10 CFR 20.1601, "Control of access to high radiation areas," and 10 CFR 20.1602, "Control of access to very high radiation areas." 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. In its response to this RAI, dated August 12, 2009 (ML092260582), the applicant provided 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. 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 its response to RAI 12.05-5, dated December 21, 2009 (ML093580194), the applicant proposed a future 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 VHRAs. The staff found the applicant's response acceptable. The staff verified that COL FSAR, Revision 4, includes the proposed changes about VHRA barriers and access controls. Therefore, RAI 12.05-5 is resolved and closed.

The staff could not locate illustrative examples of facility vital area access paths, identification of post-accident source locations, and associated mission doses for post accident access in the COL FSAR or the ABWR DCD. Therefore, the staff issued RAI 12.03-12.04-8, requesting the applicant to provide additional information about post accident vital area access paths and mission doses. In its response to this RAI, dated August 26, 2009 (ML092430136) the applicant indicated that the ABWR DCD contains DAC Table 3.2a, which provides shielding analysis and evaluations that must be completed in order to satisfy the DAC. Specifically, Tier 1, Table 3.2a, item 3 ensures proper shielding is provided to permit plant personnel to perform required safety functions in vital areas of the plant (including access and egress of these areas) under accident conditions, without receiving a whole body dose exceeding 0.05 Sv (5 rem), or its equivalent. Based on the applicant's response, and on additional staff review of the radiation zone maps, post accident access information, and Tier 1, Table 3.2a DAC in NUREG-1503, the staff found that the applicant has adequately addressed post accident vital area access. Accordingly, RAI 12.03-12.04-8 is resolved and closed.

12.5.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff identifies the following license condition:

- License Condition (12.5-1) – The licensee shall implement the Radiation Protection Program (RPP), (including the ALARA principle) or applicable portions thereof, on or before the associated milestones identified below:
 - a. Receipt of Materials – Prior to initial receipt of byproduct, source, or special nuclear materials onsite (excluding exempt quantities as described in 10 CFR 30.18, “Exempt quantities.”)
 - b. Fuel Receipt – Prior to initial receipt and storage of fuel onsite
 - c. Fuel Loading – Prior to initial fuel load
 - d. Waste Shipment – Prior to first radioactive waste shipment

12.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and 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 10 CFR 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.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.5 of NUREG-0800, and other applicable NRC RGs. 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 in accordance with 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 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.

As a result of the conclusions listed above, the staff finds Section 12.5 of the FSAR to be acceptable.