

12.0 RADIATION PROTECTION

This chapter of the Final Safety Analysis Report (FSAR) provides information regarding radiation protection methods and estimated occupational radiation exposures of operating and construction personnel during normal operation and may include refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; inservice inspection; and calibration during anticipated operational occurrences (AOOs). Specifically, Comanche Peak Nuclear Power Plant (CPNPP), Units 3 and 4 Combined License (COL), FSAR Chapter 12.0, "Radiation Protection," Revision 1 provides information regarding facility and equipment design, planning and procedures programs, and techniques and practices employed by Luminant Generation Company, LLC, hereinafter referred to as the applicant, to meet the radiation protection standards set forth 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 U.S. Nuclear Regulatory Commission (NRC or the Commission), hereinafter referred to as the staff, regulations.

The staff is reviewing the information in the United States - Advanced Pressurized-Water Reactor (US-APWR) Design Control Document (DCD), Chapter 12 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to DCD Chapter 12, incorporated by reference in the CPNPP, Units 3 and 4 COL FSAR, will be documented in the staff's safety evaluation (SE) of the design certification (DC) application for the US-APWR design. The SE for the US-APWR is not yet complete and this is being tracked as part of Open Item [1-1]. The staff will update Chapter 12 of this SE to reflect the final disposition of the DC application.

12.1 **Ensuring that Occupational Radiation Exposures are As Low As Reasonably Achievable**

12.1.1 **Introduction**

"As low as is reasonably achievable" (ALARA) means making every reasonable effort to maintain exposures to radiation as far as practicable below the dose limits of 10 CFR Part 20.1003. This includes taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety. It also includes using procedures and engineering controls based upon sound radiation protection principles.

12.1.2 **Summary of Application**

Section 12.1, "Ensuring that Occupational Radiation Exposures are As Low As Reasonably Achievable," of the CPNPP, Units 3 and 4 COL FSAR, Revision 1 incorporates by reference Section 12.1 of the US-APWR DCD, Revision 2.

In addition, in the CPNPP, Units 3 and 4 COL FSAR Section 12.1, the applicant provided the following information:

US-APWR COL Information Items

- Comanche Peak (CP) COL 12.1(1)

The applicant provided additional information in CP COL 12.1(1) to address COL Information Item 12.1(1) regarding administrative programs and procedures in conformance with RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," RG 8.8 Revision 3, "Information Relevant for Ensuring that Occupational Radiation Exposures at Nuclear Power Stations is Reasonably Achievable" and RG 8.10, Revision 1R, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as is Reasonably Achievable."

- CP COL 12.1(3)

The applicant provided additional information in CP COL 12.1(3) to address COL Information Item 12.1(3) regarding the operational radiation protection program.

- CP COL 12.1(5)

The applicant provided additional information in CP COL 12.1(5) to address COL Information Item 12.1(5) regarding the operational radiation protection program for ensuring that occupational radiation exposures are ALARA.

- CP COL 12.1(6)

The applicant provided additional information in CP COL 12.1(6) to address COL Information Item 12.1(6) regarding the performance of periodic reviews of the operational practices to ensure configuration management, personnel training and qualification updates, and procedure adherence.

- CP COL 12.1(7)

The applicant provided additional information in CP COL 12.1(7) to address COL Information Item 12.1(7) regarding record retention according to 10 CFR 50.75(g) "Reporting and Recordkeeping for Decommissioning Planning" and 10 CFR 70.25(g) "Financial Assurance and Recordkeeping for Decommissioning," as applicable.

Interface Requirements

The US-APWR DCD Tier 2, Revision 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COL Application (COLA). This table does not specify any interfaces related to Section 12.1 of the DCD.

12.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the Final Safety Evaluation Report (FSER) related to the US-APWR DCD submitted by Mitsubishi Heavy Industries, Ltd. (MHI), and within the NRC staff's safety evaluation reports (SERs) related to Nuclear Energy Institute (NEI) technical reports NEI 07-03A, "Generic DCD Template Guidance for Radiation Protection Program Description" (ADAMS Accession Number ML091490684), NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)" (ADAMS Accession Number ML093220178) and NEI 08-08A, "Guidance for Life Cycle Minimization of Contamination" (ADAMS Accession Number ML093220530).

In addition, the acceptance criteria associated with the relevant requirements of the Commission's regulations for ensuring that operational radiation exposures (ORE) are ALARA, are given in Section 12.1, "Assuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable" of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants - LWR Edition." (SRP or NUREG-0800).

The applicable regulatory requirements for ensuring that operational radiation exposures are ALARA are as follows:

1. 10 CFR Part 19.12, "Instruction to workers," as it relates to keeping workers who receive ORE informed as to the storage, transfer, or use of radioactive materials or radiation in such areas, and instructed as to the risk associated with ORE, precautions and procedures to reduce exposures, and the purpose and function of protective devices employed.
2. 10 CFR Part 20.1101, "Radiation protection programs" and the definition of ALARA in 10 CFR Part 20.1003, "Definitions," as they relate to those measures that ensure that radiation exposures resulting from licensed activities are below specified limits and ALARA.
3. 10 CFR 52.80(a), "Contents of applications; additional technical information," which requires that a COLA address the proposed inspections, tests, and analyses (ITAAC), including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the ITAAC are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, and the NRC's regulations.
4. 10 CFR 50.75(g) "Reporting and Recordkeeping for Decommissioning Planning," as it relates to maintaining records of contamination to facilitate decommissioning.

5. 10 CFR 70.25(g) "Financial Assurance and Recordkeeping for Decommissioning," as it relates to maintaining records of contamination to facilitate decommissioning.

The related acceptance criteria are as follows:

1. Policy Considerations. Acceptability will be based on evidence that a policy for ensuring that ORE will be ALARA has been formulated in accordance with the training requirements in 10 CFR Part 19.12 and the ALARA provisions of 10 CFR 20.1101(b), and that the policy has been described, displayed, and will be implemented in accordance with the provisions of RG 8.8, "Information Relevant for Ensuring that Occupational Radiation Exposures at Nuclear Power Stations is Reasonably Achievable" (Regulatory Position C.1) Revision 3, issued June 1978; RG 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as is Reasonably Achievable" (Regulatory Position C.1) Revision 1R, issued May 1977; and NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 - Standards for Protection Against Radiation," issued October 2001, as it relates to maintaining doses ALARA. A specific individual(s) will be designated and assigned responsibility and authority for implementing the ALARA policy. Alternative proposed policies will be evaluated on the basis of a comparison with the above RGs and NUREG-1736.
2. Design Considerations. Acceptability will be based on evidence that the design methods, approach, and interactions are in accordance with the ALARA provisions of 10 CFR 20.1101(b) and RG 8.8 (Regulatory Position C.2) and will include incorporation of measures for reducing the need for time spent in radiation areas; maintenance; measures to improve the accessibility to components requiring periodic maintenance or inservice inspection; measures to reduce the production, distribution, and retention of activated corrosion products throughout the primary system; measures for assuring that ORE during decommissioning will be ALARA; reviews of the design by competent radiation protection personnel; instructions to designers and engineers regarding ALARA design; experience from operating plants and past designs; and continuing facility design reviews. Alternative proposed design policies will be evaluated on the basis of a comparison with the design guidance in RG 8.8 (Regulatory Position C.2).
3. Operational Considerations. Acceptability will be based on evidence that the applicant has a program to develop plans and procedures in accordance with RG 1.33, "Quality Assurance Program Requirements (Operation)," Revision 2, issued February 1978; RG 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," Revision 3, issued May 2000; RG 8.8; and RG 8.10 that can incorporate the experiences obtained from facility operation into facility and equipment design and operations planning and that will implement specific exposure control techniques.

4. Radiation Protection Considerations. Acceptability will be based on evidence that overall facility operations, as well as the radiation protection program, integrate the procedures necessary to ensure that radiation doses are ALARA, including work scheduling, work planning, design modifications, and radiological considerations.

12.1.4 Technical Evaluation

The staff reviewed Section 12.1 of the CPNPP, Units 3 and 4 COL FSAR and reviewed the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.¹ The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to ensuring that OREs are ALARA. Section 12.1 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The staff's technical evaluation of the information incorporated by reference related to ensuring that OREs are ALARA will be documented in the staff's SER of the DC) application for the US-APWR design.

The applicant incorporates by reference, NEI 07-03A and NEI 07-08A in Sections 12.1 and 12.5 of the FSAR. The staff issued its safety evaluations (SEs) that approved of NEI 07-03A and NEI 07-08A on March 18, 2009, and October 15, 2009, respectively. The referenced NEI documents provide acceptable generic ALARA and Radiation Protection program descriptions which conform to the guidance of Regulatory Guidance described in CP COL 12.1(1), CP COL 12.1(3), CP COL 12.1(5) and the operational program review requirements of CP COL 12.1(6).

CPNPP, Units 3 and 4 FSAR Sections 12.1 and 12.5 state that they address the radiation protection program elements described in CP COL 12.1(1), CP COL 12.1(3), CP COL 12.1(5) and CP COL 12.1(6), with information provided in NEI templates NEI 07-03A and NEI 07-08A, in combination with existing or modified CPNPP, Units 1 and 2 site program information. However, because the applicant did not provide any additional information regarding the pre-existing radiation program at CPNPP, Units 1 and 2, and in particular, how those programs may have elements or features that deviate from the guidance provided in NEI templates NEI 07-03A and NEI 07-08A, in Request for Additional Information (**RAI 3510, Question 12.05-3**), the staff asked the applicant to describe how the pre-existing radiation program at CPNPP, Units 1 and 2, deviates from the guidance provided in NEI templates NEI 07-03A and NEI 07-08A. In response to **RAI 3510, Question 12.05-3**, dated November 16, 2009, the applicant committed to removing the statement "...in combination with existing or modified CPNPP Units 1 and 2 site program information." The staff finds the applicant's response to this RAI acceptable because it provided a description of the radiation protection and ALARA programs based solely on program description templates previously approved by the staff. This ensures that the implementation of the radiation protection and ALARA programs will meet the requirements of 10 CFR 19.12, "Instructions to Workers," and 10 CFR 20. , therefore, the staff considers **RAI 3510, Question 12.05-3** to be resolved. The staff will confirm that the proposed revisions to COL FSAR Section 12.1 and Section

¹ See Chapter 1 for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

12.5 are incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. **RAI 3510, Question 12.05-3** is now being tracked as **Confirmatory Item 12.05-1**.

While FSAR Section 12.1 discusses aspects of policy that are related to maintaining personnel radiation exposure ALARA, FSAR Section 12.5, "Operational Radiation Protection Program," describes the required elements of the radiation protection program, including those elements required to maintain personnel radiation exposure ALARA. Because the NEI 07-08A template was still being developed at the time that the CPNPP, Units 3 and 4 FSAR was issued, the staff, in **RAI 3316, Question 12.01-2**, asked the applicant to revise the CPNPP, Units 3 and 4 FSAR to reflect the use of the finalized NEI 07-08A template. In response to **RAI 3316, Question 12.01-2** dated November 16, 2009, the applicant committed to revising the CPNPP, Units 3 and 4 FSAR to reflect the use of the finalized template. The information regarding the ALARA program conforms to the guidance in SRP Section 12.1 and Section 12.5. The staff finds the applicant's response to this RAI acceptable because it provided a description of the radiation protection and ALARA programs based on program description templates previously approved by the staff. This ensures that the implementation of the radiation protection and ALARA programs will meet the requirements of 10 CFR 19.12, "Instructions to Workers," and 10 CFR 20, therefore the staff considers **RAI 3316, Question 12.01-2** to be resolved. The staff will confirm that the proposed revisions to CPNPP, Units 3 and 4 FSAR Section 12.1 and Section 12.5, is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3316, Question 12.01-2** is now being tracked as **Confirmatory Item 12.01-1**.

The staff reviewed the following information contained in the CPNPP, Units 3 and 4 COL FSAR:

US-APWR COL Information Items

- CP COL 12.1(1). The COLA is to demonstrate that the policy considerations regarding plant operations are in compliance with RG 1.8, RG 8.8 and RG 8.10.

The staff reviewed CP COL 12.1(1) related to COL Information Item 12.1(1) included under Section 12.1 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the paragraph in DCD Section 12.1.1.3.1 with the following information as revised by its response to **RAI 3510, Question 12.05-3**. **RAI 3510** is discussed in Section 12.5.4 of this SE.

The administrative programs and procedures demonstrate compliance with RG 1.8, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing Nuclear Energy Institute (NEI) Technical Report, NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)." These are addressed in the operational radiation protection program, described in Section 12.5, "Operational Radiation Protection Program."

In addition, the applicant replaced the second paragraph in DCD Section 12.1.1.3.2 with the following:

The administrative programs and procedures demonstrate compliance with RG 8.8, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing of NEI 07-08A. These are addressed in the operational radiation protection program, described in Section 12.5.

Further, the applicant replaced the paragraph in DCD Section 12.1.1.3.3 with the following:

The administrative programs and procedures demonstrate compliance with RG 8.10, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing of NEI 07-08A. These are addressed in the operational radiation protection program, described in Section 12.5.

As described above in Section 12.1.4, of FSAR Section 12.1 and Section 12.5, the applicant incorporates by reference NEI 07-03A and NEI 07-08A, without departures. The staff issued its SEs that approved of NEI 07-03A and NEI 07-08A on March 18, 2009, and October 15, 2009, respectively. Because the referenced NEI documents provide acceptable generic descriptions of the ALARA and Radiation Protection programs which the staff has previously found to conform to the guidance of RG 1.8, RG 8.8 and RG 8.10 and the responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed CP COL 12.1(1).

- CP COL 12.1(3). The COL Applicant is to describe how the plant follows the guidance of RG 8.2, RG 8.4, RG 8.6, RG 8.7, RG 8.9, RG 8.13, RG 8.15, RG 8.25, "Air Sampling in the Workplace", RG 8.27, RG 8.28, RG 8.29, RG 8.34, RG 8.35, RG 8.36 and RG 8.38, "Control and Access to High and Very High Radiation Areas of Nuclear Plants."

The staff reviewed CP COL 12.1(3) related to COL Information Item 12.1(3) included under Section 12.1 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the first and second paragraphs in DCD Section 12.1.3 with the following:

The operational radiation protection program for ensuring that operational radiation exposures are as low as reasonably achievable (ALARA) is discussed in Section 12.5, by utilizing of NEI 07-03A. The program follows the guidance of RG 8.2, Revision 0, "Guide for Administrative Practices in Radiation Monitoring", 8.4, Revision 0, "Direct-Reading and Indirect-Reading Pocket Dosimeters", 8.6, Revision 0, "Standard Test Procedure for Geiger-Muller Counters", 8.7, Revision 2, "Instructions for Recording and Reporting Occupational Radiation Exposure Data", 8.9, Revision 1, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program", 8.13, Revision 3, "Instruction Concerning Prenatal Radiation Exposure", 8.15, Revision 1, "Acceptable Programs for

Respiratory Protection”, 8.27, Revision 0, “Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants,” 8.28, Revision 0, “Audible Alarm Dosimeters”, 8.29, Revision 1, “Instruction Concerning Risks from Occupational Radiation Exposure”, 8.34, Revision 0, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses”, 8.35, Revision 0, “Planned Special Exposures”, 8.36, Revision 0, “Radiation Doses to Embryo/Fetus”, and 8.38.

US-APWR DCD Section 12.1.3, “Operational Considerations,” states that the COLA is to provide a radiation protection program that is developed, implemented and maintained as described in NEI 07-03A. As described above, in FSAR Section 12.1, the applicant states that the radiation protection program as described in Section 12.5 of the FSAR is to be implemented in accordance with NEI 07-03A. As discussed in the staff approved SE, dated March 18, 2009, NEI 07-03A provides a detailed description of the radiation protection program, that when incorporated by reference into the COL FSAR, provides reasonable assurance of the COL applicant’s compliance with the applicable requirements of 10 CFR Part 19, 10 CFR Part 20, 10 CFR Part 50, 10 CFR Part 52, and 10 CFR Part 71 as well as reasonable assurance of the applicant’s adherence to the guidance of RG 1.206, RG 1.8, RG 8.2, RG 8.4, RG 8.5, RG 8.6, RG 8.8, RG 8.9, RG 8.10, RG 8.13, RG 8.15, RG 8.27, RG 8.28, RG 8.29, RG 8.34, RG 8.35, RG 8.36, RG 8.38, and NUREG-1736.

In Section 12.1 and Section 12.5 of the FSAR, the applicant incorporates by reference NEI 07-03A and NEI 07-08A, without departures. Because the referenced NEI documents provide acceptable generic descriptions of the ALARA and Radiation Protection programs which the staff has previously found to conform to the guidance of the RGs listed in CP COL 12.1(3) and the responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**, as discussed in Section 12.1.4 above, the staff concludes that the applicant has adequately addressed CP COL 12.1(3).

- CP COL 12.1(5). The COL Applicant is to provide the operational radiation protection program for ensuring that OREs are ALARA.

The staff reviewed the information the applicant provided in CP COL 12.1(5), related to COL Information Item 12.1(5), included under Section 12.1.3, “Operational Considerations,” of the CPNPP, Units 3 and 4 COL FSAR. COL Information Item 12.1(5) states that the radiation protection and ALARA programs, as described in Section 12.5 of the FSAR are to be implemented in accordance with NEI 07-03A and NEI 07-08A. DCD Section 12.5 describes the required elements of the radiation protection and ALARA programs. The applicant replaced the contents in DCD Section 12.5 with the following:

NEI 07-03A, Generic FSAR Template Guidance for Radiation Protection Program Description, Revision 0, is incorporated by reference. The site specific radiation protection program will be implemented in accordance with the milestones listed in Table 13.4-201, “Operational Programs Required by NRC Regulation and Program Implementation,” by utilizing of NEI 07-03A, and NEI 07-08A, Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is

Reasonably Achievable (ALARA), in combination with existing or modified CPNPP Units 1 and 2 site program Information.

The generic radiation protection program description presented in the NEI 07-03A template commits an applicant to NRC regulatory requirements, guidance and acceptance criteria listed in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)" and SRP Section 12.5. The purpose is to maintain occupational and public doses below regulatory limits and ALARA. When combined with the applicant's site specific information identified within the template, the NEI 07-03A template provides a radiation protection program that complies with applicable NRC regulations and guidance. The licensee must develop operational programs by its implementation milestones, as specified in Section 13.4 of the applications, license conditions, and DCs. The CPNPP, Units 3 and 4 FSAR states that the radiation protection program for ensuring that operational radiation exposures are ALARA, as discussed in CPNPP, Units 3 and 4 FSAR Section 12.5, is achieved by utilizing NEI 07-03A.

NEI 07-08A states that company and station policies are to keep all radiation exposure of personnel within limits defined by 10 CFR Part 20. The ALARA policy conforms to and will be implemented in accordance with the ALARA provisions of the guidance in RG 8.8 and RG 8.10. As stated in FSAR Section 13.1, "Organizational Structure of Applicant," specific individuals will be assigned responsibility and authority for implementing ALARA policy at the CPNPP, Units 3 and 4. All station personnel will be responsible for ALARA. Individual workers are responsible for conforming with ALARA requirements, which are presented in worker training in accordance with the training requirements contained in 10 CFR Part 19.12. The extent of the worker training provided will be commensurate with the worker's job responsibilities.

NEI 07-08A 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. By referencing NEI 07-08A, the COL applicant commits to ALARA policies and practices which will comply with the applicable regulations in 10 CFR Part 20 and will conform to the guidance found in RG 1.8; RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition);" RG 8.2; RG 8.7; RG 8.8; RG 8.9; RG 8.10; RG 8.13, "Instruction Concerning Prenatal Radiation Exposure;" RG 8.15; RG 8.27; RG 8.28; RG 8.29; RG 8.34; RG 8.35; RG 8.36; RG 8.38, "Control of Access to High and Very High Radiation Areas of Nuclear Plants;" and the applicable portions of NUREG-1736.

In addition, NEI 07-08A describes an ALARA program based on mature programs in use at other operating commercial nuclear facilities and incorporating lessons learned from plant operating experience. Industry operating experience is regularly reviewed and applicable exposure control technique lessons learned are incorporated into plans, procedures, and policies. These plans and procedures are developed in accordance with the guidance in RG 1.8, RG 8.8, and RG 8.10.

As described above in Section 12.1.4, in response to staff inquiries regarding the interaction between the existing CPNPP, Units 1 and 2 radiation protection program and the proposed radiation protection program for CPNPP, Units 3 and 4, the applicant has stated that the radiation protection program will be based solely on NEI 07-03A and NEI

07-08A. The staff considers **RAI 3510, Question 12.05-3** to be resolved. The staff will confirm that the proposed revision to COL FSAR Section 12.1 is incorporated into the next revision of the CPNPP COL FSAR. **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**.

Examples of some of the ALARA work practices described in NEI 07-08A include:

- Use of appropriate dosimetry to record personnel doses,
- use of pre-job briefs and post-jobs debriefs to ascertain lessons-learned,
- use of dry-run training and mockups to improve worker efficiency for complex jobs in high radiation areas,
- use of protective clothing, respiratory equipment and special ventilation systems for work in contaminated environments,
- use of remote monitoring of personnel to reduce worker exposures,
- the establishment of low dose “waiting areas,” and
- the use of permanent or temporary shielding to reduce worker exposure at the work site.

Because the applicant has committed to the use of NEI 07-03A, the applicant has committed to preparing procedures that will be consistent with the guidance provided in RG 1.8, RG 8.2, RG 8.7, RG 8.8, RG 8.10, and the guidance referenced in NUREG-1736 that is applicable to power reactors. NEI 07-03A requires that radiation protection procedures will be established, implemented and reviewed against the quality assurance criteria described by the COL applicant in its FSAR. As documented in the SE for NEI 07-03A, this ensures that radiation protection procedures will meet the requirements of 10 CFR 19.12 and 10 CFR 20. Therefore, the radiation protection procedures, which are described in COL FSAR Section 12.1 and Section 12.5, are developed in accordance with the standards described in COL FSAR Section 13.5, “Plant Procedures,” and Section 17.5, “Quality Assurance Program Guidance,” meet the applicable requirements of 10 CFR Part 19, “Notices, Instructions and Reports to Workers: Inspection and Investigations,” 10 CFR Part 20, 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material,” and 10 CFR Part 71, “Packaging and Transportation of Radioactive Material.”

In Section 12.1 and Section 12.5 of the FSAR, the applicant incorporates by reference NEI 07-03A and NEI 07-08A, without departures. Because the referenced NEI documents provide generic descriptions of the ALARA and Radiation Protection programs, which the staff has previously found to be acceptable, and the responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**, have also been found to be acceptable, as discussed in Section 12.1.4 above, the staff concludes that the applicant has adequately addressed CP COL 12.1(5).

- CP COL 12.1(6). The COL applicant is to perform periodic reviews of the operational practices to ensure configuration management, personnel training and qualification updates, and procedure adherence.

The staff reviewed CP COL 12.1(6) related to COL Information Item 12.1(6), regarding the performance of periodic review of operational practices, included under Section 12.1 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced part of the contents in DCD Section 12.1.3 with the following:

Operational procedures are developed to perform periodic review of operational practices to ensure that operating procedures are revised to reflect the installation of new or modified equipment, personnel qualification and training are kept current, and facility personnel follow operating procedures

NEI 07-03A states that the applicant is to describe the site specific quality assurance (QA) criteria and the requirement for periodic reviews. In FSAR Section 12.5, the applicant met this information need by stating that the radiation protection program and procedures are established, implemented, maintained and reviewed consistent with 10 CFR 20.1101 and the quality assurance program referenced in FSAR Chapter 17.

Because FSAR Section 12.1 states that the radiation protection program is to be implemented in accordance with NEI 07-03A, which was previously accepted by the staff, and the applicant has provided the supplemental information regarding QA and review criteria identified within NEI 07-03A, and the responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**, have also been found to be acceptable, as discussed in Section 12.1.4 above, the staff concludes that the applicant has adequately addressed CP COL 12.1(6).

- CP COL 12.1(7). The COL applicant is to track implementation of requirements for record retention according to 10 CFR 50.75(g) and 10 CFR 70.25(g) as applicable.

The NRC staff reviewed CP COL 12.1(7) related to COL Information Item 12.1(7), regarding record retention according to 10 CFR 50.75(g) and 10 CFR 70.25(g), included under Section 12.1 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the contents in DCD Section 12.1.3 with the following:

Operational procedures are developed to track implementation of requirements for record retention according to 10 CFR Part 50.75(g) and 10 CFR Part 70.25(g) as applicable. This record, containing facility design and construction, facility design changes, site conditions before and after construction, onsite waste disposal and contamination, and results of radiological surveys, is used to facilitate decommissioning. These procedures are addressed in the Plant Radiation Protection

Procedures, described in 13.5.2.2, "Maintenance and Other Operating Procedures."

The applicant's FSAR, Section 12.1 and Section 12.5 did not describe how the program for minimizing facility contamination would be implemented in accordance with 10 CFR 20.1406 and the guidance provided in RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning." Therefore, in **RAI 3316, Question 12.01-4**, the staff asked the applicant to describe the program it would use to minimize contamination of the facility. In response to **RAI 3316, Question 12.01-4** dated November 16, 2009, the applicant committed to full adoption of NEI template NEI 08-08A, once approved by the staff. The staff issued its SE that approved NEI 08-08A, "Guidance for Life Cycle Minimization of Contamination" (ADAMS Accession Number ML093220530) on October 19, 2009. This NEI template discusses operational policies and operational programs sufficient to meet the programmatic requirements of 10 CFR Part 20.1406 for life cycle minimization of contamination, in part by addressing the applicable regulatory position elements of RG 4.21. In addition, NEI 08-08A includes provisions for the licensee to ensure that decommissioning records are retained and retrievable to meet the requirements of 10 CFR 50.75(g) and 10 CFR 72.30(d). This NEI template discusses operational policies and operational programs sufficient to meet the programmatic requirements of 10 CFR 20.1406 for life cycle minimization of contamination, in part by addressing the applicable regulatory position elements of RG 4.21. In addition, NEI 08-08A includes provisions to ensure that decommissioning records are retained and retrievable to meet the requirements of 10 CFR 50.75(g) and 10 CFR 72.30(d). The information provided in NEI 08-08A conforms to the guidance of RG 4.21, Revision 0, and therefore provides an acceptable means of demonstrating compliance with 10 CFR 20.1406, 10 CFR 50.75(g) and 10 CFR 72.30(d). Because the applicant has committed to implementing NEI 08-08A, the staff has determined that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3316, Question 12.01-4** to be resolved. The staff will confirm that the proposed revision to COL FSAR Section 12.1 is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. **RAI 3316, Question 12.01-4** is being tracked as **Confirmatory Item 12.01-2**.

In Section 12.3 and Section 12.5 of the FSAR, the applicant incorporates by reference NEI 08-08A, without departures. Because the referenced NEI document provides a generic description of the ground water protection program, which the staff has previously found to be acceptable, and the response to **RAI 3316, Question 12.01-4** is being tracked as **Confirmatory Item 12.01-2**; the staff concludes that the applicant has adequately addressed CP COL 12.1(7).

12.1.5 **Post-Combined License Activities**

There are no post-COL activities related to this section.

12.1.6 **Conclusion**

The staff is reviewing the information in DCD Section 12.1 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to ensuring that operational radiation exposures are ALARA incorporated by reference in the

CPNPP, Units 3 and 4 COL FSAR will be documented in the staff's SER of the DC application for the US-APWR design. The SER for the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 12.1 of this SE to reflect the final disposition of the DC application.

The staff concludes that the applicant's description of its ALARA and radiation protection programs in COL FSAR Section 12.1, complies with the requirements of 10 CFR Part 20 and 10 CFR Part 50 and is consistent with the guidance contained in RG 1.8, RG 8.8 and RG 8.10, based on COL FSAR Section 12.1, and the applicant's responses to the RAIs listed below:

RAI 3316, Question 12.01-2
RAI 3316, Question 12.01-4

Confirmatory Item 12.01-1 Use of NEI 07-08A
Confirmatory Item 12.01-2 Use of NEI 08-08A

The staff based its conclusion on the following:

- CP COL 12.1(1), regarding administrative programs and procedures in compliance with RG 1.8, RG 8.8 and RG 8.10, is acceptable because the applicant committed to using the staff approved NEI 07-03A and NEI 07-08A to describe the administrative programs and procedures. The referenced NEI documents provide acceptable generic program descriptions that describe operational policies, regulatory compliance, and operational considerations consistent with the requirements of 10 CFR Part 20. Based on the review as documented above, and the applicant's responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** which is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(1).
- CP COL 12.1(3), regarding the operational radiation protection program, is acceptable because the applicant committed to using NEI 07-03A and NEI -07-08A to describe the radiation protection and ALARA programs. The referenced NEI documents provide acceptable generic program descriptions that describe operational policies, regulatory compliance, and operational considerations consistent with the requirements of 10 CFR Part 20. Based on the review as documented above, and the applicant's responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** which is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(3).
- CP COL 12.1(5), regarding the operational radiation protection program for ensuring that OREs are ALARA, is acceptable because the applicant committed to using NEI 07-08A to describe the ALARA program. The referenced NEI document provides an acceptable generic program description that describes the ALARA program operational policies, regulatory compliance, and operational considerations consistent with the

requirements of 10 CFR Part 20. Based on the review as documented above, and the applicant's responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** which is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(5).

- CP COL 12.1(6), regarding the performance of periodic reviews of the operational practices to ensure configuration management, personnel training and qualification update, and procedure adherence, is acceptable because the applicant committed to using NEI 07-03A. The referenced NEI document provides an acceptable generic program description for operational policies, regulatory compliance, and operation consistent with the requirements of 10 CFR Part 20. Specifically, NEI 07-03A states that the radiation protection program content and effectiveness of implementation are reviewed periodically (at least annually) pursuant to plant procedures. Based on the review as documented above, and the applicant's responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** which is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(6).
- CP COL 12.1(7), regarding record retention according to 10 CFR Part 50.75(g) and 10 CFR Part 70.25(g) as applicable is acceptable because the applicant committed to addressing the guidance contained in RG 4.21, Revision 0, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," by adopting the staff approved NEI 08-08A, "Guidance for Life Cycle Minimization of Contamination." Specifically, NEI 08-08A, which provides an acceptable generic program for the minimization of contamination, includes provisions to ensure that decommissioning records are retained and retrievable to meet the requirements of 10 CFR Part 50.75(g) and 10 CFR 72.30(d). Based on the review as documented above, and the applicant's response to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(7).

12.2 Radiation Sources

12.2.1 Introduction

The determination of projected radiation sources during normal operations, (AOOs), and accident conditions in the plant, is used as the basis for designing the radiation protection program and for shield design calculations. This includes definition of isotopic composition, location in the plant, source strength and source geometry. In addition, the airborne radioactive material sources in the plant are considered in the design of the ventilation systems and used for the design of personnel protective measures and for dose assessment.

12.2.2 Summary of Application

Section 12.2, "Radiation Sources" of the CPNPP, Units 3 and 4 COL FSAR, Revision 1, incorporates by reference Section 12.2, "Radiation Sources" of the US-APWR DCD, Revision 2.

In addition, in CPNPP, Units 3 and 4 COL FSAR Section 12.2, the applicant provided the following information:

US-APWR COL Information Items

- CP COL 12.2(2)

The applicant provided additional information in CP COL 12.2(2) to address COL Information Item 12.2(2) regarding radiation protection aspects of radioactive waste outside the radioactive waste storage/staging building and storage of dry active waste.

- CP COL 12.2(1)

The applicant provided additional information in CP COL 12.2(1) to address COL Information Item 12.2(1) regarding additional radioactive sources not listed in US-APWR DCD Subsection 12.2.1.

Interface Requirements

The US-APWR DCD Tier 2, Revision 2 Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 12.2 of the DCD.

12.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

The acceptance criteria associated with the relevant requirements of the Commission's regulations for radiation sources are given in Section 12.2, "Radiation Sources" of NUREG-0800."

The applicable regulatory requirements for radiation sources are as follows:

1. 10 CFR Part 20.1201, "Occupational dose limits for adults," 10 CFR 20.1202, "Compliance with requirements for summation of external and internal doses," and 10 CFR 20.1206, "Planned special exposures," as they relate to limiting occupational radiation doses.

2. 10 CFR 20.1203 "Determination of external dose from airborne radioactive material" and 10 CFR 20.1204 "Determination of internal exposure," as they relate to limiting average concentrations of airborne radioactive materials to protect individuals and control the intake (inhalation or absorption) of such materials.
3. 10 CFR 20.1207, "Occupational dose limits for minors," as it relates to limiting exposure to minors to one-tenth of limits for adults.
4. 10 CFR 20.1301, "Dose limits for individual members of the public," as it relates to the determination of radiation levels and radioactive materials concentrations within the components of waste treatment systems.
5. 10 CFR 20.1801, "Security of stored material," as it relates to securing licensed materials against unauthorized removal.
6. 10 CFR 20.1802, "Control of material not in storage," as it relates to securing licensed materials not in storage against unauthorized removal.
7. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," General Design Criterion (GDC) 61 "Fuel Storage and Handling and Radioactivity Control," in Appendix A, "General Design Criteria for Nuclear Power Plants" to 10 CFR Part 50, as it relates to systems that may contain radioactive materials.
8. 10 CFR Part 20 Subpart H "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas."
9. 10 CFR 52.80(a), "Contents of Applications; Additional Technical Information," which requires that a COLA address the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, and the NRC's regulations.

The related acceptance criteria are as follows:

The following RGs, standards, and NUREGs provide information, recommendations, and guidance, and in general, describe a basis acceptable to the staff for implementing the requirements of 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1206, 10 CFR 20.1207, 10 CFR 20.1301, 10 CFR 20.1801, 10 CFR 20.1802 and 10 CFR Part 20 Subpart H.

1. RG 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," Revision 3, issued May 2000, as it relates to the qualifications and training of radiation protection personnel.

2. RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," Revision 0, issued June 2008, as it relates to maintaining records to facilitate decommissioning.
3. RG 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," Revision 3, issued June 1978, as it relates to providing radiation protection information to ensure that occupational radiation exposure is kept ALARA.
4. RG 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable," Revision 1-R, issued May 1997, as it relates to commitment by the applicant's management and vigilance by the radiation protection manager and the radiation protection staff to maintain ORE ALARA.
5. RG 8.15, Revision 1, "Acceptable Programs for Respiratory Protection", Revision 1, issued October 1999, as it relates to the review of the radiological respiratory protection program.
6. RG 8.27, "Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants," issued March 1981, as it relates to instructing personnel involved in licensed activities regarding their role and responsibilities for making every reasonable effort to maintain radiation exposures ALARA.
7. NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 – Standards for Protection Against Radiation," issued October 2001, as it relates to the requirements for a radiation protection program to maintain doses ALARA.

12.2.4 **Technical Evaluation**

The staff reviewed Section 12.2 of the CPNPP, Units 3 and 4 COL FSAR and reviewed the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic¹. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to radiation sources. Section 12.2 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The staff's technical evaluation of the information incorporated by reference related to radiation sources will be documented in the staff's SE of the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP, Units 3 and 4 COL FSAR:

US-APWR COL Information Items

- CP COL 12.2(1). The COL Applicant is responsible for the use of any additional contained radiation sources that are not identified in Subsection 12.2.1, including radiation sources used for instrument calibration or radiography.

The staff reviewed CP COL 12.2(1) related to COL Information Item 12.2(1) included under Section 12.2 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the last paragraph in DCD Section 12.2.1.1.10 with the following:

Any additional solid, liquid and gaseous radiation sources that are not identified in Subsection 12.2.1, including radiation sources used for instruments calibration or radiography, will be provided when such site specific information would become available in the procurement phase. These sources will be incorporated in the updated FSAR.

While the information the applicant provided in CP COL 12.2(1) noted that additional sources would be identified during the procurement phase, the CPNPP, Units 3 and 4 FSAR did not identify any radiation sources that required facility shielding, and the applicant did not identify what types and quantities of source material would be required. Therefore, in **RAI 3509, Question 12.02-1**, the staff asked the applicant to provide additional information regarding any site specific contained sources that were part of the current proposed site specific design. The applicant's response to **RAI 3509, Question 12.02-1** dated November 5, 2009, stated that specific details regarding additional types of radiation sources containing byproduct, source, and special nuclear material that may be utilized at CPNPP, Units 3 and 4 was not currently available. The applicant committed to revising the CPNPP, Units 3 and 4 FSAR Subsection 12.2.1.1.10 to assure that the facility design will accommodate the activity and types of sources procured. The applicant's response ensures that any additional sources that require changes to the facility design would be evaluated and documented in accordance with the requirements of Section 52.63, "Finality of standard design certifications," of 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," which states that licensees may make changes to the facility as described in the FSAR, by using the provision of 10 CFR 50.59, "Changes, tests and experiments," which in turn requires the licensee to evaluate the proposed facility changes with respect to the regulatory requirements and guidance applicable at the time of the facility change, and to update the FSAR as required. The radiation program described in NEI 07-03A, which as discussed in Section 12.1.4 above which was previously approved by the staff, describes acceptable methods for storing and controlling radiation sources, such as calibration sources, that do not require changes to the facility design. The radiation program described in NEI 07-03A also states that the Radiation Protection Manager (RPM) will provide radiation protection input to facility design and modifications. The staff finds the applicant's response to this RAI acceptable because the applicant has provided the information described in SRP Section 12.2 for already identified radiation sources, and has committed to using the process described in 10 CFR 52.63, for any additional sources that may require a change to the facility design, therefore, the staff considers **RAI 3509, Question 12.02-1** to be resolved. The staff will confirm that the proposed revision to COL FSAR Section 12.2 is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. **RAI 3509, Question 12.02-2** is being tracked as **Confirmatory Item 12.02-1**.

Another example of a site-specific source at CPNPP, Units 3 and 4 is the Evaporation Pond. CPNPP, Units 3 and 4 FSAR Subsection 11.2.3.4, "Evaporation Pond," describes the use of an Evaporation Pond in the liquid radioactive waste processing system effluent stream to control tritium concentrations in the Squaw Creek Reservoir (SCR). The evaporation pond is designed to provide sufficient surface area for natural evaporation based on the local area rainfall, evaporation rate, and receiving half of the CPNPP, Units 3 and 4 liquid effluents. 10 CFR 20.1802 requires licensees to secure from unauthorized removal or access, radioactive materials in controlled or unrestricted areas that are not in storage. SRP Section 12.2 notes that the COL applicant is responsible for identifying and quantifying any sources not identified in the referenced DCD. 10 CFR Part 20 Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas," requires licensees to use process or engineering controls to control the concentration of airborne radioactive material for the protection of plant personnel from airborne contamination. In CPNPP, Units 3 and 4 FSAR 12.2.1.1.10 however, the applicant did not provide any information regarding the corrosion and fission activity contained within the Evaporation Pond, the methods, models and assumptions employed to determine the residual fission and corrosion product activity in the pond, or how the material will be controlled in accordance with the requirements of 10 CFR 20.1801, nor did the CPNPP, Units 3 and 4 FSAR describe the estimated airborne activity concentrations that could result from dispersion of the dried pond sediment due to wind and the resultant exposure to operating plant personnel. Therefore, in **RAI 3317, Question 12.02-2**, the staff asked the applicant to describe the source term associated with the evaporation pond. In response to **RAI 3317, Question 12.02-2** dated November 5, 2009, the applicant committed to revising the CPNPP, Units 3 and 4 FSAR to include Table 12.2-201, "Estimated Initial Activity into the Evaporation Pond (Based on the Realistic Source Terms of the Waste Monitor Tank)," describing the activity in the evaporation pond and the use of engineering controls and barriers to provide protection to site personnel. Table 12.2-201 identifies the activity contained in the pond, consistent with the guidance provided in SRP Section 12.2. The applicant's response also described the use of a fence to meet the requirements of 10 CFR 20.1801 regarding the control of radioactive material. The applicant's response stated that the pond is washed each time it is emptied to reduce the potential for the accumulation of radioactive material and subsequent generation of airborne radioactive material, to meet the requirements of 10 CFR 20 Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas." The staff finds the applicant's response to **RAI 3317, Question 12.02-2** acceptable because the applicant has committed to include a description of the Evaporation Pond radiation source in FSAR Section 12.2, consistent with the guidance described in SRP Section 12.2 related to radiation sources, provided to ensure compliance with 10 CFR 20.1802 and Subpart H. Therefore the staff considers **RAI 3317, Question 12.02-2** to be resolved. The staff will confirm that the proposed revision to COL FSAR Section 12.2 is incorporated into the next revision of the CPNPP, Units 3 and 4 COL FSAR. **RAI 3317, Question 12.02-2** is being tracked as **Confirmatory Item 12.02-2**.

Based on the information provided by the applicant to address CP 12.2(1) as discussed above, and the responses to **RAI 3509, Question 12.02-1**, which is being tracked as **Confirmatory Item 12.02-1** and **RAI 3317, Question 12.02-2**, which is being tracked as **Confirmatory Item 12.02-2**, the staff concludes that the applicant has adequately addressed CP COL 12.2(1).

- CP COL 12.2(2). The COL Applicant is to provide the detailed design of additional storage space for radwaste and/or additional radwaste facilities for dry active waste.

The staff reviewed CP COL 12.2(2) related to COL Information Item 12.2(2) included under Section 12.2 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the second and third sentences of the sixth paragraph in DCD Section 12.2.1.1.10 with the following:

CPNPP Units 3 and 4 have no additional storage space for radioactive waste (radwaste) inside the plant structures. CPNPP Units 3 and 4 have a plan to store temporarily radioactive wastes/materials in Interim Radwaste Storage/Staging Building outside the plant structures. The radiation protection program (see Section 12.5) is in place to ensure compliance with Title 10, Code of Federal Regulations (CFR) Part 20 and to be consistent with the recommendations of RG 8.8.

The applicant also replaced the second sentence of the seventh paragraph in DCD Section 12.2.1.1.10 with the following:

CPNPP Units 3 and 4 have no additional radwaste facilities for dry active waste. An additional storage space for radwaste, to be named the Interim Radwaste Storage Building, is planned for the future construction outside the plant structures.

The COL FSAR further states that the radiation protection program, as described in NEI 07-03A, ensures that the design criteria of the proposed facility described in COL FSAR Subsection 11.4.2.3, will be in compliance with 10 CFR 20, 10 CFR 50, Appendix A, GDC 61, GDC 63, 40 CFR 190 and will be consistent with the recommendations of RG 8.8 and Generic Letter (GL) 81.38, "Storage of Low Level Radioactive Wastes at Power Reactor Sites."

While the applicant has stated that it plans to provide additional radioactive waste storage capacity in an Interim Radioactive waste storage facility, the current CPNPP FSAR Chapter 11, "Radioactive Waste Management" does not contain a description of an interim radioactive waste storage facility. The staff finds that the information provided to address CP 12.2(2) is acceptable because the applicant has committed to ensuring that the future Interim Radwaste Storage Building, will be in compliance with 10 CFR 20, 10 CFR 50, Appendix A, GDC 61, GDC 63, and 40 CFR 190 and will be consistent with the recommendations of RG 8.8 and GL 81.38. The radiation program described in NEI 07-03A, states that the RPM will provide radiation protection input to facility design and modifications, thus ensuring that the facility will meet the requirements of 10 CFR 20, GDC 61, GDC 63 and 40 CFR 190. Based on the information provided by the applicant to address CP 12.2(2) and the requirement contained within the previously approved NEI 07-03A for the RPM to review changes to the facility, the staff concludes that the applicant has adequately addressed CP 12.2(2). 10 CFR 52.63, "Finality of standard design certifications," states that changes to the licensee's facility, as described in the FSAR can be made using the provision of 10 CFR 50.59, "Changes, tests and experiments," which in turn requires the licensee to evaluate the proposed facility

changes with respect to the regulatory requirements and guidance applicable at the time of the facility change, and to update the FSAR as required.

The staff's memorandum (ADAMS Accession Number ML083030065), dated December 9, 2008, proposed that COL applicants incorporate a number of 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," 10 CFR Part 40, "Domestic Licensing of Source Material," and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," license conditions into the COLA. Subsequent to this memorandum, the staff has revised some of these license conditions, and therefore issued **RAI 198**, "Questions Related to Standard License Conditions for 10 CFR Parts 10, 30, 40 and 70" asking the applicant to describe in the CPNPP, Units 3 and 4 FSAR program requirements and implementation milestones for receipt. The applicant's response to the questions presented in **RAI 198**, dated May 6, 2011, and is currently under review by the staff. This is identified as **Open Item 12.02-1**.

12.2.5 **Post-Combined License Activities**

There are no post-COL activities related to this section.

12.2.6 **Conclusion**

The staff is reviewing the information in DCD Section 12.2 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to radiation sources incorporated by reference in the CPNPP, Units 3 and 4 COL FSAR will be documented in the staff's SE of the DC application for the US-APWR design. The SE of the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 12.2 of this SE to reflect the final disposition of the DC application.

The staff concludes, based on COL FSAR Section 12.2, and the applicant's responses to RAI listed below:

RAI 3509, Question 12.02-1
sources.

Confirmatory Item 12.02-1 Additional

RAI 3317, Question 12.02-2
Pond.

Confirmatory Item 12.02-2 Activity in

And with the exception of **Open Item 12.02-1**, "Questions Related to Standard License Conditions for 10 CFR Parts 10, 30, 40 and 70", that the applicant's description of radiation sources complies with the requirements of 10 CFR Part 20 and 10 CFR Part 50 and is consistent with the guidance contained in RG 8.8. As explained above, the staff finds the applicant's commitment to revise the COL FSAR to describe additional sources provided by the applicant, and the process to be used by the applicant to address the acquisition of future sources (**Confirmatory Item 12.02-1**) and to include Table 12.2-201, "Estimated Initial Activity into the Evaporation Pond (Based on the Realistic Source Terms of the Waste Monitor Tank)," describing the activity in the evaporation pond and the use of engineering controls and barriers to provide protection to site personnel

(**Confirmatory Item 12.02-2**) acceptable, and the staff will confirm that this information is included in a future revision of the FSAR.

The staff based its conclusion on the following:

- CP COL 12.2(2), related to radiation protection aspects of radioactive waste outside the radioactive waste storage/staging building and storage of dry active waste, is acceptable because the applicant stated that the radiation protection program will conform to NEI 07-03A, which requires the RPM to review modifications to the facility, and any additional radioactive waste storage facilities would conform to the requirements of NEI 07-03A. This is consistent with the guidance in RG 8.8 and the ALARA provisions of 10 CFR Part 20. Based on the information provided by the applicant to address CP 12.2(2), and the applicant's commitment to adhere to the guidance within the previously approved NEI 07-03A for the RPM to review changes to the facility, the staff concludes that the applicant has adequately addressed CP 12.2(2)
- CP COL 12.2(1), related to additional radioactive sources not listed in Section 12.2.1, is acceptable because in the applicant's response to RAI 3509, **Question 12.02-1** the applicant committed to revising the CPNPP, Units 3 and 4 FSAR Subsection 12.2.1.1.10 to assure that the facility design will accommodate the activity and types of sources procured. Because the applicant's response to this question is consistent with the guidance in the SRP Section 12.2, the staff finds the response to this question acceptable. Based on the information provided by the applicant to address CP 12.2(1) as discussed above, and the responses to **RAI 3509, Question 12.02-1**, which is being tracked as **Confirmatory Item 12.02-1** and **RAI 3317, Question 12.02-2** which is being tracked as **Confirmatory Item 12.02-2**, the staff concludes that the applicant has adequately addressed CP COL 12.2(1)

12.3 Radiation Protection Design Features

12.3.1 Introduction

This section focuses on radiation protection design features, including the equipment used for assuring that OREs will be ALARA. Radiation zones are defined for various modes of plant operation. Design features to control personnel radiation exposures include the physical layout of equipment, shielding and barriers to high radiation areas, fixed area radiation, and continuous airborne radioactivity monitoring instrumentation, including instrumentation for accident conditions.

12.3.2 Summary of Application

Section 12.3, "Radiation Protection Design Features," of the CPNPP, Units 3 and 4 COL FSAR, Revision 1 incorporates by reference Section 12.3, "Radiation Protection Design Features," of the US-APWR DCD, Revision 2.

In addition, in CPNPP, Units 3 and 4 COL FSAR Section 12.3, the applicant provided the following:

US-APWR COL Information Items

- CP COL 12.3(4)

The applicant provided additional information in CP COL 12.3(4) to address COL Information Item 12.3(4) regarding site specific radiation zones.

- CP COL 12.3(5)

The applicant provided additional information in CP COL 12.3(5) to address COL Information Item 12.3(5) regarding administrative control of the fuel transfer tube inspection and the access control of the area near the seismic gap below the fuel transfer tube.

- CP COL 12.3(1)

The applicant provided additional information in CP COL 12.3(1) to address COL Information Item 12.3(1) regarding the portable instrumentation, training and procedures needed to accurately measure post-accident iodine concentrations in areas of the facility that require access.

Supplemental Information (SUP)

- CP SUP 12.3(1)

The applicant provided supplemental information regarding the essential service water (ESW) pipe tunnel structure at elevation 793'-1", which has been changed in the site-specific layout.

Interface Requirements

The US-APWR DCD Tier 2, Revision 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 12.3 of the DCD.

12.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the acceptance criteria associated with the relevant requirements of the Commission's regulations for the radiation protection design features are given in Section 12.3, "Radiation Protection Design Features" of NUREG-0800.

The applicable regulatory requirements for the radiation protection design features are as follows:

1. 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003, as they relate to persons involved in licensed activities making every reasonable effort to maintain radiation exposures ALARA.
2. 10 CFR 20.1201, as it relates to occupational dose limits for adults.
3. 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1701, "Use of process or other engineering controls," and 10 CFR 20.1702, "Use of other controls," as they relate to design features, ventilation, monitoring, and dose assessment for controlling the intake of radioactive materials.
4. 10 CFR 20.1301 and 10 CFR 20.1302, "Compliance with dose limits for individual members of the public," as they relate to the facility design features that impact the radiation exposure to a member of the public from non-effluent sources associated with normal operations and AOOs.
5. 10 CFR 20.1406, as it relates to the design features that will facilitate eventual decommissioning and minimize, to the extent practicable, the contamination of the facility and the generation of radioactive waste.
6. 10 CFR 20.1601, "Control of access to high radiation areas," 10 CFR 20.1602, "Control of access to very high radiation areas," 10 CFR 20.1901, "Caution signs," 10 CFR 20.1902, "Posting requirements," 10 CFR 20.1903, "Exceptions to posting requirements," and 10 CFR 20.1904, "Labeling containers," as they relate to the identification of potential sources of radiation exposure and the controls of access to, and work within, areas of the facility with a high potential for radiation exposure.
7. 10 CFR 20.1801, as it relates to securing licensed materials against unauthorized removal from the place of storage.
8. 10 CFR 50.34(f)(2)(xxvii), as it relates to the use of portable instruments and the associated training and procedures to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.
9. 10 CFR Part 50, Appendix A, GDC 61, as it relates to occupational radiation protection aspects of site specific radioactive waste and other systems that may contain radioactivity, designed to ensure adequate safety during normal and postulated accident conditions, with suitable shielding and appropriate containment and filtering systems.
10. 10 CFR Part 50, Appendix A, GDC 63, "Monitoring Fuel and Waste Storage," as it relates to detecting excessive radiation levels in the facility.

11. 10 CFR 52.80(a), which requires that a COLA address the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, and the NRC's regulations.

The related acceptance criteria are as follows:

The following RGs, NUREGs, and industry standards provide information, recommendations, and guidance and describe a basis acceptable to the staff for implementing the requirements of the regulations identified above:

1. RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants", issued June 2006, as it relates to a method acceptable to the staff for complying with the Commission's regulations to provide instrumentation for radiation monitoring following an accident in a light-water-cooled nuclear power plant.
2. RG 4.21, Revision 0, issued June 2008, as it relates to design features provided for site specific structures for the purpose of minimization of contamination, and facilitation of decommissioning.
3. RG 8.2, Revision 1, dated May 2011, "Guide for Administrative Practices in Radiation Monitoring," as it relates to general information regarding radiation monitoring programs for administrative personnel.
4. RG 8.8, Revision 3, issued June 1978, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," as it relates to actions taken during facility design, engineering, construction, operation, and decommissioning to maintain ORE ALARA in accordance with 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003, concerning the radiation protection information to be supplied in COLA FSAR Section 12.
5. RG 8.10, Revision 1-R, issued May 1977, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable," as it relates to the commitment by management and vigilance by the radiation protection manager and staff to maintain ORE ALARA in accordance with 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003.
6. RG 8.38, Revision 1, issued May 2006, "Control of Access to High and Very High Radiation Areas of Nuclear Plants," as it relates to the physical controls for personnel access to high and very high radiation areas.
7. NUREG-0737, "Clarification of TMI Action Plan Requirements," issued November 1980, Task Action Plan Item III.D.3.3, as it relates to the use of

portable instruments and the associated training and procedures to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

8. GL 81-38, "Storage of Low-Level Radioactive Wastes at Power Reactor Sites," issued November 10, 1981, as it relates to site-specific radioactive waste storage facilities.

12.3.4 Technical Evaluation

The staff reviewed Section 12.3 of the CPNPP, Units 3 and 4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic¹. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to radiation protection design features. Section 12.3 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The NRC staff's technical evaluation of the information incorporated by reference related to radiation protection design features will be documented in the staff's SE of the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP, Units 3 and 4 COL FSAR:

Supplemental Information

- CP SUP 12.3(1)

The applicant added the following information after the last sentence of the second paragraph in DCD Section 12.3.1.2.2:

The essential service water (ESW) pipe tunnel structure at elevation 793'-1" has been changed in the site-specific layout. However, the radiation protection design in DCD Chapter 12 is not affected by the modification of ESW pipe tunnel structure, and Figures 12.3-2 ["General Plant Arrangement with Post Accident Vital Areas"] through 12.3-6 ["Post Accident Radiation Zone MAP: 1month After Accident"] can be used except for the structure of ESW pipe tunnel. Thus, these figures are not replaced in Final Safety Analysis Report (FSAR) Chapter 12. The structure of the ESW pipe tunnel is shown on Figure 1.2-2R ["Comanche Peak Units 3 & 4 Power Block at Elevation 793'-1" - Plan View."

The US-APWR DCD Tier 2 Subsection 9.2.1, "Essential Service Water System," states that the ESW system (ESWS) provides cooling water to remove the heat from the component cooling water (CCW) heat exchangers (HXs) and the essential chiller units. While the DCD does note that radioactive contaminants may enter the ESWS from the CCW system (CCWS), the system is designed to detect and preclude release of radioactive contaminants to the environment by acting as an additional barrier between the source of radioactive material and the ESWS piping, therefore the concentration of radioactive material expected to be present within the ESW piping contained within the ESW pipe tunnel is not expected to cause dose rates above the 2.5 E-03 mSv/h (0.25

mrem/h) criteria for Radiation Zone 1 as defined in DCD Figure 12.3-1, "Radiation Zones for Normal Operation/Shutdown." Therefore, the information provided demonstrates that the radiation zoning of the changed structure is consistent with the guidance provided in SRP Section 12.3.

US-APWR COL Information Items

- CP COL 12.3(4). The COL Applicant is to provide the site radiation zones that are shown on the site-specific plant arrangement plan.

The staff reviewed CP COL 12.3(4) related to COL Information Item 12.3(4) included under Section 12.3 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the fourth sentence of the fourth paragraph in DCD Section 12.3.1.2.1.1 with the following:

Site radiation zones for CPNPP Units 3 and 4 plant arrangement plan under normal operation/shutdown conditions are shown in Figure 12.3-1R (COL information provided on Sheet 1 of 34).

Areas within the restricted area are divided into [number of zones] radiation zones. The dose rate criterion for each of these zones is derived from expected occupancy and access restrictions. The staff reviewed Figure 12.3-1R, "Radiation Zones for Normal Operation/Shutdown (Sheet 1 of 34) Site." The figure depicts radiation zones for site specific structures such as the Condensate Water Storage Tanks, and the Interim Radwaste Storage/Staging Building, that are consistent with the expected use of the structures, and the guidance in SRP Section 12.3. Because the plant design and layout facilitates the control of access to and work within plant areas in accordance with the requirements of 10 CFR 20.1601, 10 CFR 20.1602, 10 CFR 20.1901 and 10 CFR 20.1902, the staff concludes that the applicant has adequately addressed CP COL 12.3(4).

- CP COL 12.3(5) The COL Applicant is to discuss the administrative control of the fuel transfer tube inspection and the access control of the area near the seismic gap below the fuel transfer tube.

The staff reviewed CP COL 12.3(5) related to COL Information Item 12.3(5) included under Section 12.3 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the last paragraph in DCD Section 12.3.2.2.8 with the following:

Administrative control of the fuel transfer tube inspection and the access control of the area near the seismic gap below the fuel transfer tube will be addressed in a radiation protection program, described in Section 12.5.

NEI 07-03A and NEI 07-08A, which the applicant incorporates by reference, provide acceptable methods of describing the radiation protection and ALARA programs that the staff has reviewed and found to be acceptable. The use of physical barriers in conjunction with the administrative controls described in NEI 07-03A and NEI 07-08A is consistent with the guidance provided in RG 8.38 for

meeting the access control requirements for very high radiation areas (VHRA) stated in 10 CFR 20.1602.

The applicant committed to using NEI 07-03A and NEI 07-08A to describe the administrative programs and procedures for the radiation protection and ALARA programs. The referenced NEI documents provide generic program descriptions that describe operational policies, regulatory compliance, and operational considerations consistent with the requirements of 10 CFR Part 20 and the guidance in RG 8.38. The staff issued its SEs that approved of NEI 07-03A and NEI 07-08A on March 18, 2009, and October 15, 2009, respectively. NEI 07-03A states that each COL applicant will include in its application a description of each VHRA including the location of physical barriers to prevent unauthorized entry, the reasons for entering each VHRA, the anticipated entry frequency to each VHRA and associated additional administrative controls for restricting access to each VHRA. Therefore, the staff, in **RAI 3318, Question 12.03-12.04-2**, requested that the applicant provide the information specified by NEI 07-03A. In response to **RAI 3318, Question 12.03-12.04-2**, dated November 16, 2009, the applicant committed to providing the requested information in the CPNPP, Units 3 and 4 FSAR. The applicant's response stated that VHRAs are identified on DCD Figure 12.3-1, which is incorporated by reference. The response further stated that routine entry into VHRA areas is not required, and should entries be required, access to the areas would be controlled by a specific Radiation Work Permit, consistent with the guidance in NEI 07-03A. The applicant's response is consistent with the guidance in SRP Section 12.3-12.4 regarding the description radiation protection design features and meets the requirements of 10 CFR Part 20.1602 regarding control of access to VHRAs. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3318, Question 12.03-12.04-2** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3318, Question 12.03-12.04-2** is being tracked as **Confirmatory Item 12.03-12.04-2**.

Based on the information provided by the applicant to address CP 12.3(5) as discussed above, and the response to **RAI 3318, Question 12.03-12.04-2** which is being tracked as **Confirmatory Item 12.03-12.04-2**, the staff concludes that the applicant has adequately addressed CP COL 12.3(5).

- CP COL 12.3(1). The COL Applicant is responsible for the use of portable instruments, and the associated training and procedures, to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident, in accordance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the criteria in Item III.D.3.3 of NUREG-0737.

The staff reviewed CP COL 12.3(1) related to COL Information Item 12.3(1) included under Section 12.3 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the last paragraph in DCD Section 12.3.4 with the following:

Portable instruments to be used in the event of an accident are placed so as to be readily available to personnel responding to an emergency.

The use of portable instruments and the associated training and procedures to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident, in accordance with the requirements of 10 CFR Part 50.34(f)(2)(xxvii) and the criteria in Item III.D.3.3 of NUREG-0737 will be addressed in radiation protection program, described in Section 12.5.

Procedures for locating suspected high-activity areas are part of the radiation protection program that is described in Section 12.5.

NEI 07-03A, which the applicant incorporates by reference describes a generic radiation protection program that the staff has reviewed and found to be acceptable. The use of portable instruments, and the associated training to determine airborne radioiodine concentrations during and following an accident consistent with the criteria in NUREG-0737, Item III.D.3.3, is described in NEI 07-03A.

10 CFR 20.1501 requires that radiation protection instrumentation be periodically calibrated. NUREG-0800, SRP Section 12.3-12.4 and RG 1.206 C.111 Subsection C.1.12.5.2, notes that the applicant is to provide the criteria for selection and the method of calibration of portable and laboratory radiation protection instrumentation. NEI 07-03A Subsection 12.5.4.1, "Radiological Surveillance," notes that instruments are calibrated prior to initial use and at least annually thereafter. The US-APWR DCD FSAR Tier 2 Section 12.3.4 describes Area and Airborne Radioactivity Monitoring Instrumentation and notes that procedures for the calibration of Portable Personnel Monitors and Radiation Survey Instruments are to be provided by the COL applicant. NEI 07-03A and NEI 07-08A do not specify any criteria for the selection or calibration of portable radiation protection instrumentation. Therefore, the staff in **RAI 3318, Question 12.03-12.04-3** requested that the applicant provide information about instrument calibration. In response to **RAI 3318, Question 12.03-12.04-3**, dated November 16, 2009, the applicant committed to including instrument calibration information in the CPNPP, Units 3 and 4 FSAR. The applicant stated that selection and calibration of instrumentation and equipment would be based on relevant industry standards such as (American National Standards Institute (ANSI) N42.17A-1989, "Performance Specifications for Health Physics Instrumentation-Portable Instrumentation for Use In Normal Environmental Conditions," as it relates to the accuracy and overall performance of portable survey instrumentation, and ANSI N323A-1997, "American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments." The applicant's response is consistent with the guidance in SRP Section 12.3-12.4 regarding the description of the methods for the calibration of portable survey instruments that meet the requirements of 10 CFR Part 20.1501. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3318, Question 12.03-12.04-3** to be resolved.

The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3318, Question 12.03-12.04-3** is being tracked as **Confirmatory Item 12.03-12.04-3**.

The guidance in SRP Section 12.3-12.4, states that the applicant should describe design features that will meet the requirements of 10 CFR 20.1406 to minimize contamination of

the facility and the environment, and to facilitate the eventual decontamination of the facility. The regulatory position statements of RG 4.21 provide guidance related to the prevention and early detection of leakage, which includes barriers to leakage, maintenance and monitoring of components important to the prevention of leakage. The COL applicant is responsible for addressing the design, inspection and maintenance features provided to minimize facility contamination for site-specific structures, systems and components (SSCs). Industry experience has shown that extensive low-level environmental or facility and personnel contamination can occur due to leakage from systems or components. Examples of potentially contaminated systems or components include: portions of cooling water return piping located downstream of radioactive waste connection points; steam and condensate lines containing fluid supplied by the main-steam or condensate system (due to the low level tritium content in secondary side water systems, or primary to secondary leakage within Technical Specifications (TS) limits); fluid systems supplied by recycled Reactor Coolant system water sources, such as the Primary Makeup Water Storage Tank; Interconnections between non-radiological plant systems, such as station air and demineralized water and applicant supplied systems, such as mobile liquid waste processing systems (LWPS); heating, ventilation and air-conditioning system condensate drains; and piping to and from COL applicant supplied structures, like evaporation ponds. Therefore, in **RAI 3511, Question 12.03-12.04-1**, the staff asked the applicant to describe how the design features provided for the site specific SSCs conformed to the guidance provided in RG 4.21. In response to **RAI 3511, Question 12.03-12.04-1**, dated November 11, 2009, the applicant listed some design features associated with the US-APWR DCD specified portions of the plant, such as: HXs made from corrosion resistant materials; the use of non-porous epoxy coatings to minimize contamination; and the use of incompatible connectors for temporary hose connections to prevent intersystem contamination; which are provided to minimize contamination of the facility and the environment, and are consistent with the guidance contained in RG 4.21. The applicant committed to modifying the table in the application that lists the guidance the applicant commits to conform to (Table 1.9-202, "Comanche Peak Nuclear Power Plant Units 3 & 4 Conformance with Division 4 Regulatory Guides") to include RG 4.21, and the table that lists additional guidance referenced (CPNPP, Units 3 and 4 FSAR Table 1.6-201, "Material Referenced"), to include NEI 08-08A. The applicant also stated that the guidance in NEI 08-08A would be used minimize contamination of the facility and the environment, including the use of photographs and video records to facilitate decommissioning. NEI 08-08A has been approved by the staff as a method of describing procedures provided for minimizing contamination of the environment and facilitating decommissioning. The staff finds the applicant's response acceptable because the information provided is consistent with the guidance provided in RG 4.21 and NEI 08-08A for meeting the requirements of 10 CFR 20.1401 for minimizing contamination and facilitating decommissioning. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3511, Question 12.03-12.04-1** is being tracked as **Confirmatory Item 12.03-12.04-1**.

However, because the information provided in the response to **RAI 3511, Question 12.03-12.04-1** did not fully describe the design features for site specific SSCs, the issue remains open and the staff issued follow-up **RAI 4206, Question 12.03-12.04-11** asking the applicant to provide additional information about site-specific portions of the LWPS, the steam and condensate systems, the steam generator blow down system (SGBDS) and systems receiving distillate from the boron recycle system. The applicant's

response to **RAI 4206, Question 12.03-12.04-11**, dated September 22, 2010, provided additional information regarding site-specific design features to minimize contamination and committed to adding Table 12.3-201, "Regulatory Guide 4.21 Design Objectives and Applicable FSAR Subsection Information for Minimizing Contamination and Generation of Radioactive Waste" and Figure 12.3-201, "Yard Piping Routing and Building Penetration Schematic." The applicant stated in Table 1.9-202, "Comanche Peak Nuclear Power Plant Units 3 & 4 Conformance with Division 4 Regulatory Guides," its intention to conform to the guidance provided in RG 4.21. The applicant described design features for site specific SSCs that were provided to minimize contamination of the environment, such as use of corrosion resistant piping material, routing of some piping in pipe chases, the use of epoxy coatings in trenches, the use of double wall piping and the use of leakage detection instruments, consistent with the guidance contained in RG 4.21 for complying with 10 CFR 20.1406. The NRC staff finds the applicant's response acceptable because the information provided is consistent with the guidance provided in RG 4.21 and NEI 08-08A for meeting the requirements of 10 CFR 20.1401 for minimizing contamination and facilitating decommissioning. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4206, Question 12.03-12.04-11** is being tracked as **Confirmatory Item 12.03-12.04-9**.

Following discussions with the staff regarding the completeness of the response provided in RAI 4206, Question 12.03-12.04-11, the applicant submitted a supplemental response to **RAI 4206, Question 12.03-12.04-11**, dated April 13, 2011, in which the applicant committed to changing the CPNPP, Units 3 and 4 FSAR to include: a description of the provisions for preventing contamination from the Condensate Storage Tank (CST) overflow line; additional information about preventing contamination from some below grade piping; additional information about the design features of the site specific portions SGBDS provided to minimize contamination, and some design features of the site specific Auxiliary Boiler provided to minimize contamination. The applicant:

- stated that the CST overflow line would be directed to a sump, equipped with an alarm, located within a diked area,
- stated that the SGBDS design would include the use of epoxy coatings, collection sumps and a leakage detection instrument,
- provided additional information in Table 12.3-201, "Regulatory Guide 4.21 Design Objectives and Applicable FSAR Subsection Information for Minimizing Contamination and Generation of Radioactive Waste,"
- added Figure 9.2.6-1, "Condensate Storage Facilities System Flow Diagram," and
- described controls for fluids from the Auxiliary Boiler.

The staff finds the applicant's response to **RAI 4206, Question 12.03-12.04-11**, dated April 13, 2011, acceptable because these methods are consistent with the guidance provided in RG 4.21 for meeting the requirements of 10 CFR 20.1401 for minimizing contamination and facilitating decommissioning. The staff will confirm that the proposed

revision to CPNPP, Units 3 and 4 FSAR Section 12.3 for this portion of the response to **RAI 3511, Question 12.03-12.04-11** is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3511, Question 12.03-12.04-11** is being tracked as **Confirmatory Item 12.03-12.04-10**.

Following a teleconference with the applicant held on May 24, 2011, to clarify some aspects of the applicant's previous supplemental response, the applicant submitted supplemental responses to **RAI 4206, Question 12.03-12.04-11**, dated July 28, 2011, in which the applicant committed to changing the characterization of some non-radiological areas through which pipes containing radioactive material transit. The applicant's response deleted the phrase "...with no piping system containing radioactive material and no other radioactive material located within the area,..." from FSAR Appendix 9A "Fire Hazard Analysis," for those non-radiological areas of the plant through which pipes containing radioactive material transit. The responses provided by the applicant are consistent with the guidance contained within RG 4.21 and comply with the requirements of 10 CFR 20.1406 for minimizing contamination of the facility and the environment and for facilitating decommissioning. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 4206, Question 12.03-12.04-11** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4206, Question 12.03-12.04-11** is identified as **Confirmatory Item 12.03-12.04-11**.

The guidance contained in RG 4.21 describes an acceptable method of meeting the requirement of 10 CFR 20.1406(a) for describing the procedures for operation that will minimize contamination of the facility and the environment and also facilitate decommissioning. Guidance contained in RG 4.21 states that plans and procedures to facilitate decommissioning should include comprehensive video records of the equipment layout in areas where radiation fields are expected to be high following operations and further notes that construction records should include global positioning system readings that pinpoint all buried component locations, particularly components in the site environs. NEI template NEI 08-08A endorses the guidance of Electric Power Research Institute (EPRI) technical report 1016099, "Groundwater Protection Guidelines for Nuclear Power Plants - Public Edition," dated January 2008, which notes that photographs taken during the construction phase that show foundations, pipes, conduits and other below grade structures should be used as part of the site conceptual model. The staff issued its SE that approved of NEI 08-08A on October 19, 2009. In CPNPP, Units 3 and 4 FSAR Chapter 12, the applicant did not, however, describe the intended practices with respect to documentation of actual structures located below grade or in high radiation areas of the plant. Therefore, the staff in **RAI 3318, Question 12.03-12.04-7**, requested that the applicant describe the methods that will be used to provide as-built construction details needed to support the continual maintenance of the Conceptual Site Model for groundwater movement, and the facility decommissioning efforts. In response to **RAI 3318, Question 12.03-12.04-7**, dated November 16, 2009, the applicant committed to revising CPNPP, Units 3 and 4 to reflect that the guidance provided in NEI 08-08A is used, including the use of photographs and video records during construction, to facilitate updating the Conceptual Site Model for groundwater movement. The applicant's response is consistent with the guidance in the SRP Section 12.3-12.4, "Radiation Protection Design Features," regarding facilitation of decommissioning and meets the requirements of 10 CFR Part 20.1406. Accordingly, the

staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3318, Question 12.03-12.04-7** to be resolved. However, the CPNPP, Units 3 and 4 FSAR has not yet been updated to include the information provided in the response to the above question. Therefore **RAI 3318, Question 12.03-12.04-7** is identified as **Confirmatory Item 12.03-12.04-6** and the staff will confirm that this information is included in a future revision of the CPNPP, Units 3 and 4 FSAR.

In addition to addressing the US-APWR COL information items, the applicant noted in CPNPP, Units 3 and 4 FSAR Subsection 12.2.1.1.10 that radioactive wastes will be stored in a site-specific Interim Radioactive Waste Storage Facility, to be constructed outside the plant structures. SRP Section 11.4, "Solid Waste Management System," Appendix 11.4-A, "Design Guidance for Temporary Storage of Low-Level Radioactive Waste," and the guidance of NRC GL 81-38, "Storage of Low Level Radioactive Wastes at Power Reactor Sites," provide guidance applicable to meeting the requirements of GDC 61, GDC 63, 10 CFR 20.1801. However, the applicant did not include in the FSAR any radiation protection design information that would allow the staff to make a reasonable assurance determination of compliance with these requirements. Therefore, in **RAI 3318, Question 12.03-12.04-4**, the staff asked the applicant to provide this information. In response to **RAI 3318, Question 12.03-12.04-4** dated November 16, 2009, the applicant committed to revising CPNPP, Units 3 and 4 FSAR Subsection 11.4.2.3, "Packaging, Storage, and Shipping," to describe the Interim Radioactive Waste Storage Facility radiation protection design features and design criteria discussed in the July 2009 Health Physics Safety Site Visit Information Need (ADAMS Accession Number ML091690542), item HP-09 and to revise the CPNPP, Units 3 and 4 FSAR to include a statement that the interim radioactive Waste Storage Facility will comply with 10 CFR Part 50, Appendix A, GDC 61 and GDC 63, as well as 10 CFR 20.1801, and conform to the guidance of GL 81-38. The applicant's response is consistent with the guidance in the SRP Section 12.3-12.4, SRP Appendix 11.4-A and RG 8.8, regarding the description of radiation protection design features and meets the requirements of 10 CFR 20.1101(b) and 10 CFR 20.1801. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3317, Question 12.01-2** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3318, Question 12.03-12.04-4** is being tracked as **Confirmatory Item 12.03-12.04-4**.

Title 10 of the *Code of Federal Regulations*, Part 20, "Standards for Protection Against Radiation," Section 1101(b), "Radiation protection programs" requires that OREs be maintained as ALARA. 10 CFR 20.1406(b), "Minimization of contamination" requires licensees to describe design feature to reduce contamination of the facility, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. US-APWR DCD Tier 2 Subsection 12.1.2.1, "General Design Considerations for Keeping Exposures ALARA" states that the US-APWR design supports the use of zinc injection (into the reactor coolant system) as one of the possible methods to reduce ORE. MHI, the applicant for the US-APWR DCD has stated that while the standard design does ensure that zinc injection can be employed and the standard certified design includes provisions for future implementation by applicants, the zinc injection system is not directly a part of the standard certified design, and no specific equipment is included for zinc injection in the standard certified design. Industry

literature documents the impact the use of zinc injection has on reducing ORE and reducing facility contamination. The CPNPP, Units 3 and 4 FSAR Chapter 12, "Radiation Protection" did not state whether the applicant intends to use zinc injection; CPNPP, Units 3 and 4 FSAR Chapter 9, "Auxiliary Systems" does not describe the locations of components, piping and interfaces to plant systems, of the zinc injection system and CPNPP, Units 3 and 4 FSAR Section 12.3, "Radiation Protection Design Features" did not describe the use of the zinc injection components for ORE reduction. As such, in **RAI 5981, Question 12.03-12.04-12**, the staff asked the applicant to describe in CPNPP, Units 3 and 4 FSAR Chapter 12, the use of zinc injection at CPNPP, Units 3 and 4, and to describe the locations of components, piping and interfaces of the zinc injection system to plant systems in the appropriate sections of CPNPP, Units 3 and 4 FSAR Chapter 9. In response to **RAI 5981, Question 12.03-12.04-12**, dated September 16, 2011, the applicant committed to revising CPNPP, Units 3 and 4 to describe the use of zinc injection, including the target concentration values, the major components of the system and where the system connects to other plant systems. Because the applicant's response is consistent with the guidance in SRP Section 12.3-12.4 regarding provisions for reducing plant ORE consistent with the requirements of 10 CFR 20.1101(b), the staff considers this issue to be resolved. The staff will confirm that the proposed revisions to the affected portions of the CPNPP, Units 3 and 4 FSAR are incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 5981, Question 12.03-12.04-12** is being tracked as **Confirmatory Item 12.03-12.04-12**

12.3.5 Post-Combined License Activities

There are no post-COL activities related to this section.

12.3.6 Conclusion

The staff is reviewing the information in DCD Section 12.3 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to radiation protection design features incorporated by reference in the CPNPP, Units 3 and 4 COL FSAR will be documented in the staff's SE of the DC application for the US-APWR design. The SE for the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 12.3 of this SE to reflect the final disposition of the DC application.

The staff has reviewed the applicant's submittal to the requirements of 10 CFR Part 20 as it relates to limits on doses to occupationally exposed persons in restricted areas, and the requirements of GDC 61, as it relates to the information on radiation sources provided by the applicant.

The staff concludes, based on COL FSAR Section 12.3, and the applicant's responses to the RAIs listed below:

RAI 3511, Question 12.03-12.04-1	Confirmatory Item 12.03-12.04-1	20.1406
RAI 3318, Question 12.03-12.04-2	Confirmatory Item 12.03-12.04-2	VHRAs
RAI 3318, Question 12.03-12.04-3	Confirmatory Item 12.03-12.04-3	Calibration
RAI 3318, Question 12.03-12.04-4	Confirmatory Item 12.03-12.04-4	Waste
RAI 3318, Question 12.03-12.04-7	Confirmatory Item 12.03-12.04-6	20.1406

RAI 4206, Question 12.03-12.04-11 Confirmatory Item 12.03-12.04-9 20.1406
RAI 4206, Question 12.03-12.04-11 Confirmatory Item 12.03-12.04-10 20.1406
RAI 4206 Question 12.03-12.04-11 Confirmatory Item 12.03-12.04-11 20.1406
RAI 5981 Question 12.03-12.04-12 Confirmatory Item 12.03-12.04-12 Zinc Injection

and that the applicant's description of radiation protection design features help maintain occupational radiation exposures within regulatory limits and ALARA, comply with the requirements of 10 CFR Part 20 and 10 CFR Part 50 and are consistent with the guidance contained in RG 8.8, RG 8.38, RG 4.21 and NUREG-0737. The staff evaluated COL Information Items, and COL Supplemental information:

- CP COL 12.3(4), as it relates to on-site radiation zones, is acceptable because radiation zones for site specific structures as depicted on Figure 12.3-1R, "Radiation Zones for Normal Operation/Shutdown (Sheet 1 of 34) Site," such as the Condensate Water Storage Tanks, and the Interim Radwaste Storage/Staging Building, appear to be consistent with the expected use of the structures, and the guidance in SRP Section 12.3. Because the plant design and layout facilitates the control of access to and work within plant areas in accordance with the requirements of 10 CFR 20.1601, 10 CFR 20.1602, 10 CFR 20.1901 and 10 CFR 20.1902, the staff concludes that the applicant has adequately addressed CP COL 12.3(4).
- CP COL 12.3(5), as it relates to administrative control of the fuel transfer tube inspection and the access control of the area near the seismic gap below the fuel transfer tube, is acceptable because NEI 07-03A and NEI 07-08A, which are incorporated by reference, provide acceptable methods of describing the radiation protection and ALARA programs that the staff has reviewed and found to be acceptable. The use of physical barriers in conjunction with the administrative controls describe in NEI 07-03A and NEI 07-08A is consistent with the guidance provided in RG 8.38 for meeting the access control requirements for VHRAs stated in 10 CFR 20.1602. The information that the applicant committed to providing is consistent with the guidance provided in NEI 07-03A for meeting the requirements of 10 CFR 20.1602 regarding control of access to VHRAs. Based on the review as documented above, and the applicant's response to **RAI 3318, Question 12.03-12.04-2** which is being tracked as **Confirmatory Item 12.03-12.04-2**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.3(5).
- CP COL 12.3(1), as it relates to portable instruments, is acceptable because NEI 07-03A which is incorporated by reference provides an acceptable method of describing the radiation protection program that the staff has reviewed and found to be acceptable. The use of portable instruments, and the associated training to determine airborne radioiodine concentrations during and following an accident consistent with the criteria in NUREG-0737, Item III.D.3.3, is described in NEI 07-03A. Assurance that the instruments will be calibrated in accordance with the requirements of 10 CFR 20.1501 is provided by the use of consensus

standards as a basis for establishing the methods for calibrating these instruments. Based on the review as documented above, and the applicant's response to **RAI 3318, Question 12.03-12.04-3** which is being tracked as **Confirmatory Item 12.03-12.04-3**, the staff concludes that the applicant has adequately addressed COL information item CP COL 12.3(1).

- CP SUP 12.3(1), as it relates to the ESW pipe tunnel structure at elevation 793'-1" has been changed in the site-specific layout, is acceptable because while the US-APWR DCD does note that radioactive contaminants may enter the ESWS from the CCWS, the system is designed to detect and preclude release of radioactive contaminants to the environment. Because the concentration of radioactive material expected to be present within the ESW piping contained within the ESW pipe tunnel is not expected to result in external dose rates, the area is zoned consistent with the guidance contained in SRP Section 12.3-12.4. Because the supplemental information provided by the applicant is consistent with the guidance provided in SRP Section 12.3-12.4 regarding radiations zones established to ensure compliance with 10 CFR 20, the staff concludes that the information provided by the applicant is acceptable.

Additional Technical Evaluation:

- The applicant provided information regarding the design criteria of the proposed interim radioactive waste storage facility. The applicant committed to using the guidance contained in SRP Appendix 11.4-A and GL 81-38 to ensure that the facility design would meet the requirements of 10 CFR 20.1801, GDC 61 and GDC63. Based on the review as documented above and the applicant's response to **RAI 3318, Question 12.03-12.04-4** which is being tracked as **Confirmatory Item 12.03-12.04-4**, the staff concludes that the information provided by the applicant is acceptable.

Consistent with the guidance contained in RG 4.21, the applicant provided additional information about site specific SSC design features provided to comply with the requirements of 10 CFR 20.1406 regarding minimizing contamination of the facility and the environment. The applicant committed to providing and describing design features to minimize contamination that is consistent with the guidance contained in RG 4.21. Based on the review as documented above and the applicant's responses to **RAI 3511, Question 12.03-12.04-1**, which is being tracked as **Confirmatory Item 12.03-12.04-1**; **RAI 3318, Question 12.03-12.04-7**, which is being tracked as **Confirmatory Item 12.03-12.04-6**; **RAI 4206, Question 12.03-12.04-11**, which is being tracked as **Confirmatory Item 12.03-12.04-9**; **RAI 4206, Question 12.03-12.04-11**, which is being tracked as **Confirmatory Item 12.03-12.04-10** and **RAI 4206, Question 12.03-12.04-11**, which is being tracked as **Confirmatory Item 12.03-**

12.04-11, the staff concludes that the information provided by the applicant is acceptable.

Consistent with the guidance contained in RG 4.21 and RG 8.8 the additional information the applicant provided regarding the use of zinc injection provided to comply with the requirements of 10 CFR 20.1406 regarding minimizing contamination of the facility and the environment and 10 CFR 20.1101 regarding maintaining ORE ALARA. The applicant committed to including a description of the zinc injection process. Based on the review as documented above and the applicant's responses to **RAI 5981, Question 12.03-12.04-12**, which is being tracked as **Confirmatory Item 12.03-12.04-12**, the staff concludes that the information provided by the applicant is acceptable.

12.4 Dose Assessment

12.4.1 Introduction

This section focuses on dose rates during normal operation, AOOs, and accident conditions. The estimated annual personnel doses associated with major functions, such as operation, handling of radioactive waste, normal maintenance, special maintenance (e.g., steam generator tube plugging), refueling, and in-service inspection provide a measure of the effectiveness of the proposed design features in Section 12.3.

12.4.2 Summary of Application

Section 12.4 "Dose Assessment" of the CPNPP, Units 3 and 4 COL FSAR, Revision 1 incorporates by reference Section 12.4, "Dose Assessment" of the US-APWR DCD, Revision 2.

In addition, in CPNPP, Units 3 and 4 COL FSAR Section 12.4, the applicant provided the following:

US-APWR COL Information Item

- CP COL 12.4(1)

The applicant provided additional information in CP COL 12.4(1) to address COL Information Item 12.4(1) regarding dose to construction workers.

Interface Requirements

The US-APWR DCD Tier 2, Revision 2, Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 12.4 of the DCD.

12.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD. In addition, acceptance criteria associated with the relevant requirements of the Commission's regulations for the dose assessment are given in Section 12.4, "Radiation Protection Design Features" of NUREG-0800. The applicable regulatory requirements for the dose assessment are as follows:

1. 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003, as they relate to persons involved in licensed activities making every reasonable effort to maintain radiation exposures ALARA.
2. 10 CFR 20.1201, as it relates to occupational dose limits for adults.
3. 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, 10 CFR 20.1204, 10 CFR 20.1701, and 10 CFR 20.1702, as they relate to design features, ventilation, monitoring, and dose assessment for controlling the intake of radioactive materials.
4. 10 CFR 20.1301 and 10 CFR 20.1302, as they relate to the facility design features that impact the radiation exposure to a member of the public from non-effluent sources associated with normal operations and AOOs.
5. 10 CFR 20.1406, "Minimization of contamination," as it relates to the design features that will facilitate eventual decommissioning and minimize, to the extent practicable, the contamination of the facility and the generation of radioactive waste.
6. 10 CFR 20.1601, 10 CFR 20.1602, 10 CFR 20.1901, 10 CFR 20.1902, 10 CFR 20.1903, and 10 CFR 20.1904, as they relate to the identification of potential sources of radiation exposure and the controls of access to, and work within, areas of the facility with a high potential for radiation exposure.
7. 10 CFR 20.1801, as it relates to securing licensed materials against unauthorized removal from the place of storage.
8. 10 CFR 52.80(a), which requires that a COLA address the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, and the NRC's regulations.

The related acceptance criteria are as follows:

The following RGs, NUREGs, and industry standards provide information, recommendations, and guidance and in general describe a basis acceptable to the staff for implementing the requirements of the regulations identified above:

1. RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4, issued June 2006, as it relates to a method acceptable to the staff for complying with the Commission's regulations to provide instrumentation for radiation monitoring following an accident in a light-water-cooled nuclear power plant.
2. RG 8.2, "Guide for Administrative Practices in Radiation Monitoring," Revision 1, issued May 2011, as it relates to general information regarding radiation monitoring programs for administrative personnel.
3. RG 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," Revision 3, issued June 1978, as it relates to actions taken during facility design, engineering, construction, operation, and decommissioning to maintain ORE ALARA in accordance with 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003, concerning the radiation protection information to be supplied in SAR Section 12.
4. RG 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable," Revision 1-R, issued May 1997, as it relates to the commitment by management and vigilance by the radiation protection manager and staff to maintain ORE ALARA in accordance with 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003 .

12.4.4 Technical Evaluation

The staff reviewed Section 12.4 of the CPNPP, Units 3 and 4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to dose assessment. Section 12.4 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The staff's technical evaluation of the information incorporated by reference related to dose assessment will be documented in the staff's SE of the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP, Units 3 and 4 COL FSAR:

US-APWR COL Information Item

- CP COL 12.4(1)

The staff reviewed CP COL 12.4(1) related to COL Information Item 12.4(1) included under Section 12.4 of the CPNPP, Units 3 and 4 COL FSAR. In CPNPP, Units 3 and 4 FSAR Section 12.4.1.9, "Dose to Construction Workers," the applicant discussed some of the potential exposure pathways for workers involved with the construction of CPNPP, Units 3 and 4. The applicant's supplemental information regarding Section 12.4.1.9,

included Sections 12.4.4.1.9.1, "Site Layout," through 12.4.4.1.9.4.4, "Total Doses." The applicant states, in part the following information:

12.4.4.1.9 Dose to Construction Workers

RG 1.206, Revision 1, "Combined License Applications for Nuclear Power Plants (LWR Edition)," requires that an annual dose to construction workers be estimated in a new unit construction area for multi-unit plants. This subsection discusses the potential radiological dose impacts to construction workers at the CPNPP, Units 3 and 4 resulting from the operation of CPNPP, Units 1 and 2. Because the CPNPP, Units 3 and 4 construction period occurs while CPNPP, Units 1 and 2 are operating, construction workers at CPNPP, Units 3 and 4 would be exposed to direct radiation and gaseous radioactive effluents from CPNPP, Units 1 and 2. Doses to CPNPP, Unit 4 construction workers from operation of CPNPP, Unit 3 are not evaluated because the CPNPP, Unit 4 construction will be substantially complete and many of the construction workers gone before CPNPP, Unit 3 begins commercial operation. Gaseous effluent releases from CPNPP, Unit 3 during fuel loading and low power testing, less than 5 percent power, are not expected to be significant, and are bounded by the conservatism in the applicant's dose estimate. During CPNPP, Unit 3 testing, the overall work force, as well as outdoor construction activities on CPNPP, Unit 4, would be reduced.

12.4.4.1.9.1 Site Layout

The CPNPP, Units 3 and 4 power block areas are shown on FSAR Figure 1.2-1R, "Site Plan". As shown, the additional units would be located northwest of the protected area for the existing units. Construction activity for CPNPP, Units 3 and 4 would be outside the protected area for CPNPP, Units 1 and 2, but inside the restricted area boundary.

12.4.4.1.9.2 Radiation Sources

Workers constructing CPNPP, Units 3 and 4 could be exposed to direct radiation and to gaseous and liquid radioactive effluents emanating from the routine operation of CPNPP, Units 1 and 2.

12.4.4.1.9.2.1 Direct Radiation

The refueling water storage tanks are the principal contained sources that could contribute to direct radiation exposure at the construction site. This source is not significant at CPNPP, Units 1 and 2 because a 0.76 meter (2 ft.-6 in.) thick concrete wall, instead of a thin steel shell wall is used to enclosed the refueling water storage tanks. CPNPP, Units 1 and 2 do not currently have an independent spent fuel storage installation (ISFSI); therefore, this source of direct radiation is not considered. In general, the dose rate at a proposed ISFSI protected area fence would be below 0.05 mSv/h (5 mrem/h). The radiation intensity from the ISFSI decreases with distance from the source, varying as the inverse square of the distance. For a point source, the following relation expresses the inverse square spreading effect:

$$\phi = S/4 R^2$$

Where ϕ is the intensity at the surface of a sphere of radius R, and S is the source strength. The energy twice as far from the source is spread over four times the area; therefore, it has one fourth the intensity. The distance from the CPNPP, Units 3 and 4 construction area to any potential ISFSI site is well over 1000 ft. Neglecting attenuation in the air and applying the inverse square relation, a 0.05 mSv/h (5 mrem/h) dose rate within the confines of the ISFSI (at an assumed distance of one ft from the source) would be reduced to 5.0E-8 mSv/h (5.0E-06 mrem/h) at about 305 meter (1000 ft) from the ISFSI facility. Considering an exposure period of 2500 h/y, the annual dose to a construction worker from direct radiation emanating from the ISFSI would be 1.25E-4 mSv/y (1.25E-02 mrem/y).

12.4.4.1.9.2.2 Gaseous Effluents

Some radioactive gaseous effluents are released on a batch basis from CPNPP, Units 1 and 2 to the environment. Release pathways in this category include intentional discharges from the containment purge exhaust and the waste gas decay tanks via the plant vent stacks. Radioactive gaseous effluents are released continuously from CPNPP, Units 1 and 2 to the environment from the fuel buildings, safeguards buildings, and auxiliary building ventilation exhaust systems, and the condenser off gas system via the plant vent stacks.

The CPNPP, Units 1 and 2 annual releases for 2006 were reported in the "Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006." The contribution of gaseous effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 & 4 FSAR Chapter 11, "Radioactive Waste Management System".

12.4.4.1.9.2.3 Liquid Effluents

Effluents from the liquid waste disposal system introduce small amounts of radioactivity into SCR and the low volume waste pond. The CPNPP, Units 1 and 2 annual releases for 2006 were reported in the "Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006." The contribution of liquid effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 and 4 FSAR Chapter 11.

12.4.4.1.9.3 Measured and Calculated Dose Rates

12.4.4.1.9.3.1 Direct Radiation

CPNPP, Units 1 and 2 have a general area monitoring program that monitors various points inside the protected area. The limiting cumulative dose rate is 0.1 micro Sv/h (0.001 mrem/h) from the protected area fence thermoluminescent dosimeter (TLD) readings for 2006. This dose rate bounds the CPNPP, Units 3 and 4 construction workers direct radiation dose rate from CPNPP, Units 1 and 2 because this location is closer to CPNPP, Units 1 and 2 than to the CPNPP, Units 3 and 4 construction area.

12.4.4.1.9.3.2 Gaseous Effluents

The CPNPP, Units 1 and 2 annual releases for 2006 were reported in the "Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006." The contribution of gaseous effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 and 4 FSAR Chapter 11 "Radioactive Waste Management System".

12.4.4.1.9.3.3 Liquid Effluents

The CPNPP, Units 1 and 2, "Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006," reports doses calculated in accordance with the existing units' Offsite Dose Calculation Manual. The contribution of liquid effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 and 4 FSAR Chapter 11.

12.4.4.1.9.4 Construction Worker Doses

Construction worker doses were conservatively estimated using the following information:

- The estimated maximum dose rate for each pathway.
- An exposure time of 2500 h/y (50 h/week * 50 week/y).
- A peak loading of 4300 construction workers per year.

The estimated maximum annual dose for each pathway as well as the total dose is discussed below.

12.4.4.1.9.4.1 Direct Radiation

Using the protected area fence cumulative dose rate of 0.1 micro Sv/h (0.001 mrem/h) from Subsection 12.4.1.9.3.1, the annual dose due to direct radiation at the CPNPP, Units 1 and 2 protected area fence would be 0.025 mSv (2.5 mrem) based on an exposure of 2500 h/y. This is the dose at the CPNPP, Units 1 and 2 protected area fence. Doses to the CPNPP, Units 3 and 4

construction workers would be reduced due to the distance to the construction area.

12.4.4.1.9.4.2 Gaseous Effluents

The CPNPP, Units 1 and 2, "Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006," reports doses calculated in accordance with the existing units' Offsite Dose Calculation Manual. The contribution of gaseous effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 & 4 FSAR Chapter 11.

12.4.4.1.9.4.3 Liquid Effluents

The annual liquid effluent doses to the maximally exposed member of the public are based on continuous occupancy and are adjusted for an exposure time of 2500 h/y. Although the liquid effluent dose rates to which the workers would be exposed are not expected to be as high as the dose to the maximally exposed member of the public, the doses calculated for the public are used. The contribution of liquid effluents from CPNPP, Units 1 and 2 to the radiation exposure of CPNPP, Units 3 and 4 construction workers was evaluated during the review of CPNPP, Units 3 and 4 FSAR Chapter 11.

12.4.4.1.9.4.4 Total Doses

The annual doses from all three pathways were compared to the public dose criteria of 10 CFR Part 20.1301 in Table 12.4-201, "Construction Worker Dose Comparison to 10 CFR Part 20.1301 Criteria." Because the calculated doses meet the public dose criteria of 10 CFR Part 20.1301, the workers do not need to be classified as radiation workers. The maximum annual collective dose to the construction work force of 4300 workers is estimated to be 0.1075 person-Sv (10.75 person-rem).

The projected doses are based on available dose rate measurements and calculations. It is possible that these dose rates could increase in the future as site conditions change. The site will be continually monitored during the construction period, and appropriate actions would be taken as necessary to ensure that the construction workers are protected from radiation.

The annual estimated construction worker doses attributable to the operation of CPNPP, Units 1 and 2 for the proposed construction areas for CPNPP, Units 3 and 4 are below 10 CFR Part 20 limits. Therefore, in accordance with 10 CFR 20.1301 criteria, monitoring of individual construction workers is not required.

The NRC Staff's Evaluation

The estimated maximum dose to an individual construction worker is well within the 10 CFR 20.1301 and 10 CFR 20.1302 dose limits for individual members of the public of 100 mrem in one year and 2 mrem in any one hour. The applicant has stated that

construction workers at CPNPP, Units 3 and 4 will be considered members of the public for the purposes of exposure control, estimates of dose, training, and dosimetry.

The dose limits to the construction workers are reviewed by the staff against 10 CFR 20.1301, which states in (a)(1) "The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year." CPNPP, Units 3 and 4 FSAR Chapter 12.4.1.9.4.1, "Direct Radiation," states that the refueling water storage tanks are the principal contained sources that could contribute to direct radiation exposure at the construction site resulting from the operation of CPNPP, Units 1 and 2. TLD readings from CPNPP, Units 1 and 2 protected area fence that form the basis for the construction worker direct dose assessment, do not account for doses from other sources such as: the current interim radioactive waste storage facility for CPNPP, Units 1 and 2, shipment/receipt of CPNPP, Units 1 and 2 outage support equipment and materials, movement of radioactive materials during CPNPP, Units 1 and 2 outages and other radioactive material storage areas of CPNPP, Units 1 and 2. Since the CPNPP, Units 3 and 4 FSAR Section 12.4 does not describe the location of the TLDs used to determine the construction worker dose estimates, it is not clear if the reported values are bounding for all of the onsite construction workers. Therefore, in **RAI 3318, Question 12.03-12.04-5**, the staff asked the applicant to provide additional information regarding the potential sources of direct exposure to construction workers and the location of TLDs used to perform the construction worker exposure estimates. The applicant's response to **RAI 3318, Question 12.03-12.04-5**, dated November 16, 2009, stated that because the distance to applicant identified sources of direct radiation exposure to construction workers was greater than 1000 feet, and worker exposure rates would be kept to less than 0.02 mSv/h (2 mrem/h) in accordance with the current site radiation protection program, the applicant did not need to specify the location of the TLDs. Because applicant's response failed to address the identified issues, this question is closed but this issue was not resolved and the staff issued follow up **RAI 4207, Question 12.03-12.04-10** which stated that controlling construction worker to exposure to dose rates less than 2 mrem/hr does not address § 20.1301 (a)(1), which limits doses to members of the public to 100 mrem (1 milli Sv) in a year, nor does it address the requirements of § 20.1101 (b), which requires exposure to members of the public be ALARA, and asked the applicant to describe how it would meet the requirements of 10 CFR 20.1101, 10 CFR 20.1301 and 10 CFR 20.1302 for construction workers. The applicant's response to **RAI 4207, Question 12.03-12.04-10**, dated March 18, 2011, committed to revising the CPNPP, Units 3 and 4 FSAR Subsection 12.2.1.1.10, "Miscellaneous Sources" and Subsection 12.4.1.9 to include a statement that the applicant procedures to control, limit and monitor cumulative dose for construction workers and security employees would ensure that the total exposure for each construction worker and security employee is maintained less than 100 mrem per year in accordance with 10 CFR 20.1301. The applicant's response is consistent with the guidance in the SRP Section 12.3-12.4 regarding control of dose to members of the public, and meets the requirements of 10 CFR Part 201301. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 4207, Question 12.03-12.04-10** to be resolved. The staff will confirm that the proposed revisions to CPNPP, Units 3 and 4 FSAR Section 12.1 and Section 12.3 are incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4207, Question 12.03-12.04-10** is being tracked as **Confirmatory Item 12.03-12.04-8**.

10 CFR 20.1301 (a)(1) states, "The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year." CPNPP, Units 3 and 4 FSAR Section 12.4.1.9 provides a description of the potential sources of exposure to construction workers, and states that the dose limits to the workers are reviewed by the staff against the standards of 10 CFR 20.1301. CPNPP, Units 3 and 4 FSAR Subsection 12.4.1.9.4.3 discusses sources of exposure from effluents to site construction workers, but does not include potential exposure to liquid effluents from CPNPP, Units 1 and 2 while workers are performing liquid waste effluent discharge piping connections. In addition, CPNPP, Units 3 and 4 FSAR Subsection 12.4.1.9 discusses sources of exposure from operating reactors, other than CPNPP, Units 1 and 2, to site construction workers, who are treated as members of the public, and states that construction work from low power testing at less than five percent power at CPNPP, Unit 3, is not expected to present a significant source of exposure to the construction workers. However, there is no discussion of the controls or reviews that are required prior to operation of one of the units at a power level greater than five percent while construction work is still in progress, nor does it address the condition of operation of CPNPP, Unit 4, while construction work is still in progress. Therefore, in **RAI 3318, Question 12.03-12.04-6**, the staff asked the applicant to provide additional information regarding the control of construction worker exposure. In response to **RAI 3318, Question 12.03-12.04-6**, dated November 16, 2009, the applicant committed to revising the CPNPP, Units 3 and 4 FSAR to clarify the radiation protection requirements for construction workers involved with connections to existing radioactive systems at CPNPP, Units 1 and 2, and exposure of construction workers as a result of the operation of CPNPP, Unit 3 at above five percent power, in compliance with 10 CFR 20.1301. In addition, to ensure compliance with 10 CFR 20.1302, Radiation Work Permits will be used to control construction work exposure to effluent materials during connection to the existing plant piping containing radioactive material. The applicant's response is consistent with the guidance in the SRP Section 12.3-12.4 regarding control of dose to members of the public and meets the requirements of 10 CFR Part 20.1301 and 10 CFR 20.1302. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3318, Question 12.03-12.04-6** to be resolved. The NRC staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.3 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3318, Question 12.03-12.04-6** is being tracked as **Confirmatory Item 12.03-12.04-5**.

10 CFR 20.1001(b) states in part that the control, receipt, possession, use, transfer, and disposal of licensed material will be done in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations of 10 CFR Part 20. The applicant has stated that construction workers at CPNPP, Units 3 and 4 will be considered members of the public for the purposes of exposure control, estimates of dose, training, and dosimetry. Public dose as defined in 10 CFR 20.1003, includes the dose received by a member of the public from exposure to "... any other source of radiation under the control of a licensee exclusive of occupational, background, or medical administrations." NUREG-1736 provides further guidance, noting that the 10 CFR 20.1301 limits for public dose from licensed activities includes dose from transient activities (i.e., dose in any one hour) and cumulative activities over a year, and further notes that this regulation is applicable to all NRC licensees whose activities may

result in exposure to members of the public. NUREG-1736 also notes that the licensee must have a written radiation protection program to reduce exposure, including to members of the public, and to address 10 CFR 20.1101 with reviews to be performed at least annually. Because the radiation protection program implementation milestones stated within NEI 07-03A will not have the required elements for ALARA and program reviews until after receipt of radioactive sources by the COL, it was not clear to the staff how the COL licensee would conform to the guidance for construction worker exposure controls after receipt of the COL and prior to the implementation milestones described in NEI 07-03A. Therefore, in **RAI 3318, Question 12.03-12.04-8**, the staff asked the applicant to revise the CPNPP, Units 3 and 4 FSAR to provide information regarding the radiation program elements associated with maintaining Construction Worker doses ALARA consistent with the guidance of NUREG-1736, due to exposure resulting from licensee related activities, such as construction related radiography and other uses of radioactive materials related to COL construction activities. In response to **RAI 3318, Question 12.03-12.04-8**, dated November 16, 2009, the applicant committed to revising the CPNPP, Units 3 and 4 FSAR to include monitoring of the CPNPP site during the construction period, and stated that use of radioactive materials and sources during construction, such as sources used in radiography, would be controlled and monitored to maintain construction worker doses ALARA. However, since the Radiation Protection milestones described in CPNPP, Units 3 and 4 FSAR Table 13.4-201, "Operational Programs Required by NRC Regulation and Program Implementation" do not require any radiation protection program elements until the receipt of radioactive sources under the COL, the staff is unable to determine who has responsibility for monitoring and controlling cumulative construction worker dose resulting from activities of diverse licensees after issuance of the COL but prior to the radiation protection milestones as described in NEI 07-03A. Therefore, this issue is considered closed, but unresolved, and the staff issued follow up **RAI 4207, Question 12.03-12.04-9** asking the applicant to describe who would be responsible for ensuring that doses to CPNPP, Units 3 and 4 construction workers meet the requirements of § 20.1101, 1301 and 1302. In response to **RAI 4207, Question 12.03-12.04-9**, dated March 18, 2011, the applicant committed to revising the CPNPP, Units 3 and 4 FSAR to ensure that prior to the implementation of the CPNPP, Units 3 and 4 radiation protection program, the controls in the Offsite Calculation Manual (ODCM) for CPNPP, Units 1 and 2 and its supporting procedures would be used to control and monitor exposure and would be used to limit the dose in Unrestricted Areas (which includes the construction sites for Units 3 and 4), until the elements of the CPNPP, Units 3 and 4 radiation protection program are implemented per CPNPP, Units 3 and 4 FSAR Section 12.5 and Table 13.4-201. The applicant stated that construction worker doses maintained less than 1 mSv/y (100 mrem/y), including doses from sources brought on site by contractors performing construction services. The applicant's response is consistent with the guidance in the SRP Section 12.3-12.4 regarding control of construction worker dose and meets the requirements of 10 CFR 20.1101 regarding maintaining dose to members of the public ALARA and 10 CFR 20.1301 and 10 CFR 20.1302 regarding limiting dose to members of the public. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 4207, Question 12.03-12.04-9** to be resolved. The staff will confirm that the proposed revisions to CPNPP, Units 3 and 4 FSAR, Section 12.4 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4207, Question 12.03-12.04-9** is being tracked as **Confirmatory Item 12.03-12.04-7**.

Based on the information provided by the applicant to address CP 12.4(1) as discussed above, and the responses to **RAI 4207, Question 12.03-12.04-9** which is being tracked as **Confirmatory Item 12.03-12.04-7** and **RAI 4207, Question 12.03-12.04-10** which is being tracked as **Confirmatory Item 12.03-12.04-8**, the staff concludes that the applicant has adequately addressed CP COL 12.4(1).

12.4.5 **Post-Combined License Activities**

There are no post-COL activities related to this section.

12.4.6 **Conclusion**

The staff is reviewing the information in DCD Section 12.3-4 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to dose assessment incorporated by reference in the CPNPP, Units 3 and 4 COL FSAR will be documented in the staff's SE of the DC application for the US-APWR design. The SE for the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 12.4 of this SE to reflect the final disposition of the DC application.

The staff concludes, based on COL FSAR Section 12.4, and the applicant's responses to the RAIs listed below:

RAI 3318, Question 12.03-12.04-6	Confirmatory Item 12.03-12.04-5	Dose Limits
RAI 4207, Question 12.03-12.04-9	Confirmatory Item 12.03-12.04-7	100 mrem/y
RAI 4207, Question 12.03-12.04-10	Confirmatory Item 12.03-12.04-8	Source dose

and that the applicant's description of dose to construction workers, comply with the requirements of 10 CFR Part 20 and 10 CFR Part 50 and are consistent with the guidance contained in NUREG-1736.

The staff evaluated COL Information Item:

- CP COL 12.4(1), as it relates to dose to construction workers, is acceptable because the estimated maximum dose to an individual construction worker is well within the 10 CFR 20.1301 and 10 CFR 20.1302 dose limits for individual members of the public of 100 mrem in one year and 2 mrem in any one hour. The CPNPP, Units 3 and 4 construction period occurs while CPNPP, Units 1 and 2 are operating, therefore construction workers at CPNPP, Units 3 and 4 would be exposed to direct radiation and gaseous radioactive effluents from CPNPP, Units 1 and 2. However the applicant has committed to monitor the radiation doses to construction workers from the existing units, and diverse sources employed during construction, using the CPNPP, Units 1 and 2 ODCM prior to issuance of the COL. After the issuance of the COL, the Radiation Protection Program for CPNPP, Units 3 and 4 will ensure compliance with the public dose limits for construction workers once the program is implemented. The applicant will ensure that doses to CPNPP, Unit 4 construction workers from operation of CPNPP, Unit 3 will

remain within the limits of 10 CFR 20.1301. The information that the applicant committed to providing is consistent with the guidance provided in NEI 07-03A for meeting the requirements of 10 CFR 20.1602 regarding control of access to VHRAs. Based on the review as documented above, and the applicant's response to **RAI 3318, Question 12.03-12.04-6** which is being tracked as **Confirmatory Item 12.03-12.04-5, RAI 4207, Question 12.03-12.04-9** which is being tracked as **Confirmatory Item 12.03-12.04-7** and **RAI 4207, Question 12.03-12.04-10** which is being tracked as **Confirmatory Item 12.03-12.04-8**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.4(1).

12.5 Operational Radiation Protection Program

12.5.1 Introduction

The operational radiation protection program for a nuclear power facility assures that exposures of plant personnel to radiation are controlled and minimized. The administration of the radiation protection program and the qualifications of the personnel responsible for conducting various aspects of the radiation protection program and for handling and monitoring of radioactive material are important components of the program. Adequate equipment, instrumentation and facilities must also be provided for (1) performing radiation and contamination surveys, (2) in plant airborne radioactivity monitoring and sampling, (3) area radiation monitoring, and (4) personnel monitoring. Procedures and methods of operation, including those for ensuring that ORE will be ALARA, must be in place. This includes procedures used in normal operation, refueling, inservice inspections, handling of radioactive material, spent fuel handling, routine maintenance, and sampling and calibration related to radiation safety.

12.5.2 Summary of Application

Section 12.5, "Operational Radiation Protection Program," of the CPNPP, Units 3 and 4 COL FSAR, Revision 1 incorporates by reference Section 12.5, "Operational Radiation Protection Program" of the US-APWR DCD, Revision 2.

In addition, in CPNPP, Units 3 and 4 COL FSAR Section 12.5, the applicant provided supplemental information for the following COL Information items:

US-APWR COL Information Items

- CP COL 12.1(5)

The applicant provided additional information in CP COL 12.1(5) to address COL Information Item 12.1(5) regarding revising the contents of NEI 07-03A.

- CP COL 12.2(2), CP COL 12.3(1), and CP COL 12.3(5)

The applicant provided additional information in CP COL 12.2(2), CP COL 12.3(1), and CP COL 12.3(5) to revise the contents of NEI 07-03A.

License Conditions

In Revision 1 of its COLA, the applicant proposed to implement the following license condition in Table 13.4-201, "Operational Programs Required by NRC Regulation and Program Implementation," and Part 10, "Proposed ITAAC and License Conditions."

The licensee shall implement the Radiation Protection Program on or before the associated milestones below:

- Prior to initial receipt of by-product, source, or special nuclear materials (excluding exempt qualities as described in 10 CFR 30.18) for those elements of the Radiation Protection (RP) Program necessary to support such receipt.
- Prior to fuel receipt for those elements of the RP Program necessary to support receipt and storage of fuel on-site.
- Prior to fuel load for those elements of the RP Program necessary to support fuel load and plant operation.
- Prior to first shipment of radioactive waste for those elements of the RP Program necessary to support shipment of radioactive waste.

Interface Requirements

The US-APWR DCD Tier 2, Revision 2 Section 1.8, Table 1.8-1, "Significant Site-Specific Interfaces with the Standard US-APWR Design," identifies significant interfaces between the US-APWR standard design and the COLA. This table does not specify any interfaces related to Section 12.5 of the DCD.

12.5.3 **Regulatory Basis**

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the DCD.

In addition, the acceptance criteria associated with relevant requirements of the Commission's regulations for the operational RP program are given in Section 12.5, "Operational Radiation Protection Program" of NUREG-0800.

The applicable regulatory requirements for the operational RP program are as follows:

1. 10 CFR 19.12, as it relates to keeping workers informed about the storage, transfer, or use of radioactive materials or radiation and instructing them about the risk associated with ORE, necessary precautions, procedures to reduce exposures, and the purpose and function of the protective devices employed.

2. 10 CFR 20.1101, as it relates to (a) development, documentation, and implementation of a RP program; (b) the use of procedures and controls to achieve doses to workers and the public that are ALARA, as defined in 10 CFR 20.1003; and (c) the review and audit of the RP program content and implementation.
3. 10 CFR 20.1201, as it relates to occupational dose limits for adults.
4. 10 CFR 20.1201, 10 CFR 20.1202, 10 CFR 20.1203, and 10 CFR 20.1204, as they relate to demonstrating compliance with internal and external dose limits.
5. 10 CFR 20.1206 and 10 CFR 20.2105, as they relate to the authorization, control, and documentation of planned special exposures to adult workers.
6. 10 CFR 20.1207, as it relates to control of occupational radiation doses received by minors.
7. 10 CFR 20.1208, as it relates to control of radiation doses received by the embryo/fetus of a declared pregnant worker.
8. 10 CFR 20.1301 and 10 CFR 20.1302, as they relate to controlling radiation doses to individual members of the public and the maximum dose rate in unrestricted areas.
9. 10 CFR 20.1406, as it relates to the facility design and procedures for operation of the plant for minimizing contamination of the facility site.
10. 10 CFR 20.1501, as it relates to performance of surveys to comply with the regulations in 10 CFR Part 20.
11. 10 CFR 20.1501(c) and 10 CFR 20.1502, as they relate to requirements for providing appropriate personnel monitoring equipment to individuals who are occupationally exposed.
12. 10 CFR 20.1601, 10 CFR 20.1602, 10 CFR 20.1901, 10 CFR 20.1902, 10 CFR 20.1903, 10 CFR 20.1904, and 10 CFR 20.1905, "Exemptions to labeling requirements," as they relate to posting of, and control of access to, radiation areas, high radiation areas, very high radiation areas, airborne radioactivity areas, and other indicators necessary to identify and quantify the presence of radioactive materials in an area.
13. 10 CFR 20.1701 and 10 CFR 20.1702, as they relate to controlling the concentrations and limiting the intake of radioactive materials in the air.
14. 10 CFR 20.1703, as it relates to the use of respiratory protective equipment to limit the intake of radioactive material.

15. 10 CFR 20.1906, "Procedures for receiving and opening packages ", as it relates to appropriate handling of packages containing certain quantities of radioactive materials.
16. 10 CFR 20.1801, as it relates to securing licensed materials against unauthorized removal from the place of storage.
17. 10 CFR 20.1802, as it relates to controlling licensed material that is not in storage.
18. 10 CFR 20.2001, "General requirements" and 10 CFR 20.2006, "Transfer for disposal and manifests," as they relate to the transfer of radioactive materials and the disposal of low level radioactive waste.
19. 10 CFR 20.2101, "General provisions," 10 CFR 20.2102, "Records of radiation protection programs," 10 CFR 20.2103, "Records of surveys," 10 CFR 20.2104, "Determination of prior occupational dose," 10 CFR 20.2105, "Records of planned special exposures," 10 CFR 20.2106, "Records of individual monitoring results," 10 CFR 20.2107, "Records of dose to individual members of the public," and 10 CFR 20.2110, "Form of records," as they relate to maintaining records of individuals who are provided with personnel monitoring equipment and who are exposed to radiation, and records of the radiation protection program, including surveys.
20. 10 CFR 20.2201, "Reports of theft or loss of licensed material," as it relates to reports to the NRC required from licensees immediately after they become aware of any loss or theft of certain quantities of licensed material.
21. 10 CFR 20.2202, "Notification of incidents," 10 CFR 20.2203, "Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits," 10 CFR 20.2204, "Reports of planned special exposures," and 10 CFR 20.2205, "Reports to individuals of exceeding dose limits," as they relate to requirements for reports to the NRC concerning individual exposures that exceed regulatory limits, incidents requiring notification, levels of radiation or concentrations of radioactive materials in excess of certain values, and planned special exposures.
22. 10 CFR 20.2206, "Reports of individual monitoring," and 10 CFR 19.13, "Notifications and reports to individuals," as they relate to requirements for informing workers of the results of their individual monitoring.
23. 10 CFR 50.34 "Contents of construction permit and operating license applications; technical information," 10 CFR 50.34(f)(2)(viii) and 10 CFR 50.34(f)(2)(xxvii)1, as they relate to monitoring of in plant radiation and airborne radioactivity for routine and accident conditions. Refer also to NUREG-0737, Items II.B.3 and III.D.3.3, for additional detail and clarification of requirements.

24. 10 CFR 50.120, "Training and qualification of nuclear power plant personnel," as it relates to the provisions and requirements for training radiation protection technicians.
25. 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases," as it relates to the provision of appropriate monitoring for the reactor containment atmosphere and spaces containing components for the recirculation of loss-of-coolant accident (LOCA) fluids.
26. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 and Subpart H, "Quality Assurance," of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," as they relate to QA programs.
27. 10 CFR 71.5, "Transportation of licensed material," and Subpart G, "Operating Controls and Procedures," of 10 CFR Part 71, as they relate to the control of licensed radioactive material during packaging and transportation, as well as Subpart K, "Waste Disposal," of 10 CFR Part 20, as it relates to the transfer of low level radioactive materials and waste.

The related acceptance criteria are as follows:

The following RGs, NUREGs, and industry standards provide information, recommendations, and guidance describe a basis acceptable to the staff for implementing the requirements of the regulations identified above:

1. RG 1.8, "Qualification and Training of Personnel for Nuclear power Plants," Revision 3, issued May 2000, as it relates to compliance with the Commission's regulations regarding qualification of nuclear power plant personnel.
2. RG 1.33, "Quality Assurance Program Requirements (Operation)," Revision 2, issued February 1978, as it relates to compliance with the Commission's QA regulatory requirements during nuclear power plant operations.
3. RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4, issued June 2006, as it relates to compliance with the Commission's regulations to provide instrumentation to monitor plant variables and systems during and following an accident.
4. RG 8.2, "Guide for Administrative Practices in Radiation Monitoring," Revision 1, issued May 2011, as it relates to general information on radiation monitoring programs for administrative personnel.
5. RG 8.4, "Personnel Monitoring, Device - Direct - Reading Pocket Dosimeters," Revision 1, issued June 2011, as it relates to standards for

direct reading and indirect reading pocket dosimeters used for personnel dose or dose rate measurements.

6. RG 8.6, "Standard Test Procedure for Geiger Muller Counters," issued May 1973, as it relates to testing the operating characteristics of Geiger-Mueller counters before making calibrations and measurements.
7. RG 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data," Revision 2, issued November 2005, as it relates to the specification of records necessary to describe the ORE of individuals and to the conditions under which the exposure may occur.
8. RG 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," Revision 3, issued June 1978, as it relates to meeting the requirements of 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003 by providing RP information pertaining to actions taken during the design, construction, operation, and decommissioning to ensure that ORE remains ALARA.
9. RG 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program," Revision 1, issued July 1993, as it relates to appropriate concepts, models, equations, and assumptions to be used in determining the extent of an individual's intake of radioactive materials and resulting committed organ dose.
10. RG 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable," Revision 1-R, issued May 1977, as it relates to meeting the requirements of 10 CFR 20.1101(b) and the definition of ALARA in 10 CFR 20.1003 concerning commitment by the applicant's management and vigilance by the radiation protection manager and the RP staff to maintain ORE ALARA.
11. RG 8.13, "Instruction Concerning Prenatal Radiation Exposure," Revision 3, issued June 1999, as it relates to the description of the instruction to be provided concerning biological risks to embryos or fetuses resulting from prenatal ORE.
12. RG 8.15, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," Revision 3, issued June 1978, as it relates to elements of acceptable respiratory protection programs.
13. RG 8.27, "Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants," issued March 1981, as it relates to a radiation protection training and retraining program consistent with the ALARA objective and acceptable to the staff for meeting the training requirement of 10 CFR Part 19.

14. RG 8.28, "Audible-Alarm Dosimeters," issued August 1981, as it relates to the appropriate use of audible alarm dosimeters and the conditions under which they should not be relied on to perform their intended function.
15. RG 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," Revision 1, issued February 1996, as it relates to providing appropriate instruction on the risks associated with ORE to individuals who might be exposed that are acceptable to the staff for meeting the training requirement of 10 CFR Part 19.
16. RG 8.34, "Monitoring Criteria and Methods To Calculate Occupational Radiation Doses," issued July 1992, as it relates to criteria acceptable to the staff that licensees may use to determine when monitoring is required, as well as methods acceptable to the staff for calculating occupational doses when intake is known.
17. RG 8.35, "Planned Special Exposures," Revision 1, issued August 2010, as it relates to guidance on the conditions and prerequisites for permitting planned special exposures, as allowed by 10 CFR Part 20, and the associated specific monitoring and reporting requirements.
18. RG 8.36, "Radiation Dose to the Embryo/Fetus," issued July 1992, as it relates to determination of the total radiation dose to the embryo/fetus as the sum of the deep dose equivalent to, and dose to the embryo/fetus from, intakes of the declared pregnant worker.
19. RG 8.38, "Control of Access to High and Very High Radiation Areas of Nuclear Plants," Revision 1, issued May 2006, as it relates to guidance on acceptable methods to control access to high- and very high radiation areas in nuclear power plants that follows the requirements specified in 10 CFR Part 20.
20. NUREG-0731 "Guidelines for Utility Management Structure and Technical Resources," as it relates to appropriate staffing levels and technical expertise considered essential within a utility to support nuclear power plant operation properly.
21. NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 - Standards for Protection Against Radiation," as it relates to the requirements for a RP program (including program review and audit) and compliance with 10 CFR Part 20.

12.5.4 **Technical Evaluation**

The staff reviewed Section 12.5 of the CPNPP, Units 3 and 4 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic¹. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the operational

RP program. Section 12.5 of the US-APWR DCD is being reviewed by the staff under Docket Number 52-021. The staff's technical evaluation of the information incorporated by reference related to the operational RP program will be documented in the staff's SE of the DC application for the US-APWR design.

The staff reviewed the information contained in the CPNPP, Units 3 and 4 COL FSAR:

CP COL Information Items

- CP COL 12.1(5). The COL Applicant is to provide the operational RP program for ensuring that OREs are ALARA.

The staff reviewed CP COL 12.1(5) related to COL Information Item 12.1(5) included under Section 12.5 of the CPNPP, Units 3 and 4 COL FSAR. The applicant replaced the contents in DCD Section 12.5 with the following information and stated in part:

NEI 07-03A "Generic DCD Template Guidance for Radiation Protection Program Description" is incorporated by reference. Site specific elements of the radiation protection program will be implemented in accordance with the milestones listed in Table 13.4-201, "Operational Programs Required by NRC Regulation and Program Implementation", by utilizing of NEI 07-03A, and NEI 07-08A, Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA), Revision 3,

The staff issued its SEs that approved of NEI 07-03A and NEI 07-08A on March 18, 2009, and October 15, 2009, respectively. US-APWR DCD Tier 2, Section 12.1.3, "Operational Considerations," COL Information Item 12.1(1) and COL Information Item 12.1(3), states that the COL applicant will comply with the requirements of 10 CFR Part 20 and the guidance in the following RGs. Site specific information in the RP program will be implemented in accordance with the milestones listed in Table 13.4-201, "Operational Programs Required by NRC Regulation and Program Implementation," by utilizing NEI 07-03A and NEI 07-08A.

The staff reviewed the information that the applicant provided related to CP COL 12.2(2), CP COL 12.3(1), and CP COL 12.3(5) included under Section 12.5 of the CPNPP, Units 3 and 4 COL FSAR. The applicant added the following information after the first paragraph in Section 12.5.3.3 of NEI 07-03A:

In case the National Institute for Occupational Safety and Health/Mine Safety and Health Administration certified equipments are not used, equipments are used to be compliance with 10 CFR Part 20.1703(b) and 20.1705.

RG 8.15 provides guidance to licensees regarding methods acceptable to the staff for demonstrating compliance with the respiratory protection requirements of 10 CFR Part 20 Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas," and states that in 1988, the NRC and the Occupational Safety and Health Administration (OSHA) signed a Memorandum of Understanding (MOU) *Federal*

Register Notice 53 *FR* 43950, dated October 31, 1988, to clarify jurisdictional responsibilities at NRC-licensed facilities. The MOU makes it clear that if an NRC licensee is using respiratory protection to protect workers against non-radiological hazards, the OSHA requirements apply. In RG 8.15, licensees are cautioned, that in situations involving mixed hazards, such as airborne radioactive materials and non-radioactive hazardous materials, compliance with 10 CFR Part 20 alone may not provide sufficient protection. CPNPP, Units 3 and 4 FSAR Chapter 12 is silent with respect to respiratory protection program elements for non-radiological hazards from work activities in radiological controlled areas, or for respiratory protection training and equipment provided for dual use (radiological and non-radiological conditions such as the Control Room where respiratory protection equipment may be required for chemical or radiological accident or AOO conditions). Therefore in **RAI 3319, Question 12.05-1**, the staff asked the applicant to describe those program elements that will be used to satisfy the respiratory protection program requirements associated with non-radiological hazards (i.e. toxic gases, smoke or immediate danger to life and health (IDLH) atmospheres) that may be encountered in the radiological controlled areas of the plant. In response to **RAI 3319, Question 12.05-1**, dated November 11, 2009, the applicant stated that the program for radiological respiratory protection is generically described in NEI 07-03A, Subsection 12.5.4.9, so no change was required. However, while this statement is true, Section 12.5.4.9 of NEI 07-03 states that the respiratory protection program will comply with 10 CFR Part 20 Subpart H and will be consistent with the guidance in RG 8.15, however, as stated in the original question, NEI 07-03A only addresses the radiological respiratory protection program, as described in RG 8.15. Following the guidance of RG 8.15 is insufficient to ensure compliance with the regulatory requirements for non-radiological hazards. OSHA regulations are not listed as a reference for the development of NEI 07-03A, or as part of the SE for the NEI 07-03A template. Therefore, this question is closed but unresolved, and the staff issued follow up **RAI 4208, Question 12.05-5** asking the applicant to describe those program elements that will be used to satisfy the respiratory protection program requirements associated with non-radiological hazards (i.e. toxic gases, smoke or IDLH atmospheres) that may be encountered in the radiological controlled areas of the plant. In response to **RAI 4208, Question 12.05-5**, dated March 9, 2010, the applicant committed to revising CPNPP, Units 3 and 4 FSAR Subsection 12.5.4.9 to clarify the differences between the requirements for respiratory protection against radiological and non-radiological hazards and to state that the elements of the respiratory program requirements associated radiological and non-radiological hazards are derived from RG 8.15, and the relevant portions of Title 29 "Labor" CFR 1910.134, "Occupational Safety and Health Standards - Respiratory Protection" to assure protection against non-radiological hazards, such as fumes, dust, smoke, or oxygen deficiency. The applicant's response is consistent with the guidance in RG 8.15 for protection of personnel from mixed hazards, and meets the requirements of 10 CFR Part 20 Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas," for the protection of personnel from airborne radiological hazards. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 4208, Question 12.05-5** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.5 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4208, Question 12.05-5** is being tracked as **Confirmatory Item 12.05-3**.

In addition, the applicant added the following information after the paragraph in the discussion regarding Radioactive Waste Handling in Section 12.5.4.2 of NEI 07-03A:

CPNPP Units 3 and 4 have a plan to store temporarily radioactive wastes/materials in an Interim Radioactive Waste Storage/Staging Building to be located outside the plant structures. Entry to this building is allowed only through the issuance of a Radiation Work Permit. Non-radiologically controlled areas allow for general access.

As described above in Section 12.1.4, NEI 07-03A describes a generic RP program that has been previously approved by the staff. The additional information provided by the applicant is consistent with the program requirement contained within NEI 07-03A regarding access controls for VHRAs, provided to ensure consistency with the guidance contained within RG 8.38 and the requirements of 10 CFR 20 Subpart G, "Control of Exposure From External Sources in Restricted Areas."

Further, the applicant added the following information after the third paragraph in Section 12.5.4.4 of NEI 07-03A:

The locations and radiological controls of the radiation zones on plant layout drawings are located in DCD Subsection 12.3.1.2. Administrative controls for restricting access to Very High Radiation Areas are provided by Plant Manager's (or designee) approval. Access control for Very High Radiation Areas is controlled by gates and entry to these areas is allowed only through the issuance of a Radiation Work Permit. Subsection 12.3.1.2 includes detailed drawings of the very high radiation areas and indicates the physical access controls. Radiation monitor locations for each area are indicated in DCD Subsection 12.3.4.

As described above in Section 12.1.4, NEI 07-03A describes a generic RP program that has been previously approved by the staff. The additional information provided by the applicant is consistent with the program requirement contained within NEI 07-03A regarding access controls for VHRAs, provided to ensure consistency with the guidance contained within RG 8.38 and the requirements of 10 CFR 20.1602.

The applicant also added the following information after the sixth paragraph in Section 12.5.4.4 of NEI 07-03A:

The gates provide access control of the fuel transfer tube inspection (Very High Radiation Area) and the area near the seismic gap below the transfer tube. Access control for these areas is controlled by the gates and entry to these areas is allowed only the issuance of a Radiation Work Permit.

As described above in Section 12.1.4, NEI 07-03A describes a generic RP program that has been previously approved by the staff. The additional information provided by the applicant is consistent with the program requirement contained within NEI 07-03A regarding access controls for VHRAs, provided to ensure consistency with the guidance contained within RG 8.38 and the requirements of 10 CFR 20.1602.

Lastly, the applicant replaced the first paragraph in Section 12.5.4.12 of NEI 07-03A with the following:

The radiation protection program and procedures are established, implemented, maintained and reviewed consistent with the 10 CFR Part 20.1101 and the quality assurance program referenced in FSAR Chapter 17, "Quality Assurance and Reliability Assurance."

As described in the staff approved SEs for the NEI 07-03A and NEI 07-08A templates, the generic RP and ALARA program descriptions presented in the NEI 07-03A and NEI 07-08A templates provide an acceptable means for an applicant to meet the NRC regulatory requirements, conform with the NRC guidance and meet acceptance criteria listed in RG 1.206 and SRP Section 12.5. When combined with the applicant-provided site-specific information described above, NEI 07-03A and NEI 07-08A provide programs that comply with applicable NRC regulations and guidance. Accordingly, the information provided by the applicant to address CP COL 12.2(2), CP COL 12.3(1), and CP COL 12.3(5) is acceptable.

Additional Technical Review:

10 CFR 20.1101 (b) requires that the licensee develop and implement a RP program that includes exposure reduction measures that implement the ALARA concept. The guidance contained in RG 1.206 states that the applicant should describe the methods that will be used to maintain operational exposures ALARA. RG 8.8 Regulatory Position C.2.e states that reducing cobalt content is an integral part of maintaining radiation exposure ALARA. 10 CFR 20.1406 requires that the applicant minimize the contamination of the facility and the environment. The guidance contained in RG 4.21 states that facility design can reduce the amount of activity present during decommissioning. Reducing the cobalt content of plant materials reduces the amount of facility contamination and facilitates decommissioning. SRP Section 12.5 III.6 "Operational Programs," states that the RP program is to be fully described. Based on industry guidance documents, implementation of the elements expected for source term identification and reduction strategy includes understanding of the plant source term, including knowledge of input mechanisms to reduce the source term, and elements to reduce cobalt containing components. The applicant is relying on NEI 07-03A to describe the RP program, but since NEI 07-03A does not specifically address having a cobalt reduction strategy, the staff issued **RAI 3319, Question 12.05-2**, asking the applicant to describe those program elements related to establishing knowledge of the plant source term, understanding of input mechanisms and program elements to reduce unnecessary cobalt containing components. In response to **RAI 3319, Question 12.05-2**, dated November 11, 2009, the applicant relied on design features provided to reduce cobalt content during construction, but did not address the program elements for identifying and controlling future cobalt introduction, therefore, the staff considers this question closed but unresolved, and issued follow up **RAI 4208, Question 12.05-6** asking the applicant to describe those program elements related to establishing an understanding of input mechanisms to the plant source term and the program elements that will be used to reduce unnecessary contributions to the plant source term from components. In response to **RAI 4208, Question 12.05-6**, dated March 9, 2011, the applicant acknowledged that the reduction and control of the plant radiation source term is an essential element of meeting the requirements of 10 CFR Part 20.1101(b), and

committed to changing the CPNPP, Units 3 and 4 FSAR to state that during plant, operation, the applicant would utilize industry practice guidance similar to EPRI Technical Report - 103296 "Cobalt Reduction Guidelines" to ensure that procurement of components or piping, conducting maintenance, or modifications consider the identification and control of sources of cobalt and other activated materials. The applicant's response is consistent with the guidance in the SRP Section 12.5 and RG 8.8, and meets the requirements of 10 CFR Part 20.1101(b) and 10 CFR 20.1406. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 4208, Question 12.05-6** to be resolved. The NRC staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.5 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 4208, Question 12.05-6** is being tracked as **Confirmatory Item 12.05-4**.

10 CFR 20.1101 requires each licensee to have a RP program. Guidance for the content of this program is provided in RG 8.8, and RG 8.10. SRP Section 12.5 provides guidance regarding the content of the RP program. CPNPP, Units 3 and 4 FSAR Section 12.1 and Section 12.5 note that they address the required RP program elements with information provided in NEI templates NEI 07-03A and NEI 07-08A, in combination with existing or modified CPNPP, Units 1 and 2 site program information. However, because the applicant did not provide any additional information regarding the pre-existing radiation program at CPNPP, Units 1 and 2, and in particular, how those programs may have elements or features that deviate from the guidance provided in NEI templates NEI 07-03A and NEI 07-08A, in **RAI 3510, Question 12.05-3**, the staff asked the applicant to describe how the pre-existing radiation program at CPNPP, Units 1 and 2, deviates from the guidance provided in NEI templates NEI 07-03A and NEI 07-08A. In response to **RAI 3510, Question 12.05-3**, dated November 16, 2009, the applicant committed to removing the statement "...in combination with existing or modified CPNPP Units 1 and 2 site program information." In order to remove any confusion, the applicant committed to remove the statements linking the RP and ALARA programs of CPNPP, Units 3 and 4 to the programs to the existing or modified CPNPP, Units 1 and 2 site program information. Since, as discussed before, NEI 07-03A and NEI 07-08A provide methods previously approved by the staff of describing RP and ALARA programs for meeting the requirements of 10 CFR 20, and conforming with the associated regulatory guidance. The applicant's response is consistent with the guidance in the SRP Section 12.5 and RG 8.8, and meets the requirements of 10 CFR Part 20. Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3510, Question 12.05-3** to be resolved. However, the CPNPP, Units 3 and 4 FSAR has not yet been updated to include the information provided in the response to the above question. Therefore **RAI 3510, Question 12.05-3** is identified as **Confirmatory Item 12.05-1** and the staff will confirm that this information is included in a future revision of the CPNPP, Units 3 and 4 FSAR.

10 CFR 20.1501(b) requires that instruments used for radiation measurements be periodically calibrated. NUREG-1736 states that this is normally done by adjusting an instrument response to reflect the value from a known standard. The guidance contained in SRP Section 12.5 states that the applicant is to describe calibration methods for radiation protection equipment. The applicant is relying on NEI 07-03A to provide the RP program elements described in the guidance of SRP Section 12.5. While NEI 07-03A discusses instrument calibration, neither NEI 07-03A or the CPNPP, Units 3 and 4 FSAR specifically address the process to be used to ensure that calibration of

portable and laboratory instruments is performed using known standards (i.e. traceability to the National Institute of Standards and Technology or equivalent international standards). Since NEI 07-03A does not specifically address methods for establishing reference values for calibration standards, in **RAI 3510, Question 12.05-4**, the staff asked the applicant to describe those program elements related to establishing traceability of portable and laboratory radiation protection instrument calibrations to recognized national or international standards. In response to **RAI 3510, Question 12.05-4** dated November 16, 2009, the applicant committed to selecting and calibrating instrumentation and equipment based on relevant industry standards such as ANSI N42.17A-1989 "Performance Specifications for Health Physics Instrumentation-Portable Instrumentation for Use In Normal Environmental Conditions," as it relates to the accuracy and overall performance of portable survey instrumentation, and ANSI N323A-1997, "American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments," as it relates to the calibration and maintenance of portable radiation survey instruments. The applicant's response is consistent with the guidance in the SRP Section 12.5 and meets the requirements of 10 CFR Part 20.1501(b). Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3510, Question 12.05-4** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.5 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3510, Question 12.05-4** is being tracked as **Confirmatory Item 12.05-2**.

10 CFR 20.1406 requires licensees to describe the procedures for operation provided to minimize contamination of the facility and the environment. RG 4.21 notes that ground water monitoring programs are part of a leakage detection and minimization program. NEI Template NEI 08-08A "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," which represents an acceptable method of demonstrating compliance with 10 CFR 20.1406, notes that applicants should develop the appropriate site procedures and implement these procedures and programs consistent with applicant's FSAR Section 13.4 (prior to initial fuel load as referenced in Radiation Protection Milestone 3). However, CPNPP COLA FSAR Section 13.4 does not contain any milestones for the development of a ground water monitoring program. The applicant's response to RAI 3316, Question 12.01-4 dated November 16, 2009, committed to revising the CPNPP FSAR Section 12.1 to fully adopt NEI 08-08A. However, CPNPP FSAR Section 13.4 did not contain any Groundwater Protection Program elements implementation milestone information under the RP Program area. The applicant's response to **RAI 3592, Question 13.04-1** dated November 5, 2009, committed to revising CPNPP FSAR Table 13.4-201 "Operational Programs Required by NRC Regulation and Program Implementation," to include an implementation milestone for the Ground Water Monitoring Program as an element of the RP Program. Specifically, the applicant added the following license condition for COL FSAR Section 11.5 in FSAR Table 13.4-201:

- The licensee shall implement the Process and Effluent Monitoring and Sampling Program, including the Ground Water Monitoring Program prior to fuel load.

The staff has determined that the applicant's response to the staff's RAI, including the proposed license condition, provides an acceptable Groundwater Protection Program

elements implementation milestone under the RP Program, and therefore meets the requirements of 10 CFR 20.1406. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 13.4 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3592, Question 13.04-1 is being tracked as Confirmatory Item 13.04-1.**

10 CFR 20.1406 and 10 CFR 20.1101(b) require the licensee to minimize contamination of the facility and the environment and to minimize ORE. The guidance contained in SRP Section 12.5 requires program elements for meeting the requirements of 10 CFR 20.1406 and 10 CFR 20.1101(b). The primary to secondary leakage program ensures that the integrity of the steam generator tubes is sufficient to preclude tube ruptures that cause additional contamination of the secondary side of the facility and result in additional ORE working of the secondary portions of the plant. During the review of program elements related to radiation monitoring systems, the staff noticed that US-APWR DCD Tier 2 Section 5.4.2.2 identified the requirement for a Primary-to-Secondary Leakage program in accordance with the criterion of NEI 97-06 "Steam Generator Program Guidelines." CPNPP, Units 3 and 4 FSAR Section 13.4, Table 13.4-201 "Operational Programs Required by NRC and Program Implementation," Items 1 "Inservice Inspection Program," and 2 "Inservice Testing Program," do not reference this section of the FSAR, nor do they reference 10 CFR 50.55a.b(2)(iii) "Steam Generator Tubing." Because the implementation milestones listed for these two items did not appear to be consistent with the monitoring criteria noted in TS 3.4.13.2 "RCS Operational LEAKAGE," the staff asked the applicant to describe the milestones for the implementation of the Primary to Secondary Leakage Monitoring program. In response to **RAI 3592, Question 13.04-2** dated November 5, 2009, the applicant committed to revising CPNPP, Units 3 and 4 FSAR Table 13.4-201 "Operational Programs Required by NRC Regulation and Program Implementation" to include implementation milestones for the Primary to Secondary Leakage program to the Inservice Inspection Program and Inservice Testing program areas, thus ensuring that the applicant will have and implement a primary to secondary leakage program, which will help minimize facility contamination and reduce ORE, consistent with 10 CFR 20.1406 and 10 CFR 1101(b). Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3592, Question 13.04-2** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 13.4 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3592, Question 13.04-2** is being tracked as **Confirmatory Item 13.04-2.**

10 CFR 20.1406 and 10 CFR 20.1101(b) require the licensee to minimize contamination of the facility and the environment and to minimize ORE. The guidance contained in SRP Section 12.5 requires program elements for meeting the requirements of 10 CFR 20.1406 and 10 CFR 20.1101(b). 10 CFR 50.34.f(2)(xxvi) [NUREG- 0737 III.D.1.1] "Additional TMI-related requirements," requires leakage control and detection for systems outside containment that might contain highly radioactive fluids, and requires applicants to submit a leakage control program, including an initial test program and a schedule for retesting systems. This program ensures ORE is minimized, and it also helps minimize contamination of the facility. US-APWR DCD Tier 2 Chapter 16, "Technical Specifications," Subsection 5.5.2 "Primary Coolant Sources Outside Containment," requires a leakage minimization program for systems outside containment that might contain highly radioactive fluids. However, CPNPP, Units 3 and 4 FSAR Section 13.4, Table 13.4-201 "Operational Programs Required by NRC and Program

Implementation,” Items 1 “Inservice Inspection Program,” and 2 “Inservice Testing Program,” do not reference this section of the CPNPP, Units 3 and 4 FSAR, nor do they reference 10 CFR 50.34.f(2)(xxvi). Also, while CPNPP FSAR Table 13.4-201 also includes Item 6, “Preservice Testing Program,” it does not appear to list either the FSAR section or the “Program Source,” consistent with the initial test requirements stated in 10 CFR 50.34.f(2)(xxvi) and NUREG- 0737 III.D.1.1. Therefore, the staff asked the applicant to describe the implementation milestones for the leakage program for systems outside containment. The applicant’s response to **RAI 3592, Question 13.04-3** dated November 5, 2009, committed to revising CPNPP FSAR Table 13.4-201 “Operational Programs Required by NRC Regulation and Program Implementation” to include implementation milestones for the program elements for monitoring the Highly Radioactive Fluid Systems Outside Containment, to the Inservice Inspection Program area and Inservice Testing program areas. This ensures that the applicant will have and implement a leakage control program for primary coolant sources outside containment, that will help minimize facility contamination and reduce ORE, consistent with 10 CFR 20.1406 and 10 CFR 1101(b). Accordingly, the staff determines that the COL applicant has adequately addressed this issue and, therefore, the staff considers **RAI 3592, Question 13.04-3** to be resolved. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 13.4 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3592, Question 13.04-3** is identified as **Confirmatory Item 13.04-3**.

12.5.5 **Post-Combined License Activities**

As stated in COLA Revision 1, Part 2, FSAR Table 13.4-201, Item 10 and COLA Part 10, the applicant proposed to include the following license conditions regarding the RP Program:

- License Condition (12-1) - The licensee shall implement the RP Program prior to initial receipt of by-product, source, or special nuclear materials (excluding exempt qualities as described in 10 CFR 30.18) for those elements of the RP Program necessary to support such receipt.
- License Condition (12-2) - The licensee shall implement the RP Program prior to fuel receipt for those elements of the RP Program necessary to support receipt and storage of fuel on-site.
- License Condition (12-3) - The licensee shall implement the RP Program prior to fuel load for those elements of the RP Program necessary to support fuel load and plant operation.
- License Condition (12-4) - The licensee shall implement the RP Program prior to first shipment of radioactive wastes for those elements of the RP Program necessary to support shipment of radioactive waste..

The applicant incorporates by reference NEI 07-03A and NEI 07-08A in Sections 12.1 and 12.5 of the FSAR. The staff issued its SEs that approved of NEI 07-03A and NEI 07-08A dated March 18, 2009, and October 15, 2009, respectively. The referenced NEI documents provide acceptable, generic ALARA and the RP program. NEI 07-03A and

NEI 07-08A state that the RP and ALARA programs are to be implemented in stages, consistent with regulatory requirements that are required to be met for that stage. The implementation milestones described in NEI 07-03A and NEI 07-08A correspond to the stated license conditions. Therefore, the staff concludes that the license conditions adequately describe the requirements for implementing the radiation protection and ALARA programs.

In addition, as stated in its RAI response dated November 5, 2009, the applicant proposed to include the following license condition regarding the Process and Effluent Monitoring and Sampling Program:

- License Condition (11-5) - The licensee shall implement the Process and Effluent Monitoring and Sampling Program, including the Ground Water Monitoring Program prior to fuel load

The staff issued its SE that approved NEI 08-08A "Guidance for Life Cycle Minimization of Contamination" (ADAMS Accession Number ML093220530) on October 19, 2009. This NEI template discusses operational policies and operational programs sufficient to meet the programmatic requirements of 10 CFR Part 20.1406 for life cycle minimization of contamination, in part by addressing the applicable regulatory position elements of RG 4.21. The implementation milestone described in NEI 08-08A corresponds to the stated license condition. Therefore, the staff concludes that the license condition adequately describes the requirement for implementing the ground water monitoring program.

10 CFR 20.1406 requires licensees to describe the procedures for operation provided to minimize contamination of the facility and the environment. RG 4.21 notes that ground water monitoring programs are part of a leakage detection and minimization program. NEI Template 08-08A "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," which represents an acceptable method of demonstrating compliance with 10 CFR 20.1406, notes that applicants should develop the appropriate site procedures and implement these procedures and programs consistent with applicant's FSAR Section 13.4 (prior to initial fuel load as referenced in RP Milestone 3). However, CPNPP COLA FSAR Section 13.4 does not contain any milestones for the development of a ground water monitoring program. The applicant's response to RAI 3316, Question 12.01-4 dated November 16, 2009, committed to revising the CPNPP FSAR Section 12.1 to fully adopt NEI 08-08A. However, CPNPP FSAR Section 13.4 did not contain any Groundwater Protection Program elements implementation milestone information under the RP Program area. The applicant's response to **RAI 3592, Question 13.04-1** dated November 5, 2009, committed to revising CPNPP FSAR Table 13.4-201 "Operational Programs Required by NRC Regulation and Program Implementation" to include an implementation milestone for the Ground Water Monitoring Program as an element of the RP Program. Specifically, the applicant added the following license condition for COL FSAR Section 11.5 in FSAR Table 13.4-201:

- The licensee shall implement the Process and Effluent Monitoring and Sampling Program, including the Ground Water Monitoring Program prior to fuel load.

The staff has determined that the applicant's response to the staff's RAI, including the proposed license condition meets the requirements of 10 CFR 20.1406. The staff will confirm that the proposed revision to CPNPP, Units 3 and 4 FSAR Section 12.5 is incorporated into the next revision of the CPNPP, Units 3 and 4 FSAR. **RAI 3592, Question 13.04-1** is being tracked as **Confirmatory Item 13.04-1**.

Based on the review as documented above, and the applicant's response to **RAI 3592, Question 13.04-1** is being tracked as **Confirmatory Item 13.04-1**, the staff concludes that the applicant's License Condition (11-5) adequately provides for implementation of the Process and Effluent Monitoring and Sampling Program, including the Ground Water Monitoring Program, prior to fuel load.

12.5.6 Conclusion

The staff is reviewing the information in DCD Section 12.5 under Docket Number 52-021. The results of the staff's technical evaluation of the information related to the operational RP program incorporated by reference in the CPNPP, Units 3 and 4 COL FSAR will be documented in the staff's SE of the DC application for the US-APWR design. The SE for the US-APWR is not yet complete, and this is being tracked as part of Open Item [1-1]. The staff will update Section 12.5 of this SE to reflect the final disposition of the DC application.

The staff concludes, based on COL FSAR Section 12.5, and the applicant's responses to the RAIs listed below:

RAI 3510, Question 12.05-3	Confirmatory Item 12.05-1	CPNPP 1&2 RPP
RAI 3510, Question 12.05-4	Confirmatory Item 12.05-2	Calibration
RAI 4208, Question 12.05-5	Confirmatory Item 12.05-3	Mixed Hazards
RAI 4208, Question 12.05-6	Confirmatory Item 12.05-4	Cobalt control
RAI 3592, Question 13.04-1	Confirmatory Item 13.04-1	Groundwater
RAI 3592, Question 13.04-2	Confirmatory Item 13.04-2	SG Leakage
RAI 3592, Question 13.04-3	Confirmatory Item 13.04-3	ESF Leakage

that the applicant's description of the RP program elements maintain OREs within regulatory limits and ALARA, comply with the requirements of 10 CFR Part 20 and 10 CFR Part 50 and are consistent with the guidance contained in NUREG-1736.

As explained above, the applicant committed to a number of changes that the staff found acceptable, which are described as follows: In order to remove any confusion, the applicant committed to remove the statements linking the RP and ALARA programs of CPNPP, Units 3 and 4 to the programs to the existing or modified CPNPP, Units 1 and 2 site program information. **RAI 3510, Question 12.05-3** is being tracked as **Confirmatory Item 12.05-1**. The applicant committed to using consensus standards as a basis for establishing the methods for calibrating RP instruments. **RAI 3510, Question 12.05-4** is being tracked as **Confirmatory Item 12.05-2**. The applicant committed to ensuring the safety of workers exposed to mixtures of hazardous materials. **RAI 4208, Question 12.05-5** is being tracked as **Confirmatory Item 12.05-3**. The applicant committed to adopting program elements to identify and control the introduction of cobalt in order to maintain ORE ALARA in accordance with 10 CFR

20.1101(b). **RAI 4208, Question 12.05-6** is being tracked as **Confirmatory Item 12.05-4**. The applicant committed to providing a milestone for the implementation of the ground water monitoring program, consistent with NEI 08-08A. **RAI 3592, Question 13.04-1** is being tracked as **Confirmatory Item 13.04-1**. The applicant committed to identifying the element for the primary to secondary leakage program. **RAI 3592, Question 13.04-2** is being tracked as **Confirmatory Item 13.04-2**. The applicant committed to identifying the element for the leakage control program for sources outside of the containment. **RAI 3592, Question 13.04-3** is being tracked as **Confirmatory Item 13.04-3**.

The staff evaluated COL Information Items that were related to the program information provided within Section 12.5:

- CP COL 12.1(5), as it relates to revising the contents of NEI 07-03A, is acceptable because the applicant committed to using NEI 07-08A to describe the ALARA program. When combined with the applicant provided site specific information identified within these templates, NEI 07-03A and NEI 07-08A provide programs that comply with applicable NRC regulations and guidance. Based on the review as documented above, and the applicant's responses to **RAI 3316, Question 12.01-2** which is being tracked as **Confirmatory Item 12.01-1** and **RAI 3510, Question 12.05-3** which is being tracked as **Confirmatory Item 12.05-1**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.1(5).
- CP COL 12.2(2), CP COL 12.3(1), and CP COL 12.3(5), as they relate to revising the contents of NEI 07-03A, is acceptable. When combined with the applicant provided site specific information identified within these templates, NEI 07-03A and NEI 07-08A provide programs that comply with applicable NRC regulations and guidance. Based on the information provided by the applicant to address CP 12.2(2) and the requirement contained within the previously approved NEI 07-03A for the RPM to review changes to the facility, the staff concludes that the applicant has adequately addressed CP 12.2(2). Assurance that the instruments will be calibrated in accordance with the requirements of 10 CFR 20.1501 is assured by the use of consensus standards as a basis for establishing the methods for calibrating these instruments. Based on the review as documented above, and the applicant's response to **RAI 3318, Question 12.03-12.04-3** which is being tracked as **Confirmatory Item 12.03-12.04-3**, the staff concludes that the applicant has adequately addressed COL Information Item CP COL 12.3(1). Based on the information provided by the applicant to address CP 12.3(5) as discussed above, and the response to **RAI 3318, Question 12.03-12.04-2** which is being tracked as **Confirmatory Item 12.03-12.04-2**, the staff concludes that the applicant has adequately addressed CP COL 12.3(5).