

12.0 RADIATION PROTECTION

This chapter provides information on radiation protection methods and estimated occupational radiation exposures to operating and construction personnel during both normal operations (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection (ISI); and calibration), and anticipated operational occurrences (AOOs) (activities such as loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss of offsite power). Specifically, this chapter provides information on facility and equipment design, planning and procedures programs, and techniques and practices employed by the applicant to meet the radiation protection standards 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, where the practices set forth in such guides are used to implement NRC regulations.

12.1 Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable

12.1.1 Introduction

This section of the Fermi 3 combined license (COL) Final Safety Analysis Report (FSAR) addresses policy and design considerations to ensure that the occupational radiation exposure (ORE) to personnel will be kept as low as is reasonably achievable (ALARA). The ALARA Program and Radiation Protection Program are addressed in Appendices 12AA and 12BB, respectively. The Fermi 3 COL FSAR adopts the following final versions of the Nuclear Energy Institute (NEI) generic templates accepted by the United States Nuclear Regulatory Commission (NRC): NEI 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program Description," (ML091490684) and NEI 07-08A "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)," (ML093220178).

12.1.2 Summary of Application

Section 12.1 of the Fermi 3 COL FSAR Revision 3 incorporates by reference Section 12.1 of the certified Economic Simplified Boiling-Water Reactor (ESBWR) design control document (DCD), Revision 9.

In addition, in FSAR Section 12.1, the applicant provides the following:

COL Items

- STD COL 12.1-1-A Regulatory Guide 8.10

The applicant is responsible for demonstrating compliance with the guidance of Regulatory Guide (RG) 8.10 Revision 1-R, "Operating Philosophy for Maintaining Occupational Radiation Exposures ALARA." The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item.

- STD COL 12.1-2-A Regulatory Guide 1.8

The applicant is responsible for demonstrating compliance with the guidance of RG 1.8 Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants." The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A, for meeting the needs of this COL item.

- STD COL 12.1-3-A Operational Considerations

The applicant is responsible for providing criteria and conditions by which various operating procedures and techniques will be implemented to ensure that occupational exposures are ALARA using the guidance of NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 — Standards for Protection Against Radiation." The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item.

- STD COL 12.1-4-A Regulatory Guide 8.8

The applicant is responsible for demonstrating compliance with the guidance of RG 8.8 Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be ALARA." The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item.

Supplemental Information

- STD SUP 12.1-1 ALARA Program

The applicant provides supplemental information in FSAR Appendices 12AA and 12BB to address the ALARA Program and Radiation Protection Program at the site. These appendices reference NEI 07-08A and NEI 07-03A, which in turn provide additional operating policy guidance for developing and implementing an ALARA program.

12.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling Water Reactor Standard Design," (the FSER for the ESBWR DCD).

Also, the NRC staff followed the guidance in RG 1.206, "Combined License Applications for Nuclear power Plants (LWR Edition)," June 2007, in evaluating Fermi 3 FSAR, Section 12.1 for compliance with NRC regulations.

In addition, the relevant requirements of the Commission regulations for ensuring that occupational radiation exposures are ALARA, and the associated acceptance criteria, are in Section 12.1 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, (LWR Edition)," (the Standard Review Plan [SRP]).

In particular, the regulatory basis for acceptance of the resolution to the COL and the supplemental items is established in 10 CFR Part 20, "Standards for Protection against

Radiation” and the guidance of RG 1.206; RG 8.10, Revision1; RG 1.8, Revision 3; and RG 8.8, Revision 3.

Moreover, the acceptance of the COL and supplemental items in this section are based on guidance in the following RGs and NEI templates:

- RG 8.2, “Guide for Administrative Practices in Radiation Monitoring,”
- RG 8.7, Revision 2, “Instructions for Record Keeping and Recording Occupational Radiation Exposure Data,”
- RG 8.9, Revision 1, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program,”
- RG 8.13, Revision 3, “Instruction Concerning Prenatal Radiation Exposure,”
- RG 8.15, Revision 1, “Acceptable Programs for Respiratory Protection,”
- RG 8.27, “Radiation Protection Training for Personnel at Light-Water Cooled Nuclear Power Plants,”
- RG 8.28, “Audible-Alarm Dosimeters,”
- RG 8.29, Revision 1, “Instructions Concerning Risks from Occupational Radiation Exposure,”
- RG 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,”
- RG 8.35, “Planned Special Exposures,”
- RG 8.36, “Radiation Dose to the Embryo/Fetus,”
- RG 8.38, Revision 1, “Control of Access to High and Very High Radiation Areas in Nuclear Power Plants,”
- RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” and
- NEI 07–03A and NEI 07–08A.

12.1.4 Technical Evaluation

As documented in NUREG–1966, NRC staff reviewed and approved Section 12.1 of the certified ESBWR DCD. The staff reviewed Section 12.1 of the Fermi 3 COL FSAR, Revision 3, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR appropriately

represents the complete scope of information relating to this review topic.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to "Ensuring that Occupational Radiation Exposures are ALARA."

Section 1.2.3 of this safety evaluation report (SER) discusses the NRC's strategy to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating the subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for North Anna Unit 3 were equally applicable to the Fermi 3 COL application, the staff undertook the following reviews:

- The staff compared the North Anna Unit 3 COL FSAR, Revision 1 to the Fermi 3 COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from requests for additional information (RAIs); and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant endorsed all responses to RAIs identified in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences were not relevant to this section.

The staff completed its review and found the evaluation performed for the North Anna standard content to be applicable to the Fermi 3 COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting.

The staff reviewed the information in the Fermi 3 COL FSAR as follows:

COL Items

- STD COL 12.1-1-A Regulatory Guide 8.10

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ML091740254):

- *STD COL 12.1-1-A Regulatory Guide 8.10*

The applicant provided additional information in STD COL 12.1-1-A to address the resolution of DCD COL Item 12.1-1-A, which states:

"The COL applicant will demonstrate compliance with Regulatory Guide 8.10"

The FSAR states that this COL information item is addressed in NEI Template 07-03, "Generic FSAR Template Guidance for Radiation Protection Program Description," which is referenced in Appendix 12BB of the FSAR. This template is currently under review by NRC staff.

¹ See "Finality of Referenced NRC Approvals," in SER Section 1.2.2, 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.

The staff reviewed the current version of NEI Template 07-03 with respect to compliance with RG 8.10. RG 8.10 describes the operating philosophy for maintaining occupational radiation exposures ALARA and states that the management of the licensed facility should be committed to maintaining exposures ALARA, and the personnel responsible for radiation protection should be continually vigilant for means to reduce exposures. NEI template 07-03 states that the plant management will establish a written policy on radiation protection that is consistent with the guidance in RG 8.10. The radiation protection responsibilities of the Radiation Protection Manager will be consistent with the guidance in RG 8.10 and will include establishing, implementing, and enforcing the Radiation Protection Program. In addition, management is committed to assuring that each individual working at the facility understands and accepts the responsibility to follow radiation protection procedures and instructions provided by radiation protection staff and to maintain his or her dose ALARA.

*As stated above, NEI Template 07-03 is still under staff review and, therefore, the staff cannot find the applicant's reference to this template to be acceptable until the staff completes the review of and approves this template, and the FSAR is updated by the applicant to reference the final version of this template. Since the template addresses the applicant's commitment to RG 8.10, the staff cannot consider DCD COL Item 12.1-1-A to be resolved until the staff approves this template. The applicant has committed to update the FSAR to reference the final version of this template when this template is approved by the staff. **This is Confirmatory Item 12.01-1.***

In Fermi 3 COL FSAR Revision 3, the applicant states that compliance with this regulatory guide is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item. NRC staff has reviewed and approved these NEI templates for addressing this COL item (ML090510379, and ML091130034). NEI 07-03A and NEI 07-08A are the final approved version of NEI 07-03 and NEI 07-08 (ML091490684 and ML093220178). Therefore, the applicant has adequately addressed STD COL Item 12.1-1-A (compliance with the guidance of RG 8.10) and **Confirmatory Item 12.01-1** is closed.

- *STD COL 12.1-2-A Regulatory Guide 1.8*

The applicant provided additional information in STD COL 12.1-2-A to address the resolution of DCD COL Item 12.1-2-A, which states:

“The COL applicant will demonstrate compliance with Regulatory Guide 1.8.”

The FSAR states that this COL information item is addressed in NEI Template 07-03, “Generic FSAR Template Guidance for Radiation Protection Program Description,” which is referenced in Appendix 12BB of the FSAR.

*NRC staff has reviewed the current version of NEI Template 07-03 with respect to compliance with RG 1.8. RG 1.8 states that the American National Standards Institute (ANSI)/ American Nuclear Society (ANS)-3.1-1993, with certain additions, exceptions, and clarifications delineated in the RG, provides acceptable criteria for the selection, qualification, and training of personnel for nuclear power plants. NEI Template 07-03 states that the Radiation Protection Manager, Radiation Protection Technicians, and Radiation Protection Supervisory and Technical Staff will be trained and qualified in accordance with the guidance in RG 1.8. As stated above, NEI Template 07-03 is still under staff review. Therefore, the staff cannot find the applicant's reference to this template to be acceptable until the staff completes the review and approves this template and the FSAR is updated by the applicant to reference the final version of the template. Since the template addresses the applicant's commitment to RG 1.8, the staff cannot consider DCD COL Item 12.1-2-A to be resolved until the staff approves this template. The applicant has committed to update the FSAR and reference the final version of this template when the template is approved by the staff. See **Confirmatory Item 12.01-1**.*

In Fermi 3 COL FSAR, Revision 3, the applicant states that compliance with this regulatory guide is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item. NRC staff has reviewed and approved these NEI templates for addressing this COL item (ML090510379, and ML091130034). Therefore, the applicant has adequately addressed STD COL Item 12.1-2-A (compliance with the guidance of RG 1.8), and **Confirmatory Item 12.01-1** is closed.

- *STD COL 12.1-3-A Operational Considerations*

The applicant provided additional information in STD COL 12.1-3-A to address the resolution of DCD COL Item 12.1-3-A, which states:

“The COL applicant will provide the criteria and/or conditions under which various operating procedures and techniques will be implemented to ensure that occupational radiation exposures are ALARA using the guidance of NUREG-1736, to the level of detail provided in RG 1.206.”

NRC staff reviewed the applicant's response to STD COL 12.1-3-A related to criteria and conditions under which various operating procedures and techniques will be implemented to ensure that occupational radiation exposures are ALARA, using the guidance in NUREG 1736 to the level of detail provided in RG 1.206. The staff also reviewed the applicant's response to ensure that the applicant has committed to follow the guidance in the following RGs: 8.2, 8.7, 8.9, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38. The criteria and conditions in STD COL 12.1-3-A are addressed in NEI 07-03, “Generic FSAR Template Guidance for Radiation Protection Program Description,”

which is referenced in Appendix 12 BB of the FSAR. The template is currently under review by NRC staff.

*NEI 07-03 addresses various operating procedures and techniques used in dose-related activities found in typical nuclear plants. These activities include refueling, inservice inspections, radwaste handling, spent fuel handling, normal operations, routine maintenance, sampling, and calibration. The template allows for COL applicants to modify procedures based on design- and site-specific information. The staff reviewed the categories listed in the template for coverage of the ESBWR activities. On the basis of this review, the staff determined that NEI 07-03, as supplemented by material presented in the DCD, provides the criteria and/or conditions under which various operating procedures and techniques will be implemented to ensure that occupational radiation exposures are ALARA. Since NEI 07-03 is still under staff review, the staff cannot find the applicant's reference to this NEI template to be acceptable until the staff completes the review and approves this template, and the FSAR is updated by the applicant to reference the final version of the template. Since the template addresses the applicant's resolution of DCD COL Item 12.1-3-A, the staff cannot consider DCD COL Item 12.1-3-A to be resolved until the staff approves the template. The applicant has committed to update the FSAR to reference the final version of the template when it is approved by the staff. See **Confirmatory Item 12.01-1**.*

In Fermi 3 COL FSAR Revision 3, the applicant states that the operational considerations for ALARA Program is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item. NRC staff has reviewed and approved these NEI templates for addressing this COL item in separate SERs (ML090510379, and ML091130034). Therefore, the applicant has adequately addressed STD COL Item 12.1-3-A (providing criteria and conditions by which various operating procedures and techniques will be implemented to ensure that occupational exposures are ALARA using the guidance of NUREG-1736, "Consolidated Guidance: 10 CFR Part 20 — Standards for Protection Against Radiation," to the level of detail provided in RG 1.206), and **Confirmatory Item 12.01-1** is closed.

- *STD COL 12.1-4-A Regulatory Guide 8.8*

The applicant provided additional information in STD COL 12.1-4-A to address the resolution of DCD COL Item 12.1-4-A, which states:

"The COL applicant will demonstrate compliance with Regulatory Guide 8.8."

The FSAR states that this COL information item is addressed in NEI template 07-03, "Generic FSAR Template Guidance for Radiation Protection Program Description," which is referenced in Appendix 12BB of the FSAR. NRC staff has reviewed the current version of NEI template 07-03 with respect to compliance with RG 8.8. This template, which is currently under review by the staff, addresses the operational portions of RG 8.8 that were not addressed in the ESBWR DCD,

*including a description of the plant organization, personnel, and personnel responsibilities; facilities (to the extent that they were not described in the DCD), instrumentation, and equipment. The template also includes a description of radiation protection procedures sufficient to provide adequate control over the receipt, possession, use, transfer, and disposal of byproduct, source, and special nuclear material and assure compliance with the applicable requirements in 10 CFR Parts 19, 20, 50, 70, and 71. The procedures described in this template include procedures for radiation protection training, access control of radiation areas, methods to maintain exposures ALARA, personnel monitoring, respiratory protection, and contamination control. Since NEI 07-03 is still under staff review, the staff cannot find the applicant's reference to this template to be acceptable until the staff completes the review and approves the template, and the FSAR is updated by the applicant to reference the final version of the template. Since the template addresses the applicant's commitment to RG 8.8, the staff cannot consider DCD COL Item 12.1-4-A to be resolved until the staff approves the template. The applicant has committed to update the FSAR to reference the final version of the template. See **Confirmatory Item 12.01-1**.*

In Fermi 3 COL FSAR Revision 3, the applicant states that compliance with this regulatory guide is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A for meeting the needs of this COL item. NRC staff has reviewed and approved these NEI templates for addressing this COL item (ML090510379, and ML091130034). Therefore, the applicant has adequately addressed STD COL Item 12.1-4-A (compliance with the guidance of RG 8.8) and **Confirmatory Item 12.01-1** is closed.

Supplemental Information

- *STD SUP 12.1-1 ALARA Program*

STD SUP 12.1-1 of the North Anna COL FSAR references Appendices 12 AA and 12 BB for a description of the ALARA program. Appendix 12 AA refers to NEI 07-08, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)." Appendix 12 BB refers to NEI 07-03, "Generic FSAR Template Guidance for Radiation Protection Program Description. Both templates are currently under review by NRC staff.

The staff reviewed current versions of NEI Templates 07-08 and 07-03 with respect to a description of the ALARA program. NEI template 07-08 states that company and station policies are to keep all radiation exposures of personnel within the limits defined by 10 CFR Part 20. The ALARA policy is consistent with and will be implemented in accordance with the ALARA provisions of RGs 8.8 and 8.10. As stated in FSAR Section 13.1, "Organizational Structure of Applicant," and in NEI template 07-03, specific individuals will be assigned the responsibility and authority for implementing the ALARA policy at North Anna 3. All station personnel are responsible for the ALARA program. Individual workers are responsible for complying with ALARA requirements, which are

presented in worker training in accordance with the training requirements contained in 10 CFR 19.12. The extent of the training is commensurate with the worker's job responsibilities.

North Anna's ALARA policies and practices are consistent with the applicable regulations in 10 CFR 20 and the guidance in RGs 1.8, 1.206, 8.2, 8.7, 8.8, 8.9, 8.10, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38 and the applicable portions of NUREG-1736.

The ALARA program is based on mature programs in use at other operating commercial nuclear facilities and incorporates 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 developed in accordance with RGs 1.8, 8.8, and 8.10.

Overall facility operations, as well as the Radiation Protection Program, integrate the procedures necessary to ensure that radiation doses are ALARA. Radiation protection procedures, which are described in FSAR Section 12.5, are developed in FSAR Sections 13.5 and 17.5 and meet the applicable requirements in 10 CFR Parts 19, 20, 50, 70, and 71. Examples of some ALARA work practices incorporated in these procedures, and described in NEI template 07-08, to help ensure that exposures to personnel will be ALARA include use of:

- Appropriate dosimetry to record personnel doses*
- Pre-job briefings and post-job debriefings to ascertain lessons-learned*
- Dry-run training and mockups to improve worker efficiency for complex jobs in high-radiation areas*
- Protective clothing, respiratory equipment, and special ventilation systems for working in contaminated environments*
- Remote monitoring of personnel to reduce worker exposures, and the establishment of low dose "waiting areas," and*
- Permanent or temporary shielding to reduce worker exposure at the work site.*

As stated above, NEI templates 07-03 and 07-08 are still under staff review. Therefore, the staff cannot find the applicant's reference to these templates to be acceptable until the staff completes the review and approves the templates, and the FSAR is updated by the applicant to reference the final version of these templates. Since these templates provide a description of the applicant's ALARA program, the staff cannot consider the applicant's ALARA program to be acceptable until the staff approves this template. The applicant has committed to update the FSAR to reference the final version of these templates.

*These are **Confirmatory Items 12.01-1** (updating the FSAR to reference the final version of NEI template 07-03) and **12.01-3** (updating the FSAR to reference the final version of NEI template 07-08).*

In Fermi 3 COL FSAR, Revision 3, the applicant provides supplemental information in Appendices 12AA and 12BB to address the ALARA Program and Radiation Protection Program at the site. These appendices reference NEI 07–08A and NEI 07–03A, which provide additional operating policy guidance for developing and implementing an ALARA Program. The applicant also provides site-specific information regarding access control in these appendices. The staff’s evaluation of the site-specific information on access control is addressed in Section 12.5 of this SER.

NRC staff has reviewed and approved these NEI templates for addressing the ALARA Program. The staff found that the applicant has adequately addressed the ALARA Program and has identified the locations of very high radiation areas requiring access control. Therefore, **Confirmatory items 12.01-1** and **12.01-3** are closed.

12.1.5 Post Combined License Activities

There are no post COL activities related to this section.

12.1.6 Conclusion

The NRC staff’s finding related to information incorporated by reference is in NUREG-1966. The NRC staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [X], Section VI.B.1, all nuclear safety issues relating to “Ensuring that Occupational Radiation Exposures are ALARA,” that were incorporated by reference, have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.1 of NUREG–0800, and other NRC regulatory guides. The staff’s review concluded that the applicant has adequately addressed COL Items 12.1-1-A through 12.1-4-A. The applicant has also adequately incorporated by reference NEI 07–03A and NEI 07–08A with additional site-specific information added to COL FSAR. These NEI templates meet the acceptance criteria defined in Section 12.1 of NUREG–0800. Therefore, the staff determined that the information in this section adequately addresses an acceptable ALARA Program, and is in accordance with the NRC requirements.

12.2 Plant Sources

12.2.1 Introduction

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

This section also addresses doses to members of the public due to radioactive effluent releases. All liquid effluent releases are processed and monitored through the liquid waste management system (LWMS) for process liquids generated during the operation of the LWMS. Airborne releases from the operation of LWMS, gaseous waste management system (GWMS), and solid waste management system (SWMS) and ventilation exhaust systems servicing radiologically controlled areas, where process equipment are located, are monitored and discharged through their respective stacks, specifically, the reactor/fuel building stack, turbine building stack, and the radwaste building (RWB) stack.

12.2.2 Summary of Application

Section 12.2 of the Fermi 3 COL FSAR, Revision 3 incorporates by reference Section 12.2 of the certified ESBWR DCD, Revision 9.

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

Tier 2 Departures Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

In this departure, the Fermi 3 RWB is reconfigured to accommodate a minimum of 10 years volume of packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This reconfiguration results in changes in equipment location and layout. The applicant provides revised radiation source parameters in Table 12.2-22R.

COL Items:

- EF3 COL 12.2-2-A Airborne Effluents and Doses

The applicant provides updated information to supplement the DCD with the site-specific parameters for addressing DCD COL Item 12.2-2-A, airborne effluent releases and doses to members of the public. The applicant references Table 12.2-16 in DCD Revision 9 for the non-radioiodine airborne release source terms, and provides site-specific radioiodine airborne release source terms. In FSAR Table 12.2-205, the applicant provides the reactor water iodine radioisotope concentrations during normal operation. The applicant adds that this limit will be part of the Fermi 3 offsite dose calculation manual (ODCM). In FSAR Table 12.2-206, the applicant provides the estimates for radioiodine airborne releases consistent with the reactor water concentration in Table 12.2-205. The non-radioiodine airborne release source terms are based on NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR)," method. Based on these source terms (i.e., values in DCD Tables 12.2-16, and FSAR Table 12.2-206), the applicant provides the comparison of airborne release concentrations with the 10 CFR Part 20 limits in Table 12.2-17R, and the results of the gaseous pathway dose calculations to the maximally exposed individual (MEI) in Table 12.2-18bR. This information addresses compliance with the regulatory dose limits in Sections II.B and II.C of Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion as Low as is Reasonably Achievable for Radioactive

Material in Light-Water-Cooled Nuclear Power Reactor Effluents,” to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”; compliance Section II.D of Appendix I to 10 CFR Part 50; airborne effluent concentration limits in Table 2 (Column 1) of Appendix B, “Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage,” to 10 CFR Part 20; and dose limits in 10 CFR 20.1301 and 20.1302. Compliance with the requirements in Section II.D of Appendix I to 10 CFR Part 50 for airborne effluents is addressed in FSAR Section 11.3.1.

- EF3 COL 12.2-3-A Liquid Effluents and Doses

The applicant provides updated information to supplement the DCD with the site-specific parameters for addressing DCD COL Item 12.2-3-A, liquid effluent releases and doses to members of the public. The applicant adds that the plant has the capability of recycling 100 percent of the liquid radwaste and intends to operate Fermi 3 with zero liquid effluent releases. However, the applicant provides liquid pathway doses to address compliance with the regulatory dose limits in Section II.A of Appendix I to 10 CFR Part 50; compliance with Section II.D of Appendix I to 10 CFR Part 50; liquid effluent concentration limits in Table 2 (Column 2) of Appendix B to 10 CFR Part 20; and dose limits in 10 CFR 20.1301 and 20.1302. Compliance with the requirements in Section II.D of Appendix I to 10 CFR Part 50 for liquid effluents is addressed in FSAR Section 11.2.1.

- STD COL 12.2-4-A Other Contained Sources

The applicant includes Subsection 12.2.1.5, “Other Contained Sources,” in the Fermi 3 FSAR. This subsection provides information about additional contained radioactive sources not described in the DCD that contain by-product, source, or special nuclear materials that may be maintained on site. These contained sources, which are not part of the permanent plant design, are used as calibration, check, or radiography sources.

12.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the radiation sources, and the associated acceptance criteria, are in Sections 11.2 of NUREG–0800.

Also, the NRC staff followed the guidance in RG 1.206, in evaluating Fermi 3 FSAR, Section 12.2 for compliance with NRC regulations.

In accordance with Section VIII, “Processes for Changes and Departures,” of “Appendix [X] to Part 52--Design Certification Rule for the Economic Simplified Boiling Water Reactor,” the applicant identifies Tier 2 departures. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix [X], Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

The regulatory bases for acceptance of the resolution to the COL items are the applicable requirements of 10 CFR Part 20, and the guidance of RG 1.206,.

The regulatory basis for acceptance of the supplementary information in assessing doses to members of the public is established in 10 CFR 20.1301(e), 10 CFR 20.1302, 10 CFR 50.34a and 50.36a; 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criteria (GDC) 60, "Control of releases of radioactive materials to the environment," and 64, "Monitoring radioactivity releases"; and 10 CFR Part 50, Appendix I, Sections II.A, II.B, II.C, and II.D. The regulatory basis for the performance of the LWMS, GWMS and SWMS is in 10 CFR 52.80(a) and Generic Letter 89-01, "Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications."

12.2.4 Technical Evaluation

As documented in NUREG-1966, NRC staff reviewed and approved Section 12.2 of the certified ESBWR DCD. The staff reviewed Section 12.2 of the Fermi 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR appropriately represents the complete scope of information relating to this review topic.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to "Radiation Sources."

In addition, the staff reviewed the applicant's proposed resolution to the departure, and the COL items included under Section 12.2 of the Fermi 3 COL FSAR. The staff used the applicable sections of the SRP and RG 1.206.

Section 1.2.3 of this SER discusses the NRC's strategy to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating the subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for North Anna Unit 3 were equally applicable to the Fermi 3 COL application, the staff undertook the following reviews:

- The staff compared the North Anna Unit 3 COL FSAR, Revision 1 to the Fermi 3 COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from requests for RAIs; and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant endorsed all responses to RAIs identified in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences were not relevant to this section.

The staff completed its review and found the evaluation performed for the North Anna standard content to be applicable to the Fermi 3 COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting.

The staff reviewed the information in the Fermi 3 COL FSAR as follows:

¹ See "*Finality of Referenced NRC Approvals*," in SER Section 1.2.2, 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.

Tier 2 Departures Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The Fermi 3 RWB is reconfigured to accommodate a minimum of 10 years volume of packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This reconfiguration results in changes in equipment location and layout. The applicant provides revised radiation source parameters in Table 12.2-22R. The staff reviewed the equipment location, and compared FSAR Table 12.2-22R with the DCD Table 12.2-22. This comparison confirmed that the radiation source parameters remained unchanged, except for sources in DCD Rooms 6171 and 6172, which are now located in the reconfigured FSAR Room 6171. In the new configuration, the equipment drain sample tank and floor drain sample tank will be in one room (FSAR Room 6171). These tanks were originally in two separate rooms (DCD Room 6171 and 6172). Review of the DCD Figure 12.3-19 and FSAR Figure 12.3-19R revealed that FSAR Room 6171 has a larger overall area than the two DCD rooms (6171 and 6172) combined. Therefore, the staff concluded that, given the size of Room 6171, the radiation level and required shielding will remain the same as those identified for Rooms 6171 and 6172 in the DCD, regardless of tank locations.

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

COL Items:

- EF3 COL 12.2-2-A Airborne Effluents and Doses

This COL item provides an update of estimated airborne releases and associated doses to members of the public. The revised information and analyses address compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50, gaseous effluent concentration limits in Table 2 (Column 1) of Appendix B to 10 CFR Part 20, and requirements in 10 CFR 20.1301 and 20.1302. Several tables in FSAR Section 12.2.2 present updated information as compared to ESBWR DCD Tier 2, Revision 9. The revised tables in the Fermi 3 FSAR are Tables 12.2-15R, 12.2-17R, 12.2-18aR, and 12.2-18bR. FSAR Table 12.2-17R presents an estimate of the annual gaseous effluent source term by radionuclides and results demonstrating compliance with gaseous effluent concentration limits in Appendix B to 10 CFR Part 20. FSAR Tables 12.2-18aR and 12.2-18bR present results demonstrating compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50. Compliance with the U.S. Environmental Protection Agency (EPA) standard in 40 CFR Part 190, "Environmental Radiation Protection Standards For Nuclear Power Operations," as implemented under 10 CFR 20.1301(e), is demonstrated in FSAR Tables 12.2-201 and 12.2-203. Compliance with Section II.D of Appendix I to 10 CFR Part 50 on ALARA is addressed in FSAR Section 11.3 for gaseous effluents, as evaluated in SER Section 11.3.

In a change from Section 12.2.2 of the ESBWR DCD, Tier 2, the applicant applied site-specific information and assumptions in assessing the radiological impacts on

members of the public. The revisions are associated with information item EF3 COL 12.2-2-A. The staff reviewed the proposed updates, information and commitments identified in FSAR, Subsections 12.2.2.1 and 12.2.2.2. The staff performed independent evaluations of offsite doses due to gaseous effluents using the GASPARI code (NUREG/CR-5643, "GASPARI – Technical Reference and User Guide," March 1989); the applicant's basis for the gaseous effluent source term; and assumptions and data in modeling exposure pathways and estimating doses to offsite receptors. The gaseous effluent source terms are based on ESBWR DCD Section 12.2.2. For gaseous effluents, the exposure pathways include external exposure to the airborne plume, external exposure to ground-deposited radioactivity, inhalation of airborne radioactivity, and food products containing radioactivity. The applicant identified locations of expected maximum exposures, including the nearest site boundary, garden, residence, and meat consumption from beef cattle.

As part of this review, the staff identified a number of issues requiring clarification and correction of specific technical and regulatory topics. NRC staff issued several RAIs asking the applicant to provide additional information for the purpose of resolving these issues. The following paragraphs discuss the evaluations of the applicant's responses to the NRC staff's major RAIs.

The staff identified incorrect presentation of the estimated gaseous effluent concentration at the site boundary for compliance with the concentration limits in 10 CFR Part 20, Appendix B, Table 2 (Column 1). In **RAI 12.02-1**, the applicant was requested to revise Table 12.2-17R and add a column to this table showing the ratio of each radionuclide to the corresponding limits in Appendix B to 10 CFR Part 20. In the response to this RAI dated April 8, 2009 (ML091060496), the applicant revises the gaseous effluent concentration at the site boundary and provides the information requested in the RAI. This response was also incorporated into Revision 1 of the Fermi 3 COL FSAR, dated March 2009. The staff found the applicant's response correctly presents the requested information and the compliance with 10 CFR Part 20, Appendix B, Table 2 (Column 1). Therefore, **RAI 12.02-1** is resolved.

In March 2010, the applicant submitted Revision 2 of the COL FSAR incorporating the DCD Revision 6 source terms. In March 2010, ESBWR DCD Revision 7 was issued. DCD Revision 7 revised the gaseous effluent source term. The COL FSAR Revision 2 did not revise the gaseous source term to be consistent with the DCD.

The applicant revises airborne effluent and corresponding dose calculations as part of the response to the Environmental Report (ER) RAIs HH5.4.2-1 and HH5.4.3.3-1 dated September 1, 2010 (ML102510498), and includes this revised information in FSAR Revision 3. In Subsection 12.2.2.1, the applicant states that the gaseous effluents predicted in DCD Table 12.2-16 are based on the pumped forward design of the ESBWR feedwater heaters. In the pump forward design, a significant portion of steam flow bypasses the condensate demineralizer, thereby increasing the concentration of radionuclides in the reactor water system. The gaseous effluent predicted in the DCD Table 12.2-16 could result in an exposure that exceeds the 10 CFR Part 50 dose limit of 15 mrem to a Fermi 3 MEI critical organ during a calendar year. The applicant emphasizes that the gaseous effluent predicted using NUREG-0016 methodology is overly conservative, given the enhanced fuel design, industry's low tolerance for fuel failure, and the industry-wide efforts to maintain radiation exposures ALARA. In order to limit the critical organ dose, the applicant adds that the operation of the reactor would be

in accordance with COL FSAR Subsection 11.5.4.5 and the Fermi 3 ODCM to limit the concentration of radioiodine in the reactor water. This is accomplished by altering the feedwater system valve lineup to secure pumped forward feedwater heaters and to operate the feedwater heaters in a cascade mode. The applicant provides FSAR Table 12.2-205, which lists the limiting reactor water iodine radioisotope concentrations, as part of the revised COL FSAR Subsection 12.2.2.1. In addition, the applicant provides a revised COL FSAR Table 12.2-17R, listing the Fermi 3 annual airborne effluent source terms and showing compliance with the 10 CFR Part 20, Appendix B, Table 2 (Column 1).

The staff reviewed the applicant's information on the operational method to limit the reactor water radioiodine concentrations. The staff noted that the applicant proposed an alternative methodology to achieve the bounding dose objectives of the certified ESBWR design. The cited radioiodine concentrations in FSAR Table 12.2-205 correspond to an operating condition consistent with 100 percent flow through the condensate demineralizer, which is higher than the fraction used in the certified ESBWR design (i.e., 0.663). Therefore, the staff Issued **RAI 12.02-7** requesting the applicant to provide additional information relative to the proposed revisions to the FSAR:

1. The discussion refers to NUREG-0016 methodology, as referenced by the DCD, and upon which the staff's review was based, as "overly conservative." However, this characterization and the corresponding operational limitations proposed do not provide a quantification of the asserted conservatism. Please provide this information in sufficient detail for the staff to quantify the effect on effluent concentrations and resultant public doses, and occupational doses to in-plant workers.
2. The NUREG-0016 methodology is used for all boiling-water reactor (BWR) design applications. The proposed revision does not provide an alternative methodology, instead appearing to assert the conservatism as a justification for not providing an alternative methodology. Please provide an alternative methodology, including quantifiable changes to input, clarifying your quantification and technical basis for this statement; or provide information to support the deviation from the routine source term in Chapter 11.1 of the DCD, and resulting calculations of effluents.
3. The description of the condensate purification system in the ESBWR DCD was changed such that the purification flow went from 100 percent to about 67 percent of condensate flow. This resulted in an increase to the calculated routine source term. FSAR Revision 3 proposes to reduce calculated doses by reducing the source term back to the values calculated in the design before the change in the description. This is proposed to be accomplished through operational limitations, such that purification flow would be 100 percent of condensate flow. This proposal, however, does not address the revised power level to account for the loss of efficiency in the thermal cycle. Further, the proposal does not quantify the differences to the routine and accidental source terms from prolonged operation at the reduced power levels. Please clarify whether this proposed operational limitation will be stated in the ODCM, or will be proposed as a license condition to satisfy 10 CFR Part 50, Appendix I.
4. The resulting calculated MEI and population doses provided in FSAR Revision 3 do not appear to be fully consistent with the revised release concentrations in the

ESBWR DCD. Please provide additional information regarding the effect of these changes on the information presented in Tables 12.2-17R, 12.2-18bR, 12.2.201, 12.2.203, and 12.2-204 of the FSAR, including operation at the expected reduced thermal efficiencies consistent with the proposed operational limitation.

The applicant's response to this RAI dated June 17, 2011 (ML11171A297), provides additional clarifying statements on the proposed changes. The applicant reiterates the statement in DCD Subsection 12.2.2.2, that the COL applicant is responsible for ensuring that offsite dose (using site-specific parameters) due to radioactive airborne effluents complies with the regulatory dose limits in 10 CFR Part 50, Appendix I, Section II.B and II.C. Also, the applicant notes that the staff's FSER on ESBWR DCD, Chapter 2 states that:

Other parameters, such as releases rates, can also be adjusted to demonstrate compliance with 10 CFR Part 50, Appendix I, dose criteria.

The applicant adds that preliminary dose calculations using the gaseous release source terms in DCD Table 12.2-16 indicated that the estimated exposure to the Fermi 3 MEI critical organ during a calendar year could exceed 15 mrem (ML102510498). To limit the potential MEI critical organ dose below the regulatory limit, the applicant chooses to lower the iodine release rate, consistent with the staff's statement, by placing administrative limits on the reactor water iodine radioisotopes concentrations during normal operation at levels indicated in FSAR Table 12.2-205. The applicant adds that the values in Table 12.2-205 were developed consistent with DCD Section 11.1, using the methodology described in ANSI/ANS-18.1-1999, "Radioactive Source Term for Normal Operation of Light Water Reactors." The applicant references Regulatory Position C.4 of RG 1.112 Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," and the staff's ESBWR DCD FSER Chapter 11 (NUREG-1966), indicating the acceptability of ANSI/ANS-18.1-1999 methodology as an alternative to the NUREG-0016 methodology.

Furthermore, the applicant adds that the limits established in Table 12.2-205 were developed assuming that plant was operating in a cascade configuration; 100 percent of steam flow is treated by the condensate demineralizer. In the supplemental response to RAI 12.02-7 dated August 5, 2011 (ML11221A075), the applicant states that the ESBWR DCD does not describe the maximum capabilities of the condensate polishing system (CPS) or the condensate system components (pumps, valves, and pipes). The maximum component capabilities are established during the detailed design. Therefore, the applicant adds supplements EF3 SUP 10.4-1 and EF3 SUP 10.4-2 in FSAR Subsections 10.4.6.2.2 and 10.4.7.2.1, respectively, to ensure that the CPS and condensate system components design can accommodate 100 percent of feedwater flow to support cascade configuration.

The staff reviewed the applicant's response and confirmed the reactor water iodine radioisotope concentrations in Table 12.2-205 through an independent confirmatory calculation. The applicant's use of ANSI/ANS-18.1-1999 methodology is consistent with the guidance of RG 1.112 Regulatory Position C.4, and the staff's review of ESBWR DCD Chapter 11. The staff found that the applicant's approach, through two site-specific supplements EF SUP 10.4-1 and 10.4-2, in ensuring that the CPS and condensate components design will have the capability for 100 percent feedwater flow is acceptable. Therefore, RAI 12.02-7 is closed.

In response to item 1, the applicant states that the characterization of the conservative nature of NUREG–0016 is based on experience at operating BWRs; the reactor water iodine concentrations at operating BWRs are lower than the values determined using the NUREG–0016 methodology. However, because this method was not used in determining iodine source terms, the discussion of conservative nature of NUREG–0016 will be removed from FSAR Subsection 12.2.2.1. The staff found this response acceptable and this issue is resolved.

In response to item 2, the applicant states that ANSI/ANS-18.1–1999 was used as alternative methodology to the NUREG–0016 method. The use of ANSI/ANS-18.1-1999 is consistent with the guidance in RG 1.112 and the NRC FSER on the ESBWR DCD (NUREG–1966). The iodine releases in Table 12.2-206 were developed using the reactor water radioiodine concentrations in Table 12.2-205 and the method described in DCD Appendix 12B. The applicant adds that clarifying statements will be added to the FSAR Subsection 12.2.2.1 to specify the method used to develop normal operating radioiodine limits and releases in Tables 12.2-205 and 12.2-206, respectively. The staff found the applicant’s response acceptable, because the applicant used acceptable methods in ANSI/ANS-18.1-1999 for determining the iodine radioisotopes concentrations and releases. Therefore, this issue is resolved. Verification that the applicant’s proposed changes are included in the next FSAR revision is being tracked as **Confirmatory Item 12.02-7.**

In response to item 3, the applicant states that Fermi 3 will operate in a pumped forward configuration, when the normal operating reactor water radioiodine concentrations are less than the concentration limit values in FSAR Table 12.2-205. If the radioiodine concentrations reach the values in Table 12.2-205, the unit will operate in the cascade configuration. In this configuration, all the condensed steam is routed to the condenser and then treated by the condensate demineralizer, resulting in a small power reduction due to loss of thermal efficiencies. The applicant adds that this action does not replace the design basis reactor water radioiodine concentrations in DCD Table 11.4a, but causes the continued operation of Fermi 3 at lower reactor water radioiodine concentrations compared to the limits for the normal ESBWR operational radioiodine values. The reactor water radioiodine concentrations in Table 12.2-205 is an administrative limit controlled through the ODCM, as indicated in FSAR Subsection 11.5.4.5. The staff found the applicant’s response reasonable, because operating at higher reactor water radioiodine concentrations than those cited in FSAR Table 12.2-205 will result in a Fermi 3 MEI critical organ dose that exceeds the regulatory dose limit. The applicant imposes an administrative control through the ODCM to limit the Fermi 3 MEI critical organ dose below the regulatory dose limit. Therefore, this issue is resolved.

In response to item 4, the applicant states, as described earlier in response to ER RAI 01-1(ML102510498), and in the responses to the above items, that limiting the maximum allowable radioiodine concentrations in the reactor water ensures that the MEI critical organ dose will be less than the regulatory limit. The information presented in FSAR Tables 12.2-17R, 12.2-18bR, 12.2-203, and 12.2-204 is based on the gaseous release values presented in Table 12.2-206 for radioiodine and in DCD Table 12.2-16 for releases other than iodine radioisotopes. The staff found the applicant’s response acceptable. As indicated earlier, to ensure that the MEI doses will not exceed the regulatory limits of 10 CFR Part 50, Appendix I, the applicant must limit the iodine releases during normal operation. One method to achieve this is to maintain the reactor

water iodine radioisotopes concentrations at levels lower than the normal ESBWR DCD operational radioiodine values. The applicant limits the normal operating radioiodine concentrations in the reactor water to the values listed in FSAR Table 12.2-205. This concentration limit is controlled through the ODCM. The staff found the applicant's response acceptable and this issue is closed. The staff's review of information in FSAR Tables 12.2-18bR, 12.2-203 and 12.2-204 is presented below.

In RAI 12.02-3, the staff requested that the applicant provide the input and output files for the data used in GASPAR II computer code analyses in generating dose estimates to members of the public associated with the operation of Fermi 3. Specifically, the applicant was asked to describe all assumptions and bases for the use of factors that are different than the default values noted in RG 1.109 Revision 1 "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," and/or GASPAR II code. In the response to this RAI dated August 25, 2009 (ML092580311), the applicant provides the GASPAR II site-specific input parameters and their bases, along with electronic input and output files. The staff reviewed the applicant's response and performed confirmatory analyses to determine the gaseous pathway doses to the MEI and to the 50-mile population. The staff confirmed the gaseous pathway doses presented in the COL FSAR Tables 12.2.18bR and 12.2-201 (for the MEI), and Table 12.204 (for 50-mile population). These results indicated that the projected annual doses to the MEI from gaseous effluents comply with the regulatory dose limits in 10 CFR Part 50, Appendix I, Section II.B and II.C. In addition, the projected gaseous effluent 50-mile population doses would be insufficient to result in any cost-beneficial gaseous radwaste augments. Therefore, RAI 12.02-3 is resolved.

However, the applicant issued COL FSAR Revision 2 but did not consider the DCD Revision 7 revised gaseous effluent source term. In addition, the applicant did not include the potential direct dose from the independent spent fuel storage installation (ISFSI) as a contributor to the total dose at the nearest site boundary.

The applicant revised MEI and population doses as part of the response to the ER RAIs (ML102510498), and included this result in FSAR Revision 3. In FSAR Revision 3, the applicant provides the MEI doses for selected locations at the site boundary and at the nearest resident, and revises FSAR Tables 12.2-15R, 12.2-18aR, 12.2.18bR, 1.2-201, 12.2.203, 12.2-204, and 12.2.206. For dose calculations, the applicant uses the maximum long-term atmospheric dispersion estimates from the onsite-meteorology data during the 1989 through 1995, and 2002 through 2007 calendar years. The staff reviewed the applicant's revised information and performed confirmatory analyses. In these analyses, the staff used the applicant's airborne releases for radioiodine in FSAR Table 12.2-206, and for other isotopes in Table 12.2-16 of DCD Revision 9. The staff performed two analyses, one with the X/Q values provided by the applicant, and the second with the X/Q values listed in tables of Section 2.3 of the FSAR. For the first analysis, the staff's results confirmed the revised doses provided in FSAR Table 12.2-18bR, 12.2-201, and 12.2-204. The second analysis resulted in higher plume doses to the MEI at the site boundary. This is because the X/Q values used by the applicant contained adjusted values for no decay undepleted X/Q, which resulted in unreasonably long plume travel time to the MEI locations. The staff found, however, that this higher plume dose would not cause the total MEI dose to exceed the 10 CFR Part 50 dose limits. These results reaffirmed that the projected annual doses to MEI

from gaseous effluent comply with the regulatory dose limits in 10 CFR Part 50, Appendix I, Section II.B and II.C.

In addition, the staff considered the direct dose to the nearest site resident from the Fermi 2 ISFSI. Based on the ISFSI dose rate of 6.64×10^{-3} mrem per hour at a distance of 252 meters (m) (820 feet [ft]) as provided in Section 12.4.4 of this SER, the staff estimated the direct dose to the nearest site boundary to be about 10 mrem per year. If this dose is added to the whole body dose in FSAR Table 12.2-203 for comparisons of site dose to the MEI with the 40 CFR Part 190 dose limit, the site total dose will be less than the dose limit of 25 mrem per year. Therefore, RAI 12.02-3 is closed.

On the basis of the information described above, the staff found that the applicant has adequately addressed EF3 COL Item 12.2-2-A (description of site specific airborne effluent releases and doses to members of the public).

- EF3 COL 12.2-3-A Liquid Effluents and Doses

This COL item provides an update of estimated liquid releases and associated doses to members of the public. The revised information and analyses address compliance with Section II.A of Appendix I to Part 50; liquid effluent concentration limits in Table 2 (Column 2) of Appendix B to Part 20; and requirements of 10 CFR 20.1301 and 20.1302. Several tables in the FSAR present updated information as compared to the ESBWR DCD Tier 2, Revision 9. The revised tables in the Fermi 3 FSAR are Tables 12.2-19bR, 12.2-20aR, 12.2-20bR and Tables 12.2-202 and 12.2-203. FSAR Table 12.2-19bR presents an estimate of the annual liquid effluent source term by radionuclides and results demonstrating compliance with liquid effluent concentration limits of Appendix B to 10 CFR Part 20. Compliance with the EPA standard in 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), is demonstrated in FSAR Tables 12.2-202 and 12.2-203. FSAR Tables 12.2-20aR and 12.2-20bR present results demonstrating compliance with Sections II.A of Appendix I to Part 50. Compliance with Section II.D of Appendix I to 10 CFR Part 50 on ALARA is addressed in FSAR Section 11.2 for liquid effluents, as evaluated in SER Section 11.2.

In a change from Section 12.2.2 of the ESBWR DCD Tier 2, the applicant applied site-specific information and assumptions in assessing the radiological impacts on members of the public. The staff reviewed the proposed updates, information and commitments identified in FSAR, Subsection 12.2.2.4. The staff performed independent evaluations of offsite doses due to liquid effluents using the LADTAP II code, (NUREG/CR-1276, "User's Manual for LADTAP II – A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents," March 1980); the applicant's basis for the liquid effluent source term; and assumptions and data in modeling exposure pathways and estimating doses to offsite receptors. The liquid effluent source terms are based on ESBWR DCD, Section 12.2.2. The exposure pathways include ingestion of aquatic food, ingestion of drinking water, exposure to shoreline sediment, and exposure to water through boating and swimming.

As part of the review, the staff identified a number of issues requiring clarification and correction of specific technical and regulatory topics. NRC staff asked the applicant to provide additional information for the purpose of resolving these issues. The following paragraphs discuss the staff's evaluations of the applicant's responses to the staff's major RAIs.

The staff identified inconsistency in presentation of compliance with 10 CFR Part 20, Appendix B, Table 2 (Column 2). In **RAI 12.02-2**, the applicant was requested to update the FSAR by listing in a tabular format, the liquid discharge nuclide concentrations, along with comparisons to the corresponding values in Table 2 of 10 CFR Part 20, Appendix B, for consistency with the unity rule. In the response to this RAI dated August 8, 2009 (ML091060496), the applicant revises Table 12.2-19bR to include a comparison with the unity rule. This response was incorporated into Revision 1 of the FSAR dated March 2009. The staff reviewed the applicant's response and found it acceptable. Therefore, **RAI 12.02-2** is resolved. This response was based on the liquid effluent source term from DCD Revision 5. In March 2010, the applicant issued COL FSAR Revision 2. However, FSAR Table 12.2-19bR did not list the correct liquid effluent source term from the DCD Revision 7. The staff verified that FSAR Revision 3 still does not list the correct liquid effluent source term from the DCD Revision 9. In the supplemental response to RAI 12.02-2 dated August 1, 2011 (ML1121A021), the applicant provides the revised Table 12.2-19bR incorporating the annual liquid effluent source terms consistent with the DCD Revision 9. The staff found this response acceptable. Verification that this change will be included in the next FSAR revision is being tracked as **Confirmatory Item 12.02-2**.

In RAI 12.02-4, the staff requested the applicant to provide the input and output files or the data used in LADTAP II computer code analyses in generating dose estimates to members of the public associated with the operation of Fermi 3. Specifically, the applicant was asked to:

- a. Provide justification for transit times and dilution factors used in LADTAP II code dose calculations for liquid effluent discharges at different intake locations (commercial fish and invertebrate catch locations, drinking water intake locations). Also, provide a discussion describing the impact of thermal variations on applied dilution factors.
- b. Provide estimates of the amount of invertebrate stocks caught from waters within 50 miles downstream of the facility's radwaste discharge line that is consumed locally and regionally.
- c. Provide discussions describing local wildlife game, plants, agricultural practices, game harvests, and food processing operations having the potential to contribute 10 percent or more to either individual or population doses in areas affected by liquid effluents, such as irrigation, livestock watering, and food-processing operations, involving local and regional water use.
- d. Describe all assumptions and basis for the use of factors that are different than the default values noted in RG 1.109 and/or LADTAP II code.

The applicant responded to this RAI in a letter dated August 25, 2009 (ML092580311). In response to part a, the applicant provides transit time and dilution factors for drinking water and fish and invertebrate harvest, considering the impacts of thermal variations in Lake Erie. The applicant uses CORMIX computer program (Jirka, G.H., R.L. Doneker, and S.W. Hinton, "User's Manual for CORMIX: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters," Developed for U.S. Environmental Protection Agency, Office of Science and Technology, 2007) to determine dilution in Lake Erie, provide monthly total dilution factors, and compare the

average annual dilution factor with that used in liquid effluent dose calculations. For the drinking water, the overall dilution factor (blow down dilution multiplied by Lake Erie dilution), ranged from 6,930 to 10,240, with an average value of 8,914, versus 7,705 used by the applicant for dose calculations. For the fish and invertebrates harvest, the overall dilution factor ranged from 8,880 to 10,823, with an average value of 10,172, versus 11,500 used by the applicant.

In response to part b, the applicant states that even though currently there is no commercial fishery for invertebrates in the Great Lakes, it was conservatively assumed that the invertebrates catch in the Great Lakes is similar to that of salt water sites. Therefore, the total catch was based on the total invertebrate consumptions within the 50-mile radius of the site using the projected 50-mile population at year 2060, and the LADTAP II default child/teen/adult population fractions and their corresponding invertebrate consumption values in Table E-5 of RG 1.109, Revision 1.

In response to part c, the applicant states that the estimate for the quantities of invertebrates harvest presented in part b bounds any recreational harvesting operation. The applicant adds that the ER, in Part 3 of the COL application, provides surface water usage for drinking water, irrigation, and livestock consumption from the Lake Erie. This data indicates that potable water usage is more than eight times that of the other usages. In addition, the consumptive surface water usage from the western basin of Lake Erie, in the local area of Monroe County for irrigation and livestock, is small. Furthermore, there are no food processing operations utilizing large quantities of water from the western basin of Lake Erie. Therefore, surface water usage for irrigation and live stock would not provide significant means for contributing 10 percent or more to either the individual; or the public dose due to local animal meat, plant agricultural practices and game harvest.

In response to part d, the applicant provides LADTAP II site-specific and generic input values and bases, along with electronic input and output files.

The staff reviewed the applicant's response and concurred with the information provided in response to parts b through d. The MEI dose from the liquid releases, as indicated in FSAR Table 12.2-20bR, for ingestion of fish and invertebrates accounts for well over 90 percent of the total MEI dose, both for the adult and the child age group. Drinking water adds the balance of the total body dose for both age groups. Therefore, the potential doses from surface water usage for irrigation and animal consumption would be small.

In response to part a, the staff found the dilution factor used by the applicant for the drinking water and fish and invertebrates harvest was not conservative. Therefore, two LADTAP confirmatory runs were made: one using the applicant's assumption on dilution factors, and another using the minimum overall dilution factors to determine the impact of dilution factor on the MEI and population doses. In the latter confirmatory run, the Lake Erie dilution factor was adjusted to correspond to the minimum overall dilution factor. The dose results from this run indicate an increase of about 29 percent in total body dose and maximum organ dose for an MEI; and about 30 percent increase in total body dose and maximum organ dose for population. As indicated in FSAR Table 12.2-203, in comparisons to the regulatory dose limit, offsite liquid effluent doses are smaller by about 2 to 3 orders of magnitude. Since the baseline MEI dose is very small, and complies with the regulatory dose limit in 10 CFR Part 50, Appendix I,

Section II.A, by a wide margin, the additional 30 percent increase in the baseline dose estimates is negligible. With respect to population dose, the 30 percent increase in offsite liquid effluent dose would not change the conclusion that none of the liquid radwaste augments would be cost-beneficial. Again, in response to part c, the applicant stated that there is little consumptive use of surface water for irrigation or livestock, so an increase in the baseline dose estimate by 30 percent would not increase the estimated doses and conclusions. Therefore, based on the above, the staff found Fermi 3 complies with the requirement of 10 CFR Part 50, Appendix I, Section II.A and Section II.D. Therefore, RAI 12.02-4 is resolved. This analysis was based on the DCD Revision 5 liquid effluent source term.

The applicant provided COL FSAR, Revision 2 in March 2010. In this FSAR revision, the applicant used the DCD, Revision 6 liquid effluent source term. The liquid effluent source term remained unchanged in DCD Revision 7, and thereafter. The staff reviewed the updated doses to the MEI and population, and performed confirmatory analyses to determine the liquid effluent pathway doses to the MEI and to the 50-mile population. The analyses confirmed the applicant's liquid effluent pathway dose results presented in FSAR Revision 2, Tables 12.2-20bR, 12.2-202, 12.2.203 and 12.2.204. Therefore, the staff found Fermi 3 complies with the requirement of 10 CFR Part 50, Appendix I, Section II.A and Section II.D, and RAI 12.02-4 is resolved. In the supplemental response to RAI 12.02-2 dated August 1, 2011 (ML1121A1021), the applicant provides the revised Table 12.2-19bR to be consistent with the annual liquid release using DCD Revision 9, Table 12.2-19b. Therefore, RAI 12.02-2 is closed.

On the basis of the information described above, the staff found that the applicant has adequately addressed EF3 COL Item 12.2-3-A (description of site-specific liquid effluent releases and doses to members of the public).

- STD COL 12.2-4-A Other Contained Sources

The following portion of this technical evaluation section is reproduced from Section 12.2.4 of the North Anna Unit 3 SER (ML091740254):

- *STD COL 12.2-4-A Other Contained Sources*

The applicant provided additional information under STD COL 12.2-4-A that addresses the resolution of DCD COL Item 12.2-4-A, which states:

“The COL applicant will address any additional contained radiation sources (including sources for instrumentation and radiography) not identified in Subsection 12.2.1.5.”

The COL applicant stated that additional contained sources which contain by-product, source, or special nuclear materials may be used and maintained on site. These sources are typically used as calibration or radiography sources. In response to staff RAI 12.02-6, the applicant stated that, in addition to use as calibration and radiography sources, the contained sources described in Subsection 12.2.1.5 will also be used as check sources. The staff finds this response acceptable and RAI 12.02-6 is closed.

Calibration sources will be used to calibrate the process and effluent radiation monitors, the area radiation monitors, and portable and laboratory radiation detectors and radiation measurement instruments. All calibration sources will be traceable to the National Institute of Standards and Technology, or equivalent. Radiography sources will be surveyed upon entry to the site and radiation protection personnel will maintain copies of the most recent leak test records for owner-controlled sources. Radiography will be conducted in accordance with approved procedures. Check sources, which are not necessarily calibrated, are used to confirm the continuing satisfactory operation of an instrument. In response to staff RAI 12.02-8, the applicant stated that check sources, which are an integral part of (i.e., physically located in) area, process, and effluent monitors and are not easily removed, do not require special handling, storage, or use procedures for radiation protection purposes. Since these check sources consist of small quantities of by-product material and since access to these sources would require procedures and tools to disassemble components of the monitors, the staff finds this response acceptable and RAI 12.02-8 is closed. Except for check sources physically located in monitors, as described above, and exempt quantities or concentrations of solid and liquid sources used for instrument calibration, the applicant stated that Radiation Protection Program procedures will be used to govern the use and control of these additional contained radiation sources. The applicant stated that these procedures will consider guidance provided in RG 8.8 to ensure that occupational doses from the control and use of these sources are ALARA.

In addition, Section 12.5.4.10 of NEI template 07-03, referenced in the North Anna 3 COL FSAR Section 12.5, describes Radiation Protection Program radioactive material control procedures. This section states that procedures will be established, implemented, and maintained to ensure compliance with the relevant requirements in 10 CFR Part 20 to ensure positive control over licensed radioactive material to avoid unnecessary or inadvertent exposures and releases of such material into uncontrolled areas in a manner that is not authorized by regulation or the license. In response to staff RAI 12.02-5, the applicant verified that these procedures will apply to byproduct, source, and special nuclear material, including the contained sources described in Subsection 12.2.1.5. The staff finds this response acceptable and RAI 12.02-5 is closed.

RG 1.206 states that the applicant should describe any required radiation sources containing byproduct, source, and special nuclear material that may warrant shielding considerations, and, for any such sources, should provide a listing by isotope, quantity, form, and use for all of these sources that exceed $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries). The staff issued RAI 12.02-7 and asked the applicant to ascertain whether any of the contained sources described in Subsection 12.2.1.5 met these criteria. In response to this RAI, the applicant stated that FSAR Appendix 12BB (which incorporates by reference NEI template 07-03) addresses shielding requirements for all byproduct, source, and special nuclear material, including the portable sources described in Subsection 12.2.1.5.

The applicant stated that two standard calibration sources that exceed 3.7×10^9 Bq (100 millicuries) will be purchased. Details of isotope type, quantity, form, shielding requirements, and use of future contained sources will be available when these required sources are purchased. Because these sources will be controlled by the applicant's Radiation Protection Program, the staff finds this response acceptable and RAI 12.02-7 is closed.

On the basis of the information provided in Subsection 12.2.1.5 of the FSAR, the staff finds that the applicant has adequately addressed DCD COL Item 12.2-4-A regarding the description of any other contained radiation sources not described in Subsection 12.2.1.5 of the ESBWR DCD. Therefore, the staff finds DCD COL Item 12.2-4-A to be resolved.

In addition, as part of the review of Fermi 3 plant-specific information on other contained sources under STD COL 12.2-4-A, the staff issued RAI 12.03-12.04-8 requesting the applicant to provide a description of the condensate storage tank (CST) as it will be located at the Fermi site. In addition, the RAI requested that the applicant provide information on the CST's expected maximum radionuclide inventory, maximum dose rate at 30 centimeters (cm) (1 ft) from the outside surface, and radiation zone classification. The staff also requested that the applicant identify any physical or administrative features that will be incorporated to limit the access to the CST to ensure that radiation exposure to personnel who are in the vicinity of the tank is ALARA.

In the response to this RAI dated October 19, 2010 (ML102940219), the applicant provides the requested information, and provides a description of the CST location, projected CST design dimensions, and tank material usage. It should be noted that no CST design information was provided in the DCD. The applicant adds that the primary source of water to the CST is purified and demineralized water from the makeup water system, which is not contaminated. However, the CST can receive contaminated recycled water from the control rod drive system, treated water from the LWMS, and condenser rejects in cases of high water levels in the condenser.

To establish a bounding source term, the applicant assumes the main sources of CST contaminations are from the condensate reject and LWMS recycle. The applicant compares the expected radionuclide concentrations in the condenser and those in the equipment drain sample tank of the LWMS, and selects the largest value as the bounding activity in the CST. Because the CST water volume (4,885 cubic meters [1.29 million gallons]) is the only CST parameter provided in the ESBWR DCD, the applicant considers two different CST designs based on tank aspect ratios of 0.5 and 2 that limit the tank area and height. Based on this design, the applicant calculates the potential dose at 30 cm (1 ft) from the surface of the tank to be 2.2 and 2.1 mrem/hr for the tanks with aspect ratios of 0.5 and 2, respectively. Because these estimated doses are below the threshold to be considered as a radiation area per 10 CFR Part 20, the applicant concludes that no special physical or administrative features are needed to maintain the exposures in the vicinity of the CST ALARA.

The staff reviewed the applicant's information, assumptions, and the method of analysis, and found them acceptable. The staff performed confirmatory analyses for determining the potential radionuclide concentrations in the CST and the expected doses in the vicinity of the CST. The staff's analyses confirmed the applicant's cited results.

Therefore, this RAI is closed. The staff verified that FSAR, Revision 3 includes Table 12.2-207 providing the bounding radionuclide inventory in the CST. The staff found that STD COL 12.2-4-A meets the requirements of 10 CFR Part 20, and is therefore acceptable.

12.2.5 Post Combined License Activities

There are no post COL activities related to this section.

12.2.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to the radiation sources, and no outstanding information is expected to be addressed in the Fermi 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [X], Section VI.B.1, all nuclear safety issues relating to the radiation sources that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.2 of NUREG-0800, and other NRC regulatory guides. The staff's review concluded that the applicant has adequately addressed the COL items involving the site-specific airborne and liquid effluent doses, and contained sources in accordance with NUREG-0800, Section 12.2. The staff concluded that the applicant has adequately addressed COL items by providing a description of the contained sources that were not described in the ESBWR DCD. Regarding liquid and gaseous effluent releases and doses to members of the public, the results of the dose assessment analyses and estimates of offsite liquid and gaseous effluent concentrations are acceptable and meet the applicable requirements of 10 CFR 20.1301, 20.1302, and 20.1301(e); 10 CFR Part 50, Appendix I design and ALARA objectives; and effluent concentration limits of Appendix B (Table 2) to 10 CFR Part 20.

12.3 Radiation Protection Design Features

12.3.1 Introduction

This section of the FSAR addresses the issues related to radiation protection equipment and design features used to ensure that occupational radiation exposures are ALARA. The discussion takes into account design dose rates, anticipated operational occurrences, and accident conditions. These issues include the facility design features, shielding, ventilation, area radiation and airborne radioactivity monitoring instrumentation, and dose assessment.

12.3.2 Summary of Application

Section 12.3 of the Fermi 3 COL FSAR, Revision 3, incorporates by reference Section 12.3 of the certified ESBWR DCD, Revision 9.

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

Tier 2 Departures Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The Fermi 3 RWB is reconfigured to accommodate a minimum of 10 years volume of packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This reconfiguration results in changes in equipment location and layout affecting various DCD figures and tables. The replacement tables and figures are: Tables 12.3-4R and 12.3-8R, Figures 12.3-19R through 12.3-22R, 12.3-39R through 12.2-42R, and 12.3-61R through 12.3-64R. The applicant performed a qualitative evaluation of each wall in the reconfigured RWB against the same wall and functions described in the DCD. This evaluation confirmed that the radiation zones in the departure will be maintained the same as those in the DCD.

COL items

- STD COL 12.3-2-A Operational Considerations

STD COL 12.3-2-A addresses the operational considerations for airborne radiation monitoring, such as the procedures for operation and calibration of the monitors, as well as the placement of the portable monitors. The applicant references Section 12.5 of the FSAR, which in turn references NEI 07-03A.

- STD COL 12.3-4-A Compliance with 10 CFR 20.1406

STD COL 12.3-4-A addresses the operational and post-construction objectives of RG 4.21. The applicant states that programs and procedures are implemented consistent with NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," to meet the objectives of RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," and the requirements of 10 CFR 20.1406.

Supplemental Information

- EF3 SUP 12.3-1 Radwaste Building

In FSAR Revision 3, Subsection 12.3.1.4.5, "Radwaste Building," the applicant adds the following design features to minimize occupational exposure:

- Provision for control of fluids exiting high activity rooms, including provision to isolate floor drains, and remote operation of control valves from the radwaste control room.
- Piping from high activity rooms are arranged to minimize exposure to normally occupied areas, and are designed to maintain radiation levels in the RWB process system area as shown in Figure 12.3-19R through Figure 12.3-22R.

12.3.3 Regulatory Basis

The regulatory basis of information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the radiation protection design features, and the associated acceptance criteria, are in Section 12.3-12.4 of NUREG–0800.

Also, the NRC staff followed the guidance in RG 1.206, in evaluating Fermi 3 FSAR, Section 12.3 for compliance with NRC regulations.

In accordance with Section VIII, “Processes for Changes and Departures,” of, “Appendix [X] to Part 52--Design Certification Rule for the Economic Simplified Boiling Water Reactor,” the applicant identifies Tier 2 departures. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix [X], Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

In particular, the regulatory basis for acceptance of the resolution to the COL information items is in the applicable requirements of 10 CFR Part 20, Part 50, and Part 70, “Domestic Licensing of Special Nuclear Material,” and the guidelines in:

- Item III.D.3.3 of NUREG–0737, “Clarification of TMI Action Plan Requirements,”
- RG 1.97, Revision 4, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants, “
- RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning,”
- RG 8.2,
- RG 8.8

12.3.4 Technical Evaluation

As documented in NUREG–1966, NRC staff reviewed and approved Section 12.3 of the certified ESBWR DCD. The staff reviewed Section 12.3 of the Fermi 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to the “Radiation Protection Design Features.”

Section 1.2.3 of this SER discusses the NRC’s strategy to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating the subsequent COL applications. To ensure that the staff’s findings on standard content that were documented in the SER for North Anna Unit 3 were equally applicable to the Fermi 3 COL application, the staff undertook the following reviews:

¹ See “*Finality of Referenced NRC Approvals*,” in SER Section 1.2.2, 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.

- The staff compared the North Anna Unit 3 COL FSAR, Revision 1 to the Fermi 3 COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from requests for RAIs; and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant endorsed all responses to RAIs identified in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences were not relevant to this section.

The staff completed its review and found the evaluation performed for the North Anna standard content to be applicable to the Fermi 3 COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting.

The staff reviewed the information in the Fermi 3 COL FSAR as follows:

Tier 2 Departures Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

FSAR Section 12.3, Revision 2 provides revised DCD tables and figures as a result of Departure EF3 DEP 11.4-1. In Part 7 of the COL application, the applicant states that consistent with the guidance of NUREG-0800 Section 11.4, Fermi 3 RWB waste storage space has been configured to accommodate at least 10 years of Class B and C waste generated during plant operation. In addition, shielding analysis has been performed for this design change, which shows that the resultant dose rates in surrounding areas, both within the building and externally, are maintained below the allowable limits in accordance with the radiological area classification in FSAR Subsection 12.3.1.3. Long-term, temporary storage of Class B and C waste in high integrity containers, with design lifetimes of 300 years, will not have an adverse effect on the integrity of the waste containers. Furthermore, periodic inspections will be performed to confirm container integrity during storage. There is, however, no discussion of this departure in FSAR Section 12.3, Revision 2.

The staff reviewed the information in Part 7 of the COL application. A comparison of the revised tables and figures with those in Section 12.3 of DCD, Revision 7 revealed numerous changes in room layout and dimensions, with some rooms/walls showing elevation above the grade level, where as in Section 12.3 of the DCD they are below grade. In addition, the layout changes resulted in changes in access and egress routes within this building. In order for the staff to better evaluate what impact the changes described in this departure would have on the RWB as described in the DCD, the staff issued **RAI 12.03-12.04-7** requesting that the applicant:

1. Provide a discussion of this departure in FSAR Section 12.3 and include a discussion in the FSAR of the table (Table 12.3-8) and figures (Figures 12.3) added to Chapter 12 of the FSAR.
2. Verify that the source terms used for the components in the radwaste building are the same as those provided in Section 12.3 of the DCD Revision 7.

3. Provide analyses and descriptions of the effects of the geometry and layout changes (made for the Fermi radwaste building) on the various radwaste building dose rates calculated in the DCD.
4. Describe the basis for any differences between the equipment dimensions for the various pieces of equipment located in the various rooms in the radwaste building at Fermi and the comparable values described in the DCD (as described in Table 12.2-22 of the DCD).
5. Describe any differences in shield wall thickness between those specified in FSAR Table 12.3-8R and in the comparable thickness shown in Table 12.3-8 of the ESBWR DCD and describe the basis for any differences.

In the response to RAI 12.03-12.04-7 dated October 19, 2010 (ML102940218), the applicant provides the requested information and the revised affected FSAR pages. In responses to Items 1 and 2, the applicant provides additional information describing the effects of Departure EF3 DEP 11.4-1 in Section 12.3 of the COL FSAR. This departure reconfigures the RWB to accommodate increased storage space capacity for Class B and C solid waste. The applicant identifies the various ESBWR DCD tables and figures affected by this departure. The applicant adds that only equipment locations have been revised, and the equipment size, content and source terms have remained unchanged. The thicknesses of RWB walls have been revised to maintain the same radiation zones as those identified in the DCD. Therefore, the radiation levels and the required shielding will remain the same regardless of equipment locations. The applicant provides FSAR Table 12.3-8R and Figures 12.3-19R through 12.3-22R showing the revised wall thicknesses and the reconfigured equipment locations within the RWB. The staff reviewed the applicant's information, compared the revised figures and tables against those in the DCD, and found the changes acceptable.

In response to Items 3 through 5, the applicant provides a qualitative evaluation of the revised wall thickness changes against those identified in the DCD, and restates that equipment dimensions; source geometry; and source characteristics and quantities, except for room number; changes remain unchanged and are similar to those in DCD Table 12.2-22. The applicant provides Table 12.2-22R identifying the room number changes for select equipment in the RWB. Based on this evaluation, the applicant concludes that the radiation zones in the departure are maintained the same as those in the DCD.

The staff reviewed the applicant's revised information and compared it against the information in the DCD. The staff's review confirmed that the revised equipment locations would not result in changes in radiation zones that could impact the dose rates calculated in the DCD. The staff's review found that the revised configuration provides an enhanced arrangement of equipment locations. In this arrangement, the rooms with high radiation source term equipment are located between those with low radiation zones, and when the equipment cubicle with high radiation sources are adjacent to a corridor they have thicker concrete walls than the comparable cubicle walls in the DCD. Except for Room 6251, the staff concluded that the Departure EF3 DEP 11.4-1 would not impact the dose rates calculated in the DCD, and that they would be maintained below the allowable limits.

During the review of the equipment relocation in RWB Figures 12.3-19R and 12.3-20R, the staff noted that the equipment for the high activity phase separator has been relocated from the ground floor at elevation -9350 (Room 6151 in Figure 12.3-19 of the ESBWR DCD) to the second floor at elevation -2350 (Room 6251 in Figure 12.2-20R of the Fermi FSAR). DCD Section 11.2.2.3.2 states that "Tank cubicles are lined with steel to preclude accidental releases to the environment." The applicant did not provide any information on design provisions for controlling radioactive contamination. Furthermore, review of the wall thicknesses listed in Table 1 of the applicant's response to RAI 12.03-12.04-7 identifies that, in those areas where a wall separates high activity tanks (having radiation zone levels of H or I) from a corridor, the wall has a thickness of 100 cm in the DCD. This approach is used in the reconfigured RWB except for the walls of the cubicle housing the high activity phase separator (Room 6251). In the DCD RWB configuration, this room is identified as a radiation Zone H with a cubicle wall thickness of 100 cm (39.37 inches [in.]) adjacent to the corridor (the southern wall of Room 6151). The reconfigured FSAR layout drawing shows the walls adjacent to the corridor (the western wall of Room 6251) and to the control room (the eastern wall of Room 6251) on the second floor as being only 90 cm (35.43 in.) thick. Therefore, the staff issued **RAI 12.03-12.04-9** requesting the applicant to provide the following:

- 1) Explain the provisions included in this design to prevent the spread of contamination in the case of a tank leak or tank failure in Room 6251. RG 8.8 states that the exposure to station personnel to radiation from pipes carrying radioactive material can be reduced by means of shielded chases.
- 2) Explain any shielding provisions incorporated for the floor drain and the drain pipe for Room 6251 which would serve to minimize the potential of increased dose rates in the adjacent areas traversed by the room drain line in the event of a tank leak or failure in Room 6251.
- 3) Explain why the west- and east-facing walls for this radiation Zone H cubicle do not have a thickness of 100 cm to ensure that the radiation zoning of the corridor and the control room (both Zone B areas), respectively, are not exceeded due to the radiation sources in Room 6251.

In FSAR Revision 3, Subsection 12.3.1.4.5, the applicant adds Supplemental Item EF3 SUP 12.3-1 to address design provision features for the RWB (see below). In addition, the applicant revises Table 12.3-8R to change the wall thickness in Room 6251 to be consistent with the design provisions in the DCD. Furthermore, the applicant's response to RAI 12.03-12.04-9 dated March 29, 2011 (ML110900094), provides additional explanations regarding the changes in FSAR Revision 3, Subsection 12.3.1.4.5. In addition, the applicant emphasizes that the revisions to the east- and west-facing wall thicknesses for Room 6251 from 90 cm (35.43 in.) to 100 cm (39.37 in.) is consistent with the comparable cubicle walls in the DCD. The wall thickness revisions resolve the staff's concerns in Item 3. The resolutions of the item 1 and 2 are discussed under the supplementary information below.

During the review of the equipment relocation in RWB Figures 12.3-21R and 12.3-41R, the staff noted that, in room 6381, the radiation zone and area radiation monitor assignments on elevation 4650 are not consistent with similar locations in DCD Figures 12.3-21 and 12.3-41. The applicant informed the staff that the reason for the change is that the assigned radiation zone and the area monitor in Room 6381 is for the

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

Section 12.5.4.1 of NEI 07-03 describes the operational considerations of these monitors. The template states that airborne radioactivity levels are surveyed by using continuous air monitors (CAMs) and by taking grab samples using portable high and low volume air samplers. The CAM alarm set points are set at a fraction of the concentration values in 10 CFR Part 20, Appendix B, Table 1 (Column 3) for radionuclides expected to be encountered.

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

In response to the staff's RAI 12.03/04-1 requesting the applicant to describe the criteria for the placement and sensitivities of portable airborne monitors, the applicant stated that the requested information is contained in NEI template 07-03. Section 12.5.3.2 of this template states that CAMs equipped with local alarm capability are used in occupied areas where needed to alert personnel to sudden changes in airborne radioactivity concentrations. This section also states that radiation monitoring instrumentation and equipment will provide the appropriate detection capabilities, ranges, sensitivities, and accuracies required for the types and levels of radiation anticipated in the plant and in the environs during routine operations, major outages, abnormal occurrences, and postulated accident conditions. Staff RAI 12.03/04-1 also requested the applicant to verify that North Anna 3 has a sufficient number of portable airborne radiation monitors to sample air at all normally occupied locations where airborne radioactivity may exist. The applicant stated that Milestone 1.c. of NEI template 07-03 ensures that an adequate number of instruments is available to provide for appropriate detection capabilities to conduct radiation surveys in accordance with 10 CFR 20.1501 and 20.1502, including the capability to sample air at all

normally occupied locations where airborne radioactivity may exist. The staff finds that the applicant has adequately described the airborne radiation monitoring operational considerations to resolve both RAI 12.03/04-1 and DCD COL Item 12.3-2-A.

Since the applicant references this template in responses to both RAI 12.03/04-1 and DCD COL Item 12.3-2-A, the staff cannot consider either RAI 12.03/04-1 or DCD COL Item 12.3-2-A resolved until the staff approves this template. The applicant has committed to update the FSAR to reference the final version of this template.

In Fermi 3 FSAR Revision 3, the applicant references the final version of NEI 07-03 (i.e., NEI 07-03A) in Section 12.5. As stated earlier, the staff reviewed and approved this template for addressing this COL item. Therefore, this response addressing COL Item STD COL 12.3-2-A (description of operational considerations for airborne radiation monitoring) is acceptable, and **RAI 12.03/04-1** is closed.

In addition, the review identified the following area requiring evaluation as summarized below:

Standard conceptual design information (STD CDI) for Fermi FSAR Subsection 1.2.2.12.15, "Zinc Injection System," states that a zinc injection system (ZIS) will not be utilized at Fermi 3. One of the benefits of using a ZIS to inject depleted zinc oxide (DZO) in the feedwater is to suppress cobalt plate-out on reactor building piping. Minimizing the plate-out of radioactive cobalt on reactor building piping can lead to potentially lower dose rates in the vicinity of this piping and result in correspondingly lower doses to personnel in this portion of the plant. Therefore, NRC staff issued RAI-12.03-12.04-2, requesting the applicant to justify the decision to not utilize a ZIS in light of the requirement in 10 CFR 20.1101 which states that the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses that are ALARA.

In the response to this RAI dated April 23, 2009 (ML091250352), the applicant provides the following rationale for not using zinc injection. The applicant is using an alternate method of minimizing the plate-out of radioactive cobalt on reactor components. The ESBWR standard plant restricts the cobalt content in stainless steel components in the reactor vessel and other selected stainless steel components that have large surface areas exposed to high flow rates toward the reactor vessel and minimizes and/or eliminates the use of Stellite (which is a high cobalt alloy) containing components. Because this design reduces the potential for the creation of radioactive cobalt in the primary system, there is potentially less cobalt in the reactor coolant to plate-out on reactor building piping. The staff found this method of minimizing the plate-out of radioactive cobalt to be an acceptable alternative to zinc injection. In addition, the facility design incorporates design features to allow the addition of a ZIS at a later date, should increases in personnel exposure at the facility due to the plate-out of radioactive cobalt warrant the change. Therefore, no revision to the FSAR is required. The staff reviewed the response, and found it acceptable, because the applicant retains the option of utilizing a ZIS, if needed. Therefore, RAI 12.03-12.04-2 is closed.

- STD COL 12.3-4-A

Compliance with 10 CFR 20.1406

In FSAR Subsection 12.3.1.5, Revision 2, the applicant provides supplemental information related to compliance with 10 CFR 20.1406 in regards to operational and programmatic considerations that the applicant will implement to prevent the spread of contamination and thereby facilitate decommissioning. The applicant lists several measures that prevent the spread of contamination, consistent with the operational and post-construction objectives in RG 4.21, Regulatory Position C.1 through C.4.

The applicant states that these objectives include:

- Periodic review of operational practices to ensure that operating procedures reflect the installation of new or modified equipment, personnel qualification and training are kept current, and personnel are following the operating procedures.
- Maintenance of records relating to facility design and construction, facility design changes, site conditions before and after construction, onsite waste disposal and contamination, and results of radiological surveys.
- Maintenance of a conceptual site model based on site characterization and facility design and construction.
- Evaluation of the final site configuration after construction to assist in preventing the migration of radionuclides offsite via unmonitored pathways.
- Implementation of an onsite contamination monitoring program along the potential pathways from the release sources to the receptor points.

The staff found these objectives meet the objectives of RG 4.21 and, therefore, they are acceptable in meeting the requirements of 10 CFR 20.1406.

Subsection 12.3.1.5.1 of the ESBWR DCD Tier 2, Revision 7 states that the piping for the following system and components will contain underground piping segments; 1) CST and CST retention area drain, 2) radwaste effluent discharge pipeline, 3) cooling tower blowdown line, and 4) hot machine shop drain. This section of the DCD goes on to state that these lines will be kept as short and direct as possible and will be designed to preclude inadvertent or unidentified leakage to the environment. In accordance with the guidance provided in RG 4.21, DCD Subsection 12.3.1.5.1 states that the underground pipes for these systems and components are either enclosed within a guard pipe and are monitored for leakage, or are accessible for visual inspections via a trench or tunnel.

Fermi 3 FSAR Subsection 12.3.1.5, Revision 2 provided supplemental information to address STD COL 12.3-4-A. However, this response failed to include site-specific provisions to minimize the potential for unmonitored and uncontrolled releases to the environment from the underground piping. Therefore, NRC staff issued RAI 12.03-12.04-6 requesting the applicant to modify FSAR Subsection 12.3.1.5 to include:

- a. a listing of the system and components at Fermi which will have piping segments which will be run underground;

- b. a description of the features associated with the underground piping for each of these system and components to minimize contamination in accordance with the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406;
- c. a description of the monitoring program associated with the piping for each of these system and components that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment from these pipes will be minimized;
- d. a description of the portion of the discharge line that runs from the cooling tower blowdown to the point of release into the environment beyond the owner-controlled area or EAB. Also, include a description of the monitoring program associated with this portion of the discharge piping that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment will be minimized; and to
- e. incorporate by reference NEI Template 08-08A, which addresses the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406.

In the response to RAI 12.03-12.04-6 dated October 19, 2010 (ML102940218), the applicant provides the requested information and the revised affected FSAR pages. In response to part a, the applicant cites ESBWR DCD, Revision 7, Subsection 12.3.1.5 that identifies systems with underground buried pipe segments that could potentially contain radioactive fluids. In addition, the applicant identifies the site-specific systems with buried pipe segments which have no potential to contain radioactive fluids. The staff found this information acceptable.

In response to parts b and c, the applicant states that the Fermi 3 FSAR incorporates by reference Subsection 12.3.1.5 of the ESBWR DCD. This section of the DCD lists features that are provided to minimize contamination in accordance with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The applicant adds that there are no other buried pipe segments that could potentially contain radioactive fluid. Therefore, the provisions stated in DCD Subsection 12.3.1.5 will be followed, and the following statement will be added to COL FSAR Subsection 12.3.1.5:

There are no other underground piping segments at Fermi 3 that require features to minimize contamination or monitoring to ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment is minimized.

The staff found that the applicant's response adequately addresses the RAI concerns.

In response to part d, the applicant provides a brief description of the blowdown piping and its point of release into Lake Erie. The applicant states that the blowdown line is a 122-cm (4-foot) diameter pipe which is buried until the point where it enters Lake Erie. The blowdown line will continue approximately 396 m (1300 ft) into Lake Erie, where it will discharge underwater into the lake. The underground portion of this blowdown line will be designed with the features as described in ESBWR DCD, Revision 7, Subsection 12.3.1.5.1 to preclude inadvertent or unidentified leakage to the environment.

In the supplemental responses to RAI 12.03-12.04-6 dated August 1, 2011 (ML1121A1021), and August 24, 2011 (ML11238A049), the applicant modifies FSAR Subsection 11.2.3.2 and adds supplemental information EF3 SUP 11.2-2. In this supplement, the applicant states that the LWMS exterior discharge piping from the Fermi 3 RWB is a buried stainless steel pipe with no valves, vacuum breakers, or other inline components and is enclosed within a guard pipe, which is monitored for leakage to comply with 10 CFR 20.1406. The LWMS discharge line connects to the blow down line within the exclusion area boundary for dilution below the release limits of 10 CFR Part 20, Appendix B, Table 2 Column 2. The blowdown line is a buried high density polyethylene pipe with no valves, vacuum breaker, or other inline components in the blowdown downstream of the LWMS connections as required by DCD Subsection 12.3.1.5.1. Monitoring of the blowdown line downstream of LWMS connection will be consistent with NEI 08-08A, as described in DCD Subsection 12.3.1.5.2. The staff found this information acceptable, because the design of the LWMS discharge and blowdown piping and the associated monitoring program will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment will be minimized. In response to part e, the applicant supplements FSAR Subsection 12.3.1.5.2 to state that:

Program and procedures are implemented consistent with the NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," to meet the post-construction and operational objectives of Regulatory Guide 4.21 and the requirements of 10 CFR 20.1406.

In addition, the applicant states that the underground portion of the blowdown line will be monitored by an on-site ground water monitoring program which will be consistent with NEI 08-08A. The applicant adds that FSAR Subsection 2.4.12.4 describes the onsite groundwater monitoring program. The applicant revises this subsection to include a reference to NEI 08-08A to ensure that the considerations in this NEI report are included in the ground water monitoring program. The applicant will establish this groundwater program to ensure timely detection of any inadvertent radiological releases to the ground water, in accordance with the guidance of RG 4.21. The applicant adds Commitment (COM 13.4-034) to Table 13.4-201 as Operational Program Item # 22 to develop an operational program for lifecycle minimization of contamination in compliance with 10 CFR 20.1406 prior to fuel load. The applicant proposed Commitment (COM-13.4-034) to be a license condition.

The staff reviewed the applicant's response and the proposed changes to the affected pages in the COL FSAR Subsections 12.3.1.5.2 and 2.4.12.4, and found the applicant has adequately addressed this concern. In addition, Operational Program Item #22 in Table 13.4-201 is composed of a number of elements and considerations that are described in NEI 08-08A. Because, the applicant incorporates by reference NEI 08-08A in FSAR Subsection 12.3.1.5.2 and other affected sections, the staff found this program milestone acceptable. The staff verified that FSAR Revision 3 includes the applicant's proposed changes; therefore, RAI 12.03-12.04-6 is closed. For operational program readiness, in Section 3.6 of Part 10 of COL application, the applicant adds a general implementation plan for operational programs in Table 13.4-201 stating that (ML11229A767):

The licensee shall submit to the appropriate director of the NRC, a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until either the operational programs in the FSAR table have been fully implemented or the plant has been placed in commercial service, whichever comes first.

On the basis of the information described above, the staff found the applicant has adequately addressed STD COL Item 12.3-4-A (compliance with 10 CFR 20.1406).

Supplemental Information

- EF3 SUP 12.3 Radwaste Building

In FSAR Revision 3, Subsection 12.3.1.4.5, "Radwaste Building," the applicant adds the following design features to minimize occupational exposure:

- Provision for control of fluids exiting high activity rooms, including provision to isolate floor drains, and remote operation of control valves from the radwaste control room.
- Piping from high activity rooms are arranged to minimize exposure to normally occupied areas, and are designed to maintain radiation levels in the RWB process system area as shown in Figure 12.3-19R through Figure 12.3-22R.

These design provisions are provided in response to the staff's concerns in RAIs 12.03-12.04-7 and 12.03-12.04-9. In the response to RAI 12.03-12.04-9 (ML110900094), the applicant adds that the first provision provides isolation capability (both local and remote) to prevent the spread of the contamination. The second provision minimizes occupational exposure from radioactive fluid in the piping. In addition, the applicant adds that the second provision will be revised in the next revision of the FSAR to indicate that it will apply to "*process as well as drain piping*" in high activity rooms. With regards to RG 8.8, the applicant states that, as shown in FSAR Table 1.9-202, Fermi 3 conforms to RG 8.8, which in turn encompasses conforming with the guidelines related to facility and equipment design, including pipe routing and shielding to minimize occupational exposure. The staff found the applicant's response acceptable, and RAI 12.03-12.04-9 and RAI 12.03-12.04-7 are resolved. Verification that the proposed change is included in the next FSAR revision is being tracked as **Confirmatory Item 12.03/04-1**.

12.3.5 Post Combined License Activities

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

- License Condition (12-1) - Prior to initial fuel load, the licensee shall implement an operational program for lifecycle minimization of contamination.

- License Condition (12-2) – No later than 12 months after issuance of the COL, the licensee shall submit to the Director of the Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the operational program (RPP). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until this operational program has been fully implemented.

12.3.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information related to radiation protection design features and no outstanding information is expected to be addressed in the Fermi 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the radiation protection design features that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations; the guidance in Section 12.3-12.4 of NUREG-0800, and other NRC RGs. The staff's review found the applicant has adequately addressed the COL items involving operational considerations for in-plant airborne radiation monitoring operational considerations, and minimization of contamination to facilitate decommissioning by committing to implement the required programs and procedures consistent with the NEI 08-08A. The staff found the RWB reconfiguration departure reasonable and in accordance with the 10 CFR 52.63 (b)(2).

12.4 Dose Assessment

12.4.1 Introduction

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

12.4.2 Summary of Application

Section 12.4 of the Fermi 3 COL FSAR incorporates by reference Section 12.4 of the certified ESBWR DCD, Revision 9.

In addition, in FSAR Section 12.4, the applicant provides the following:

Supplemental Information:

- EF3 SUP 12.4-1 Annual Doses to Construction Workers

This site-specific supplemental item addresses the potential dose to construction workers from operation and emissions associated with the current operating nuclear power plant at the nearby site. In Revision 3 of the Fermi 3 COL FSAR, the applicant

provides supplemental information on doses to construction workers from Section 4.5 of the ER in Part 3 of the COL application.

12.4.3 Regulatory Basis

The regulatory basis of information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the dose assessment, and the associated acceptance criteria, are in Section 12.3-12.4 of NUREG–0800.

Also, the NRC staff followed the guidance in RG 1.206, in evaluating Fermi 3 FSAR, Section 12.4 for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the resolution to the supplemental information is in the applicable requirements of 10 CFR Part 20; in RG 1.206; and in Section 4.5, “Radiation Exposure to Construction Workers” of NUREG–1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants.”

12.4.4 Technical Evaluation

As documented in NUREG–1966, NRC staff reviewed and approved Section 12.4 of the certified ESBWR DCD. The staff reviewed Section 12.4 of the Fermi 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to dose assessment.

The staff reviewed the information in the Fermi 3 COL FSAR as follows:

Supplemental Information

- EF3 SUP 12.4-1 Annual Doses to Construction Workers

The applicant provides information in Chapter 4 of the ER to address supplemental information EF3 SUP 12.4-1 regarding the annual doses to construction workers. As part of the review, the staff identified a number of issues requiring clarification and correction of specific technical and regulatory topics. NRC staff asked the applicant to provide additional information for the purpose of resolving these issues. The following paragraphs discuss the applicant’s information and the staff’s evaluation of the applicant’s responses to the staff’s major RAIs.

The sources of radiation exposure to site preparation and construction workers include direct radiation and gaseous radioactive effluents from Unit 2 operation. Exposure to releases of radioactive liquid effluents via the radwaste discharge to Lake Erie is expected to be negligible. This is because Lake Erie provides further dilution through natural mixing characteristics in the vicinity of the discharge and construction activities

¹ See “Finality of Referenced NRC Approvals,” in SER Section 1.2.2, 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.

would be well removed from the release points for liquid effluents. In addition, the ER states, "There has not been a liquid radioactive discharge from Fermi 2 since 1994."

A. Direct Radiation Dose

The applicant identifies three sources of direct radiation doses to construction workers: nitrogen-16; the condensate storage tank and onsite low-level storage facility; and the ISFSI. Direct radiation from the nitrogen-16 source is present in the operating Fermi 2 main steam lines, turbines, and moisture separators. Other sources at Fermi 2 with the potential for a direct radiation dose contribution to construction workers are the condensate storage tanks and the onsite low-level waste storage facility. However, these sources are considered negligible because of the minimal activity in the storage tanks and the concrete shielding used in the design of the onsite storage facility. Currently there is no ISFSI at the Fermi site, but there are plans to construct an ISFSI in the near future.

The applicant states that thermoluminescent dosimeters (TLDs) are used to measure the radiation exposure at various locations around the Fermi 2 site. These measurements are used to estimate the direct radiation dose to the construction workers. There are three TLD locations (TLD 47, 48 and 54) that are relevant for estimating construction workers doses. The applicant states that TLD 48 is considered to be at the most representative location of these three TLDs, and the maximum annual measurement during the 1999 through 2006 calendar years at this location is used to estimate the direct radiation dose to a construction worker.

In ER Revision 0, Subsection 4.5.2.1, the applicant stated that the proposed ISFSI would be approximately 229 m (750 ft) from the Fermi 3 construction site and provided an estimated dose rate in the range of 4.5×10^{-4} mrem per hour (mrem/hr) to 2.2×10^{-3} mrem/hr.

The staff's review of this information resulted in two RAIs. In RAI-12.03-12.04-1, NRC staff requested that the applicant provide additional information on the selection of the TLDs used to estimate the dose rates, and the estimated ISFSI dose rates. In RAI 12.03-12.04-3, the staff requested that applicant provide 1) the estimated number of construction workers, 2) effects of future decommissioning activities of Fermi 1 on Fermi 3 construction worker dose, and 3) plans for radiological monitoring of the Fermi 3 construction site to verify construction worker dose calculations.

In the response to RAI 12.03-12.04-1 dated April 23, 2009 (ML091250352), the applicant states that clarifying information is being developed and will be submitted in a future update to the COL application. In the response to RAI 12.03-12.04-3 dated August 25, 2009 (ML092580311), the applicant provides additional information on the TLD selection, ISFSI dose rate, dose from decommissioning Fermi 1 activities, and an estimate of the peak annual construction workers.

With regards to the applicant's rationale for using the data from TLD 48 to estimate construction worker dose, the applicant reiterated the discussions in the ER, which emphasized that TLD 47, with the highest direct dose measurement, is just outside of the Fermi 2 protected area and remote from eventual locations of Fermi 3 structures. Review of the site layout indicates that three TLDs (i.e., TLD 47, 48, and 54) provide a range of direct dose measurements for construction workers. TLD 54, at the visitor

center, is farthest from, and TLD 48 is the nearest to, Fermi 2. The construction activities on the Fermi 3 site are closest to TLDs 47 and 48. Therefore, the staff's opinion is that the use of TLD 47 as a sole means to measure direct dose to a construction worker would be nonconservative, because it ignores the dose rates at locations near TLD 48. With respect to ISFSI dose rate, the applicant reiterated the estimated dose rate given earlier, without providing any additional information.

With regards to the portion of the RAI on the effects of future decommissioning of Fermi 1, the applicant states that the exposure measured by TLDs 47, 48 and 54 includes the contribution from Fermi 1. The ongoing decommissioning of Fermi 1 will continue to reduce Fermi 1 contributions in the future. The applicant adds that the acceptable residual levels of radioactive material that could be present after decommissioning is subject to the limits established in 10 CFR 20.1402, with a maximum annual total effective dose equivalent of 25 mrem to an "average member of the critical group." This represents a dose to a resident farmer, which would not be applicable to a construction worker. Nevertheless, the applicant considers this dose to be a conservative estimate of the dose to a construction worker from activities related to Fermi 3 construction on the Fermi 1 site.

The staff concurred with the applicant that the Fermi 1 dose contribution decreases as decommissioning progresses, and the dose estimate for the resident farmer would not be applicable to the construction worker. Therefore, the staff considered the 25 mrem annual dose to be conservative, and found the applicant's response acceptable.

In order to obtain additional information regarding TLD use and ISFSI dose rates, the staff issued RAI 12.03-12.04-5, requesting the applicant to provide justification for not using the average readings from TLD 47 and TLD 48 instead of readings from TLD 47 alone as the basis for the direct dose component to a construction worker. This RAI also asked the applicant to provide the calculated annual dose to construction workers, along with the bases, models, assumptions, and input data used to calculate such doses in the FSAR. In the response to this RAI dated May 21, 2010 (ML101450195), the applicant modifies the basis for calculating the direct dose component to a construction worker by using the average maximum TLD measurements from these two locations (TLDs 47 and 48), and estimates the annual (2080 hours) direct dose component of construction worker doses due to operations of Fermi 2 as 56.3 mrem (excluding background radiation). The staff found this analysis acceptable.

With regards to the ISFSI dose rate, the applicant states that the dose calculation uses a distance of about 250 m (820 ft) from the nearest construction area, assuming uniform loading of all casks with 15-year cooled spent fuel from Fermi 2. The annual (2080 hours) dose to a construction worker from Fermi 2 ISFSI is estimated to be about 13.8 mrem (or a dose rate of 6.64×10^{-3} mrem/hr). In order to evaluate the acceptability of the applicant's response, the staff compared the applicant's dose analysis with a similar acceptable ISFSI dose analysis performed by Grand Gulf for stored BWR spent fuel with similar characteristics (Grand Gulf RAI response dated October 9, 2008, [ML082880101]). On the basis of this comparison, the staff found the applicant's dose estimate to be reasonable and, therefore, the staff found the applicant's direct dose estimate from the ISFSI to be acceptable.

B. Airborne Release Dose

Environmental radiological monitoring data obtained from the Fermi 2 Annual Radioactive Effluent Release and Radiological Environmental Operating Reports were used to assess any potential radiological impact on construction workers due to the operation of Fermi 2. The data from these reports is considered representative for the Fermi 3 site construction worker dose evaluations. The location considered to be most representative of the gaseous effluent dose rates to which construction workers would be exposed would be the dose rates calculated at the Fermi 2 Visitor's Center. The radiological data used to calculate the dose rate from gaseous effluents were collected for the years 1999 through 2008. The calculated maximum dose rate that a construction worker would receive due to gaseous releases would be 1.6 mrem per year (/yr) total body and 10.4 mrem/yr thyroid. This dose estimate is based on the releases in calendar year 2001, which resulted in maximum dose during this period (1999 through 2008).

The staff found this annual dose rate to be reasonable, given that the recent environmental dose rates are much smaller, as indicated in Table 4.5-2 of the ER in Part 3 of the COL application.

C. Annual Construction Worker Dose

Based on the updated construction worker direct dose estimates, the applicant calculated a maximum annual and hourly dose to a Unit 3 construction worker from direct radiation sources and gaseous effluents of 96.6 mrem/yr, and 0.13 mrem/hr, respectively (ML101450195). The applicant also updated FSAR Subsection 12.4.7.1 by providing a summary of the annual construction worker dose, and summarizing the information provided in Section 4.5 of the ER. This subsection also provides information showing how the estimated doses comply with the applicable requirements in 10 CFR 20.1301, 40 CFR Part 190, and 10 CFR Part 50, Appendix I (for gaseous effluent). The applicant stated that the construction workers are considered to be members of the general public. Radiation monitoring of the Fermi 3 construction workers as members of the general public, and compliance with the requirements of 10 CFR Part 20, Subpart D is controlled per the requirements of the Fermi 2 Radiological Effluent Monitoring Plan (REMP).

The staff reviewed the applicant's assumptions and updated analyses for doses to construction workers for conformance to 10 CFR 20.1301, 40 CFR Part 190, and 10 CFR Part 50, Appendix I (for gaseous effluent), and agreed with the applicant's response.

In addition, the staff evaluated potential doses to construction workers at other locations on site. As part of the evaluation, the staff reviewed the doses to a construction worker involved in activities related to the Fermi 2/Fermi 3 (EF2/EF3) warehouse, which is the nearest potential construction activity to the Fermi 2 ISFSI. The EF2/EF3 warehouse is located due west of the Fermi 2 ISFSI. Based on the applicant's estimated construction duration of about 3 months for the EF2/EF3 warehouse (provided in the response to RAI HH 4.5-4, dated October 30, 2009, [ML0993090165]), and an ISFSI dose rate of about 6.6×10^{-3} mrem/hr at a distance of 250 m (820 ft) from the ISFSI, the staff calculated a construction worker dose of 35 mrem for the duration of construction at an average distance of about 152.4 m (500 ft) from the ISFSI. The construction workers at this facility would be exposed to a smaller direct dose from Fermi 2 operation, and

therefore, the total construction worker dose would be within the maximum dose value of 96.6 mrem/yr estimated above.

Based on the above evaluation, the staff found the applicant's response to RAI 12.03-12.04-5 acceptable. The staff confirmed that FSAR Revision 3 includes the proposed revisions in response to RAI 12.03-12.04-5; therefore, this RAI and RAI 12.03 12.04-3 are closed.

On the basis of the above evaluation, the staff found that the applicant's estimates for doses to construction workers during the construction of Fermi 3 are within the applicable limits of 10 CFR 20.1301, 40 CFR Part 190, and 10 CFR Part 50, Appendix I (for gaseous effluents) and, therefore, are acceptable.

12.4.5 Post Combined License Activities

There are no post COL activities related to this section.

12.4.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the Fermi 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [X], Section VI.B.1, all nuclear safety issues relating to the dose assessment that were incorporated by reference have been resolved.

In addition, the staff evaluated the supplemental information that the applicant provided to address doses to construction workers. The staff evaluated this supplemental information using the acceptance criteria contained in Section 4.5, of NUREG-1555. NUREG-1555 addresses the relevant requirements of 10 CFR Part 20 with respect to occupational and public dose limits. On the basis of the staff's review, the staff found this supplemental information to be acceptable and in compliance with the applicable portions of 10 CFR Part 20.

12.5 Operational Radiation Protection Program

12.5.1 Introduction

This section of the FSAR addresses the operational radiation protection program, which is designed to maintain occupational and public doses below regulatory limits and ALARA. The Operational Radiation Protection Program is designed with the objective of:

- Providing capability for administrative control of the activities of plant personnel to limit personnel exposures to radiation and radioactive materials to levels which are ALARA and within the guidelines of 10 CFR Part 20.

12.5.2 Summary of Application

Section 12.5 of the Fermi 3 COL FSAR, Revision 3 incorporates by reference Section 12.5 of the certified ESBWR DCD Revision 9.

In addition, in FSAR Section 12.5, the applicant provides the following:

COL Items:

- STD COL 12.5-1-A Equipment, Instrumentation, and Facilities

STD COL 12.5-1-A describes radiation protection equipment, instrumentation, and facilities. The applicant references Appendix 12BB, which in turn adopts NEI 07-03A, as a means to address the needs of this standard COL item.

- STD COL 12.5-2-A Compliance with 10 CFR Part 50.34(f)(2)(xxvii) and NUREG-0737 Item III.D.3.3

STD COL 12.5-2-A describes portable instruments to measure radioiodine concentrations under accident conditions in compliance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and guidance of NUREG-0737 Item III.D.3.3. The applicant references Appendix 12BB, which in turn adopts NEI 07-03A, as a means to address the needs of this standard COL item.

- STD COL 12.5-3-A Radiation Protection Program

This DCD COL item requires the applicant to provide a description of the operational radiation protection program and to include description of access controls to "Very High Radiation Areas." The applicant references Appendix 12BB, which in turn adopts NEI 07-03A, as a means to address the needs of this standard COL item.

Operational Program

- Operational Program Item #10 Radiation Protection Program

DCD Section 13.4 directs the COL applicant to develop and implement the required operational programs. The applicant provides Operational Program Item #10 in Table 13.4-201 identifying the program milestones as Commitments COM13.4-012 through COM13.4-015.

12.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for the operational radiation protection program, and the associated acceptance criteria, are in Section 12.5 of NUREG-0800.

Also, the NRC staff followed the guidance in RG 1.206, in evaluating Fermi 3 FSAR, Section 12.5 for compliance with NRC regulations.

In particular, the regulatory bases for acceptance of the resolution to the COL items are:

- Management and organization are established in RGs 1.8, 8.2, 8.8, and 8.10, as required by 10 CFR 20.1101 and 10 CFR 20.2102;

- Adequate facilities are established in RGs 1.97, 8.8, 8.9, 8.15, 8.20 Revision 1 “Applications of Bioassay for I-125 and I-131,” 8.26 “Applications of Bioassay for Fission and Activation Products ,” and 8.28, as required by 10 CFR 20.1801, 10 CFR 20.1802, and 10 CFR 20.1906;
- Instrumentation and equipment are established in 10 CFR 20.1501 and 10 CFR 20.1502, 10 CFR 50.34(f)(2)(xxvii) and the criteria in Item III.D.3.3 of NUREG–0737; and
- Training and procedures are established in RGs 1.8, 1.33 Revision 2 “Quality Assurance Program Requirements (Operation),” 8.2, 8.7, 8.8, and 8.10, as required by 10 CFR 19.11, 10 CFR 19.12 and the applicable requirements in 10 CFR Part 20, Part 50, Part 70, and Part 71, “Packaging And Transportation Of Radioactive Material.”

The regulatory basis for acceptance of the resolution to Operational Program #10, dealing with the radiation protection program, is satisfied based on meeting the requirements of 10 CFR 20.1101.

12.5.4 Technical Evaluation

As documented in NUREG–1966, NRC staff reviewed and approved Section 12.5 of the certified ESBWR DCD. The staff reviewed Section 12.5 of the Fermi 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the Fermi 3 COL FSAR appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information contained in the application and the information incorporated by reference address the required information related to the “Operational Radiation Protection Program.”

In addition, the staff reviewed the applicant’s proposed resolution to the COL items and the supplemental item included under Section 12.5 of the Fermi 3 COL FSAR. The staff used the applicable sections of the SRP and RG 1.206, as guidance.

Section 1.2.3 of this SER discusses the NRC’s strategy NRC to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating the subsequent COL applications. To ensure that the staff’s findings on standard content that were documented in the SER for North Anna Unit 3 were equally applicable to the Fermi 3 COL application, the staff undertook the following reviews:

- The staff compared the North Anna Unit 3 COL FSAR, Revision 1 to the Fermi 3 COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from requests for RAIs; and open and confirmatory items identified in the North Anna SER with open items.

¹ See “*Finality of Referenced NRC Approvals*,” in SER Section 1.2.2, 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.

The staff finds that the applicant has adequately described the plant health physics equipment, instrumentation, and facilities to resolve DCD COL Item 12.5-1-A.

*Since the applicant references this template in addressing the resolution of DCD COL Item 12.5-1-A, the staff cannot consider DCD COL Item 12.5-1-A resolved until the staff approves this template. The applicant has committed to update the FSAR to reference the final version of this template. See **Confirmatory Item 12.01-1**.*

As stated earlier, NRC staff has reviewed and accepted the final revision of the NEI 07-03 template for addressing this COL item. The applicant adopts the final revision of this template (i.e., NEI 07-03A) in Fermi 3 COL FSAR Appendix 12BB. Therefore, the staff found the applicant has adequately addressed STD COL Item 12.5-1-A (radiation protection equipment, instrumentation, and facilities) and Confirmatory Item 12.01-1 is closed.

- *STD COL 12.5-2-A Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR 50 and NUREG-0737 Item III.D.3.3*

The applicant provided additional information in STD COL 12.5-2-A to address the resolution of DCD COL Item 12.5-2-A, which states:

“The COL applicant will provide a description of the portable instruments that accurately measure radio-iodine concentrations in plant areas under accident conditions and of the training and procedures on the use of these instruments.”

The FSAR states that this COL information item is addressed in NEI template 07-03, “Generic FSAR Template Guidance for Radiation Protection Program Description,” which is referenced in Appendix 12BB of the FSAR. This template is currently under review by NRC staff. In order to resolve this COL action item, the licensee must show compliance with 10 CFR 50.34(f)(2)(xxvii) and Item III.D.3.3 of NUREG-0737. 10 CFR 50.34(f)(2)(xxvii) (as supplemented by the criteria in Item III.D.3.3 of NUREG-0737) requires the licensee to provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident. NEI 07-03 discusses procedures to be used to collect and analyze samples to detect and measure radioiodine. This template states that radiation protection technicians will be trained and qualified under a program established in accordance with 10 CFR 50.120. This training, along with the procedures on radiological surveillance described in NEI 07-03, will ensure that the radiation protection technicians will have the capability of determining the airborne iodine concentrations in areas within the facility where personnel may be present during an accident and for a broad range of routine conditions. Milestone 1.c. of NEI 07-03 ensures that an adequate number of instruments are available to provide for appropriate detection

capabilities to conduct radiation surveys in accordance with 10 CFR 20.1501 and 20.1502, including the capability to determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

The staff finds that the applicant has provided an adequate description of the portable instruments that accurately measure radio-iodine concentrations in plant areas under accident conditions and of the training and procedures provided on the use of these instruments.

*Since the applicant makes reference to this template in addressing the resolution of DCD COL Item 12.5-2-A, the staff cannot consider DCD COL Item 12.5-2-A resolved until the staff approves the template. The applicant has committed to update the FSAR to reference the final version of this template. **See Confirmatory Item 12.01-1.***

As stated earlier, NRC staff has reviewed and accepted the final revision of the NEI 07-03 template for addressing this COL item. The applicant adopts the final revision of this template (i.e., NEI 07-03A) in Fermi 3 COL FSAR Appendix 12BB. Therefore, the staff found the applicant has adequately addressed STD COL Item 12.5-2-A (compliance with 10 CFR Part 50.34(f)(2)(xxvii) and NUREG-0737 item III.D.3.3) and Confirmatory Item 12.01-1 is closed.

- *STD COL 12.5-3-A Radiation Protection Program*

The applicant provided additional information in STD COL 12.5-3-A to address the resolution of DCD COL Item 12.5-3-A, which states:

“The COL applicant will provide a description of the operational Radiation Protection Program.”

*The FSAR states that this COL information item is addressed in NEI template 07-03, “Generic FSAR Template Guidance for Radiation Protection Program Description,” which is referenced in Appendix 12BB of the FSAR. This template is currently under review by NRC staff. The template provides a detailed description of the Radiation Protection Program. **See Confirmatory Item 12.01-1.***

NEI template 07-03 contains several bracketed sections that allow for design and site specific deviations or additions. In the review of the COL, the staff noted that the applicant did not address how they would disposition each of these bracketed sections of the template. The staff issued RAI 12.05-2 to determine whether the applicant planned to deviate from or supplement the information provided in the template for each bracketed section. In response to this RAI, the applicant supplemented Appendix 12BB of the FSAR in Revision 1 to state how they will address each bracketed section in NEI 07-03. The staff finds this response acceptable and RAI 12.05-2 is closed.

As discussed in Section 12.3.1.3 of the North Anna 3 FSAR, access to very high radiation areas is discussed in Section 12.5 of the North Anna 3

FSAR as part of the operational program for radiation protection. In Section 12.5.3 of the North Anna 3 COL FSAR, the applicant states that the operational program for radiation protection is addressed in Appendix 12BB. Appendix 12BB references NEI 07-03 (which is currently under review by NRC staff) as the generic FSAR template guidance for the description of North Anna's Radiation Protection Program.

*Section 12.5.4.4 of NEI 07-03 (specifically the bracketed "Note" portion of Section 12.5.4.4) states that each COL applicant should provide additional plant specific information in the FSAR to describe each Very High Radiation Area (VHRA) and to refer to each location on the plant layout diagrams in FSAR Section 12.3. The description of additional administrative controls for restricted access to each Very High Radiation Area is required by 10 CFR 20.1602. Section 12.5.4.4 of NEI 07-03 also states that applicants need to provide detailed drawings of each VHRA and indicate physical access controls for each of these areas. Since the applicant did not provide the plant-specific information on access controls described in Section 12.5.4.4 of NEI 07-03, the NRC staff issued RAI 12.03/04-2. In response to this RAI, the applicant revised Appendix 12BB of FSAR Revision 1, by adding a description of some physical and administrative access controls that will be used to restrict access to the very high radiation areas at North Anna 3. The applicant's response to RAI 12.03/04-2 did not address all of the plant-specific information on access controls described in Section 12.5.4.4 of NEI 07-03. Therefore, the staff issued RAI 12.03/04-11. This supplemental RAI requested that the applicant to (1) provide a listing and location of all designated VHRAs in the plant, (2) describe why each of these areas would need to be accessed, and (3) provide a description of the physical barriers (and a description of how these barriers will be verified in the final design of the facility) used to preclude inadvertent access to these areas. In the applicant's response to RAI 12.03/04-11, the applicant committed to add a table to the FSAR listing all accessible VHRAs in the plant, the conditions under which each area will be designated a VHRA, and the area's location on the DCD plant layout drawings. The applicant also committed to modify the FSAR to specify the administrative requirements for accessing each of these VHRAs. Finally, the applicant committed to modify the FSAR to describe the physical barriers in place to prevent inadvertent access to each of the identified VHRAs. The existence of these barriers will be verified via ITAAC as identified in DCD Tier 1 Table 2.5.10-1. The applicant will amend Section 12.5.4.4 of the FSAR [Appendix 12BB] to reference sections of the ESBWR DCD that identify the physical controls, interlocks, and annunciators used to control access to areas immediately adjacent to the Inclined Fuel Transfer System (IFTS). These areas are immediately adjacent to the IFTS, and they become VHRAs during the transfer of spent fuel in the IFTS. The staff finds that the applicant's response to this RAI is acceptable. However, since the applicant will incorporate the response to this RAI in a future amendment to the FSAR, the staff considers the applicant's response to RAI 12.03/04-11 to be confirmatory. **This is Confirmatory Item 12.03/04-11.***

In Fermi 3 COL FSAR Revision 2, the applicant referenced NEI 07-03 in Appendix 12BB for addressing access control to the very high radiation area (VHRA) as part of the response to resolve STD COL 12.5-3A. As stated earlier, NRC staff has reviewed and accepted the final revision of the NEI 07-03 template for addressing this COL item. The applicant is committed to adopting the final revision of this template in the COL FSAR. NEI issued the final revision of this template as NEI 07-03A, Revision 0 (ML091490684).

Subsection 12.5.4.4 of NEI 07-03A specifies that the COL applicant should provide: 1) a listing of all VHRAs and references to their locations on plant layout diagrams; 2) the anticipated frequency of accessing each of the VHRAs and the means for restricting access to these areas; and 3) detailed drawings for each VHRA that show physical barriers in place to restrict access to these areas, or if such detailed drawings are not available, describe how such barriers will be verified in the final design of the facility. In FSAR Revision 2, Appendix 12BB, Subsection 12.5.4.4, the applicant referenced DCD Section 12.3 for isometric drawings of the VHRA, and listed various means of access controls. However, there are no isometric drawings of VHRA in DCD Section 12.3. Therefore, NRC staff informed the applicant of this shortcoming and inconsistency with the standard response, and requested that the applicant revise FSAR Appendix 12BB and provide the additional information specified in Subsection 12.5.4.4 of NEI 07-03A. In FSAR Revision 3, the applicant revises Appendix 12BB, which in turn adopts NEI 07-03A as a means to address the needs of this COL item to include the requested information. The staff confirmed that FSAR Revision 3 includes additional text regarding the bracketed items identified in Subsection 12.5.4.4 of NEI 07-03A, and identifies the plant VHRAs consistent with the closure of the Standard RAI 12.03/04-11. Therefore, the staff found that the applicant has adequately addressed STD COL Item 12.5-4-A (description of the operational radiation protection program, including a description of access controls to "Very High Radiation Areas), and Standard RAI 12.03/04-11 and Confirmatory Item 12.03/04-11 are closed.

Operational Program

- Operational Program Item #10 Radiation Protection Program

In Table 13.4-201 of the Fermi 3 FSAR, the applicant lists four milestones and the associated implementation schedules for Operational Program Item #10. The Radiation Protection Program is required by 10 CFR Part 20.1101. The four listed milestones are: 1) prior to initial receipt of byproduct, source, or special nuclear materials (excluding Exempt Quantities as described in 10 CFR 30.18) for those elements of Radiation Protection (RP) Program necessary to support such receipt [COM 13.4-012]; 2) prior to fuel receipt for those elements of RP Program necessary to support receipt and storage of fuel onsite [COM 13.4-013]; 3) prior to fuel load for those elements of Radiation Protection Program necessary to support fuel load and plant operation [COM 13.4-014]; and 4) prior to the first shipment of radioactive waste for those elements of the Radiation Protection Program necessary to support shipment of radioactive waste [COM 13.4-015]. The applicant proposed Commitment (COM 13.4-012) through Commitment (COM 13.4-015) as license conditions for tracking these four milestones (ML11229A767). The Radiation Protection Program is composed of a number of elements that are described in NEI 07-03A. Because the applicant incorporates by reference NEI 07-03A in FSAR Appendix 12BB, the staff found these program milestones acceptable. For operational program readiness, in Section 3.6 of Part 10 of COL application in response to RAI 19.03-38 dated August 16, 2011 (ML11229A767),

the applicant adds a general implementation plan for operational programs in Table 13.4-201 stating that:

The licensee shall submit to the appropriate director of the NRC, a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until either the operational programs in the FSAR table have been fully implemented or the plant has been placed in commercial service, whichever comes first.

The staff found the applicant's general implementation plan for operational programs in Table 13.4-201 to be consistent with the guidance in SECY-05-197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." In addition, in FSAR Appendix 12BB, the applicant incorporates by reference NEI 07-03A, which provides Radiation Protection Program milestones. Therefore, the staff found the applicant has adequately addressed Operational Program Item #10.

12.5.5 Post Combined License Activities

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

- License Condition (12-3) - The licensee shall implement the Radiation Protection Program (RPP), (including the ALARA principle) or applicable portions thereof, on or before the associated milestones identified below:
 - a. Receipt of Materials – Prior to initial receipt of byproduct, source, or special nuclear materials onsite (excluding exempt quantities as described in 10 CFR 30.18, "Exempt quantities.")
 - b. Fuel Receipt – Prior to initial receipt and storage of fuel onsite
 - c. Fuel Loading – Prior to initial fuel load
 - d. Waste Shipment – Prior to first radioactive waste shipment
- License Condition (12-4) – No later than 12 months after issuance of the COL, the licensee shall submit to the Director NRO a schedule that supports planning for and conduct of NRC inspections of the operational program. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until this operational program has been fully implemented..

12.5.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the COL FSAR related to

this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the Operational Radiation Protection Program that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COL application to the relevant NRC regulations, the guidance in Section 12.5 of NUREG-0800, and other pertinent NRC RGs. The staff's review concluded that the applicant has adequately addressed COL items involving the Operational Radiation Protection Program; radiation protection equipment, instrumentation, facilities; and portable instruments to measure radio-iodine concentrations under accident conditions. The applicant also listed Operational Program Item #10, pertaining to the Radiation Protection Program and its implementation milestones, in FSAR Table 13.4-201. The overall description of the applicant's operational program for radiation protection is addressed in FSAR Appendix 12BB, which references NEI 07-03A. An acceptable Radiation Protection Program meets the requirements of 10 CFR 19.12, 10 CFR 19.13, 10 CFR Part 20, and the applicable parts of 10 CFR Parts 50, 52, and 71. On the basis of the staff's review of the applicant's Operational Radiation Protection Program, as described above, the staff found the applicant's Operational Radiation Protection Program and the associated milestones to be acceptable.

12.6 Appendices 12A and 12B – Calculation of Airborne Radionuclides and Airborne Releases

Appendices 12A and 12B of the Fermi 3 COL FSAR, Revision 3, incorporates by reference, Appendices 12A, "Calculation of Airborne Radionuclides," and 12B, "Calculation of Airborne Releases," of certified ESBWR DCD Revision 9, referenced in 10 CFR Part 52, Appendix [X], with no departures or supplements. NRC staff reviewed the application and checked the referenced DCD to ensure that no issues relating to this section remained for review.¹ The NRC staff's review confirmed that there are no outstanding issues related to this section. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix [X] to 10 CFR Part 52, all nuclear safety issues relating to the Appendices 12A and 12B have been resolved.

¹ See "Finality of Referenced NRC Approvals" in Section 1.2.2 of the safety evaluation report (SER) for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.