

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; inservice inspection [ISI]; and calibration) and anticipated operational occurrences (AOOs) (such as loss of power to all recirculation pumps, the tripping of the turbine generator set, isolation of the main condenser, and loss of offsite power). This chapter provides specific information on facility and equipment design, planning and procedures programs, and techniques and practices employed by the applicant to meet the radiation protection standards in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection against Radiation"; and to be consistent with the guidance in the appropriate regulatory guides (RGs). The practices in those guides are used to implement the U.S. Nuclear Regulatory Commission (NRC) regulations.

12.1 Ensuring that Occupational Radiation Exposures Are as Low as Is Reasonably Achievable

12.1.1 Introduction

This combined license (COL) Final Safety Analysis Report (FSAR) section 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 NRC: NEI 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program Description," (Agencywide Documents Access and Management System (ADAMS) ML091490684) and NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)," (ADAMS Accession No. ML093220178).

12.1.2 Summary of Application

Section 12.1 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 12.1 of the certified Economic Simplified Boiling-Water Reactor (ESBWR) Design Control Document (DCD), Revision 10, referenced in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the Economic Simplified Boiling-Water Reactor." 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 to meet 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 to meet the needs of this COL item.

- STD COL 12.1-3-A Operational Considerations

The applicant is responsible for providing criteria and conditions for implementing various operating procedures and techniques ensuring that occupational exposures are ALARA according to 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 to meet 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 to meet 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 the 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 staff followed the guidance in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," to evaluate Fermi 3 FSAR Section 12.1 for compliance with NRC regulations.

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 the acceptance of the COL items and the supplemental information is established in 10 CFR 19.12, "Instructions to workers"; 10 CFR Part 20, "Standards for Protection against Radiation"; and the guidance of RG 1.206; RG 8.10, Revision 1-R; RG 1.8, Revision 3; and RG 8.8, Revision 3.

Moreover, the acceptance of the COL items and the supplemental information 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, 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 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to “Ensuring that Occupational Radiation Exposures are ALARA.”

In addition, the staff reviewed the applicant’s proposed resolution to the COL items and the supplemental information included under Section 12.1 of the Fermi 3 COL FSAR. In this review, the staff used the applicable sections of the SRP and RG 1.206 as guidance.

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 in a COL application that references a design certification.

Section 1.2.3 of this safety evaluation report (SER) discusses the NRC’s strategy for performing one technical review for each standard issue outside the scope of the design certification (DC) and to use this review to evaluate the subsequent COL applications. To ensure that the staff’s findings on the standard content that were documented in the SER with open items for the North Anna Unit 3 application are 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 this comparison, the staff considered changes 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 has endorsed all responses to the RAIs in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the North Anna standard content to be directly applicable to the Fermi 3 COL application. This SER identifies the standard content material with italicized, double-indented formatting.

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

COL Items

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ADAMS Accession No. 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.

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 RG 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 (ADAMS Accession Nos. ML090510379 and ML091130034). NEI 07-03A and NEI 07-08A are the final approved versions of NEI 07-03 and NEI 07-08 (ADAMS Accession Nos. ML091490684 and ML093220178, respectively). Therefore, the applicant has adequately addressed COL Item STD COL 12.1-1-A (compliance with the guidance of RG 8.10). Confirmatory Item 12.01-1 is closed.

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *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 RG is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A to meet the needs of this COL item. NRC staff reviewed and approved these NEI templates for addressing this COL item (ADAMS Accession Nos. ML090510379 and ML091130034). Therefore, the applicant has adequately addressed COL Item STD COL 12.1-2-A (compliance with the guidance of RG 1.8). Confirmatory Item 12.01-1 is closed.

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *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 the ALARA Program are addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07–03A to meet the needs of this COL item. NRC staff reviewed and approved these NEI templates for addressing this COL item in separate SERs (ADAMS Accession Nos. ML090510379 and ML091130034). Therefore, the applicant has adequately addressed COL Item STD COL 12.1-3-A (providing criteria and conditions for implementing various operating procedures and techniques to ensure that occupational exposures are ALARA, according to the guidance of NUREG–1736 to the level of detail in RG 1.206). Confirmatory Item 12.01-1 is closed.

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *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 RG is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A to meet the needs of this COL item. NRC staff reviewed and approved these NEI templates for addressing this COL item (ADAMS Accession Nos. ML090510379 and ML091130034). Therefore, the applicant has adequately addressed COL Item STD COL Item 12.1-4-A (compliance with the guidance of RG 8.8). Confirmatory Item 12.01-1 is closed.

Supplemental Information

The following portion of this technical evaluation section is reproduced from Section 12.1.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *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 the 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 in Section 12.5 of this SER.

As stated earlier, NRC staff reviewed and approved these NEI templates for addressing the ALARA Program. Therefore, the applicant has adequately addressed the ALARA Program and

has identified the locations of very high radiation areas that require access control. 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. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms 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 E, Section VI.B.1, all nuclear safety issues relating to "Ensuring that Occupational Radiation Exposures Are ALARA" that were incorporated by reference are resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in Section 12.1 of NUREG-0800, and other NRC RGs. The staff's review concludes that the applicant has adequately addressed STD COL Items 12.1-1-A through 12.1-4-A and, as described in the staff's evaluation above, the staff finds the information contained in STD SUP 12.1-1 acceptable. The applicant has also adequately incorporated by reference NEI 07-03A and NEI 07-08A, with additional site-specific information added to the COL FSAR. These NEI templates meet the acceptance criteria defined in Section 12.1 of NUREG-0800. Therefore, the staff determines that the information in this section adequately addresses an acceptable ALARA program and is in accordance with NRC requirements.

12.2 Plant Sources

12.2.1 Introduction

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

This FSAR section also addresses doses to members of the public from radioactive effluent releases. All liquid effluent releases are conducted and monitored through the liquid waste management system (LWMS) for process liquids generated during the operation of the LWMS, the gaseous waste management system (GWMS), and the solid waste management system (SWMS). Airborne effluent releases are conducted and monitored from the operation of the LWMS, GWMS, and SWMS; and from the ventilation exhaust systems servicing radiologically controlled areas where process equipment are located. Airborne effluent release normally occur from the reactor/fuel building stack, the 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 7, incorporates by reference Section 12.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 12.2, the applicant provides the following:

Tier 2 Departure 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 was reconfigured to accommodate a minimum 10-year 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 to equipment location and layout. The applicant provides revised radiation source parameters in FSAR 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 public. 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 with 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, "Dose limits for the individual members of the public"; and 20.1302, "Compliance with the dose limits for individual member of the public." Compliance with the requirements in Section II.D of Appendix I to 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 public. This information addresses compliance with the regulatory dose limits in Section II.A of Appendix I to 10 CFR Part 50; Section II.D of Appendix I to 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. FSAR Section 11.2.1 addresses compliance with the requirements in Section II.D of Appendix I to Part 50 for liquid effluents.

- 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 byproduct, source, or special nuclear materials that may be maintained onsite. These contained sources are not part of the permanent plant design; they are used as calibration, check, or radiographic sources.

Supplemental Information

- STD SUP 12.2-1

The applicant provides supplemental information in FSAR Subsection 12.2.1.1.2, "Other Radioactive Sources," to provide details regarding the Californium-252 (Cf-252) reactor startup source.

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 Section 12.2 of NUREG–0800.

The staff followed the guidance in RG 1.206 to evaluate Fermi 3 FSAR Section 12.2 for compliance with NRC regulations.

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

The regulatory bases for the acceptance of the COL items in this section include the applicable requirements of 10 CFR Part 20, 10 CFR Part 50, and the guidance of RG 1.206.

In particular, the regulatory basis for the acceptance of the COL Items for assessing doses to members of the public from liquid and gaseous effluent releases in unrestricted areas is established in:

- 10 CFR 20.1301(e), 10 CFR 20.1302, 10 CFR 50.34a, and 50.36a.
- Appendix A, "General Design Criteria for Nuclear power Plants"; to 10 CFR Part 50 General Design Criterion (GDC) 60, "Control of releases of radioactive materials to the environment"; and GDC 64, "Monitoring radioactivity releases."
- Appendix I to 10 CFR Part 50, 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 (GL) 89–01, "Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications."

SRP acceptance criteria include:

- RG 1.109, "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."
- RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for comment)."
- RG1.111, Revision 1, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."
- RG 1.112, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors."

- RG 1.113, Revision 1, “Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I,” and RG1.206.
- Full descriptions of the applicable regulatory and acceptance criteria are in Section 11.2 through Section 11.4 of NUREG–0800.

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 COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to “Radiation Sources.”

In addition, the staff reviewed the applicant’s proposed departure and the proposed resolution to the COL items included under Section 12.2 of the Fermi 3 COL FSAR. The staff’s review used the applicable sections of the SRP and RG 1.206 as guidance. The staff performed an independent evaluation of doses from liquid and gaseous effluents using the LADTAP II computer code (NUREG/CR–1276, “User’s Manual for LADTAP II – A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents”) and the GASPAR II computer code (NUREG/CR–4653, “GASPAR II – Technical Reference and User Guide”). The staff reviewed the basis for the liquid and gaseous effluents source terms and the applicant’s assumptions and data used to model exposure pathways and to estimate doses to offsite receptors.

Section 1.2.3 of this SER discusses the NRC’s strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff’s findings on the standard content that were documented in the SER with open items for the North Anna Unit 3 application are 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 this comparison, the staff considered changes to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and the evaluation of the North Anna standard content to be directly applicable to the Fermi 3 COL application. This SER identifies the standard content material with italicized, double-indented formatting.

The staff reviewed the following information in the Fermi 3 COL FSAR:

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 in a COL application that references a design certification.

Tier 2 Departure 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 was reconfigured to accommodate a minimum 10-year 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 to equipment location and layout. The applicant provides revised radiation source parameters in FSAR Table 12.2-22R. The staff reviewed the equipment location and compared FSAR Table 12.2-22R with DCD Tier 2 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 Rooms 6171 and 6172). A review of 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. The staff therefore concluded that given the size of Room 6171, the radiation level and the required shielding will remain the same as those identified for Rooms 6171 and 6172 in the DCD, regardless of the tank locations.

The applicant's evaluation determined that this departure does not require prior NRC approval in accordance with 10 CFR Part 52, Appendix E, Section VIII.B.5. Within the review scope of this section, the staff finds 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 updates estimated airborne (gaseous) effluents source term, and associated doses to the public. The 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 of 10 CFR 20.1301 and 20.1302. Several tables in the FSAR present updated site information compared to the ESBWR DCD, Tier 2, Revision 9. The FSAR presents an estimate of the annual gaseous effluents source term by radionuclides and results demonstrating compliance with gaseous effluent concentration limits of Appendix B to Part 20. The FSAR also presents dose results that demonstrate compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50. Compliance with the U.S. Environmental 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 presented in FSAR Tables. Compliance with the EPA standard in 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), will be described just before the discussion of COL Item EF3 COL 12.2-3-A, as well as the 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 discussed in FSAR Section 11.3 for gaseous effluents, as evaluated in SER Section 11.3. The staff's evaluations concerning this gaseous effluent information and resulting compliance are discussed below.

Gaseous Effluents Source Term/10 CFR Part 20 Compliance

Gaseous Effluents Source Term Determination Summary

The estimated gaseous effluents source term is based on the information in ESBWR DCD, Tier 2, Section 12.2.2. Although the ESBWR design has three plant stacks (the reactor/fuel building stack, the turbine building stack, and the RWB stack), the applicant assumes that all releases will occur from a single stack with each receptor assumed to be at the nearest location from the proposed plant (see the staff's evaluations in Section 2.3.5 of this SER for details). Several tables in ESBWR DCD, Tier 2, Revision 9, present information normally incorporated from the DCD into the FSAR to represent the gaseous effluents source term. DCD Tier 2, Tables 12.2-15 and 12.2-16 present the input effluent release data and the output airborne (gaseous) release source term in terms of curies per year based on the method in NUREG-0016 Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE CODE)." However, the gaseous effluent doses predicted from the ESBWR DCD, Tier 2, Table 12.2-16 source term indicate that the resultant design exposure could exceed the design basis 10 CFR Part 50 guidance, as seen in ESBWR DCD, Tier 2, Table 12.2-18b for the maximally exposed individual (MEI) critical organ during a calendar year. The gaseous effluents source term estimates in ESBWR DCD, Tier 2, Table 12.2-16 are based on the pumped forward configuration of the ESBWR feedwater heater drains that bypass the condensate demineralizer cleanup system, thus increasing the concentration of radionuclides in the gaseous effluents and the corresponding effluent doses. In order to alleviate this increase in radionuclide activity, which leads to an increase in the gaseous effluents source term, the applicant made changes in the FSAR. FSAR Subsection 12.2.2.1 states that in accordance with FSAR Subsection 11.5.4.5 and the Fermi 3 offsite dose calculation manual (ODCM), compensatory methods are implemented (such as realigning from a pumped forward to a cascade operating configuration so that 100 percent of the radionuclides are treated by the condensate demineralizer) to ensure that the estimated dose to the MEI critical organ is less than 0.15 millisievert (mSv) (15 milliroentgen equivalent man [mrem]). Gaseous effluent rates will be maintained by limiting the radioiodine concentrations in the reactor water to those prescribed in FSAR Table 12.2-205, which were determined using the methodology in DCD Section 11.1, "Source Terms." The annual airborne radioiodine effluent releases in FSAR Table 12.2-206 are then determined from the reactor water radioiodine concentrations in FSAR Table 12.2-205. The final normal operating annual gaseous effluents source term is therefore a combination of the values in FSAR Table 12.2-205 for the radioiodine isotopes and in DCD Tier 2, Table 12.2-16 for all radionuclides, except the radioiodine isotopes.

Gaseous Effluents Source Term Details

The staff reviewed the applicant's information on the operational method to limit the reactor water radioiodine concentrations. The staff noted that the applicant has 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 percentage used in the certified ESBWR design of 66.3 percent (0.663). Therefore, the staff issued RAI 12.02-7 with the following items and 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. The applicant proposes to accomplish this 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 (ADAMS Accession No. ML11171A297), provided additional clarifying statements on the proposed changes. The applicant reiterated the statement in DCD Tier 2, Subsection 12.2.2.2, that the COL applicant is responsible for ensuring that the offsite dose (using site-specific parameters) due to radioactive airborne effluents complies with the regulatory dose limits in 10 CFR Part 50, Appendix I, Sections II.B and II.C. Also, the applicant noted that the staff's Final SER (FSER) on ESBWR DCD, (NUREG–1966), 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 added that preliminary dose calculations using the gaseous effluents source term in DCD Tier 2, Table 12.2-16 indicate that the estimated exposure to the Fermi 3 MEI critical organ during a calendar year could exceed 0.15 mSv (15 mrem) (ADAMS Accession No. ML102510498). To limit the potential MEI critical organ dose below the regulatory limit, the applicant chose to lower the iodine release rate (consistent with the staff's statement) by placing administrative limits on the reactor water iodine radioisotope concentrations during normal operations at levels indicated in FSAR Table 12.2-205. The applicant stated 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 and the staff’s ESBWR DCD FSER Chapter 11 (NUREG–1966), thus indicating the acceptability of the ANSI/ANS-18.1–1999 methodology as an alternative to the NUREG–0016 methodology.

Furthermore, the applicant added that the limits established in Table 12.2-205 were developed with the assumption that the plant was operating in a cascade configuration (i.e., 100 percent of the steam flow is treated by the condensate demineralizer). In the supplemental response to RAI 12.02-7 dated August 5, 2011 (ADAMS Accession No. ML11221A075), the applicant stated that the ESBWR DCD does not describe the maximum capabilities of the condensate purification system (CPS) or the condensate system components (i.e., pumps, valves, and pipes). The maximum component capabilities were established during the detailed design. Therefore, the applicant added Supplemental Information 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 the condensate system components design can accommodate 100 percent of the feedwater flow to support the 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 the 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. Therefore, the applicant’s approach through the two site-specific supplements (EF SUP 10.4-1 and EF SUP 10.4-2) is acceptable, because it ensures that the CPS and condensate components design will have the capability for a 100-percent feedwater flow to support a cascade configuration.

In response to Item 1, the applicant states that the characterization of the conservative nature of NUREG–0016 is based on experience 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 to determine the iodine source terms, the discussion of the conservative nature of NUREG–0016 will be removed from FSAR Subsection 12.2.2.1. The staff finds the applicant’s response is acceptable, and RAI 12.02-7, Item 1 is resolved.

In response to Item 2, the applicant states that ANSI/ANS-18.1–1999 was used as an 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 FSAR Table 12.2-206 were developed using the reactor water radioiodine concentrations in FSAR Table 12.2-205 and the method described in DCD Tier 2, Appendix 12B. The applicant notes that clarifying statements will be added to FSAR Subsection 12.2.2.1 specifying the method used to develop normal operating radioiodine limits and releases in FSAR Tables 12.2-205 and 12.2-206, respectively. Therefore, the applicant’s response is acceptable, because the applicant used acceptable methods described in ANSI/ANS-18.1–1999 to determine the iodine radioisotope concentrations and releases. RAI 12.02-7, Item 2 is resolved.

The applicant’s response to Item 3 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 of the condensed steam is routed to the condenser and then treated by the

condensate demineralizer, thus resulting in a small power reduction due to the loss of thermal efficiency. The applicant adds that this action does not replace the design-basis reactor water radioiodine concentrations in DCD Tier 2, Table 11.1-4a. This action results in 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 listed in FSAR Table 12.2-205 are administrative limits controlled through the ODCM, as indicated in FSAR Subsection 11.5.4.5. The staff finds 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, RAI 12.02-7, Item 3 is resolved.

The applicant's response to Item 4 states that as described earlier in response to the Environmental Report (ER) RAI 01-1 dated September 1, 2010 (ADAMS Accession No. ML102510498), and in the responses to the above items, 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 in FSAR Tables 12.2-17R, 12.2-18bR, 12.2-203, and 12.2-204 is based on the gaseous release values in FSAR Table 12.2-206 for radioiodine and in DCD Table 12.2-16 for releases other than iodine radionuclide isotopes. The staff finds the applicant's response acceptable. As indicated earlier, to ensure that the MEI doses will not exceed the regulatory limits of Appendix I to 10 CFR Part 50, the applicant must limit the iodine releases during normal operation. One method for achieving this is to maintain the reactor water iodine radioisotope concentrations at levels lower than the normal ESBWR DCD operational radioiodine values. The applicant is committed to limiting the normal operating radioiodine concentrations in the reactor water to the values listed in FSAR Table 12.2-205. This concentration limit will be controlled through the ODCM. The staff finds the applicant's response acceptable, and RAI 12.02-7, Item 4 is resolved. Therefore, this RAI 12.02-7 is closed.

10 CFR Part 20 Compliance

Based on this revised source term (i.e., values in DCD Tier 2, Table 12.2-16 and in FSAR Table 12.2-206), the applicant in FSAR Table 12.2-17R provides the list of radionuclide airborne effluents; their annual release quantities; and the comparison of airborne effluent release concentrations with the 10 CFR Part 20 concentration limits. This information addresses compliance with the regulatory airborne effluent concentration limits in Table 2 (Column 1) of Appendix B to 10 CFR Part 20.

The staff's review of the Fermi 3 FSAR Revision 0 identified an incorrect presentation of the estimated gaseous effluent concentrations 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 FSAR Table 12.2-17R and to 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 (ADAMS Accession No. ML091060496), the applicant revised the gaseous effluent concentrations at the site boundary. The applicant also incorporated this response into Revision 1 of the Fermi 3 COL FSAR dated March 2009. The staff finds that the applicant's response correctly presents the requested information and is in compliance with 10 CFR Part 20, Appendix B, Table 2 (Column 1). Therefore, RAI 12.02-1 is closed and resolved.

Gaseous Effluent Doses

DCD COL Item 12.2-2-A directs the applicant to provide a site-specific estimate of airborne effluents and associated doses to the public. The site-specific information and analyses address compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50. Several tables in FSAR Section 12.2.2 present updated gaseous effluents dose information compared to ESBWR DCD, Tier 2, Revision 9. The revised tables in the Fermi 3 FSAR are Tables 12.2-18aR and 12.2-18bR, which present results that demonstrate compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50.

In a change from Section 12.2.2 of the ESBWR DCD, Tier 2, the applicant applied site-specific information and assumptions to assess the radiological impacts on members of the public. 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 from gaseous effluents using the GASPARD II computer code; the applicant's basis for the gaseous effluents source term; and assumptions and data used to model exposure pathways to estimate doses to offsite receptors. The gaseous effluents source term is based on ESBWR DCD Section 12.2.2. For gaseous effluents, the exposure pathways include an external exposure to the airborne plume; an external exposure to ground-deposited radioactivity; the inhalation of airborne radioactivity; and the ingestion of food products containing radioactivity. The applicant identified locations of expected maximum exposures that included the nearest site boundary and nearest residence garden, and consumption of meat and milk from beef cattle.

In RAI 12.02-3, the staff requested the applicant to provide the input and output files for the data used in the GASPARD II computer code analyses to generate dose estimates to the public that are associated with the operation of Fermi 3. The applicant was specifically asked to describe all assumptions and bases for the use of factors that are different from the default values noted in RG 1.109, Revision 1, and/or the GASPARD II code. In the response to this RAI dated August 25, 2009 (ADAMS Accession No. ML092580311), the applicant provided the GASPARD II site-specific input parameters and their bases in addition to the 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 general population residing within an 80-kilometer (km) (50-mile [mi]) radius of the site. The staff confirmed the gaseous pathway doses in FSAR Tables 12.2-18bR and 12.2-201 (for the MEI) and Table 12.204 (for the 80-km [50-mi] population). These results indicate that the projected annual doses to the MEI from gaseous effluents comply with the regulatory dose limits in 10 CFR Part 50, Appendix I, Sections II.B and II.C. In addition, the projected gaseous effluent 80-km (50-mi) population doses would be insufficient to result in any cost-beneficial gaseous radwaste augments per the guidance in RG 1.110. Therefore, RAI 12.02-3 is resolved.

Table 12-1 of this SER compares the applicant's results to the staff's confirmatory results and to the 10 CFR Part 50, Appendix I gaseous dose design objectives. This table shows that the applicant's results and the staff's confirmatory results are below the Appendix I criteria. The staff performed independent confirmatory assessments on the latest FSAR Table 12.2-18bR gaseous effluent data. The staff concluded that the applicant has demonstrated compliance with the gaseous effluent regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

Table 12-1 Comparisons of Annual Doses per unit to the Maximally Exposed Individual from Gaseous Effluents

Type of Dose	Application*	NRC Staff's Analysis	10 CFR Part 50, Appendix I
Beta Air mGy/yr(mrad/yr) [at the Site Boundary]	2.59E-3 (2.59E-1)	2.59E-3 (2.59E-1)	1.00E-1 (1.00E+1)
Gamma Air mGy/yr (mrad/yr) [at the Site Boundary]	2.18E-3 (2.18E-1)	2.18E-3 (2.18E-1)	2.00E-1 (2.00E1)
Whole Body [includes plume exposure] mSv/yr (mrem/yr)	9.76E-3 (9.76E-1)	8.38E-3 (8.38E-1)	5.00E-2 (5.00E+0)
Skin [includes plume exposure] mSv/yr (mrem/yr)	1.15E-2 (1.15E+0)	1.15E-2 (1.15E+0)	1.50E-1 (1.50E+1)
Iodines & Particulates- Max Organ Thyroid mSv/yr (mrem/yr)	1.13E-1 (1.13E+1)	1.21E-1 (1.21E+1)	1.50E-1 (1.50E+1)
* FSAR Table 12.2.-201 mGy = milligray; 1 mGy = 100 mrad; rad = radiation absorbed dose; yr=year mrem = milliroentegn equivalent man mSv = millisievert; 1 Sv = 100 rem			

Population Dose Evaluation – Gaseous Effluents

The applicant calculated a collective whole body dose from gaseous effluents to a population of 7.71 million within an 80-km (50-mi) radius of the site. This calculation included a description of the exposure pathways that could transmit radiation and radioactive effluents to the population within the 80-km (50-mi) radius of the site. The applicant considered the following exposure pathways to evaluate the population dose: immersion in a radioactive plume, a direct radiation exposure from deposited radioactivity, inhalation of airborne radioactivity, ingestion of garden fruits and vegetables, and ingestion of meat and milk.

Table 12-2 of this SER lists the applicant's calculated population collective doses (in terms of the total body dose and the thyroid dose). NRC staff independently verified the applicant's population dose input values and gaseous effluent population doses. The cumulative population exposure was determined for annual gaseous effluent releases and then used to determine cost-beneficial gaseous radwaste augments per the guidance in RG 1.110 in FSAR Section 11.3. This regulatory guidance assesses the potential reductions in the cumulative exposure to the population using augments to the proposed gaseous radwaste systems in a cost-benefit analysis calculation. These calculations are performed to demonstrate compliance with Section II.D of Appendix I to Part 50.

Table 12-2 Annual Population Doses from Gaseous Effluents

Type of Dose	Application*
Total Body	6.70E-2 (6.70E+0)
Thyroid	2.70E-1 (2.70E+1)

* FSAR Table 12.2-204
All doses are in person-Sv/yr (person-rem/yr)

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

10 CFR 20.1301(e) requires NRC-licensed facilities to comply with “the provisions of EPA’s generally applicable environmental radiation standards of 40 CFR Part 190” for all facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ. Compliance with 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including total doses from liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and radioactive nitrogen-16 (N-16) sky shine (radiation from the interaction of N-16 with the air molecules reflected back to the ground) from BWR turbine buildings. The EPA standards apply to the entire site or facility, whether it has a single unit or multiple units.

The staff reviewed FSAR Chapter 11 for compliance with 10 CFR 20.1301(e) and EPA general radiation protection standard 40 CFR Part 190.

The applicant’s comparison of site doses in FSAR Table 12.2-203 includes the sum of the actual current liquid and gaseous effluent doses from the operating unit at the site, plus the liquid and gaseous effluent doses projected from a new unit. This table accounts for liquid and gaseous effluent site dose contributions.

The staff determined the site dose as the combined doses from the effluent dose information in FSAR Table 12.2-201 for the annual gaseous effluent doses to the MEI, the information in FSAR Table 12.2-202 for the annual doses to the MEI from Fermi 3 liquid effluents, and the annual individual doses for the liquid and gaseous effluents from the Fermi 2 operation. In addition, the staff considered the direct dose to the nearest site resident from the Fermi 2 independent spent fuel storage installation (ISFSI). Based on the ISFSI dose rate of 6.64×10^{-3} mrem per hour (mrem/hr) 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 annual dose to the nearest site boundary to be about 10 mrem/yr. This dose is added to the whole body site dose in FSAR Table 12.2-203 and is compared to the 40 CFR Part 190 dose limit. This total dose must be less than the dose limits in 40 CFR Part 190. As indicated in Table 12-3 below, the total site doses are less than the limits and are therefore acceptable.

Table 12-3 Comparisons of Annual Maximally Exposed Individual Doses in 10 CFR 20.1301(e) and 40 CFR Part 190

Type of Dose	FERMI 3 Liquid	FERMI 3 Gaseous	FERMI 2 Existing Unit**	Direct Radiation	Total	10 CFR 20.1301 and 40 CFR Part 190 Limits
Total Body Applicant	6.48E-5 (6.48E-3)	9.76E-3 (9.76E-1)	4.68E-2 (4.68E+0)	1.00E-1 (1.00E+1)	1.57E-1 (1.57E+1)	2.5E-1 (2.5E1+)

Organ/Body Applicant	8.77E-4 (8.77E-2)	1.15E-3* (1.15E-1)	5.20E-4 (5.20E-2)	1.00E-1 (1.00E+1)	1.23E-1 (1.23E+1)	2.5E-1 (2.5E+1)
Thyroid Applicant	2.63E-4 (2.63E-2)	1.13E-1 (1.13E+1)	2.66E-2 (2.66E+0)	1.00E-1 (1.00E+1)	2.40E-1 (2.40E+1)	7.5E-1 (7.5E+1)
* Skin dose; ** Sum of gaseous and liquid effluent doses All doses are in mSv/yr (mrem/yr)						

On the basis of the information in FSAR Subsection 12.2.2.1, the staff finds that the applicant adequately addresses COL Item EF3 COL 12.2-2-A regarding the description of gaseous effluents and associated doses from the Fermi 3 ESBWR. Therefore, DCD COL Item 12.2-2-A is resolved.

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

This COL item updates estimated liquid effluents and associated doses to 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 FSAR tables present updated site information compared to the information in ESBWR DCD, Tier 2, Revision 9. The FSAR presents an estimate of the annual liquid effluents source term by radionuclides and results demonstrating compliance with liquid effluent concentration limits of Appendix B to Part 20. Compliance with the EPA standard in 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), is presented in FSAR tables in addition to the results demonstrating compliance with Sections II.A of Appendix I to Part 50. Compliance with Section II.D of Appendix I to Part 50 on ALARA is addressed in FSAR Section 11.2. The staff's evaluations of the liquid effluents information and resulting compliance are described below.

Liquid Effluents Source Term/10 CFR Part 20 Compliance

Liquid Effluents Source Term Determination Summary

The liquid effluents source term is based on the information in ESBWR DCD, Tier 2, Section 12.2.2. The applicant states 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 potential liquid pathway doses to address compliance with the regulatory dose limits in Section II.A of Appendix I to 10 CFR Part 50. Several tables in the FSAR present information incorporated from ESBWR DCD, Tier 2, Revision 9, to represent the liquid effluents source term.

FSAR Table 12.2-19bR presents an estimate of the annual liquid effluents source term by radionuclides and concentration results that demonstrate compliance with the liquid effluent concentration limits of Appendix B to 10 CFR Part 20. The staff identified an inconsistency in the applicant's data showing compliance with 10 CFR Part 20, Appendix B, Table 2 (Column 2). In RAI 12.02-2, the staff requested the applicant to update the FSAR by listing the liquid discharge nuclide concentrations in a tabular format and showing the comparisons with the corresponding values in Table 2 of Appendix B to 10 CFR Part 20 for consistency with the unity rule. In the response to this RAI dated August 8, 2009 (ADAMS Accession No. ML091060496), the applicant revised 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. 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 effluents source term from DCD Revision 7. The staff verified that FSAR Revision 3 still did not list the correct liquid effluents source term from DCD Revision 9. In the supplemental response to RAI 12.02-2 dated August 1, 2011 (ADAMS Accession No. ML1121A021), the applicant provided the revised Table 12.2-19bR incorporating the annual liquid effluents source term consistent with DCD Revision 9. The staff finds this response acceptable, and RAI 12.02-2 is therefore resolved and closed.

The staff notes that FSAR Tables 12.2-19aR and 12.2-19bR are consistent with DCD Tables 12.2-19a and 12.2-19b representing the GALE-86 computer code (NUREG-0016) input parameters and the resulting average annual liquid effluent release quantities per year. Table 12.2-19bR contains the liquid effluent discharge nuclide concentrations and comparisons to the corresponding values in Table 2 of Appendix B to 10 CFR Part 20 for consistency with the unity rule. The staff's review of this table finds the information to be consistent with the corresponding DCD tables, and it is therefore acceptable.

Liquid Effluent Doses

This COL item updates estimated liquid effluents and associated doses to the public. The revised information and analyses address compliance with Section II.A of Appendix I to Part 50. FSAR Tables 12.2-20aR and 12.2-20bR present results that demonstrate compliance with Sections II.A of Appendix I to Part 50.

In a change from Section 12.2.2 of the ESBWR DCD, Tier 2, the applicant applied site-specific information and assumptions to assess the radiological impacts on the public. The staff reviewed the proposed updates, information, and commitments in FSAR Subsection 12.2.2.4. The staff performed independent evaluations of offsite doses from liquid effluents using the LADTAP II computer code, the applicant's basis for the liquid effluent source term, and assumptions and data used to model exposure pathways and to estimate doses to offsite receptors. 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 the clarification and correction of specific technical and regulatory topics. Therefore, the staff asked the applicant to provide additional information to resolve these issues.

In RAI 12.02-4, the staff requested the applicant to provide the input and output files or the data used in the LADTAP II computer code analyses to generate dose estimates to 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 (ADAMS Accession No. ML092580311).

In response to Part a, the applicant provides transit time and dilution factors for drinking water and fish and invertebrate harvests used to consider the impacts of thermal variations in Lake Erie. The applicant used the 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. Therefore, the dilution factors and transit times provided are utilized in the liquid effluent dose evaluations and the impact of the thermal variations were considered for drinking water and fish and invertebrate harvests.

In response to Part b, the applicant states that even though there is currently no commercial fishery for invertebrates in the Great Lakes, it was conservatively assumed that the invertebrate caught in the Great Lakes is similar to that in salt water sites. The total catch was therefore based on total invertebrate consumption within the 80-km (50-mi) radius of the site using the projected 80-km (50-mi) radius population for the 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. These data indicate that potable water usage is more than eight times that of the other uses. 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 livestock would not provide significant means for contributing 10 percent or more to either the individual or to the public dose due to local animal meats, plant agricultural practices, and game harvests.

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

The staff reviewed the applicant's responses to Parts b through d. As indicated in FSAR Table 12.2-20bR, the MEI liquid release doses from ingesting fish and invertebrates accounts for well over 90 percent of the total MEI dose for both adults and children. Drinking water adds to the balance of the total body dose for both age groups. Therefore, potential doses from using surface water for irrigation and animal consumption would be small.

In the response to Part a, the staff noted that the applicant's dilution factors used for the drinking water and fish and invertebrate harvests were not conservative. Therefore, two LADTAP confirmatory runs were conducted to determine the impact of dilution factors on the MEI and population doses. One run used the applicant's assumption on dilution factors, and the other used the minimum overall dilution factor. In the second confirmatory run, the Lake Erie dilution factor was adjusted to correspond to the minimum overall dilution factors. The dose results from this run indicate an increase of about 29 percent in the total body dose and the maximum organ dose for an MEI; and about a 30 percent increase among the population in the total body dose and the maximum organ dose. As indicated in FSAR Table 12.2-203 in the comparisons MEI doses to the regulatory dose limits, offsite liquid effluent doses are smaller by about 2 to 3 orders of magnitude. Because the baseline MEI dose is very small and complies by a wide margin with the regulatory dose limit in 10 CFR Part 50, Appendix I, Section II.A, the additional 30 percent increase in the baseline liquid effluent dose estimates is negligible. With respect to the population dose, the 30 percent increase in the offsite liquid effluent dose would not change the conclusion that none of the liquid radwaste augments would be cost-beneficial. Also in response to Part c, the applicant stated that there is little use of surface water for irrigation or livestock. Therefore, an increase in the baseline dose estimate by 30 percent would not increase the estimated doses and conclusions. This analysis was based on the DCD Revision 5 liquid effluents source term.

In FSAR Revision 2, the applicant used the DCD Revision 6 liquid effluents source term. The liquid effluents source term remained unchanged in DCD Revision 7 and thereafter. The staff reviewed the updated doses to the MEI and the population. The staff performed confirmatory analyses to determine the liquid effluent pathway doses to the MEI and to the 80-km (50-mi) radius population. The analyses confirmed the applicant's liquid effluent pathway dose results in FSAR Revision 2, Tables 12.2-20bR, 12.2-202, 12.2.203, and 12.2.204. The applicant's response to supplemental RAI 12.02-2 dated August 1, 2011 (ADAMS Accession No. ML1121A1021), revised Table 12.2-19bR to be consistent with the annual liquid release using DCD Revision 9, Table 12.2-19b.

Table 12-4 of this SER compares the applicant's results to the staff's confirmatory results and to the 10 CFR Part 50, Appendix I liquid dose design objectives. This table shows that the applicant's results and the staff's confirmatory results are below the Appendix I criteria. The staff also performed independent confirmatory assessments of the latest FSAR Table 12.2-19bR liquid effluent data. The staff concluded that the applicant has demonstrated compliance with the liquid effluent regulatory requirements in 10 CFR Part 20 and Appendix I to 10 CFR Part 50. Therefore, RAI 12.02-4 is closed and resolved.

Table 12-4 Comparisons of Annual Maximally Exposed Individual Doses per unit from Liquid Effluents

Type of Dose	Application*	NRC Staff's Analysis	10 CFR Part 50, Appendix I, Section II.A
Total Body	6.48E-5 (6.48E-3)	6.53E-5 (6.53E-3)	3.0E-2 (3.0E+0)

Thyroid	2.63E-4 (2.63E-2)	2.40E-4 (2.40E-2)	1.0E-1 (1.0E+1)
Bone (Adult)	8.77E-4 (8.77E-2)	8.41E-4 (8.41E-2)	1.0E-1 (1.0E+1)
* FSAR Table 12.2.-202 All doses are in mSv/yr (mrem/yr)			

Population Dose Evaluation – Liquid Effluents

The applicant calculated a collective whole body dose from liquid effluents to a population of 7.71 million, within an 80-km (50 mi) radius of the site. This calculation included a description of the exposure pathways that could transmit radiation and radioactive effluents to the public within the 80-km (50-mi) radius of the site. The applicant used the information for the ingestion of fish and invertebrates, exposure to shoreline sediments, ingestion of drinking water, and exposure to water while swimming and boating.

Table 12-5 of the SER provides a comparison of the applicant’s calculated population collective doses (in terms of the total body dose and the thyroid dose) and the staff’s independently calculated results. The results in this table show that the applicant’s assumptions and parameters resulted in approximately the same total body and thyroid doses as those in the NRC staff’s independent assessment. The cumulative population exposure was determined for annual liquid effluent releases and then used to determine cost-beneficial liquid radwaste augments, per the guidance in RG 1.110 in FSAR Section 11.2. This regulatory guidance assesses the potential reductions in the cumulative exposure to the population using augments to the proposed liquid radwaste systems in a cost-benefit analysis calculation. These calculations were performed to demonstrate compliance with Section II.D of Appendix I to 10 CFR Part 50.

Table 12-5 Comparison of Annual Population Doses from Liquid Effluents

Type of Dose	Application*	NRC Staff’s Analysis
Total Body	1.49E-1 (1.49E+1)	1.46E-1 (1.46E+1)
Thyroid	3.01E-1 (3.01E+1)	2.04E-1 (2.04E+1)
* FSAR Table 12.2-204 All doses are in person-Sv/yr (person-rem/yr)		

On the basis of the information described above, the staff finds that the applicant adequately addresses COL Item EF3 COL12.2-3-A (a description of site-specific liquid effluent releases and doses to members of the public). Therefore, DCD COL Item 12.2-3-A is resolved.

The following portion of this technical evaluation section is reproduced from Section 12.2.4 of the North Anna Unit 3 SER (ADAMS Accession No. 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 $3.7 \text{ E}+9 \text{ Bq}$ (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.

As stated above, the applicant's radioactive material control procedures (which are part of the Radiation Protection Program) will apply to byproduct, source, and special nuclear materials. In order to obtain a description of the specific types of byproduct, source, and special nuclear materials (including their chemical or physical forms and maximum quantities held at any one time) for the requested material licenses under 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material"; 10 CFR Part 40, "Domestic Licensing of Source Material"; and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material"; the staff issued RAI 01-7 (ADAMS Accession No. ML113120325). In the response to this RAI dated December 7, 2011 (ADAMS Accession No. ML11343A014), the applicant amended FSAR Subsection 12.2.1.5 to provide a description of the byproduct, source, and special nuclear material that will be received; possessed; or used during the period between the issuance of the COL and the 10 CFR 52.103(g) finding.

In FSAR Subsection 12.2.1.5, the applicant states that no 10 CFR Part 40 specifically licensed material—including natural uranium, depleted uranium, or uranium hexafluoride—will be received; possessed; or used during the period between the issuance of the COL and the 10 CFR 52.103(g) finding. Pursuant to 10 CFR Part 30, the applicant amended the FSAR to provide a description of the nominal values of projected radioactive byproduct materials (in the form of sealed sources) that will be used for radiation monitoring and laboratory and portable monitoring instrumentation. This information is in FSAR Table 12.2-208 the applicant verified that no byproduct material will be received, possessed, or used in a physical form that is "in unsealed form, on foils or plated sources, or sealed in glass," and that exceeds the quantities in Schedule C in 10 CFR 30.72, "Schedule C—Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release." The applicant

stated that special nuclear material shall be in the form of reactor fuel and spent fuel, in accordance with limitations for storage and amounts required for reactor operation as described in COL application Part 2. Pursuant to 10 CFR Part 70, the applicant amended the FSAR to provide a description of the non-fuel special nuclear material specifically required for use at Fermi 3. This non-fuel special nuclear material consists of local power range monitor assemblies and startup range nuclear monitor assemblies. This information is listed in FSAR Table 12.2-209. The applicant verified that the special nuclear material to be received, possessed, or used does not involve enriched uranium for which a criticality accident alarm system is required; uranium hexafluoride in excess of 50 kilograms (110 pounds) in a single container or 1,000 kilograms (2,200 pounds) total; or plutonium in excess of 2 curies in an unsealed form or on foils or plated sources. The staff finds that the specific material information described above satisfies the requirements of 10 CFR 30.32, "Application for specific licenses"; 10 CFR 40.31, "General domestic licenses for byproduct material"; 10 CFR 70.21, "filing"; and 10 CFR 70.22 "Contents of applications," to receive; possess; and use byproduct, source, and special nuclear material. Therefore, this information is acceptable.

In addition, as part of the Fermi 3 review of plant-specific information on other contained sources under COL Item STD COL 12.2-4-A, the staff issued RAI 12.03-12.04-8 requesting the applicant to describe the condensate storage tank (CST) and its expected location at the Fermi site. The RAI also requested the applicant to 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 the applicant to 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 (ADAMS Accession No. ML102940218), the applicant provided the requested information including a description of the CST location, projected CST design dimensions, and the estimated radionuclide inventory of the CST based on the various potentially contaminated liquid inputs into the tank. The applicant amended the FSAR to include a new table (Table 12.2-207), which lists the estimated radionuclide source term concentrations and source term inventories in the CST. The applicant stated that the primary source of water to the CST is purified and demineralized water from the makeup water system. This source of water to the CST does not contain contaminants. However, the CST can receive potentially radioactive recycled water from the control rod drive (CRD) system; treated water from the LWMS; and condensate reject from the condenser (in cases where the water level in the condenser is too high).

To establish a bounding source term, the applicant assumed that the main sources contributing to the buildup of radioactivity in the CST are condensate-reject from the condenser and treated water from the LWMS (the applicant did not consider the contribution of recycled water from the CRD system because this water has the same activity level as that of the CST). The applicant compared the expected radionuclide concentrations in the condenser with those in the equipment drain sample tank of the LWMS (the treated water from the LWMS is stored in the equipment drain sample tank before being recycled to the CST). The applicant selected the largest value as the bounding activity in the CST. The ESBWR DCD states that the capacity of the CST is 4,885 cubic meters (1.29 million gallons). The ESBWR DCD does not provide any further design parameters for the CST, so the applicant considered two different CST design configurations based on tank aspect ratios of 0.5 and 2 that limit the tank diameter and height. Based on these tank configurations, the applicant calculated the potential dose rate at 30 cm (1 ft) from the surface of the tank to be 2.2 mrem/hr for the shorter tank (aspect

ratio of 2) and 2.1 mrem/hr for the taller tank (aspect ratio of 0.5). Because these estimated dose rates are below the threshold considered to be a radiation area per 10 CFR 20.1003, the applicant concluded that no special physical or administrative features are needed to maintain the exposures ALARA in the vicinity of the CST.

The staff reviewed the applicant's information, assumptions, and the method of analysis and found them acceptable. The staff performed confirmatory analyses to determine the potential radionuclide concentrations in the CST and the expected dose rates in the vicinity of the CST. The staff's analyses confirmed the applicant's cited results. Therefore, RAI 12.03-12.04-8 is closed. The staff verified that the FSAR Revision 4 includes the revised Table 12.2-207, which provides a list of the bounding radionuclide inventory in the CST.

Overall, the staff finds that the applicant's resolution of COL Item STD COL 12.2-4-A meets the requirements of 10 CFR Part 20 and is therefore acceptable.

Supplemental Information

- STD SUP 12.2-1

As described above, in the applicant's initial response to RAI 01-7, dated December 7, 2011 (ADAMS Accession No. ML11343A014), the applicant added Tables 12.2-208 and 12.2-209 to the Fermi FSAR. Table 12.2-209, "Non-Fuel Special Nuclear Material for Use," included a listing for the CF-252 reactor startup source and classified it as being 10 CFR Part 70 non-fuel special nuclear material. In a supplemental response to RAI 01-7, dated June 28, 2013 (ML13183A145), the applicant reclassified Cf-252 as 10 CFR Part 30 byproduct material and removed the listing of CF-252 from FSAR Table 12.2-209. The applicant then added STD SUP 12.2-1 at the end of Subsection 12.2.1.1.2. STD SUP 12.2-1 specifies the quantity of Cf-252 that will be in six CF-252 sealed sources required for reactor startup. This supplemental information relating to the material description of the Cf-252 reactor startup source satisfies the requirements of 10 CFR 30.32, "Application for specific licenses," and, therefore, the staff finds STD SUP 12.2-1 to be acceptable. Therefore, this RAI 01-7 is closed and resolved.

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. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information relating to plant 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 E, Section VI.B.1, all nuclear safety issues relating to the radiation sources that were incorporated by reference are 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 RGs. The staff's review concludes that the applicant has adequately addressed the COL item involving contained sources by providing a description of the contained sources that were not described

in the ESBWR DCD. The applicant stated that these sources would be used as calibration, check, or radiographic sources. The applicant also stated that the procedures used to govern the control and use of these contained sources considers the guidance in RG 8.8. The staff's review also concludes that the applicant has adequately addressed the COL items involving liquid and gaseous effluent releases and doses to 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. Finally, as discussed in the staff's evaluation above, the staff finds the information in STD SUP 12.2-1 acceptable.

12.3 Radiation Protection Design Features

12.3.1 Introduction

This FSAR section addresses the issues related to radiation protection equipment and design features used to ensure that occupational radiation exposures are ALARA. The discussion takes into account design dose rates, AOOs, and accident conditions. These issues include 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 7, incorporates by reference Section 12.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 12.3, the applicant provides the following:

Tier 2 Departure 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 was reconfigured to accommodate a minimum 10 years of volume from 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

This COL item addresses operational considerations for airborne radiation monitoring such as the procedures for the 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

This COL item addresses the operational and post-construction objectives of RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.” The applicant states that implemented programs and procedures are consistent with NEI 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” (ADAMS Accession No. ML093220530) and meet the objectives of RG 4.21 and the requirements of 10 CFR 20.1406, “Minimization of contamination.”

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 (process and drain piping) 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 the 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.

The staff followed the guidance in RG 1.206 to evaluate Fermi 3 FSAR Section 12.3 for compliance with NRC regulations.

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

In particular, the regulatory basis for the acceptance of the COL items and the supplemental information is in the applicable requirements of 10 CFR Part 20; Part 50; and Part 70; and in the following guidelines:

- 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, RG 8.2, and 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 COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to the “Radiation Protection Design Features.”

The staff also reviewed the applicant’s proposed departure, the proposed resolution to the COL items, and the supplemental information included under Section 12.3 of the Fermi 3 COL FSAR. In the review, 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 for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff’s findings on the standard content that were documented in the SER with open items issued for the North Anna Unit 3 application are 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 this comparison, the staff considered changes to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the North Anna standard content to be directly applicable to the Fermi 3 COL application. This SER identifies the standard content material with italicized, double-indented formatting.

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

Tier 2 Departure 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, the Fermi 3 RWB waste storage space is configured to accommodate at least 10 years of Class B and C waste generated during plant operation. In addition, a shielding analysis was performed for this design change showing that the resultant dose rates in surrounding areas—within the building and

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 in a COL application that references a design certification.

externally—are maintained below the allowable limits in accordance with the radiological area classification in DCD Tier 2, 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 adversely affect the integrity of the waste containers. Furthermore, periodic inspections will be performed to confirm container integrity during storage. However, there is 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 FSAR tables and figures with those in Section 12.3 of DCD Tier 2 Revision 7 revealed numerous changes in room layout and dimensions, with some FSAR rooms/walls showing elevations 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 the following from 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.

The applicant's response to RAI 12.03-12.04-7 dated October 19, 2010 (ADAMS Accession No. ML102940218), provided the requested information and the revised affected FSAR pages. In the responses to Items 1 and 2, the applicant provided additional information in Section 12.3 of the COL FSAR describing the effects from Departure EF3 DEP 11.4-1. This departure reconfigured the RWB to accommodate increased storage space capacity for Class B and C solid waste. The applicant identified the various ESBWR DCD tables and figures that were affected by this departure. The applicant added that the equipment size, content, and source terms remained unchanged. The thicknesses of RWB walls were revised to maintain the same radiation zones as those identified in the DCD. The radiation levels and the required shielding will therefore remain the same regardless of equipment locations, which were revised. The applicant provides FSAR Table 12.3-8R and Figures 12.3-19R through 12.3-22R show the revised wall thicknesses and the reconfigured equipment locations in 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 provided a qualitative evaluation of the revised wall thickness changes against those identified in the DCD. The applicant restated that equipment dimensions, source geometry, and source characteristics and quantities except for room number changes remain unchanged and are similar to those in ESBWR DCD, Tier 2, Table 12.2-22. The applicant provided FSAR Table 12.2-22R identifying the room number changes for select equipment in the RWB. Based on this evaluation, the applicant concluded 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 calculated DCD dose rates. The staff finds that the revised configuration enhances the arrangement of equipment locations. In this arrangement, the rooms with lower radiation zones are usually located between the corridor and the rooms with equipment containing higher radiation sources. Equipment cubicles with high radiation sources that are adjacent to a corridor have thicker concrete walls than the comparable cubicle walls in the DCD, in order to reduce the doses in the adjacent corridors. Except for Room 6251, the Departure EF3 DEP 11.4-1 would not impact the dose rates calculated in the DCD; and the dose rates in each corridor would be maintained below the allowable limits.

During the review of the equipment relocation depicted in RWB Figures 12.3-19R and 12.3-20R, the staff noted the relocation of equipment for the high activity phase separator from the ground floor, at elevation -9350 millimeter (mm) (-30.68 ft) (Room 6151 in Figure 12.3-19 of the ESBWR DCD) to the second floor, at elevation -2350 mm (-7.71 ft) (Room 6251 in Figure 12.2-20R of the Fermi FSAR). DCD Subsection 11.2.2.3.2 states, "Tank cubicles are lined with steel to preclude accidental releases to the environment." However, the applicant did not provide any information on design provisions for controlling radioactive contamination. Furthermore, a review of the wall thicknesses listed in Table 1 of the applicant's response to RAI 12.03-12.04-7 identified the wall thickness of 100 cm (3.28 ft) in the DCD in those areas where a wall separates high activity tanks (with radiation zone levels of H or I) from a corridor. 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 (3.28 ft) adjacent to the corridor (the southern wall of Room 6151). The drawing of the reconfigured layout in the FSAR shows that 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 are only 90 cm (2.95 ft) 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 that 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 added Supplemental Item EF3 SUP 12.3-1 to address design provision features for the RWB (see the "Supplemental Information" section below). In addition, the applicant revised FSAR 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 (ADAMS Accession No. ML110900094), provided additional explanations regarding the changes in FSAR Revision 3, Subsection 12.3.1.4.5. The applicant also emphasized that the revisions to the wall thickness of the east- and west-facing walls for Room 6251, from 90 cm (2.95 ft) to 100 cm (3.28 ft), are consistent with the wall thicknesses of the comparable cubicle walls in the DCD. These wall thickness revisions resolve the staff's concerns in Item 3 of RAI 12.03-12.04-9. Resolutions of RAI Items 1 and 2 are discussed in the "Supplemental Information" section below.

During the review of the revised RWB layout drawings in FSAR Figures 12.3-21R and 12.3-41R, the staff noted that the radiation zone and area radiation monitor assignments in Room 6381 (elevation 4650 mm [15.26ft]) were not consistent with the radiation zone and area radiation monitor assignments for the comparable location shown in DCD Figures 12.3-21 and 12.3-41. The applicant explained the reason for this change to the staff by stating that the assigned radiation zone and the area monitor in Room 6381 in the FSAR are for the two skid-mounted liquid processing subsystems, which have their own shielding blocks. Therefore, the radiation zone level will be low when they are operating and even lower when the systems are shut down. In the supplemental response to RAI 11.04-2 dated August 24, 2011 (ADAMS Accession No. ML11238A049), the applicant provided a revised FSAR Figure 12.3-21R with the following note:

The skid-mounted processing subsystems, located in Room 6381, are individually shielded to allow [personnel] access in the room; which is classified as Radiation Zone C.

The addition of this note to the FSAR figure resolves the staff's concerns regarding inconsistencies in radiation zones between the DCD and COL FSAR in this portion of the RWB. The staff, therefore, finds this supplemental response to RAI 11.04-2 acceptable.

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

COL Items

The following portion of this technical evaluation section is reproduced from Section 12.3.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *STD COL 12.3-2-A* *Operational Considerations*

The applicant provided additional information in STD COL 12.3-2-A to address the resolution of DCD COL Item 12.3-2-A, which states:

“Airborne radiation monitoring operational considerations, such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors, are the COL applicant’s responsibility.”

The staff reviewed STD COL 12.3-2-A in regards to airborne radiation monitoring operational considerations included in Section 12.3.4 of the North Anna COL FSAR. The COL applicant stated that the airborne radioactivity monitors are classified as non-safety related. Although airborne radioactivity monitors are classified as non-safety related, they are necessary to show compliance with 10 CFR 20.1501.

The COL applicant stated that operation considerations and portable monitor placement are discussed in COL Section 12.5. COL Section 12.5 references NEI 07–03, “Generic FSAR Template Guidance for Radiation Protection Program Description,” which the staff is currently reviewing. NEI 07–03 describes several monitoring instruments that will be maintained and used at the facility, including:

- 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 Standard RAI 12.03/04-1 is closed.

In addition, the review identified the following area as requiring an evaluation, which is 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 from using a ZIS to inject depleted zinc oxide (DZO) into 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 part of the plant. Therefore, NRC staff issued RAI 12.03-12.04-2 requesting the applicant to justify the decision not to utilize a ZIS in light of the requirement in 10 CFR 20.1101, "Radiation Protection Programs." This requirement states that the licensee shall use, to the extent practical, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses that are ALARA.

In the response to this RAI dated April 23, 2009 (ADAMS Accession No. ML091250352), the applicant provided the following rationale for not using zinc injections at Fermi 3. The applicant is using an alternate method to minimize the plate-out of radioactive cobalt on reactor components. The ESBWR standard plant restricts the cobalt content in reactor vessel stainless steel components and other selected stainless steel components that have large surface areas exposed to high flow rates toward the reactor vessel. This restriction minimizes and/or eliminates the use of components containing Stellite, which is a high cobalt alloy. Because this design reduces the potential for creating radioactive cobalt in the primary system, there is

potentially less cobalt in the reactor coolant to plate-out on reactor building piping. The staff finds that the use of this method to minimize the plate-out of radioactive cobalt is an acceptable alternative to zinc injections. In addition, the facility design incorporates design features that permit the addition of the ZIS at a later date, if increases in personnel exposures should occur at the facility from the plate-out of radioactive cobalt and warrant the change. Therefore, no revision to the FSAR is required. The staff finds the response acceptable, because the applicant retains the option of utilizing the ZIS if needed. Therefore, this 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 regard 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 and are consistent with the operational and post-construction objectives in RG 4.21, Regulatory Positions 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 finds that these objectives meet those of RG 4.21 and are therefore acceptable and meet the requirements of 10 CFR 20.1406.

In Subsection 12.3.1.5.1 of the ESBWR DCD, Tier 2, Revision 7, piping containing segments that will have to run underground includes (1) the CST and CST retention area drain; (2) the radwaste effluent discharge pipeline; (3) the cooling tower blowdown line; and (4) the hot machine shop drain. This section of the DCD also states that these lines will be kept as short and direct as possible, and they will be designed to preclude an inadvertent or unidentified leakage into the environment. In accordance with the guidance 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 they are accessible for visual inspections via a trench or tunnel.

Fermi 3 FSAR Subsection 12.3.1.5, Revision 2, provided supplemental information addressing STD COL 12.3-4-A. However, this response failed to include site-specific provisions that minimize the potential for unmonitored and uncontrolled releases into 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 list of the system and components at Fermi with segments of piping that will be run underground.
- b. A description of the features associated with the underground piping for each system and the components that minimize contamination, in accordance with the guidance 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 the exclusion area boundary. Also include a description of the monitoring program associated with this portion of the discharge piping ensuring that the potential for unmonitored, uncontrolled releases of radioactivity into the environment will be minimized.
- e. Incorporate by reference NEI Template 08–08A, which addresses the guidance 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 (ADAMS Accession No. ML102940218), the applicant provided the requested information and the revised affected FSAR pages. In response to Part a, the applicant cited ESBWR DCD, Revision 7, Subsection 12.3.1.5, which identifies systems with pipe segments buried underground that could potentially contain radioactive fluids. In addition, the applicant identified the site-specific systems with buried pipe segments that have no potential for containing radioactive fluids. The staff finds this information acceptable.

In response to Parts b and c of this RAI, the applicant stated that the Fermi 3 FSAR incorporates by reference Subsection 12.3.1.5 of the ESBWR DCD. This DCD subsection 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 added that there are no other buried pipe segments with the potential for containing radioactive fluid. Therefore, the provisions stated in DCD Subsection 12.3.1.5 will be followed. The applicant also added the following statement 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 finds that the applicant's response adequately addresses Parts b and c of RAI 12.03-12.04-6.

In response to Part d of this RAI, the applicant provided a brief description of the blowdown piping and its point of release into Lake Erie. The applicant stated that the blowdown line is a 122-cm (4-ft) diameter pipe that is buried until the point where it enters Lake Erie. The

blowdown line will continue for 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 described in ESBWR DCD, Revision 7, Subsection 12.3.1.5.1, which preclude an inadvertent or unidentified leakage into the environment.

In the supplemental responses to RAI 12.03-12.04-6 dated August 1, 2011 (ADAMS Accession No. ML1121A1021); and August 24, 2011 (ADAMS Accession No. ML11238A049), the applicant modified FSAR Subsection 11.2.3.2 by adding Supplemental Information EF3 SUP 11.2-2. This supplement 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; it is enclosed within a guard pipe that is monitored for leakage to comply with 10 CFR 20.1406. The LWMS discharge line connects to the blowdown 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 the blowdown line downstream of the LWMS connection will be consistent with NEI 08-08A, as described in Fermi 3 COL FSAR Subsection 12.3.1.5.2.

Based on the above information, the staff finds the applicant's response to Part d acceptable because the design of the LWMS discharge and blowdown piping and the associated monitoring program will ensure that the potential for unmonitored and uncontrolled releases of radioactivity into the environment will be minimized.

In response to Part e, the applicant's supplement to FSAR Subsection 12.3.1.5.2 states:

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 stated that the underground portion of the blowdown line will be monitored by an on-site ground water monitoring program that will be consistent with NEI 08-08A. The applicant added that Fermi 3 COL FSAR Subsection 2.4.12.4 describes the onsite ground water monitoring program. The applicant revised this subsection to include a reference to NEI 08-08A thus ensuring that the considerations in this NEI report are included in the ground water monitoring program. The applicant will establish this groundwater monitoring program to ensure the timely detection of any inadvertent radiological releases into the ground water, in accordance with the guidance of RG 4.21. The applicant added Commitment (COM 13.4-034) to Table 13.4-201 as Operational Program Item #22 to develop an operational program for the lifecycle minimization of contamination, in compliance with 10 CFR 20.1406 before fuel loading. This proposed Commitment (COM 13.4-034) will be a license condition (License Condition 12.3-1). License Condition 12.3-1 states:

Prior to initial fuel load, the licensee shall implement an operational program for lifecycle minimization of contamination.

The staff's review of the applicant's response and the proposed changes to the affected pages in COL FSAR Subsections 12.3.1.5.2 and 2.4.12.4 finds the applicant's information adequately addresses 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 into FSAR Subsection 12.3.1.5.2 and other affected sections, the staff finds this program milestone acceptable. The staff verified that FSAR Revision 3 includes the applicant’s proposed changes. Therefore, this RAI 12.03-12.04-6 is closed.

For operational program readiness in Section 3.6 of Part 10 of the COL application, the applicant proposed to add a general implementation plan for operational programs which are listed in Table 13.4-201. The applicant provided this general implementation plan as a new license condition in response to RAI 19.03-38 dated August 16, 2011 (ADAMS Accession No. ML11229A767). This implementation plan (License Condition 12.3-2) states:

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 verified that the proposed license conditions for the lifecycle minimization of contamination (License Condition 12.3-1) and for the operational programs implementation plan (License Condition 13.3-2) are in Revision 4 of the COL application. On the basis of the information described above, the staff finds the applicant adequately addresses COL Item STD COL12.3-4-A (compliance with 10 CFR 20.1406).

Supplemental Information

- EF3 SUP 12.3-1 Radwaste Building

In FSAR Subsection 12.3.1.4.5, “Radwaste Building,” the applicant adds the following design features to minimize occupational exposures:

- 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 (process and drain piping) 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 in response to the staff’s concerns discussed in RAIs 12.03-12.04-7 and 12.03-12.04-9. In the response to Item 1 of RAI 12.03-12.04-9 (ADAMS Accession No. ML110900094), the applicant added that the first provision provides an isolation capability (both local and remote) to prevent the spread of contamination. In response to Item 2 of RAI 12.03-12.04-9, the applicant noted that the second provision minimizes occupational exposures from radioactive fluid in the piping. With regard to conformance with RG 8.8, the applicant stated that FSAR Table 1.9-202 shows that Fermi 3 conforms to RG 8.8. This RG encompasses conformance with guidelines related to facility and equipment design, including pipe routing and shielding to minimize occupational exposures. Therefore, the staff finds the applicant’s response in Supplemental Information EF3 SUP 12.3-1 acceptable. As described above, the staff finds that the applicant has adequately responded to RAIs 12.03-12.04-7 and 12.03-12.04-9. The applicant amended the Fermi 3 COL FSAR to

incorporate these responses. The applicant also amended Section 12.3 of the Fermi 3 COL FSAR to provide a discussion of the changes associated with Departure EF3 DEP 11.4-1. In addition to discussing the source terms and shield wall thicknesses in the RWB, the applicant added a supplement to the Fermi 3 COL FSAR to address provisions for controlling radioactive contamination from leaks and shielding pipe chases in the RWB. Therefore, RAI 12.03-12.04-7 and RAI 12.03-12.04-9 are resolved and closed.

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 (12.3-1) - Prior to initial fuel load, the licensee shall implement an operational program for lifecycle minimization of contamination.
- License Condition (12.3-2) – 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 (for lifecycle minimization of contamination). 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 confirms 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 E, Section VI.B.1, all nuclear safety issues relating to the radiation protection design features that were incorporated by reference are 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 finds that the applicant has adequately addressed the COL items relating to (1) operational considerations for in-plant airborne radiation monitoring operational considerations (STD COL 12.3-2-A); and (2) the minimization of contamination to facilitate decommissioning by committing to implement the required programs and procedures consistent with the NEI 08–08A (STD COL 12.3-4-A). The RWB reconfiguration departure is reasonable and is in accordance with 10 CFR 52.63(b)(2). Therefore, the staff finds that the applicant adequately addresses the radiation protection design features.

12.4 Dose Assessment

12.4.1 Introduction

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

12.4.2 Summary of Application

Section 12.4 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 12.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. 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 information addresses the potential dose to construction workers from operations and emissions associated with the current operating nuclear power plant at the nearby site. Revision 3 of the Fermi 3 COL FSAR provides supplemental information on doses to construction workers from Section 4.5 of the Fermi 3 ER, in Part 3 of the COL application.

12.4.3 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 dose assessment, and the associated acceptance criteria, are in Section 12.3-12.4 of NUREG–0800.

The staff followed the guidance in RG 1.206 to evaluate Fermi 3 FSAR Section 12.4 for compliance with NRC regulations.

In particular, the regulatory basis for the acceptance of the supplemental information is in the applicable requirements of 10 CFR Part 20 and the guidance 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 COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to “Dose Assessment.”

In addition, the staff reviewed the supplemental information under Section 12.4 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 for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff’s findings on the standard content that were documented in the SER with open items for the North Anna Unit 3 application are 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 in a COL application that references a design certification.

ISFSI at the Fermi site, as of June 2012, normal operations at the ISFSI had not yet started (“Environmental Impact Statement for the Combined License (COL) for Enrico Fermi Unit 3,” NUREG–2105, Vol. 1).

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 then used to estimate the direct radiation dose to construction workers. There are three TLD stations (TLD T-47, T-48, and T-54) that are relevant to these estimated doses because of the proximity of the TLDs to the Fermi 3 construction site. The applicant considers TLD Station T-48 to be at the most representative location of the three TLD stations. The applicant uses the highest annual dose measurement recorded at this location for the period from 1999 through 2008, as the estimated direct radiation dose to a construction worker from the Fermi 2 operation.

In order for the staff to evaluate the basis for the applicant’s construction worker dose estimates, the staff issued RAI 12.03-12.04-3 requesting the applicant to amend Section 12.4 of the Fermi 3 COL FSAR to provide (1) the basis for the thyroid and whole body dose calculations; (2) the estimated maximum annual number of construction workers in the applicant’s construction worker dose calculations; (3) the effects of future Fermi 1 decommissioning activities on exposure doses to Fermi 3 construction workers; and (4) plans for radiological monitoring of the Fermi 3 construction site to verify construction worker dose calculations.

In the response to RAI 12.03-12.04-3 dated August 25, 2009 (ADAMS Accession No. ML092580311), the applicant provided the requested information. The applicant included the selected TLD stations and the associated dose rates at these stations, an estimate of the peak annual number of construction workers, the dose from Fermi 1 decommissioning activities, and the plans for the radiological monitoring of the Fermi 3 construction site.

In discussing the basis for the construction worker dose calculations (Item 1 of RAI 12.03-12.04-3), the applicant stated that based on a review of the site layout, there are three TLD stations (i.e., T-47, T-48, and T-54) located closest to the Fermi 3 construction site that could be used to determine direct dose measurements for construction workers. TLD Station T-54, which is located at the visitor center, is farthest from Fermi 2; and TLD Station T-48 is the nearest TLD station to Fermi 2. TLD Stations T-47 and T-48 are closest to the Fermi 3 site construction activities. TLD Station T-47 has the highest direct dose measurement, is just outside the Fermi 2 protected area, and is further from the future locations of Fermi 3 structures than TLD Station T-48 is. Therefore, the applicant considered TLD Station T-48 to be at the most representative location of the three TLDs and proposed to use the dose rate measurements from TLD Station T-48 to estimate direct exposures to Fermi 3 construction workers.

With respect to Item 2 of RAI 12.03-12.04-3, the applicant estimated that during peak periods of construction, there will be 2,900 workers onsite. This is the number the applicant uses to determine the maximum collective annual construction worker dose.

Regarding RAI Item 3 on the effects from future Fermi 1 decommissioning activities on Fermi 3 construction workers, the applicant stated that the exposures measured at all three TLD stations also include the dose contribution from Fermi 1. The ongoing decommissioning of Fermi 1 will continue to reduce the Fermi 1 dose contributions to these TLDs. The applicant added 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, “Radiological criteria for unrestricted use,” with a maximum annual total effective dose equivalent of 0.25 mSv (25 mrem) to an “average

member of the critical group.” For Fermi 1, an “average member of the critical group” would be best represented by the resident farmer scenario, where the dose received by this individual would include internal dose contributions from the ingestion of plant foods grown on the Fermi 1 site; consumption of meat and milk produced on the Fermi 1 site; drinking water from wells on the Fermi 1 site; and eating fish from a pond that is contaminated from the residual radioactivity on the Fermi 1 site. A Fermi 3 construction worker would not be exposed to these dose pathways and would therefore receive less than the estimated 0.25 mSv (25 mrem) per year. Nevertheless, the applicant considers this dose to be a conservative estimate of the dose to a construction worker during Fermi 3 construction activities on the Fermi 1 site.

With respect to RAI Item 4 on plans for radiological monitoring of the Fermi 3 construction site, the applicant stated that Detroit Edison will develop the necessary program required to monitor the dose to Fermi 3 construction workers and to verify construction worker dose calculations.

The staff evaluated the applicant’s response to RAI 12.03-12.04-3. The staff finds that the estimated maximum work force size of 2,900 workers is comparable in number to the work force size estimated by other applicants for the construction of a new unit. For this reason, the staff finds this response acceptable. The staff agrees with the applicant’s response that Fermi 3 construction workers will likely receive an annual direct dose from Fermi 1 that is less than 0.25 mSv/yr (25 mrem/yr). The staff finds this annual dose contribution conservative and therefore acceptable. The staff also finds the applicant’s plans for the radiological monitoring of Fermi 3 construction workers acceptable.

As discussed above, the applicant’s response to Item 1 of RAI 12.03-12.04-3 considers TLD Station T-48 to be the most representative TLD location for estimating the Fermi 2 direct radiation dose to construction workers. Although TLD Station T-48 is located closest to the Fermi 3 power block, TLD Station T-47 is located closer to Fermi 2 and therefore has a higher average dose reading compared with TLD Station T-48. It is the staff’s position that basing the construction worker dose estimates solely on the dose rates measured at TLD Station T-48 would not be conservative, because the process ignores the dose rates at locations near TLD Station T-47. Therefore, in RAI 12.03-12.04-5, the staff requested the applicant to justify why the applicant should not base the construction worker dose estimates on the average of the readings from the TLDs at both TLD Stations T-47 and T-48 for the year with the highest TLD dose. Although the applicant provided acceptable responses to most of the staff’s requests in RAI 12.03-12.04-3, the applicant only included a summary of this information in the Fermi 3 COL FSAR. Therefore, RAI 12.03-12.04-5 also requested the applicant to supplement Section 12.4 of the Fermi 3 COL FSAR by providing the bases, models, assumptions, and input data used to calculate doses to construction workers. In the response to RAI 12.03-12.04-5 dated May 21, 2010 (ADAMS Accession No. ML101450195), the applicant modified the basis for calculating the direct dose component to a construction worker by using the average maximum TLD measurements from TLD Stations T-47 and T-48. This modification increases the annual (2,080 worker hours) Fermi 2 direct dose component to construction workers from 0.32 mSv (32 mrem) to 0.563 mSv (56.3 mrem) (excluding background radiation). The staff finds that this change results in a more realistic estimate of doses to construction workers. This analysis is therefore acceptable.

Regarding the direct dose contribution to the construction worker from the ISFSI, the applicant states that the dose calculation uses a distance of about 250 m (820 ft) from the nearest construction area and assumes a uniform loading of all casks containing 15-year cooled spent fuel from Fermi 2. The annual estimated (2080 worker hours) direct dose to a construction worker from the Fermi 2 ISFSI is about 0.138 mSv (13.8 mrem). 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 [ADAMS Accession No. ML082880101]). On the basis of this comparison, the staff finds the applicant's dose estimate reasonable; and the applicant's ISFSI direct dose estimate is therefore acceptable.

The applicant states that the sum of the direct dose contributions from the operation of Fermi 2, the ISFSI, and the decommissioned Fermi 1 site is approximately 0.966 mSv (96.6 mrem) per year. Part of the applicant's response to RAI 12.03-12.04-5 describes some of the reasons why this construction worker dose estimate is conservative. As stated earlier, the 0.25 mSv (25 mrem) dose estimate from the decommissioned Fermi 1 site is based on the maximum annual dose to an "average member of the critical group" (as defined in 10 CFR 20.1402). Because the Fermi 3 construction worker would not be exposed to the dose pathways of the "average member of the critical group," these construction workers would be expected to receive less than this estimated dose from the decommissioned Fermi 1 site. The 0.138mSv (13.8 mrem) dose estimate from the Fermi 2 ISFSI assumes that all casks are located at a single point without taking credit for cask-to-cask shielding. Therefore, the applicant states that actual dose rates from the ISFSI could be lower than estimated. Fermi 2 currently uses hydrogen water chemistry (HWC) to control the production of corrosive products to mitigate stress corrosion cracking. The use of HWC increases N-16 production and N-16 in the main steam lines, turbines, and moisture separators is one of the primary contributors to the direct dose measured at the TLD stations around Fermi 2. The applicant plans on implementing a noble metal chemistry program at Fermi 2 to reduce direct dose. The use of noble metal chemistry has proven to be instrumental in significantly reducing plant radiation levels. On the basis of TLD measurements taken before the HWC program was fully implemented at Fermi 2, the applicant estimates that the Fermi 2 direct dose contribution to Fermi 3 construction workers could be significantly reduced. Based on the reasons described in the applicant's response to RAI 12.03-12.04-5, the staff agrees that actual measured doses to the Fermi 3 construction workers could be lower than the applicant's dose estimates.

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 from the operation of Fermi 2 on construction workers. The data from these reports are considered representative for the Fermi 3 site construction worker dose evaluations. The dose rates calculated at the Fermi 2 Visitor's Center are considered to be most representative of the gaseous effluent dose rates to which construction workers would be exposed. 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 from Fermi 2 gaseous releases (based on the maximum dose results from 1999 through 2008) would be 0.016 mSv/yr (1.6 mrem/yr) to the total body and 0.104 mSv/yr (10.4 mrem/yr) to the thyroid. This dose estimate is based on the gaseous releases in calendar year 2001.

The staff finds this annual dose rate reasonable given that 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 direct dose estimates to construction workers (in response to RAI 12.03-12.04-5, the applicant modified construction worker doses to be based on the readings from TLD Stations T-47 and T-48 instead of on Station T-48 alone), the applicant calculated a maximum annual and hourly dose to a Fermi 3 construction worker from direct radiation sources and gaseous effluents of 0.966 mSv (96.6 mrem) per year and 0.0013 mSv (0.13 mrem) per hour, respectively (ADAMS Accession No. ML101450195). The applicant also updated COL FSAR Subsection 12.4.7.1 by providing a summary of the annual construction worker dose and the information in Section 4.5 of the ER. FSAR Subsection 12.4.7.1 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 effluents). The applicant stated that the construction workers are considered to be members of the general public, so radiation monitoring of the Fermi 3 construction workers and compliance with the requirements of 10 CFR Part 20, Subpart D are controlled per the requirements of the Fermi 2 Radiological Effluent Monitoring Plan (REMP).

The staff reviewed and agreed with 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 effluents).

Based on the above evaluation, the staff finds the applicant's response to RAI 12.03-12.04-5 acceptable. The staff verified that FSAR Revision 3 includes the applicant's proposed revisions in the response to RAI 12.03-12.04-5. Therefore, RAI 12.03-12.04-5 and RAI 12.03-12.04-3 are closed.

On the basis of the above evaluation, the staff finds that the applicant's estimates of 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). Therefore, the applicant's estimates 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 confirms that the applicant has addressed the relevant information relating to dose assessment, 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 E, Section VI.B.1, all nuclear safety issues relating to dose assessments that were incorporated by reference are 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 also evaluated the applicant's supplemental information to address doses to construction workers using the acceptance criteria 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.

Table 13.4-201, which identifies the program milestones as Commitment (COM13.4-012) through Commitment (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.

The staff followed the guidance in RG 1.206 to evaluate Fermi 3 FSAR Section 12.5 for compliance with NRC regulations.

In particular, the regulatory basis for the acceptance of the COL items is established in the following requirements and guidance documents:

- Management and organization are established in RG 1.8, Revision 3, RG 8.2, Revision 1, RG 8.8, Revision 3, and RG 8.10, Revision 1-R; as required by 10 CFR 20.1101 and 10 CFR 20.2102, “Records of radiation protection program.”
- Adequate facilities are established in RG 1.97, Revision 4, RG 8.8, Revision 3, RG 8.9, Revision 1, RG 8.15, Revision 1, RG 8.20, Revision 1, “Applications of Bioassay for I-125 and I-131,” and RG 8.28; as required by 10 CFR 20.1801, “Security of stored material”; 10 CFR 20.1802, “Control of material not in storage”; and 10 CFR 20.1906, “Procedures for receiving and opening packages.”
- Instrumentation and equipment are established in 10 CFR 20.1501, “General”; 10 CFR 20.1502, “Conditions requiring individual monitoring of external and internal occupational dose”; 10 CFR 50.34(f)(2)(xxvii); and the criteria in Item III.D.3.3 of NUREG–0737.
- Training and procedures are established in RG 1.8, Revision 3, RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operation),” RG 8.2, Revision 1, RG 8.7 Revision 2, RG 8.8, Revision 3, and RG 8.10, Revision 1-R; as required by 10 CFR 19.11, “Posting of notices to workers”; 10 CFR 19.12, “Instruction to workers”; 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 the acceptance of Operational Program #10, which addresses 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 COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of

information relating to this review topic.¹ The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the "Operational Radiation Protection Program."

In addition, the staff reviewed the applicant's proposed resolution to the COL items and the description of the Operational Radiation Protection Program 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 for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER with open items for the North Anna Unit 3 application are 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 this comparison, the staff considered changes to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the North Anna SER) evaluation.
- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the North Anna standard content to be directly applicable to the Fermi 3 COL application. This SER identifies the standard content material with italicized, double-indented formatting.

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

COL Items

The following portion of this technical evaluation section is reproduced from Section 12.5.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *STD COL 12.5-1-A* *Equipment, Instrumentation, and Facilities*
The applicant provided additional information in STD COL 12.5-1-A to address the resolution of DCD COL Item 12.5-1-A, which states:
"The COL applicant will provide a description of plant health physics equipment, instrumentation, and facilities."
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 thoroughly

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 in a COL application that references a design certification.

describes radiation protection facilities and monitoring instrumentation and equipment.

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

The 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 has adopted the final revision of this template (i.e., NEI 07–03A) in Fermi 3 COL FSAR Appendix 12BB. Therefore, the staff finds that the applicant adequately addresses COL Item STD COL 12.5-1-A (radiation protection equipment, instrumentation, and facilities). Confirmatory Item 12.01-1 is closed.

The following portion of this technical evaluation section is reproduced from Section 12.5.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091740254):

- *STD COL 12.5-2-A* *Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR 50 and NUREG0737 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

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 controls to the very high radiation areas (VHRAs) as part of the response to resolve COL Item STD COL 12.5-3-A. 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 (ADAMS Accession No. ML091490684).

Subsection 12.5.4.4 of NEI 07-03A specifies that the COL applicant should provide (1) a list 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 the 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 Tier 2, Section 12.3 for isometric drawings of the VHRA and listed various means of access controls. However, there are no isometric drawings of the VHRA in DCD Tier 2, Section 12.3. Therefore, NRC staff informed the applicant of this shortcoming and inconsistency with the standard response in the North Anna Unit 3 review, and requested the applicant to revise FSAR Appendix 12BB and provide the additional information specified in Subsection 12.5.4.4 of NEI 07-03A. The applicant proposed to revise Appendix 12BB in FSAR Revision 3, which in turn adopts NEI 07-03A to address the needs of this COL item and to include the requested information. The staff verified that FSAR Revision 3 includes additional text regarding the bracketed items 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 finds that the applicant adequately addresses COL Item STD COL 12.5-3-A (description of the Radiation Protection Program that includes a description of access control to "Very High Radiation Areas"). Confirmatory Item 12.03/04-11 is closed.

Operational Program

- Operational Program Item #10 Radiation Protection Program

In FSAR Table 13.4-201, 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].
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 (ADAMS Accession No. 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 into FSAR Appendix 12BB, the staff finds these program milestones acceptable. For operational program readiness in Section 3.6 of Part 10 of the COL application, the applicant (in response to RAI 19.03-38 dated August 16, 2011 [ADAMS Accession No. ML11229A767]), added a general implementation plan for operational programs, which are listed 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 finds 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 the Radiation Protection Program milestones). Therefore, the staff finds that the applicant adequately addresses 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 (12.5-1) – The licensee shall implement the Radiation Protection Program (RPP), (including the ALARA principle) or applicable portions thereof, on or before the associated milestones identified below:
 - a. Receipt of Materials – Prior to initial receipt of byproduct, source, or special nuclear materials onsite (excluding exempt quantities as described in 10 CFR 30.18, "Exempt quantities.")

- b. Fuel Receipt – Prior to initial receipt and storage of fuel onsite
 - c. Fuel Loading – Prior to initial fuel load
 - d. Waste Shipment – Prior to first radioactive waste shipment
- License Condition (12.5-2) – 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 (Radiation Protection 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 confirms that the applicant has addressed the relevant information relating to the Operational Radiation Protection Program, 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 E, Section VI.B.1, all nuclear safety issues relating to the Operational Radiation Protection Program that were incorporated by reference are 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 concludes that the applicant has adequately addressed the COL items relating to the Operational Radiation Protection Program; radiation protection equipment, instrumentation, and facilities; and portable instruments to measure radio-iodine concentrations under accident conditions. The applicant also listed Operational Program Item #10, which pertains 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 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, and 10 CFR Part 20; and the applicable sections of 10 CFR Parts 50, 52, and 71. On the basis of the staff's review of the applicant's Operational Radiation Protection Program described above, the staff finds the applicant's Operational Radiation Protection Program and the associated milestones to be acceptable.

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

Appendices 12A and 12B of the Fermi 3 COL FSAR, Revision 7, incorporate by reference Appendix 12A, "Calculation of Airborne Radionuclides;" and Appendix 12B, "Calculation of Airborne Releases;" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. NRC staff reviewed the application and checked the referenced DCD to ensure that no issues relating to these appendices remain for review.¹ The NRC staff's review confirms that there are no outstanding issues related to these

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 in a COL application that references a design certification.

appendices. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to Appendices 12A and 12B are resolved.