

19.0 PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENTS

This chapter describes the Fermi Unit 3 plant-specific probabilistic risk assessment (PRA) and severe accident evaluations and corresponding regulatory requirements. In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 52.79(a)(46), a combined license (COL) application is required to contain a description of the plant-specific PRA and its results. In addition, 10 CFR 52.79(d)(1) specifies that if the COL application references a design certification (DC), then plant-specific PRA information must use the PRA information for the DC and be updated to account for site-specific design information and any design changes or departures. The PRA provides an evaluation of the risk of core damage and release of radioactive material associated with both internal and external events that can occur during plant operation at power or while shut down.

Attachment 19.A “Loss of Large Areas of the Plant due to Explosions or Fire” (public) to this section of the safety evaluation, evaluates the measures identified by the applicant that are needed to comply with requirements to address loss of large areas of the plant due to explosions or fires from a beyond-design-basis event. The U.S. Nuclear Regulatory Commission (NRC) regulations in 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) describe these requirements. It should be noted that Attachment 19.B “Loss of Large Areas of the Plant due to Explosions or Fire” (non-public), as well as some documents referenced in Attachment 19.A include security-related or safeguards information. Therefore, Attachment 19.B, and the references that include security-related or safeguards information are withheld from the public in accordance with 10 CFR 2.390, “Public Inspections, Exemptions, Requests for Withholding.”

19.1 Introduction

This section describes the objectives of the design-specific PRA and severe accident evaluations, and the corresponding regulatory requirements. Section 19.1, “Introduction” of the Fermi Unit 3 COL final safety analysis report (FSAR), Revision 3, incorporates by reference, with no departures or supplements, Section 19.1 “Introduction” of the Economic Simplified Boiling-Water Reactor (ESBWR) design control document (DCD), Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Section 19.1 of the certified ESBWR DCD. The staff reviewed Section 19.1 “Introduction” of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the “Introduction” section, that were incorporated by reference have been resolved.

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.

19.2 PRA Results and Insights

19.2.1 Introduction

This section of the safety evaluation report (SER) addresses the results and insights from the Fermi Unit 3 plant-specific PRA, which are documented in Section 19.2 “PRA Results and Insight” of the Fermi Unit 3 COL FSAR, Revision 3.

19.2.2 Summary of Application

Section 19.2 “PRA Results and Insights” of the COL FSAR incorporates by reference Section 19.2 of the ESBWR DCD, Revision 9.

In addition, in FSAR Section 19.2.3.2.4 “Evaluation of External Event Seismic,” the applicant provides the following:

COL Item

STD COL 19.2.6-1-A Seismic High Confidence Low Probability of Failure Margins

In FSAR Section 19.2.3.2.4, the applicant provides information to address DCD COL Item 19.2.6-1-A, “Seismic High Confidence Low Probability of Failure Margins.” The applicant stated that an analysis of as-built structure, system, and component (SSC) high confidence in low probability of failure (HCLPF) will be performed before fuel load and will be compared to those values assumed in the ESBWR seismic margin analysis to determine if any new vulnerabilities have been introduced.

19.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966, the Final Safety Evaluation Report (FSER) related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for PRA results, and the associated acceptance criteria, are in Chapter 19 of NUREG-0800.

Also, the NRC staff followed the guidance in Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear power Plants (LWR Edition),” June 2007, in evaluating Femi 3 FSAR, Section 19.2 for compliance with NRC regulations.

19.2.4 Technical Evaluation

As documented in NUREG-1966, the NRC staff reviewed and approved Section 19.2 of the certified ESBWR DCD. The staff reviewed Section 19.2 of the Fermi 3 COL FSAR, Revision 3, and checked the referenced ESBWR DCD to ensure that the combination of the information in the DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that information in the application 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.

information incorporated by reference addresses the required information related to PRA results and insights.

The staff reviewed the following information in the COL FSAR:

STD COL 19.2.6-1-A Seismic High Confidence Low Probability of Failure Margins

The applicant provided the following information to address DCD COL Information Item 19.2.6-1-A:

As-built SSC HCLPFs will be compared to those assumed in the ESBWR seismic margin analysis shown in DCD Table 19.2-4. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation will be analyzed to determine if any new vulnerabilities have been introduced. This comparison and analysis will be completed prior to fuel load.[COM19.2-001]

ESBWR DCD Tier 2, Section 19.2.6, Revision 9, describes this COL Information item. In the response to request for additional information (RAI)19.2-92 (ADAMS Accession No. ML081270301) for Chapter 19 of the ESBWR DCD, Tier 2, General Electric-Hitachi revised DCD Table 19.2-4 to clarify that the safe-shutdown earthquake for HCLPF values is the ESBWR certified seismic design response spectrum (CSDRS). Therefore, the COL applicant will confirm the HCLPFs for SSCs in DCD Table 19.2-4 with respect to the ESBWR CSDRS. This comparison and the analysis will be completed prior to fuel load. Therefore, the NRC staff finds that the reference to the applicable section of the ESBWR DCD and the guidance provided in NUREG-0800 and RG 1.206 are met, and therefore is acceptable.

19.2.5 Post-Combined License Activities

The applicant identified the following commitment to track COL Information Item 19.2.6-1-A:

As-built SSC HCLPF values will be compared to those assumed in the ESBWR seismic margin analysis. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation will be analyzed to determine if any new vulnerabilities have been introduced. This comparison and analysis will be completed before fuel load. [COM19.2-001]

19.2.6 Conclusion

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

In addition, the staff compared the additional information in the application to the relevant NRC regulations, the guidance in Chapter 19 of NUREG-0800, and other NRC RGs. The staff's review concluded that the applicant has presented adequate information in Fermi Unit 3 COL FSAR, and is therefore, acceptable.

19.3 Severe Accident Evaluations

Section 19.3, “Severe Accident Evaluations” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Section 19.3, “Severe Accident Evaluations” of the ESBWR DCD, Revision 9. As documented in NUREG-1966, the NRC staff reviewed and approved Section 19.3 of the certified ESBWR DCD. The staff reviewed Section 19.3 “Severe Accident Evaluations” of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Severe Accident Evaluations, that were incorporated by reference have been resolved.

19.4 PRA Maintenance

Section 19.4, “PRA Maintenance” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Section 19.4, “PRA Maintenance” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Section 19.4 of the certified ESBWR DCD. The staff reviewed Sections 19.4 “PRA Maintenance” of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to PRA Maintenance that were incorporated by reference have been resolved.

19.5 Conclusions

19.5.1 Introduction

The PRA and severe accident evaluations contained in chapter 19 demonstrate that the ESBWR is designed with state-of-the-art safety features that have high reliability and availability with significant redundancy and diversity.

19.5.2 Summary of Application

Section 19.5 “Conclusions” of the COL FSAR incorporates by reference Section 19.5 of the ESBWR DCD Tier 2, Revision 9.

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.

In addition, in FSAR Section 19.5, the applicant provides the following information:

Supplemental Information

- EF3 SUP 19.5-1

In FSAR Section 19.5, the applicant stated that it reviewed site and plant-specific information to determine if any changes from the certified design PRA were warranted.

19.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966, the FSER related to the certified ESBWR DCD. In addition, the regulatory basis for requiring the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(a)(46) and in 10 CFR 52.79(d)(1), which requires (1) a COL applicant referencing a certified design to include, in the FSAR, information sufficient to demonstrate that the site characteristics fall within the site parameters specified in the design certification, and (2) that plant-specific PRA information in a COL application that references a standard design certification must use the PRA information from the design certification and must be updated to account for site-specific design information and any design changes or departures. Consistent with 10 CFR 50.71(h), each COL applicant shall maintain and upgrade the PRA. The upgraded PRA must cover initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect one year before each required upgrade.

19.5.4 Technical Evaluation

As documented in NUREG-1966, the NRC staff reviewed and approved Section 19.5 of the certified ESBWR DCD. The NRC staff reviewed Section 19.5 “Conclusions” of the Fermi Unit 3 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represents the complete scope of information relating to this review topic.¹ The NRC staff’s review confirmed that the information contained in the application and incorporated by reference addresses the required information related to PRA.

In addition, the NRC staff reviewed Part 4 of the Fermi Unit 3 COL FSAR, which includes the technical specifications (TSs). The NRC staff determined from this review that the ESBWR generic TSs and the bases of the referenced certified design are incorporated by reference into the Fermi Unit 3 plant-specific TSs with only minor modifications that would not impact the plant-specific PRA. The staff reviewed the following information in the COL FSAR:

Supplemental Information

- EF3 SUP 19.5-1

In Section 19.5 of the FSAR, the applicant stated the following in support of the assertion that it has met the requirement in 10 CFR 52.79(a)(46) for a description of the plant-specific PRA and its results: “The review of site-specific information and plant-specific design information

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.

determined that: (1) the PRA bounds site-specific and plant-specific design parameters and design features and (2) these parameters and features have no significant impact on the DCD PRA results and insights.” In order to confirm the validity of the applicant’s assertion, the staff issued **RAI 19-1** (ML090140336) requesting the applicant to provide additional information about the site-specific and plant-specific design parameters and design features and explain how the site-specific and plant-specific design parameters and design features were bounded by the DCD PRA. The applicant provided the response to these questions in letters dated February 16, 2009 (ADAMS Accession No. ML090610219), and December 21, 2009 (ADAMS Accession No. ML093570130). In its response to the staff, the applicant described the key site-specific parameters and features considered in its evaluation and provided a summary of the evaluation for each specific parameter or feature. The applicant incorporated their response into Appendix 19AA “Summary of Plant-Specific PRA Review” of the FSAR. Therefore, **RAI 19-1** is resolved. The staff’s technical evaluation section of Appendix 19AA of this report discusses supplemental information provided in EF3 SUP 19.5-1 and EF3 SUP 19.5-2.

19.5.4 Post-Combined License Activities

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

19.5.5 Conclusion

The NRC staff’s findings related to information incorporated by reference are in NUREG–1966. The NRC staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant addressed the required information and that there is no outstanding information expected to be addressed in the COL FSAR related to this section. As discussed in Appendix 19AA of this report, applicant’s response to RAI 19-1 addresses the staff’s concerns adequately. Based on above, staff concluded that the applicant information to address supplemental information item EF3 SUP 19.5-1 as provided in COL FSAR meets the relevant guidelines in Standard Review Plan (SRP) Chapter 19 of NUREG-0800, and other NRC RGs, and is therefore, acceptable. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the “Conclusions” that were incorporated by reference have been resolved.

Appendix 19A Regulatory Treatment of Non-Safety Systems (RTNSS)

Appendix 19A, “Regulatory Treatment of Non-Safety Systems” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, 19A, “Regulatory Treatment of Non-Safety Systems” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Appendix 19A of the certified ESBWR DCD. The staff reviewed Appendix 19A of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review

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.

confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Regulatory Treatment of Non-Safety Systems, that were incorporated by reference have been resolved.

Appendix 19ACM Availability Controls Manual

Appendix 19ACM, “Availability Controls Manual” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Appendix 19ACM, “Availability Controls Manual” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Appendix 19ACM of the certified ESBWR DCD. The staff reviewed Appendix 19ACM of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Availability Controls Manual, that were incorporated by reference have been resolved.

Appendix 19B Deterministic Analysis for Containment Pressure Capability

Appendix 19B, “Deterministic Analysis for Containment Pressure Capability” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Appendix 19B, “Deterministic Analysis for Containment Pressure Capability” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Appendix 19B of the certified ESBWR DCD. The staff reviewed Appendix 19B of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Deterministic Analysis for Containment Pressure Capability were incorporated by reference have been resolved.

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.

Appendix 19C Probabilistic Analysis for Containment Pressure Fragility

Appendix 19C, “Probabilistic Analysis for Containment Pressure Fragility” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Appendix 19B, “Probabilistic Analysis for Containment Pressure Fragility” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Appendix 19C of the certified ESBWR DCD. The staff reviewed Appendix 19C of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Deterministic Analysis for Containment Pressure Capability were incorporated by reference have been resolved.

Appendix 19D Assessment of Malevolent Aircraft Impact

Appendix 19D, “Assessment of Malevolent Aircraft Impact” of the Fermi Unit 3 COL FSAR, Revision 3, incorporates by reference, with no departures or supplements, Appendix 19D, “Assessment of Malevolent Aircraft Impact” of the ESBWR DCD, Revision 9.

As documented in NUREG-1966 “Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” the NRC staff reviewed and approved Appendix 19D of the certified ESBWR DCD. The staff reviewed Appendix 19D of the Fermi 3 COL FSAR, Revision 3, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues related to Assessment of Malevolent Aircraft Impact were incorporated by reference have been resolved.

Appendix 19AA Summary of Plant-Specific PRA Review

19AA.1 Introduction

In accordance with 10 CFR 52.79(a)(46), Appendix 19AA “Summary of the Plant-Specific PRA Review” of the COL FSAR provides a summary of plant-specific PRA and its results.

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.

19 AA.2 Summary of Application

Appendix 19AA “Summary of the Plant-Specific PRA Review” of the COL FSAR provides a summary of plant-specific PRA and its results.

In addition, in FSAR Appendix 19AA, the applicant provides the following information:

- EF3 SUP 19.5-2

In FSAR Appendix 19AA “Summary of Plant-Specific PRA Review”, the applicant summarized the results of its evaluation of site-specific and plant-specific information with respect to pertinent assumptions made in the certified design PRA. In addition, the applicant provides a summary of the supplemental information EF3 SUP 19.5-1 in Appendix 19AA.

In section 19AA.2 of the application, the applicant discussed the following Fermi site-specific PRA attributes that were compared to ESBWR PRA.

The parameters and features discussed by the applicant included the following:

- loss of preferred power (LOPP) frequency
- loss of service water frequency
- site-specific terrain and meteorological data
- seismic fragilities
- plant-specific flooding zones of the yard and service water building

19AA.3 Regulatory Basis

The regulatory basis of information incorporated by reference is in NUREG-1966, the FSER related to the certified ESBWR DCD. In addition, the regulatory basis for requiring the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(a)(46) and in 10 CFR 52.79(d)(1), which requires (1) a COL applicant referencing a certified design to include, in the FSAR, information sufficient to demonstrate that the site characteristics fall within the site parameters specified in the DC, and (2) that plant-specific PRA information in a COL application that references a standard DC must use the PRA information from the DC and must be updated to account for site-specific design information and any design changes or departures. Consistent with 10 CFR 50.71(h), each COL applicant shall maintain and upgrade the PRA. The upgraded PRA must cover initiating events and modes of operation contained in NRC endorsed consensus standards on PRA in effect one year before each required upgrade.

19AA.4 Technical Evaluation

As documented in NUREG-1966, the NRC staff reviewed and approved Chapter 19 of the certified ESBWR DCD. The NRC staff reviewed Appendix 19AA “Summary of Plant-Specific PRA Review” of the Fermi Unit 3 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represents the complete scope of information relating to this review topic.¹ The staff’s review confirmed that information in the

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.

application and the information incorporated by reference address the required information related to this section.

The staff reviewed the following information in the COL FSAR:

Supplemental Information

- EF3 SUP 19.5-1 and EF3 SUP 19.5-2

The staff evaluated the following parameters and features:

- loss of preferred power (LOPP) frequency
- loss of service water frequency
- site-specific terrain and meteorological data
- seismic fragilities
- plant-specific flooding zones of the yard and service water building

Each of these parameters and features are evaluated below.

Loss of Preferred Power Frequency

In its response to RAI 19-1(ADAMS Accession No. ML090140336), the applicant stated that it had compared LOPP frequencies for Fermi Unit 2 with the values assumed in the certified design PRA and found the Fermi Unit 2 values to be slightly lower. The staff finds this to be an adequate basis for concluding that ESBWR assumptions bound the expected plant-specific performance for the following reason: Fermi Unit 2 and Fermi Unit 3 are located on the same site and, therefore, can be expected to have quite similar frequencies for LOPP caused by weather conditions.

Loss of Service Water Frequency

The applicant stated that the ESBWR loss of service water frequency is based on NUREG/CR-5750, "Rates of Initiating Events at U.S. Nuclear Power Plants –1995." To justify the assertion that this approach is bounding, the applicant provided a detailed description of the features included in the Fermi Unit 3 service water system (SWS) design to improve reliability over that of designs used in operating boiling-water reactors. The applicant also identified features that reduce reliance of the system on raw water in Lake Erie. Some of these features include the following:

- (1) use of redundant components, automatic valves, and piping cross connects so that neither a single active nor single passive failure results in a complete loss of plant component cooling and/or plant dependence on any safety-related system
- (2) capability for remote operation from the control room
- (3) use of treated water from a closed-cycle system so that the system is not susceptible to failure mechanisms associated with the use of raw water
- (4) use of diverse and redundant heat sinks (the natural draft cooling tower is normal heat sink and the mechanical draft cooling tower is backup heat sink)

- (5) self-cleaning strainers in the pumps that operate automatically

Based on the information provided, the staff finds that there is a reasonable basis to expect that the Fermi Unit 3 SWS will be at least as reliable as the one modeled in the certified design PRA, and, therefore, the loss of service water frequency assumed in the ESBWR will bound the Fermi Unit 3 plant-specific value.

Site-Specific Terrain and Meteorological Data

Based on its review of information in the PRA report referenced in the ESBWR DCD, Tier 2, Revision 9, the staff found that the assumptions for tornado and hurricane frequencies in the certified design PRA are bounding with respect to the Fermi Unit 3 site. The tornado frequencies assumed in the certified design PRA were generated using data from the central region of the United States, where the tornado intensities and frequencies of occurrence are highest. These appropriately bound Fermi Unit 3, because the site is located in Michigan on the shore of Lake Erie. The hurricane frequencies were developed using data from a set of plants operating on the Atlantic coast in the southeastern United States. The frequencies assumed in the certified PRA were 5 times larger than the value derived from the coastal data. Because Fermi Unit 3 is not located along the Atlantic coast, the Fermi Unit 3 hurricane frequencies are well below those assumed in the certified design PRA.

Seismic Fragilities

The applicant provided an update of the ESBWR PRA-based seismic margin assessment and determined that the site- and plant-specific design parameters are bounded by the certified design PRA. As provided in Chapter 2, the applicant demonstrated that the site ground motion response spectra and foundation input response spectra are fully enveloped by the ESBWR CSDRS and established that the site geotechnical profiles are characterized as the hard rock site and that the site characteristics are bounded by the ESBWR site parameters. The applicant identified that it is the responsibility of the COL applicant to confirm the as-built SSC HCLPF capacities provided in DCD COL Item 19.2.6-1-A. The staff determined that the seismic margin assessment update provided by the applicant is consistent with the guidance in DC/COL-ISG-020, "Implementation of a Probabilistic Risk Assessment-Based Seismic Margin Analysis for New Reactors," and is therefore acceptable.

Internal Flooding

Internal Flooding Associated with Yard Area

In Appendix AA to Chapter 19 of the FSAR, the applicant discussed the extent to which the ESBWR PRA bounds the effects of site-specific internal and external flooding. The applicant noted that the yard flood zone includes essentially all outside areas of the site. It also noted that plant grade level is above the design flood level. The only components located in the yard that support a safety function are the manual fire hose connections to the reactor building and fuel building. These connections are also above design flood level. These connections provide the capability to connect another source of water to the isolation condenser/passive containment cooling system pools and the spent fuel pool after seven days following a postulated accident. The certified design PRA did not credit use of these connections; therefore, consideration of site-specific external flooding would have no impact on the PRA results and conclusions. The staff reviewed the plant-specific flooding zones of the yard described in the FSAR and the treatment of manual fire hose connections in the certified design PRA. Based on its review, the

staff considers the certified design PRA results incorporated by reference to be bounding because the PRA has not credited the components that could be affected by external flooding.

Internal Flooding Associated with Service Water Structure

The applicant also discussed the extent to which the site-specific SWS could affect the results of the internal flooding risk assessment incorporated into the FSAR by reference. The Fermi Unit 3 service water structure houses the four service water pumps and their associated power supplies and controls. The applicant noted that the certified design PRA model conservatively considers the service water structure to be one flood zone. Therefore, all four pumps are assumed to fail in an internal flood. In addition, the certified design PRA model does not credit operator actions to mitigate a flooding event, so differences in building location are not significant. Based on the information presented by the applicant, the staff considers treatment of the SWS in the certified design PRA to be bounding for Fermi Unit 3 because the service water structure is treated as one flood zone. Under this assumption, a flood in that zone would result in complete failure of the SWS.

The staff finds the information in the evaluation summarized in Appendix 19AA to Chapter 19 of the FSAR sufficient to support the conclusion that differences between site-specific parameters and features and assumptions in the DCD are small and do not invalidate the applicant's reference of the certified design PRA results and insights provided in Chapter 19 of the ESBWR DCD. Based on above, the staff's review concluded that the applicant information to address supplemental information Items EF3 SUP 19.5-1, and EF3 SUP 19.5-2 as provided in Section 19.5 and Appendix 19AA of the Fermi COL FSAR meets the relevant guidelines in Chapter 19 of NUREG-0800, and other NRC RGs, and found it acceptable. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the PRA Results and Insights have been resolved.

19AA.5 Post-Combined License Activities

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

19AA.6 Conclusion

The NRC staff's findings related to information incorporated by reference are in NUREG-1966. The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the PRA and that there is no outstanding information expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the summary of plant-specific PRA review that were incorporated by reference have been resolved.

The staff also compared the supplemental COL information within the application to the relevant NRC regulations. The regulatory basis for acceptance of the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(d)(1). The staff finds the applicant's consideration of site-specific and plant-specific information and design features sufficient to support the conclusion that differences between the site-specific parameters and features and the assumptions in the DCD are small and do not invalidate the applicant's reference to the DCD PRA results and insights provided in Chapter 19 of the ESBWR DCD.

In addition, the staff's review concluded that the applicant information to address supplemental information Items EF3 SUP 19.5-1, and EF3 SUP 19.5-2 as provided in Appendix 19AA of the Fermi COL FSAR meets the relevant guidelines in Chapter 19 of NUREG-0800, and other NRC RGs, and found it acceptable.

ATTACHMENT 19.A

LOSS OF LARGE AREAS OF THE PLANT DUE TO EXPLOSIONS OR FIRES

19.A.1 Introduction

In a letter to the U.S. Nuclear Regulatory Commission (NRC), dated July 12, 2011 (ADAMS Accession No. ML11196A011),(non-public), Detroit Edison Company submitted Revision 3 of the Loss of Large Areas of the Plant due to Explosions or Fires “Mitigative Strategies Description and Plans” report for Fermi Unit 3.

In the submittal, the applicant described how it will meet the requirements to address loss of large areas (LOLAs) of the plant due to explosions or fires from a beyond-design-basis event (BDBE). Title 10 of the *Code of Federal Regulations* (10 CFR) 52.80(d) and 10 CFR 50.54(hh)(2) detail these requirements. The attachment to this safety evaluation section, Attachment 19.B “Loss of Large Areas of the Plant due to Explosions or Fire” (non-public), as well as some documents referenced in this safety evaluation section, include security-related or safeguards information and are not publicly available.

The provisions of 10 CFR 52.80(d) require an applicant for a combined license (COL) to submit a description and plans for implementation of the guidance and strategies intended to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities under the circumstances associated with LOLAs of the plant due to explosions or fire as required by 10 CFR 50.54(hh)(2).

The provisions of 10 CFR 50.54(hh)(2) require licensees to develop and implement guidance and strategies for addressing LOLAs of the plant due to explosions or fires from a BDBE. Specifically, the guidance and strategies are intended to maintain or restore core cooling, containment, and SFP cooling capabilities and include the following:

- firefighting
- operations to mitigate fuel damage
- actions to minimize radiological release

19.A.2 Summary of Application

In a letter dated July 12, 2011 (ADAMS Accession No. ML11196A011) (not publically available), the applicant for the Fermi Unit 3 COL application submitted its “Mitigative Strategies Description and Plans.” The applicant will incorporate this report, including any applicable changes identified in response to NRC requests for additional information (RAIs), into a future revision of the Fermi Unit 3 COL application. The applicant stated that it would implement the LOLA mitigative strategies, including implementation of operational and programmatic aspects of responding to LOLA events, before initial fuel load.

19.A.3 Regulatory Basis

NRC regulations in 10 CFR Part 50 and 52 provide the regulatory basis for the NRC staff review of the information in the Fermi 3 COL application. For example, the applicable regulatory requirements for LOLAs of the plant due to explosions or fires are as follows:

- 10 CFR 50.54(hh)(2)
- 10 CFR 52.80(d)

The applicable regulatory guidance includes Interim Staff Guidance (ISG) DC/COL-ISG-016, "Interim Staff Guidance Compliance with 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) Loss of Large Areas of the Plant Due to Explosions or Fires from a Beyond-Design Basis Event" dated April 20, 2010 (ADAMS Accession No. ML101030529) (not publically available), which provides an acceptable means of meeting the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d). DC/COL-ISG-016 references the February 25, 2005, guidance letter (not publically available) to operating reactor licensees for Phase 1 and the Nuclear Energy Institute (NEI) document NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guideline," dated September 2009, Revision 3 (ADAMS Accession No. ML092890400) (not publically available), for Phases 2 and 3. DC/COL-ISG-016 takes exception to a few areas of NEI 06-12 and provides additional clarification and enhancement of NEI 06-12 and the staff's guidance letter dated February 25, 2005, based on NRC inspections of operating reactor implementation. DC/COL-ISG-016 has two attachments: Attachment 1, "Supplementary Guidance for Implementing Mitigation Strategies"; and Attachment 2, "Experience Gained from Implementation of Temporary Instruction 2515/171 at Currently Licensed Power Reactor Sites and Related Staff Positions."

19.A.4 Technical Evaluation

The staff reviewed the applicant's submittal consistent with the requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2). The staff also used the guidance in DC/COL-ISG-016 to perform its review. DC/COL-ISG-016 references the February 25, 2005, guidance letter for Phase 1 and NEI 06-12 for Phases 2 and 3. Attachment 19.B (not publically available), discusses the staff's technical evaluation of the Fermi Unit 3 LOLA Plan submittal.

The Fermi COL applicant provided the LOLA event evaluation via a three-phase approach similar to that for existing plants and consistent with Phases 1, 2, and 3 in the NEI 06-12 guidance. The applicant wrote its "Mitigative Strategies Description and Plans" report, dated December 21, 2009, at the programmatic level for licensing approval; the implementation details and documentation will be made available for inspection by the NRC before initial fuel load. In response to NRC staff RAIs 19.03-36 and 19.03-37, the applicant submitted additional information to clarify the "Mitigative Strategies Description and Plans" report. The NRC staff evaluates the applicant's responses to these RAIs in Attachment 19.B of this section.

In its submittal of the "Mitigative Strategies Description and Plans" report, the applicant provided a mitigative strategies table (MST) that follows the template guidance in Appendix D to NEI 06-12. The MST addresses various areas and issues pertinent to LOLAs and describes commitments for areas that are best resolved closer to the completion of the building of Fermi Unit 3. All commitments made in the submittal will be implemented before the initial fuel load of the unit.

The MST addresses the three phases considered in NEI 06-12:

- Phase 1—firefighting response strategy
- Phase 2—SFP cooling
- Phase 3—reactor core cooling and fission product release mitigation

Phases 1, 2, and 3 of NEI 06-12 are similar to the three areas included as part of the requirements in 10 CFR 50.54(hh)(2): firefighting, operations to mitigate fuel damage, and actions to minimize radiological release. However, the three phases are categorized differently. In 10 CFR 50.54(hh)(2), the category of operations to mitigate fuel damage includes both the reactor core and the SFP, and the category of actions to minimize radiological release is separate. In NEI 06-12, separate phases address SFP and reactor core cooling, and reactor core cooling and fission product release mitigation are combined. Despite the differences between the categorization of the phases in NEI 06-12 and the areas of the regulatory requirements, the staff finds that the submittal included all of the necessary information.

The guidance for Phases 1, 2, and 3 suggests development of certain strategies or processes to mitigate the consequences of a LOLA event. The applicant addressed all of these suggested strategies or processes. In evaluating each plant-specific mitigating strategy against its functional objective,² the staff weighed whether the strategy reasonably can be expected to successfully provide SFP cooling or to maintain or restore the key safety functions necessary to protect the reactor core and containment. The staff's review considered the expected effectiveness of strategies and the ease and timeliness of strategy implementation.

Although some strategies needed to meet 10 CFR 50.54(hh)(2) can be developed and implemented in the near future, some strategies and planning efforts cannot be effectively determined or implemented until the plant is further along in construction. To identify such commitments for future action, the applicant documented areas that would be more appropriately completed before the initial fuel load. In a letter dated August 16, 2011 (ML11229A767), the applicant has identified the following commitment and License Condition to meet the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80.

- Mitigative Strategies Description and Plans – Prior to fuel load authorization per 10 CFR 52.103(g). [COM13.4-033]
- Operational Program Readiness (License Condition)

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. This schedule shall also address:

² As used here, the functional objective is the basic description of the capabilities of the conceptual strategy(s) as proposed for Phase 2 and 3 by NEI and accepted by the NRC.

- a. The implementation of site specific Severe Accident Management Guidance.
- b. The spent fuel rack coupon monitoring program implementation.

The staff reviewed the commitment and the license condition made by the applicant in its submittal and is satisfied that the timing of all procedural or strategy development was appropriately scheduled before the initial fuel load.

The NRC staff reviewed the “Mitigative Strategies Description and Plans” report for content using DC/COL-ISG-016 and finds that it includes all strategies considered essential for such a program and is acceptable. The staff finds that the regulatory requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2) are met.

19.A.5 Post-Combined License Activities

The applicant has identified the following commitment and License Condition to meet the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80.

- Mitigative Strategies Description and Plans – Prior to fuel load authorization per 10 CFR 52.103(g). [COM13.4-033]
- Operational Program Readiness (License Condition)

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. This schedule shall also address:

- a. The implementation of site specific Severe Accident Management Guidance.
- b. The spent fuel rack coupon monitoring program implementation.

19.A.6 Conclusion

The NRC staff reviewed the information provided by the applicant under 10 CFR 52.80(d). The staff concludes that the applicant has adequately followed the guidance of DC/COL-ISG-016, NEI 06-12, and the February 25, 2005, guidance letter. The staff finds that the applicant provided sufficient information at the COL application stage, including commitments made in the Fermi Unit 3 COL application, to meet the requirements of 10 CFR 52.80(d) and to provide reasonable assurance that the requirements in 10 CFR 50.54(hh)(2) will be met before the initial fuel load of Fermi Unit 3.