6.0 ENGINEERED SAFETY FEATURES

The design and functional requirements of engineered safety features (ESF) of the plant are provided to mitigate the consequences of postulated accidents. The ESF consist of containment systems, core cooling systems, habitability systems, and fission product removal and control systems. The containment systems include the primary containment system, the passive containment cooling system (PCCS), the containment isolation system, and the hydrogen control system. The passive containment cooling system provides emergency core cooling following postulated design-basis events and is designed to operate without the use of active equipment such as pumps and ac power sources. Similarly, the PCCS removes heat from the containment without the use of active equipment or ac power sources. The control room habitability system is designed so that the main control room remains habitable following a postulated design basis event. Control of fission products following a postulated design basis event is provided by natural removal processes inside containment, the containment boundary, and the containment isolation system.

6.1 Design Basis Accident Engineered Safety Feature Materials

Section 6.1, "Design Basis Accident Engineered Safety Feature Materials" of the Fermi 3 combined license (COL) application incorporates by reference, with no departures or supplements, Economic Simplified Boiling-Water Reactor (ESBWR) design control document (DCD) Revision 9, Section 6.1, "Engineered Safety Feature Materials," which contains Section 6.1.1, "Metallic Materials," and Section 6.1.2, "Organic Materials." Materials used in the Engineered Safety Feature (ESF) components have been evaluated to ensure that material interactions do not occur that can potentially impair operation of the ESF. Materials have been selected to with stand the environmental conditions encountered during normal operation and during any postulated loss-of-coolant accident (LOCA). Their compatibility with core and containment spray solutions has been considered, and the effects of radiolytic decomposition products have been evaluated.

As documented in NUREG-1966 "Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor (ESBWR) Standard Design", the U.S. Nuclear Regulatory Commission (NRC) staff reviewed and approved Section 6.1 of the certified ESBWR DCD. The staff reviewed Section 6.1 "Design Basis Accident Engineered Safety Feature Materials" 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 Title 10 of the *Code of Federal Regulations* (10 CFR) 52.63(a)(5) and Section VI.B.1 of Appendix [x] to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," all nuclear safety issues relating to the "Design Basis Accident Engineered Safety Feature Materials" 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.

6.2 Containment Systems

The containment and its associated systems provide the final barrier against the release of significant amounts of radioactive fission products in the event of an accident. The containment structure must be capable of withstanding, without loss of function, the pressure and temperature conditions resulting from postulated loss-of-coolant, steam line, or feed water line break accidents. The containment structure must also maintain functional integrity in the long term following a postulated accident (i.e., the structure must remain a low-leakage barrier against the release of fission products for as long as postulated accident conditions require).

GE-Hitachi Nuclear Energy (GEH), used the TRACG computer program to evaluate the containment performance. Appendix 6A – "TRACG Application for Containment Analysis"; Appendix 6B – "Evaluation of the TRACG Nodalization for the ESBWR Licensing Analysis"; Appendix 6C – "Evaluation of Impact of Containment Back Pressure on the ECCS Performance"; Appendix 6D – "Containment Passive Heat Sink Details"; Appendix 6E – "TRACG LOCA Containment Response Analysis"; Appendix 6F – "Break Spectrums of Break Sizes and Break Elevations"; Appendix 6 G – "TRACG LOCA SER Confirmation Items"; Appendix 6H – "Additional TRACG Outputs and Parametrics Cases"; and Appendix 6I – "Results of Containment Design Basis Calculations with Suppression Pool Bypass Leakage Assumption of 1 cm^2 (1.08E-03 ft^2)," of the Fermi 3 COL FSAR are incorporated by reference with no departures or supplements of the certified ESBWR DCD, Revision 9.

As documented in NUREG-1966, the NRC staff reviewed and approved Section 6.2 of the certified ESBWR DCD. The staff reviewed Section 6.2 "Containment Systems" and the Appendices listed above 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 Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the "Containment Systems" that were incorporated by reference have been resolved.

6.3 Emergency Core Cooling Systems

As documented in NUREG-1966, the NRC staff reviewed and approved Section 6.3 of the certified ESBWR DCD. The staff reviewed Section 6.3 "Emergency Core Cooling Systems" 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 "Emergency Core Cooling Systems" that were incorporated by reference have been resolved.

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[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.

6.4 Control Room Habitability Systems

6.4.1 Introduction

The control room habitability area provides protection for the plant operators and suitable environmental conditions for the necessary equipment to monitor and control the plant during normal operation, and maintain the plant in a safe condition during accident conditions. The control room ventilation system and control building layout and structures ensure that plant operators are adequately protected against the effects of accidental releases of toxic chemicals and radioactive material.

6.4.2 Summary of Application

Section 6.4 "Control Room Habitability Systems" of the Fermi 3 COL FSAR incorporates by reference Section 6.4 of the ESBWR DCD, Revision 9.

In addition, in FSAR Section 6.4, the applicant provides the following:

COL Items

- STD COL 6.4-1-A — Control Room Habitability Area (CRHA) Procedures and Training

This COL item directs the applicant to address procedures for training on control room habitability. The applicant states that the operators are provided with training and procedures for control room habitability that address the applicable aspects of NRC Generic Letter (GL) 2003-01 and are consistent with the intent of Generic Issue (GI) 83. The implementation milestones for training and procedures are discussed in sections 13.4 and 13.5 of the application respectively.

- EF3 COL 6.4-1-A — CRHA Procedures and Training

The applicant addressed CRHA Procedures and Training under COL Item STD COL 6.4-1-A.

- EF3 COL 6.4-2-A — Toxic Gas Analysis

This COL item directs the applicant to address potential toxic gas sources to confirm that an external release of hazardous chemicals does not impact control room habitability.

Supplemental Information

- EF3 SUP 6.4-1

The applicant provides this supplemental information to address the impact of a postulated DBA in Fermi Unit 2 on the Fermi Unit 3 control room.

6.4.3 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 habitability systems, and the associated

acceptance criteria, are in Section 6.4 of NUREG–0800. The applicable regulatory guidance for control room habitability is as follows:

- Three Mile Island (TMI) Action Plan, Item III.D.3.4.
- Regulatory Guide (RG) 1.78, Revision 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release."
- RG 1.52, Revision 3, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post Accident Engineered Safety Feature Atmosphere Cleanup Systems in Light Water Cooled Nuclear Power Plants," June 2001.
- RG 1.206, "Combined License Applications for Nuclear Power Plants," June 2007.
- RG 1.196, "Control Room Habitability at Light Water Nuclear Power Reactors," May 2003.
- General Design Criteria (GDC) 4, "Environmental and dynamic effects design bases," as it relates to SSCs important to safety being designed to accommodate the effects of and to be compatible with environmental conditions associated with postulated accidents.
- GDC 5, "Sharing of structures, systems and components," as it relates to ensuring that sharing among nuclear power units of SSCs important to safety will not significantly impair the ability to perform safety functions, including in the event of an accident in one unit and an orderly shutdown and cooldown of the remaining unit(s).
- GDC 19, "Control room," as it relates to maintaining the nuclear power unit in a safe condition under accident conditions and providing adequate radiation protection.
- 10 CFR 50.34(f)(2)(xxviii) "Contents of application; technical information", as it relates to evaluations and design provisions to preclude certain control room habitability problems.
- 10 CFR 52.80(a) "Contents of application; additional technical information" which requires a COL application to address the proposed inspections, tests, and analyses (including those applicable to emergency planning) that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that if the inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and NRC regulations.

6.4.4 Technical Evaluation

As documented in NUREG-1966, the NRC staff reviewed and approved Section 6.4 of the certified ESBWR DCD. The staff reviewed Section 6.4 of the Fermi 3 COL FSAR, Revision 3, and checked the referenced ESBWER 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 information incorporated by reference address the required information related to the control room habitability systems.

Section 1.2.3 of this safety evaluation report (SER) provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER with open items issued for the North Anna application were equally applicable to the Fermi COL application, the staff undertook the following reviews:

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

- The staff confirmed that the applicant endorsed all responses to RAIs identified in the corresponding standard content (the North Anna SER) evaluation.

- The staff verified that the site-specific differences were not relevant.

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

The NRC staff reviewed the conformance of Section 6.4 of the Fermi 3 COL FSAR to the guidance in RG 1.206 Section C.III.1, Chapter 6, C.I.6.4 "Habitability Systems." Compliance with the control room habitability dose requirements of GDC 19 requires the applicant to show that for a plant located at the site, the control room provides adequate radiation protection to ensure that radiation exposures shall not exceed 0.05 sievert (Sv) (5 rem), a total effective dose equivalent (TEDE) to permit access and occupancy of the control room under accident conditions for the duration of the accident.

The applicant does not provide site-specific doses in the control room for the DBAs. Instead, the applicant incorporates by reference the analysis of the radiological control room habitability from ESBWR DCD Revision 9, Section 6.4.4, "System Safety Evaluation."

ESBWR DCD Revision 9, Chapter 6.4, provides the results of the analysis of control room radiological consequences for the DBAs analyzed in Chapter 15, Section 15.4, "Analysis of Accidents." DCD Section 15.4 describes the details and assumptions used to model the radiological consequences to control room operators.

The DBA analyses of control room radiological consequences in the DCD uses design reference values for the atmospheric dispersion factors (χ/Qs), in place of site-specific values. The χ/Qs are the only input to the DBA radiological consequences analyses that are impacted by the site characteristics. The applicant provides and discusses the Fermi site-specific control

[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.

room χ/Qs in the resolution of Fermi EF3 COL 2.0-10-A. The Fermi site-specific control room χ/Qs are in Fermi 3 COL FSAR Tables 2.3-301 and 2.3-378. In Section 2.3 "Meteorology" of this SER, the staff discusses its review of the resolution to Fermi EF3 COL 2.0-10-A, which is related to the Fermi site-specific χ/Qs.

The estimated DBA dose in the control room is calculated for a particular site that is affected by the site characteristics through the site-specific control room χ/Q input to the analysis. The resulting dose is different from the dose calculated generically for the ESBWR design. All other inputs and assumptions in the analyses of radiological consequences remain the same as those in the DCD. Smaller χ/Q values are associated with a greater dilution capability, thus resulting in lower radiological doses. When comparing a DCD site parameter χ/Q value and a site characteristic χ/Q value, the site is acceptable for the design if the site characteristic χ/Q value is smaller than the DCD site parameter χ/Q value. Such a comparison shows that the site has better dispersion characteristics than those required by the reactor design.

For each time-averaging period, the Fermi site-specific control room χ/Q values are less than the design reference control room χ/Q values used in the ESBWR DCD, Revision 9, for the radiological consequence analyses for each of the DBAs. The Fermi site-specific control room dose for each DBA is less than the ESBWR DCD Revision 9 referenced control room dose for each DBA because (1) the result of the radiological consequence analysis for a DBA during any time period of radioactive material release from the plant is directly proportional to the atmospheric dispersion factor for that time period; and (2) the Fermi site-specific control room χ/Q values are less than the comparable design reference control room χ/Q values in the ESBWR DCD, Revision 9, for all time periods for each accident.

The applicant has sufficiently shown that the DBA control room radiological consequences meet the requirements of GDC 19 because (1) the ESBWR DCD analyses show that the radiological consequences in the control room meet the regulatory dose requirements of GDC 19 by resulting in a TEDE of less than 0.05 Sv (5 rem); and (2) using the logic in the above discussion, the Fermi site-specific DBA control room radiological consequences are less than those for the ESBWR DCD, Revision 9. The staff reviewed the following information in the COL FSAR:

COL Items

The following portion of this technical evaluation section is reproduced from Section 6.4.4 of the North Anna SER (ML091380480):

- *STD COL 6.4-1-A CRHA Procedures and Training*

NRC staff reviewed NAPS COL 6.4-1-A related to the procedures and training included under Section 6.4 of the FSAR. The applicant provided additional information that states:

> *The COL applicant committed to develop and implement procedures and training for control room habitability that address the applicable aspects of NRC Generic Letter 2003-01 and are consistent with the intent of Generic Issue 83.*
>
> *NRC staff evaluated STD COL 6.4-1-A related to providing operators with training and procedures for control room habitability that address*

the applicable aspects of NRC Generic Letter 2003-01 and are consistent with the intent of Generic Issue 83 included under Section 6.4 of the North Anna 3 COL Application.

The applicant stated, "Operators are provided with training and procedures for control room habitability that address the applicable aspects of NRC Generic Letter 2003-01 and are consistent with the intent of Generic Issue 83. Training and procedures are developed and implemented in accordance with Sections 13.2 and 13.5, respectively."

The staff determined that the applicant has provided adequate information regarding the development of operator training and procedures for control room habitability to address the applicable aspects of NRC GL 2003-01, as well as the intent of Generic Issue 83.

The applicant identified the following commitments to track implementation milestones for operator training and procedures for control room habitability as discussed in Sections 13.4 and 13.5 of this SER:

(1) Non Licensed Plant Staff Training Program – 18 months prior to scheduled fuel load. [COM 13.4-028]

(2) Reactor Operator Training Program - 18 months prior to scheduled fuel load. [COM 13.4-016]

(3) Operating procedures are developed at least six months prior to fuel load to allow sufficient time for plant staff familiarization and to allow NRC staff adequate time to review the procedures and to develop operator licensing examinations. [COM 13.5-002]

- EF3 COL 6.4-1-A CRHA Procedures and Training

The staff's technical evaluation is discussed above under STD COL 6.4-1-A "CRHA Procedures and Training".

- EF3 COL 6.4-2-A Toxic Gas Analysis

This item addresses potential toxic gas sources to confirm that an external release of hazardous chemicals does not impact control room habitability. This COL item states, in part that "The COL Applicant will identify potential site specific toxic or hazardous materials that may affect control room habitability in order to meet the requirements of TMI Action Plan III.D.3.4 and GDC 19."

The NRC staff evaluated EF3 COL 6.4-2-A, which relates to potential toxic gas sources, to confirm that an external release of hazardous chemicals does not impact control room habitability provided included in Section 6.4 of the Fermi 3 COL application.

The applicant provides additional information in FSAR Section 6.4.5 to identify potential site-specific toxic or hazardous materials that may affect control room habitability. The potential sources of hazardous chemicals include offsite industrial facilities, transportation routes, and onsite sources from Fermi 2 and Fermi 3. The applicant evaluates potentially hazardous offsite chemicals in Section 2.2 "Nearby Industrial, Transportation, and Military Facilities" and

concludes that there are no significant control room habitability impacts due to potential sources within 8 km (5 miles) of the plant. The applicant also performs a toxic gas analysis for potentially hazardous chemicals stored on the site, in accordance with the guidelines of RG 1.78. The applicant concludes that concentrations of toxic gas in the control room will not exceed the toxicity limits in RG 1.78.

The applicant also analyzes the onsite hydrogen and oxygen storage facilities. Based on the hazards of a postulated instantaneous release followed by a vapor cloud explosion or the intake of a flammable vapor concentration into a safety-related intake, the applicant found the locations of the onsite hydrogen and oxygen storage facilities to be acceptable in accordance with RG 1.78. The applicant concludes that seismic Category I safety-related toxic gas monitoring instrumentation is not required.

The staff reviewed the information submitted by the applicant in Section 2.2 of the COL FSAR and confirmed that there are no significant control room habitability impacts from chemicals stored offsite or transported along offsite routes within 8 km (5 miles) of the plant. In response to RAI 02.02.03-5 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML092750405) dated September 30, 2009, as part of the Section 2.2 review, the applicant provided a list of all toxic chemicals considered and the methods used to evaluate toxicity. Tables 2.2-202, 2.2-203, and 2.2-205 documents these chemicals, and related information. The staff reviewed the applicant's screening methodology and found it to be consistent with RG 1.78. The applicant's conclusions are therefore acceptable.

The applicant identifies two gases, nitrogen and carbon dioxide, which are not toxic but could be an asphyxiant in some circumstances. Nitrogen is stored onsite as liquid nitrogen in a tank and is associated with Fermi 2. The carbon dioxide tank is associated with Fermi 3. Although the applicant's evaluation shows that the allowable air concentration limits for nitrogen and carbon dioxide will be exceeded by the maximum concentration at the CRHA intakes, the concentration inside the CRHA will be significantly less than the allowable limits. This finding is due primarily to the short amount of time that the chemical cloud will be at its maximum at the intake. As such, the rupture or leakage of a nitrogen or carbon dioxide tank poses no threat to control room operators. The staff found that COL Item EF3 COL 6.4-2-A conforms to the requirements of TMI Action Plan, Item III.D.3.4 and GDC 19 and is consistent with RG 1.78.

Supplemental Information

- EF3 SUP 6.4-1

The applicant provides additional information in FSAR Section 6.4.5 to address the impact of a postulated DBA in Fermi 2 on the Fermi 3 control room.

The applicant provides conservatively calculated dispersion factors at the Fermi 3 CRHA intakes along with the distance and height of the Fermi 2 release. The calculations consider meteorological data and include a safety factor.

The applicant's review of the Fermi 2 LOCA, as described in Fermi 2 UFSAR Section 15.6.5, determined that the resultant dose to the Fermi 3 control room operator is within regulatory limits.

The NRC staff evaluated the applicant's supplemental information in FSAR Section 6.4.5 related to the impact of a postulated DBA in Fermi 2 on the Fermi 3 control room operators. The staff

concurred that the information is sufficient to assure that the dose to a Fermi 3 control room operator from an accident at Fermi 2 is bounded by the dose to the control room operator from a postulated Fermi 3 DBA, which is less than GDC 19 limits.

6.4.5 Post Combined License Activities

The applicant identified the following commitments to track implementation milestones for operator training and procedures for control room habitability as discussed in Sections 13.4 and 13.5 of this SER:

(1) Non Licensed Plant Staff Training Program – 18 months prior to scheduled fuel load. [COM 13.4-028]

(2) Reactor Operator Training Program - 18 months prior to scheduled fuel load. [COM 13.4-016]

(3) Operating procedures are developed at least six months prior to fuel load to allow sufficient time for plant staff familiarization and to allow NRC staff adequate time to review the procedures and to develop operator licensing examinations. [COM 13.5-002]

6.4.6 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 has addressed the required information relating to control room habitability, 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 Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the control room habitability systems that were incorporated by reference have been resolved.

Based on the information in the technical review section above, the staff concludes that the information in the COL application is acceptable and meets the requirements of 10 CFR 50.34(f)(2)(xxviii) and GDC 19.

In addition, the staff concludes that the information presented in the COL FSAR is acceptable and meets the requirements of GDC 4 and 19 of Appendix A to 10 CFR Part 50 "Domestic Licensing of Production and Utilization Facilities", 10 CFR 50.34(f)(2)(xxviii),10 CFR 50.34(a)(6) and (10), and 10 CFR 50.34(b)(6)(iv) and (v). This conclusion is based on the following:

- STD COL 6.4-1-A is acceptable because the applicant has provided adequate information regarding the development and implementation of operator training and procedures for control room habitability to address the applicable aspects of NRC GL 2003-01 as well as the intent of GI 83. In conclusion, the applicant has provided sufficient information for satisfying 10 CFR 50.34(a)(6) and (10) and 10 CFR 50.34(b)(6)(iv) and (v).

- EF3 COL 6.4-2-A is acceptable because the staff evaluated the technical adequacy of the toxic gas hazards analysis provided by the applicant in Section 2.2. The staff finds that the onsite storage locations of nitrogen and carbon dioxide present no toxic gas concerns with regards to control room habitability, in accordance with RG 1.78.

- EF3 SUP 6.4-1 is acceptable because the staff finds that supplemental information in COL FSAR Section 6.4.5 demonstrates that the dose to a Fermi 3 control room operator from an accident at Fermi 2 is bounded by the dose to the control room operator from a postulated Fermi 3 DBA, which is less than the maximum dose allowed by GDC 19 limits.

6.5 Atmospheric Cleanup Systems

As documented in NUREG-1966, the NRC staff reviewed and approved Section 6.3 of the certified ESBWR DCD. The staff reviewed Section 6.5 "Atmospheric Cleanup Systems" 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 there is 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 Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to the "Atmospheric Cleanup Systems" have been resolved.

6.6 Preservice and Inservice Inspection and Testing of Class 2 and 3 Components and Piping

6.6.1 Introduction

Inservice inspection (ISI) Programs are based on the requirements of 10 CFR 50.55a, "Codes and Standards," in that Code Class 2 and 3 components, as defined in Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), meet the applicable inspection requirements set forth in Section XI of the ASME Code, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components." ISI includes preservice examinations before the initial plant startup, as required by IWC-2200 and IWD-2200 of Section XI of the ASME Code.

6.6.2 Summary of Application

Section 6.6, "Preservice and Inservice Inspection and Testing of Class 2 and 3 Components and Piping" of the Fermi 3 COL FSAR incorporates by reference Section 6.6 of the ESBWR DCD, Tier 2, Revision 9. In addition, in FSAR Section 6.6, the applicant provides the following supplements:

COL Items

- STD COL 5.2-1-A System Pressure Tests

In FSAR Section 6.6.6, the applicant provides additional information in STD COL 5.2-1-A to address pressure testing information for Class 2 and 3 components. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME Code Section XI, IWA-5000, IWC-5000, and IWD-5000 for Class 2 and 3 components, including the limitations of 10 CFR 50.55a(b)(2)(xx) and 10 CFR 50.55a(b)(2)(xxvi).

[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.

- STD COL 6.6-1-A Augmented Inservice Inspection

The applicant provides additional information in STD COL 6.6-1-A to address COL Item 6.6-1-A. The applicant states that: (a) the Pre-service Inspection (PSI)/ISI Program description for Class 2 and 3 components and piping is in DCD Section 6.6; (b) no relief requests have been identified; (c) the initial ISI Program is to be based on the latest edition and addenda of the ASME Code, incorporated by reference in 10 CFR 50.55a(b) on the date 12 months before fuel loading; and (d) the milestones for implementing the PSI/ISI Program are in FSAR Section 13.4, "Operational Programs Implementation."

In addition, in FSAR Section 6.6.7, the applicant supplements the ESBWR DCD with a new Subsection 6.6.7.1, "Flow Accelerated Corrosion Program Description," describing the Flow Acceleration Corrosion (FAC) Monitoring Program. The applicant adds that this program will be based on the Electric Power Research Institute "Recommendations for an Effective Flow-Accelerated Corrosion Program," Nuclear Safety Analysis Center 202L-R2. The applicant states that before startup, a comprehensive FAC susceptibility screening will be performed to identify any plant systems that may be susceptible to FAC degradation. Should any plant systems remain susceptible, a FAC Program will be implemented with PSI baseline nondestructive examinations (NDEs), and the material constituency will be identified for each as-fabricated piping component in the susceptible systems.

- STD COL 6.6-2-A PSI/ISI NDE Accessibility Plant Description

In FSAR Section 6.6.2, the applicant provides additional information to address accessibility and the NDEs of Class 1, 2, and 3 austenitic or dissimilar metal welds. The applicant states that procedures for design control and plant modifications will include provisions to assure accessibility for inspecting and testing during licensee design activities affecting Class 2 and 3 components. The applicant adds that the ISI NDE method will be similar to that of the PSI to ensure a baseline point of reference.

6.6.3 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 the PSI/ISI for Class 2 and 3 components, and the associated acceptance criteria, are in Section 6.6 of NUREG–0800.

The applicable regulatory requirement for the PSI/ISI Program for Class 2 and 3 components is as follows:

- 10 CFR 50.55a

The related acceptance criteria are as follows:

> ASME BPVC Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

The basis for accepting the COL information item and supplementary information on the ISI of Class 2 and 3 components is established in 10 CFR 50.55a, as it pertains to specifying the PSI/ISI, and testing requirements of the ASME Code for Class 2 and 3 components. Acceptance of the description of the FAC program is also based on addressing the concerns in

Generic Letter (GL) 89-08 as they pertain to establishing an erosion-corrosion monitoring program. SRP Section 10.3.6 discusses the need for a FAC program and identifies acceptance criteria.

- General Design Criteria (GDC) 32 – "Inspection of reactor coolant pressure boundary" as it relates to a periodic inspection and testing program for components that are part of reactor coolant pressure boundary to assess their structural and leaktight integrity. In addition, the program shall provide material surveillance for the reactor pressure vessel.

6.6.4 Technical Evaluation

As documented in NUREG–1966, the NRC staff reviewed and approved Section 6.6 of the certified ESBWR DCD. The staff reviewed Section 6.6 of the Fermi 3 COL FSAR 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 information incorporated by reference address the required information related to the PSI/ISI, and testing of Class 2 and 3 components.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER with open items issued for the North Anna application were equally applicable to the Fermi COL application, the staff undertook the following reviews:

- The staff compared the North Anna COL FSAR, Revision 1, to the Fermi COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 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 all responses to RAIs identified in the corresponding standard content (the North Anna SER) evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

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

The staff reviewed the conformance of FSAR Section 6.6 to the guidance in RG 1.206, Section C.III.1, Chapter 6, C.I.6.6, "Inservice Inspection of Class 2 and 3 Components." The staff's review of FSAR Section 6.6 found that it incorporates by reference Section 6.6 of the ESBWR DCD. The staff's review of DCD Section 6.6 determined that the ESBWR ISI Program for Code Class 2 and 3 components is acceptable and meets the requirements of 10 CFR 50.55a, with regard to the preservice and inservice inspectability of these components. The specific version of ASME Code Section XI, which is used as the baseline Code in the ESBWR certified design, is the 2001 Edition up to and including the 2003 Addenda. It should also be

[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.

noted that the staff did not identify any portions of the ESBWR ISI Program for Class 1, 2, and 3 components that were excluded from the scope of the staff's review of the ESBWR design. Fermi COL FSAR Section 6.6 states that the PSI/ISI Program description for Class 2 and 3 components and piping is in ESBWR DCD Tier 2, Section 6.6. Therefore, the staff's conclusions remain unchanged regarding the acceptability of the ESBWR ISI Program based on the 2001 Edition, up to and including the 2003 Addenda, of ASME Code Section XI, with regard to preservice and inservice inspectability of Class 2 and 3 components. The staff's evaluation of the operational program aspects of the ASME Code Class 2 and 3 ISI Program and the Augmented Inspection Programs is addressed with the Class 1 ISI in Section 5.2.4 of this SER. The adequacy of the ISI Program for metal containment (Class MC) components is discussed in Section 3.8.2 of this SER. Accordingly, the staff's evaluation of this section focused on the acceptability of the FSAR COL applicant's supplemental information and responses to COL items as they relate to the ISI of ASME Code Class 2 and 3 components.

COL Items

The following portion of this technical evaluation section is reproduced from Section 6.6.4 of the North Anna SER (ML091380480):

- *STD COL 5.2- 1-A Plant Specific Pressure Testing*

In FSAR Section 6.6, the applicant provided additional information in STD COL 5.2-1-A to address pressure testing information for Class 2 and 3 components. This information also addresses the staff's RAI under Section 5.2.4 pertaining to the limitations under 10 CFR 50.55a. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME Code, Section XI , IWA-5000 , IWC-5000, and IWD-5000 for Class 2 and 3 components, including the limitations of 10 CFR 50.55a(b)(2)(xx) and 10 CFR 50.55a (b)(2)(xxvi).

Revision 1 to the North Anna 3 COL FSAR agrees with the limitations for pressure testing of Class 1, 2, and 3 components in 10 CFR 50.55a, and is therefore acceptable to the staff.

- *STD COL 6.6-1-A Plant Specific PSI/ISI Program Information*

The COL applicant provided a full description of the PSI/ISI programs and augmented inspection programs for Class 2 and 3 components by supplementing the information in DCD Section 6.6. The COL applicant also provided milestones for program implementation (FSAR Section 13.4).

The COL item is addressed in the FSAR, in part, by replacing the last sentence and the parenthetical statement of the third paragraph of DCD Section 6.6 with the following:

> *The PSI/ISI program description for Class 2 and 3 components and piping is provided in DCD Section 6.6*

.

A PSI/ISI program encompasses Class 1, 2, and 3 components and is being evaluated under Section 5.2.4 of the staff SER of ESBWR DCD on

Docket No. 52-010. Though Section 6.6 applies to Class 2 and 3 components, the augmented ISI programs, which protect against postulated piping failures and erosion/corrosion of piping, contain portions of the PSI/ISI program and include Class 1 components. This topic is discussed under Section 5.2.4 of this SER.

The applicant also provided Section 6.6.7.1, Flow Accelerated Corrosion Program Description, to describe the general attributes of the applicant's program for monitoring and managing degradation (i.e., thinning) of piping and components susceptible to flow accelerated corrosion. The staff's evaluation of FSAR Section 6.6.7.1 is addressed in Section 10.3 of this SER.

Since the PSI/ISI program for Class 1, 2, and 3 components and the implementation milestones are discussed under Section 5.2.4 of this SER, the staff concludes that STD COL 6.6-1-A is acceptable for Section 6.6 of this SER.

As stated above, the staff evaluated the North Anna FAC program description in Section 10.3 of the SER. That was based on the NRC Standard Review Plan, which addresses FAC in Section 10.3.6, "Steam and Feedwater Materials." In reviewing the Fermi Unit 3 COLA, the staff concluded it would be more appropriate to include the FAC program evaluation in Section 6.6 of the SER in order to be consistent with the FSAR. The staff's evaluation of the North Anna FAC program is complete and applicable to the Fermi review since the FAC program description is part of the standard COL information under STD COL 6.6-1-A. Therefore, the following portion of this technical evaluation is reproduced from Section 10.3 of the North Anna SER (ML091520434):

The staff reviewed the information provided by the applicant in Section 6.6.7.1 of the COL FSAR, which describes the FAC program. FSAR Section 6.6.7.1 also refers to FSAR Section 13.4 for program implementation milestones. Therefore, the staff also reviewed the information provided in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations."

As part of the review, the staff requested in RAI 10.03.06-1 that the applicant discuss an implementation schedule for the detailed FAC program, (e.g., FAC program activities that will be conducted during the plant construction phase and the schedule for those activities). RAI 10.03.06-2 requested the applicant to confirm (1) that the FAC program will include pre-service thickness measurements of the as-built components considered susceptible to FAC, and (2) that these measurements will use the grid locations and measurement methods most likely to be used for inservice inspection (ISI) according to industry guidelines.

In a response dated July 14, 2008 (ML082050559), the applicant stated that the FAC program is considered an Operational Program under the ISI program listed in Table 13.4-201, "Operational Programs Required by NRC Regulations." The letter included a revised Table 13.4-201 that explicitly lists the FAC program under the ISI program in the FSAR with an

implementation milestone of "prior to commercial service." The response also stated that during the construction phase, a comprehensive FAC susceptibility screening and preservice inspection of susceptible systems will be performed.

The applicant's response provided portions of a FAC program description the applicant had developed to address the requirement in ESBWR DCD Revision 5, under COL Item 6.6-1-A. The proposed description of the FAC program included a statement that the North Anna 3 FAC program will be based on EPRI NSAC 202-L, "Recommendations for an Effective Flow-Accelerated Corrosion Program." The response also stated that preservice, baseline, and non-destructive examinations will be performed on as-fabricated components in susceptible systems and that these preservice inspections will use grid locations and measurement methods most likely to be used for ISIs.

The changes proposed in the applicant's response addressed the staff concerns about the implementation activities and schedule by making the FAC program an explicit part of the operational programs. The proposed revision also addressed the staff concerns about preservice inspections by adding a description of the preservice inspection plan to the FSAR, including the affirmation that locations and measurement methods will be those most likely to be used in subsequent inspections. The staff reviewed the FAC program information provided in Section 6.6.7.1 of Revision 1 of the FSAR and confirmed that the FAC program is included in Chapter 13 as an operational program and that it addresses the concerns discussed above regarding preservice inspection requirements. Therefore, the staff finds the information on the FAC program acceptable.

Based on the information above, the staff finds that the FAC program is acceptable because it meets the requirements of 10 CFR 50.55a and addresses the concerns in GL 89-08 as they pertain to establishing an erosion-corrosion monitoring program.

The applicant identified the following commitments to track implementation of the PSI/ISI programs:

(1) ISI - Implemented prior to commercial service (COM 13.4-024)
(2) PSI – Completion prior to initial plant startup (COM 13.4-026)

- *STD COL 6.6-2-A*

The applicant replaced the last sentence in the second paragraph of the ESBWR DCD, Revision 5, with the following:

> *During the construction phase of the project, anomalies and construction issues are addressed using change control procedures. Procedures require that changes to approved design documents, including field changes and modifications, are subject to the same review and approval process as the original design. Accessibility and inspectability are key*

components of the design process. Control of accessibility for inspectability and testing during licensee design activities affecting Class 2 and 3 components is provided via procedures for design control and plant modifications. Ultrasonic techniques (UT) will be the preferred NDE method for all PSI and ISI volumetric examinations; radiographic techniques (RT) will be used as a last resort only if UT cannot achieve the necessary coverage. The same NDE method used during PSI will be used for ISI to the extent possible to assure a baseline point of reference. If a different NDE method is used for ISI than was used for PSI, equivalent coverage will be achieved as required by the Code.

Accessibility of Class 1, 2, and 3 components, and the use of alternative NDE methods are discussed under Section 5.2.4 of this FSER and was deemed acceptable to the staff. Based on the above discussion, STD COL 6.6-2-A is acceptable.

6.6.5 Post Combined License Activities

The applicant identified the following commitments to track implementation of the PSI/ISI programs:

(1) ISI - Implemented prior to commercial service (COM 13.4-024)
(2) PSI - Completion prior to initial plant startup (COM 13.4-026)

6.6.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG–1966. The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the PSI/ISI of Class 2 and 3 components and piping, 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 Part 52, Appendix [x], Section VI.B.1, all nuclear safety issues relating to "Preservice and Inservice Inspection and Testing of Class 2 and 3 Components and Piping" that were incorporated by reference have been resolved.

In addition, the staff's review concluded that the applicant information to address STD COL Items 5.2-1-A, 6.6-1-A, and 6.6-2-A as provided in Section 6.6 of the Fermi COL FSAR meets the relevant guidelines in Standard Review Plan Section 6.6 of NUREG-0800, and other NRC RGs, and are therefore acceptable. Conformance with these guidelines provides an acceptable basis for satisfying the requirements of GDC 32 and 10 CFR 50.55a. The staff concludes that the FAC program described in FSAR Section 6.6.7.1 is consistent with industry practices for addressing the concerns related to FAC and for monitoring the piping wall degradation caused by FAC during plant operations. The establishment of an FAC monitoring program adequately addresses the concerns identified in GL 89-08.