6.0 ENGINEERED SAFETY FEATURES

6.0 ENGINEERED SAFETY FEATURES

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) discusses the NRC staff evaluation of the North Anna 3 Combined License (COL) engineered safety features (ESFs) of the Economic Simplified Boiling-Water Reactor (ESBWR) plant, which are designed to mitigate the consequences of postulated accidents. The ESFs 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, the containment isolation system, and the hydrogen control system. The passive core 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 alternating current power sources. Similarly, the passive containment cooling system removes heat from the containment without the use of active equipment or alternating current power sources. The control room habitability system is designed so that the main control room remains habitable following a postulated design-basis event. Natural removal processes inside containment, the containment boundary, and the containment isolation system provide control of fission products following a postulated design-basis event.

6.1 Design Basis Accident Engineered Safety Feature Materials

Section 6.1, "Design Basis Accident Engineered Safety Feature Materials," of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference with no departures or supplements, Section 6.1, "Design Basis Accident Engineered Safety Feature Materials," which includes Section 6.1.1, "Metallic Materials," and Section 6.1.2, "Organic Materials," of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Materials used in the ESF components have been evaluated to ensure that material interactions do not occur that can potentially impair operation of the ESFs. Materials have been selected to withstand 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 Standard Design," issued April 2014, the staff reviewed and approved Section 6.1 of the certified ESBWR DCD. Section 6.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.1 of the certified ESBWR DCD, Revision 10, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the design basis accident (DBA) ESF 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

As documented in NUREG-1966, the staff reviewed and approved Section 6.2, "Containment Systems," of the certified ESBWR DCD. Section 6.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.2, of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff's review confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to containment systems that were incorporated by reference have been resolved.

6.3 Emergency Core Cooling System

As documented in NUREG-1966, the staff reviewed and approved Section 6.3, "Emergency Core Cooling Systems," of the certified ESBWR DCD. Section 6.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff's review confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the emergency core cooling system that were incorporated by reference have been resolved.

6.4 Control Room Habitability Systems

6.4.1 Introduction

The control room habitability area (CRHA) provides protection for the plant operators and ensures suitable environmental conditions for the equipment necessary to monitor and control the plant during normal operation and to 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 North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. 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

The applicant provided additional information in STD COL 6.4-1-A. The applicant stated 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, "Control Room Habitability," dated June 12, 2003, and are consistent with the intent of Generic Issue (GI) 83,

"Control Room Habitability," Revision 3. FSAR Sections 13.4 and 13.5 contain the implementation milestones for training and procedures, respectively.

- NAPS COL 6.4-2-A Toxic Gas Analysis

The applicant provided additional information in NAPS COL 6.4-2-A. The applicant stated that potential toxic gas sources are evaluated to confirm that an external release of hazardous chemicals does not impact control room habitability.

Supplemental Information

- NAPS SUP 6.4-1 System Safety Evaluation

The applicant described the evaluation of the impact of a postulated design-basis accident in Units 1 or 2 on the Unit 3 control room.

6.4.3 Regulatory Basis

The applicable regulatory requirements for control room habitability are as follows:

- General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," as it relates to structures, systems, and components (SSCs) important to safety being designed to accommodate the effects of, and to be compatible with, the 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 to permit access and occupancy of the control room under accident conditions.

- 10 CFR 50.34(f)(2)(xxviii), as it relates to evaluation of potential radiation exposure pathways for an accident source term and design provisions to preclude control room habitability problems resulting from exposure through such pathways.

- 10 CFR 52.80(a), "Contents of application; additional technical information," which requires a COL application (COLA) 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 of 1954, as amended, and NRC regulations.

The regulatory basis of the information incorporated by reference is in NUREG–1966, related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for habitability systems and the associated acceptance criteria are , Section 6.4, "Control Room Habitability System," of NUREG-0800, "Standard Review Plan for the Review of

Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), contains the relevant regulatory requirements for habitability systems and the associated acceptance criteria.

The following regulatory guidance applies to control room habitability:

- 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," issued December 2001.

- 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 (LWR Edition)," issued June 2007.

- RG 1.196, "Control Room Habitability at Light Water Nuclear Power Reactors," May 2003.

6.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 6. 4, "Control Room Habitability Systems," of the certified ESBWR DCD, Revision 10. The staff reviewed Section 6.4 of the North Anna 3 COL FSAR Revision 8, and checked the referenced ESBWR DCD to confirm that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference include all the relevant information related to control room habitability systems.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8 as follows:

COL Items

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

The staff reviewed NAPS COL 6.4-1-A, which relates to the procedures and training included under Section 6.4 of the FSAR. The applicant provided additional information as follows:

> 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] GI 83. Training and procedures are developed and implemented in accordance with [FSAR] 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 and GI 83. Specifically, in FSAR Section 13.2 and 13.5 the applicant has described the operator training and procedures to be in place 6 months prior to scheduled fuel loading. The staff evaluation of the adequacy of these programs as well as its

safety finding is documented in FSAR Sections 13.2 and 13.5 of this this Safety Evaluation Report (SER).

- NAPS COL 6.4-2-A Toxic Gas Analysis

The applicant provided additional information to address DCD COL Item 6.4-2-A, which states:

> 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 potential sources of hazardous chemicals include offsite industrial facilities, transportation routes, and nuclear units on the site. In FSAR Section 2.2, "Nearby Industrial, Transportation, and Military Facilities," the applicant evaluated potentially hazardous offsite chemicals and concluded that there are no significant control room habitability impacts from potential sources within 8 kilometers (km) (5 miles) of the control room. The applicant also performed a toxic gas analysis for potentially hazardous chemicals stored on site, in accordance with the guidance from RG 1.78. The applicant concluded that concentrations of toxic gas in the control room will not exceed the toxicity concentrations in RG 1.78 and National Air Quality Standards.

The applicant also analyzed the onsite hazards of a postulated instantaneous release of toxic gas 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 storage facilities as well as the hazards from a tank truck delivery to be acceptable in accordance with the guidance in RG 1.78. Therefore the applicant concluded that seismic Category I safety-related toxic gas monitoring instrumentation is not required.

The applicant identified in FSAR Table 2.2-203 gases that are not toxic but could be an asphyxiant in some circumstances. Nitrogen, for example, is stored onsite as liquid nitrogen in a tank. The applicant's analysis shows that the maximum air concentration for nitrogen as well as the other listed asphyxiants listed in FSAR Table 2.2-203 that have a potential of penetrating inside the CRHA will be significantly less than the maximum concentration recommended in RG 1.78. The staff finds the applicant's analysis acceptable because the applicant's screening methodology follows the guidance of RG 1.78. Accordingly, the staff finds that the information the applicant provided in response to COL Item NAPS COL 6.4-2-A conforms to the requirements of 10 CFR 50.34(f)(2)(xxviii) and GDC 19.

In the evaluation presented in Section 2.2.3 of this SER, the staff performed calculations on seven selected chemical hazards and confirmed that the concentrations at the control room intake and inside the control room are lower than as specified in the applicable guidance, as described in detail below.

The staff conducted an audit (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML15096A147) to review the applicant's calculations supporting the chemical hazards analysis. The staff determined that the applicant's calculation results were consistent with the results of the staff's independent verification calculations for the selected analyses. In all cases, the applicant's results are well below the maximum concentrations listed in RG 1.78. While reviewing the applicant's chemical spill calculations, the staff noted that when meteorological stability class F was selected, only the nighttime temperature of 21.9 degrees Celsius (C) (71.5 degrees Fahrenheit (F)) was used. Therefore, on December, 9, 2014, the staff issued Request for Additional Information (RAI) 06.04-8,

(ADAMS Accession No. ML14344A107), requesting the applicant to explain why the daytime temperature of 33.1 degrees C (91.5 degrees F) could not coexist with meteorological stability class F. The applicant's response to this RAI dated February 3, 2015 (ADAMS Accession No. ML15035A523), states that:

> high temperature conditions beyond those considered in the [The Areal Locations of Hazardous Atmospheres (ALOHA) code] ALOHA sensitivity analysis coupled with stable conditions conducive to high [atmospheric dispersion factor] X/Q (i.e., temperatures above 71.5 ^{o}F concurrent with stability class F or G) occur only approximately 1.6 percent of the total hours under consideration, regardless of wind speed and wind direction.
>
> Therefore, a broad range of conditions was simulated using a conservative approach to estimate control room concentrations, and to ensure the values presented are not exceeded more than 5 percent of the time as required by RG 1.78, Section C, 3.3.

As described, the applicant used conservative meteorological conditions in its dispersion analysis, and provided an atmospheric dilution that is exceeded only 5 percent of the time, consistent with RG 1.78. Therefore, the staff finds that the applicant's approach is consistent with RG 1.78, Section C.3.3, and therefore acceptable. Accordingly, RAI 06.04-8 is closed and resolved.

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 hazardous chemicals stored on-site, off-site or transported along offsite routes within 8 km (5 miles) of the plant (see the evaluation in Section 2.2.3 of this SER). Therefore, the staff concludes that the applicant adequately performed the required chemical screening in accordance with guidance of RG 1.78. In addition, based on the independent staff calculations described above and resolution of RAI 06.04-08, the staff confirmed that the applicant correctly estimated control room concentrations of toxic gases, and that those results are acceptable.

Supplemental Information

- NAPS SUP 6.4-1 System Safety Evaluation

The applicant provided additional information that states:

> The impact of a postulated design basis accident (DBA) in Units 1 or 2 on the Unit 3 control room was evaluated. The bounding case is a release from the Unit 2 RB to the Unit 3 Control Building receptor based on a minimum distance criterion. The evaluation was performed as follows:
>
> - Atmospheric dispersion factors, χ/Qs, at the Unit 3 MCR [main control room] intakes were conservatively calculated assuming a point source, a distance of approximately 400 m (1312 ft), and a release height of 10 m (32.8 ft). Meteorological data used for cross-unit impact is consistent with that used for the χ/Q values presented in Section 2.3. A nominal "receptor to source" direction of 60 degrees was assumed (clockwise with respect to "true north"). The χ/Q values are presented in Table 2.3-207.

- The Unit 2 LOCA as described in Section 15.4.1.8 of the Units 1 and 2 UFSAR [updated final safety analysis report] was reviewed. The resultant dose at the Unit 3 MCR intake was determined by adjusting the [low population zone] LPZ dose consequences by the ratio of the χ/Q values, and the ratio of the breathing rates (BR) for the LPZ versus the control room values. Detailed modeling of the Unit 3 control room was not performed because the doses are bounded by a postulated Unit 3 LOCA. No credit was taken for the reduced control room occupancy factor, the Unit 3 control room emergency filtration units, or the "finite cloud" model allowed per RG 1.194.

Based on this conservative analysis, the resultant dose is bounded by the control room operator dose from a postulated Unit 3 DBA, and is less than the GDC 19 limits. The staff reviewed this supplemental information added to Section 6.4 of the COLA. The staff has determined that the applicant correctly identified the relative locations of the accident release points on the unit at which an accident is postulated and the release and control room receptor locations for proposed North Anna 3. Since the latter form the basis for the DBA radiological consequences analysis for the control room at the North Anna 3, the staff has determined that the applicant calculations described above are conservative. Accordingly, the staff finds that the supplemental information, NAPS SUP 6.4-1, provided by the applicant adequately addresses the impact on Unit 3 control room habitability from a DBA at a nearby unit on the North Anna site by showing it is bounded by the dose in the Unit 3 control room from a DBA at Unit 3.

In view of the foregoing, the staff concludes that detailed modeling of the Unit 3 control room in the event of a Unit 1 or 2 DBA is not necessary because the doses are bounded by a postulated Unit 3 LOCA, as documented in Chapter 15 of the North Anna 3 FSAR and reviewed by the staff in Section 15.4 of this SER. Furthermore, simultaneous accidents at multiple units on a common site are considered to be outside the design basis, unless there is a reliance on shared systems between the units. This is not the case for the ESBWR design, which is referenced in the North Anna 3 COLA.

The staff's evaluation of the applicant's compliance with the control room habitability dose requirements of GDC 19 in the Unit 3 control room from a postulated Unit 3 DBA is documented in Section 15.4 of this SER.

In view of the above, the staff finds that the applicant's Supplemental Information NAPS SUP 6.4-1 is adequately addressed and therefore acceptable.

6.4.5 Post Combined License Activities

There are no post COL activities related to this section.

6.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. As described above, the staff confirmed that the applicant has addressed the additional outstanding information relating to control room habitability identified in the COL items in Section 6.4 of the DCD. In regard to the rest of Section 6.4 of the DCD, the staff confirmed that no outstanding information related to this section remains to be addressed in the North Anna 3 FSAR. Pursuant to 10 CFR 52.63(a)(5)

and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to control room habitability that were incorporated by reference have been resolved.

In addition, for the reasons set forth above, 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); and 10 CFR 52.80(a). This conclusion is also 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 GL 2003-01 and 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).

- NAPS COL 6.4-2-A is acceptable because the staff verified that an external release of hazardous chemicals will not impact control room habitability, in accordance with the requirements of 10 CFR 50.34(f)(2)(xxviii) and GDC 19.

- NAPS SUP 6.4-1 is acceptable because the staff finds that the impact of a postulated DBA in Units 1 or 2 on the Unit 3 control room is bounded by a postulated Unit 3 LOCA.

6.5 Atmospheric Cleanup Systems

As documented in NUREG-1966, the staff reviewed and approved Section 6.5, "Atmosphere Cleanup Systems," of the certified ESBWR DCD. Section 6.5 of the COL FSAR incorporated Section 6.5 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed Section 6.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to confirm that the combination of the information in the ESBWR DCD and 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 related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the atmospheric cleanup systems have been resolved.

6.6 Preservice and In-service Inspection and Testing of Class 2 and 3 Components and Piping

6.6.1 Introduction

In-service inspection (ISI) programs are based on the requirements of 10 CFR 50.55a, "Codes and Standards," in that for Code Class 1, 2 and 3 components, as defined in Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), an applicant is required to meet the applicable inspection requirements set forth in ASME BPVC Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components." ISI includes preservice examinations before initial plant startup, as required by IWB-2200 (for Class 1 components), IWC-2200 (for Class 2 components) and IWD-2200 (for Class 3 components) of ASME BPVC Section XI.

6.6.2 Summary of Application

Section 6.6, "Preservice and In-service Inspection and Testing of Class 2 and 3 Components and Piping," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.6 of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 6.6, the applicant provides the following:

COL Items

- STD COL 5.2-1-A — Preservice and In-service Inspection Program Description

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. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME BPVC 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).

- STD COL 6.6-1-A — Preservice Inspection and In-service Inspection Program for Class 2 and 3 components

The applicant provided additional information in STD COL 6.6-1-A to address COL Item 6.6-1-A. The applicant states that (a) the preservice inspection (PSI)/ISI program descriptions for Class 2 and 3 components and piping is in DCD Section 6.6, (b) no relief requests for PSI/ISI programs have been identified, (c) the initial ISI program will 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 load, and (d) the milestones for the PSI/ISI program implementation are in FSAR, Section 13.4.

The applicant also provided additional information in STD COL 6.6-1-A to address the flow acceleration corrosion (FAC) program. 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 material constituency identified for each as-fabricated piping component in the susceptible systems.

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

The applicant provided additional information in STD COL 6.6-2-A to address the accessibility and NDE of Class 1, 2, and 3 austenitic or dissimilar metal welds. The applicant stated that during the construction phase of the project, anomalies and construction issues will be addressed using the change control procedures. These procedures provide that changes to approved design documents, including field changes and modifications, be subject to the same review and approval process as the original design. Accessibility and inspectability are key components of the design process. The control of component accessibility for inspection and testing affecting Class 2 and 3 components during licensee design activities and during plant construction is provided via the procedures for design control and plant modifications. Ultrasonic techniques (UTs) will be the preferred NDE method for all PSI and ISI volumetric examinations; radiographic techniques (RTs) will be used only if UTs cannot achieve the necessary coverage. The same NDE method used during PSI will be used for ISI to the extent practical to assure a baseline point of reference. If a different NDE method is used for the ISI

than was used for the PSI, equivalent coverage will be achieved as required by the ASME Code.

6.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the staff FSER related to the certified ESBWR DCD. In addition, the relevant requirements of Commission regulations for the PSI/ISI for Class 2 and 3 components, and the associated acceptance criteria, are stated in SRP Section 6.6.

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

- 10 CFR 50.55a

The related acceptance criteria are as follows:

- ASME BPVC Section XI

The basis for review of the supplementary information submitted in response to COL information items on the ISI of Class 2 and 3 Components is established in 10 CFR 50.55a, as it pertains to the specification of the PSI, ISI, and testing requirements of the ASME Code for Class 2 and 3 components. Review of the description of the FAC program is based on addressing the concerns described in GL 1989-008, "Erosion/Corrosion-Induced Pipe Wall Thinning," dated May 2, 1989, as they pertain to establishing an erosion-corrosion monitoring program. SRP Section 10.3.6, "Steam and Feedwater System Materials," discusses the need for a FAC program and identifies acceptance criteria.

6.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 6.6 of the certified ESBWR DCD. The staff reviewed Section 6.6 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to confirm 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 the information in the application and the information incorporated by reference include all the information related to the PSI, ISI, and testing of Class 2 and 3 components required in an application.

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, "In-service Inspection of Class 2 and 3 Components." The staff determined that FSAR Section 6.6 incorporates by reference Section 6.6 of the ESBWR DCD. The specific version of ASME BPVC Section XI that is used as the baseline Code in the ESBWR certified design is the 2001 edition, up to and including the 2003 addenda. 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. North Anna COL FSAR Section 6.6 states that the PSI/ISI program descriptions for Class 2 and 3 components and piping are in ESBWR DCD Tier 2, Section 6.6. Therefore, the staff's conclusions remain unchanged with regard to the acceptability of the ESBWR ISI program based on the 2001 edition, up to and including the 2003 addenda of ASME BPVC Section XI with regard to the preservice and in-service 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 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 focuses on the acceptability of the COLA supplemental information and responses to the ESBWR COL items as they relate to the ISI of ASME Code Class 2 and 3 components.

The staff also considered whether Section 6.6 of the FSAR conforms to the guidance in RG 1.206, Section C.III.1, Chapter 10, C.I.10.3.6, "Steam and Feedwater System Materials," as it relates to developing an FAC monitoring program to address GL 1989-008, which is discussed in ESBWR DCD Section 6.6 and documented in NUREG-1966, Section 6.6. SRP Section 10.3.6 contains the acceptance criteria used by the staff to evaluate FSAR Section 6.6 as it relates to the FAC program. The SRP indicates that conformance with Electric Power Research Institute (EPRI) NSAC 202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," dated April 8, 1999, is adequate for this purpose and that the implementation of a FAC program consistent with EPRI NSAC 202L-R2 addresses staff concerns identified in GL 1989-008. The applicant has included a license condition to implement a FAC program before commercial service as outlined in Operational Programs Table 13.4-201, "Operational Programs Required by NRC Regulations," in FSAR Part 10, Section 3.6, "Operational Programs Readiness."

The staff reviewed the following information in the North Anna 3 COL FSAR:

- STD COL 5.2-1-A — Preservice and In-service Inspection Program Description

In FSAR Section 6.6, the applicant provided additional information in STD COL 5.2-1-A to address pressure testing for Class 2 and 3 components. The staff addresses this information in Section 5.2.4 of this SER including the limitations under 10 CFR 50.55a. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME BPVC 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).

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

- STD COL 6.6-1-A — Preservice Inspection and In-service Inspection Program Information

The COL applicant provided a full description of the PSI/ISI programs and the 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 in FSAR Section 13.4.

This COL item is addressed in the FSAR, in part, by replacing the last sentence and the parenthetical statement in 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 evaluated in Section 5.2.4 of the staff's SER on the ESBWR DCD (NUREG–1966). Though Section 6.6

applies to Class 2 and 3 components, the augmented ISI programs that protect against postulated piping failures and the erosion/corrosion of piping include portions of the PSI/ISI programs and include Class 1 components. This topic is discussed in Section 5.2.4 of this SER. Since the staff evaluated the PSI/ISI program for Class 1, 2, and 3 components and the implementation milestones and finds them acceptable as discussed under Section 5.2.4 of this SER, the staff concludes that this portion of STD COL 6.6-1-A is acceptable for Section 6.6 of this SER. The augmented inspection program to address the applicant's FAC program is discussed below.

The staff previously documented its review of the applicant's FAC program in Section 10.3 of the Phase 2 North Anna SER (ADAMS Accession No. ML091520434) because its placement in SER Section 10.3.6 is consistent with the SRP, which provides the FAC acceptance criteria in SRP Section 10.3.6 as noted above. However, the staff has determined that the evaluation of the FAC program is more appropriately addressed in this Section of the SER because the FAC program is addressed in North Anna FSAR Section 6.6, ESBWR DCD Section 6.6, and NUREG-1966, Section 6.6.

STD COL 6.6-1-A also provides supplemental information related to the applicant's FAC program. The staff reviewed the information provided by the applicant in Section 6.6.7.1 of the North Anna 3 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."

On June 5, 2008, in RAI 10.03.06-1 and 10.03.06-2 (ADAMS Accession No. ML081580132) the staff requested detailed FAC program information (e.g., FAC program activities that will be conducted during the plant construction phase and the schedule for those activities) and requested that the applicant 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 ISI according to industry guidelines. In its response dated July 14, 2008 (ADAMS Accession No. 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 ESBWR DCD Revision 5, COL Item 6.6-1-A. The proposed description of the FAC program includes a statement that the North Anna 3 FAC program will be based on EPRI NSAC 202L-R2. The response also states that preservice, baseline, and NDE will be performed on as-fabricated components in susceptible systems and that these PSIs 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's 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 PSI by adding a description of the PSI plan to the FSAR, including the affirmation that locations and

measurement methods used for PSI will be those most likely to be used in subsequent inspections.

The staff reviewed the FAC program information provided in FSAR, Revision 1, Section 6.6.7.1 and Table 13.4-201 and confirmed that the proposed modifications in the applicant's July 14, 2008 RAI response were incorporated into the FSAR. The inclusion of the FAC program in Chapter 13 as an operational program addresses the concerns discussed above regarding PSI requirements. Therefore, the staff finds the information on the FAC program acceptable.

Based on the information described above, the staff finds that the FAC program is acceptable because it is consistent with the guidance provided in EPRI NSAC 202-L-R2 and addresses the concerns described in GL 1989-008 as they pertain to establishing an erosion-corrosion monitoring program. Therefore STD COL 6.6-1-A is acceptable.

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

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 SER and, for the reasons stated in that section, are acceptable to the staff. Accordingly, STD COL 6.6-2-A is acceptable.

6.6.5 Post Combined Operating License Activities

In FSAR Table 13.4-201, the applicant provided the implementation milestones for the PSI/ISI programs. The staff's evaluation of the operational program aspects of the PSI and ISI programs for ASME Class 1, 2, and 3 components is described in Section 5.2.4 of this SER. As discussed in SER Section 5.2.4, the staff has identified the following license condition related to the PSI/ISI programs:

> License Condition 5.2.4-1
>
> The licensee shall submit to the Director of Office of New Reactors, NRC, or the Director's designee, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in 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 the operational programs in the FSAR table have been fully implemented.

As stated in this SER, Section 5.2.4, the staff will inspect the North Anna 3 PSI and ISI programs during construction to ensure that the implementation of these operational programs will be consistent with the COL FSAR and the requirements of 10 CFR 50.55a.

6.6.6 Conclusion

The staff's findings related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to PSI/ISI of Class 2 and 3 components and piping, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to "Preservice and in-service inspections and testing of Class 2 and 3 Components and Piping: that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in Section 6.6 of the SRP, and other NRC RGs. For the reasons set forth above, the staff concludes that the information to address COL Items 5.2.1-A, 6.6-1-A, and 6.6-2-A, as provided in Section 6.6 of the North Anna COL FSAR, meet the relevant guidelines in Sections 6.6 and 10.3.6 of the SRP and are therefore acceptable. Conformance with these guidelines provides an acceptable basis for satisfying, in part, the requirements of 10 CFR 50.55a and the guidance in GL 1989-008 in regard to PSI/ISI programs.

References

1. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

2. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

3. 10 CFR 50.34b, "Final safety analysis report."

4. 10 CFR 50.34f, "Additional TMI-related requirements."

5. 10 CFR 50.55a, "Codes and Standards,"

6. 10 CFR 52.63, "Finality of standard design certification."

7. 10 CFR 52.80, "Contents of applications; additional technical information."

8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

10. 10 CFR Part 50, Appendix A, GDC 19, "Control room."

11. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."

12. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

13. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

14. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

15. ASME Boiler and Pressure Code (BPVC).

16. ASME, BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

17. ASME, BPVC, Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

18. ASME, BPVC, Section XI, Subsection IWA, "General Requirements," 2001 Edition, 2003 Addenda.

19. ASME, BPVC, Section XI, Subsection IWA, IWA-5000, "System Pressure Tests"

20. ASME, BPVC, Section XI, Subsection IWA-2300, "Qualifications of Nondestructive Examination Personnel"

21. ASME, BPVC, Section XI, Subsection IWA-5000, "System Pressure Tests."

22. ASME, BPVC, Section XI, Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Plants," 2001 Edition, 2003 Addenda.

23. ASME, BPVC, Section XI, Subsection IWB-2200, "Preservice Examination."

24. ASME, BPVC, Section XI, Subsection IWB-2500, "Examination and Pressure Test Requirements."

25. ASME, BPVC, Section XI, Subsection IWC, "Requirements for Class 2 Components of Light-Water Cooled Plants" 2001 Edition, 2003 Addenda.

26. ASME, BPVC, Section XI, Subsection IWC-2200, "Preservice Examination."

27. ASME, BPVC, Section XI, Subsection IWC-5000, "System Pressure Tests."

28. ASME, BPVC, Section XI, Subsection IWD, "Requirements for Class 3 Components of Light-Water Cooled Plants" 2001 Edition, 2003 Addenda.

29. ASME, BPVC, Section XI, Subsection IWD-2200, "Preservice Examination."

30. ASME, BPVC, Section XI, Subsection IWD-5000, "System Pressure Tests."

31. EPRI NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," April 8, 1999.

32. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

33. NRC Generic Safety Issues: Issue GI 83, Control Room Habitability (Rev. 3) (NUREG 0933, Main Report with Supplements 1-34).

34. NRC GL 1989-008, "Erosion/Corrosion-Induced Pipe Wall Thinning," May 2, 1989. (ADAMS Accession No. ML031200731).

35. NRC GL 2003-01, "Control Room Habitability," June 12, 2003. (ADAMS Accession No. ML031620248).

36. NRC RG 1.196, Revision 1, "Control Room Habitability at Light-Water Nuclear Power Reactors," January 2007. (ADAMS Accession No. ML063560144).

37. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007. (ADAMS Accession No. ML070720184).

38. NRC RG 1.52, Revision 1, "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," July 1976. (ADAMS Accession No. ML13350A197).

39. NRC RG 1.78, Revision1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," December 2001 (ADAMS Accession No. ML013100014).

40. NRC RG 1.94, Revision 1, "Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants," April 1976 (ADAMS Accession No. ML003740305).

41. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

42. NRC Staff NUREG-0933, "Resolution of Generic Safety Issues (Formerly Entitled 'A Prioritization of Generic Safety Issues')," August 2008. (ADAMS Accession No. ML082410719).

43. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).