6 ENGINEERED SAFETY FEATURES

6.0 Engineered Safety Features

Engineered safety features (ESF) are design features designed to preclude an accidental release of reactor fission products or to protect the public in the event of an accidental release from the reactor coolant system (RCS). The function of the ESF is to localize, control, mitigate, and terminate such accidents, and to maintain radiation exposure levels to the public below applicable limits and guidelines. William States Lee III Nuclear Station, Units 1 and 2, (WLS), combined license (COL) Final Safety Analysis Report (FSAR), Revision 11, Section 6.0, incorporates by reference with no departures or supplements, AP1000 Design Control Document (DCD), Revision 19, Section 6.0, "Engineered Safety Features." . The U.S. Nuclear Regulatory Commission (NRC) staff (the staff) reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The staff confirmed that there are no outstanding issues related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements.

6.1 Engineered Safety Features Materials

This section of the report provides the evaluation of the materials used in the fabrication of ESF components and of the provisions to avoid material interactions that could impair the operation of the ESF. The design information in WLS COL FSAR Section 6.1, is divided into two sections, Section 6.1.1, "Metallic Materials"; and Section 6.1.2, "Organic Materials." The staff's evaluation of these sections is provided below.

6.1.1 Metallic Materials

6.1.1.1 *Introduction*

In this section of the report, the staff reviewed metallic materials used in ESF components to ensure that they are compatible with one another and with ESF fluids. The compatibility of ESF component materials with fluids in ESF systems should ensure that there is a low probability of causing abnormal leakage, of rapidly propagating failure, and of gross rupture of reactor coolant pressure boundary components. Metallic materials and fluids should also be compatible with the auxiliary systems that directly support ESF systems.

[1] See Section 1.2.2 of this report for a discussion of the staff's review related to verification of the scope of information to be included in a COL application that references a design certification (DC).

6.1.1.2 *Summary of Application*

WLS COL FSAR, Revision 11, Section 6.1, incorporates by reference AP1000 DCD, Revision 19, Section 6.1. In addition, in WLS COL FSAR Section 6.1.1, the applicant provided the following:

AP1000 COL Information Item

- STD COL 6.1-1

The applicant provided information in Standard (STD) COL 6.1-1 to resolve AP1000 COL Information Item 6.1-1. STD COL 6.1-1 describes quality assurance measures for special processes in fabricating austenitic stainless steels. STD COL 6.1-1 is discussed in WLS COL FSAR Sections 6.1.1.2, Fabrication Requirements," and 6.1.3.1, "Procedure Review."

6.1.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. The acceptance criteria associated with the relevant requirements of NRC regulations for the metallic materials are given in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 6.1.1. This reference will be referred to in this report as the SRP.

The regulatory basis for the AP1000 COL information item is Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," as it relates to the quality assurance requirements for the design, fabrication, and construction of safety-related structures, systems, and components (SSCs). Guidance used in the review of this COL information item is described in Regulatory Guide (RG) 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal," Revision 3, and RG 1.44, "Control of the Use of Sensitized Stainless Steel."

6.1.1.4 *Technical Evaluation*

The staff reviewed WLS COL FSAR Section 6.1.1, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to metallic materials. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review to evaluate subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the safety evaluation report (SER) for the Vogtle (VEGP) reference COL (RCOL) application were equally applicable to the WLS COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from responses to requests for additional information (RAIs).

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed and that those changes were actualized in the WLS COL FSAR.

- The staff verified that the site-specific differences, if any, did not adversely affect any previous relevant evaluation or conclusion.

The staff completed its review and concluded that the evaluation performed for the standard content is directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the Bellefonte Nuclear Plant, Units 3 and 4 (BLN), COL application.

The following portion of this technical evaluation section is reproduced from the VEGP SER Section 6.1.1.4:

COL Information Item

- *STD COL 6.1-1*

The NRC staff reviewed STD COL 6.1-1 related to COL Information Item 6.1-1 included under Section 6.1.1.2 of the BLN COL FSAR, which addresses the COL information item identified in AP1000 DCD Section 6.1.3.1 related to the fabrication requirements for austenitic stainless steel.

The COL information item identified in AP1000 DCD Section 6.1.3.1 states:

> *The Combined License applicants referencing the AP1000 will address review of vendor fabrication and welding procedures or other quality assurance methods to judge conformance of austenitic stainless steels with Regulatory Guides 1.31 and 1.44.*

This commitment was also documented as COL Action Item 6.1.1-1 in the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant will review vendor fabrication and welding procedures or other quality assurance methods to ensure that austenitic stainless steels meet the guidelines of RGs 1.31 and 1.44.*

The COL information in the FSAR that is to be added to AP1000 DCD Section 6.1.1.2 states:

In accordance with Appendix B to 10 CFR Part 50, the quality assurance program establishes measures to provide control of special processes. One element of control is the review and acceptance of vendor procedures that pertain to the fabrication, welding, and other quality assurance methods for safety related component [sic] to determine both code and regulatory conformance. Included in this review and acceptance process are those vendor procedures necessary to provide conformance with the requirements of Regulatory Guides 1.31 and 1.44 for engineered safety features components as discussed in DCD Section 6.1 and reactor coolant system components as discussed in DCD Section 5.2.3.

The staff finds the COL information provided by the applicant meets the quality assurance guidelines for austenitic stainless steels specified in RG 1.31 (weld metal ferrite content) and RG 1.44 (the use of sensitized stainless steel). The staff's conclusion is based on the applicant's statement affirming that its Appendix B quality assurance program will address the concerns of these RGs. It is also based on Appendix 1A of the AP1000 DCD, as modified by a letter dated April 7, 2010, from the AP1000 applicant. The modified DCD appendix will be incorporated by reference in a future version of the BLN COL FSAR and will indicate full conformance with these RGs. In addition, the discussions in AP1000 DCD Sections 6.1.1.2 and 5.2.3.4 provide details about how conformance will be accomplished.

6.1.1.5 *Post Combined License Activities*

There are no post COL activities related to this section.

6.1.1.6 *Conclusion*

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to metallic materials used in ESF and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

The staff concludes that the relevant information presented in the WLS COL FSAR is acceptable because it meets the requirements of 10 CFR Part 50, Appendix B, and the guidance provided in RG 1.31 and RG 1.44. STD COL 6.1-1 is acceptable because the Appendix B quality assurance program proposed by the applicant provides adequate controls over vendor fabrication and welding procedures to ensure that austenitic stainless steels meet the guidelines of RG 1.31 and RG 1.44.

6.1.2 Organic Materials

6.1.2.1 *Introduction*

Protective coatings are applied for corrosion prevention to the interior and exterior surfaces of the containment vessel, radiologically controlled areas outside containment, and the remainder of the plant. The coatings selection process accounts for these differing coating needs for these four areas. The AP1000 design considers the function of the coatings, their potential failure modes, and their requirements for maintenance. Other organic materials that may be present in the containment are associated with the specific type of equipment and the supplier selected to provide it. Materials are evaluated for potential interaction with the ESF to provide confidence that the performance of the ESF is not unacceptably affected.

6.1.2.2 *Summary of Application*

WLS COL FSAR, Revision 11, Section 6.1, incorporates by reference the AP1000 DCD, Revision 19, Section 6.1. AP1000 DCD Section 6.1 includes Section 6.1.2. In addition, in WLS COL FSAR, Section 6.1.2, the applicant provided the following:

AP1000 COL Information Item

- STD COL 6.1-2

The applicant provided information in STD COL 6.1-2 to resolve AP1000 COL Information Item 6.1-2. STD COL 6.1-2 discusses a program to control procurement, application, inspection, and monitoring of Service Level I and Service Level III coatings. This COL information item is discussed in WLS COL FSAR Sections 6.1.2.1.6, "Quality Assurance Features," and 6.1.3.2, "Coating Program." In a March 31, 2010, letter, the AP1000 DCD applicant (Westinghouse) proposed revisions to AP1000 COL Information Item 6.1-2 in AP1000 DCD Section 6.1.3.2, to address Service Level II coatings. In a March 24, 2011, letter the WLS COL applicant endorsed the VEGP August 13, 2010 letter, respectively, that proposed revising the FSAR to address the updated AP1000 COL Information Item 6.1-2.

6.1.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. The acceptance criteria associated with the relevant requirements of NRC regulations for protective coatings are given in NUREG-0800, Section 6.1.2. The applicable regulatory basis for the resolution of the COL information item is 10 CFR Part 50, Appendix B, as it relates to the quality assurance requirements for the design, fabrication, and construction of safety-related SSCs. Guidance for the resolution of the COL information item is described in RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," Revision 1.

6.1.2.4 *Technical Evaluation*

The staff reviewed WLS COL FSAR Section 6.1.2, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the

application and incorporated by reference addresses the required information relating to protective coatings and other organic materials inside containment. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

The staff completed its review and concluded that the evaluation performed for the standard content is directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the BLN COL application. Although the staff concluded that the evaluation performed for the standard content is directly applicable to the WLS COL application, there is a difference in how the VEGP applicant addressed STD COL 6.1-2 and how the BLN applicant addressed this review item. This difference, which is based on a change proposed in the AP1000 DCD, is evaluated by the staff below, following the standard content material for STD COL 6.1-2. The two confirmatory items in the standard content material retain the number assigned in the VEGP SER, and are also addressed in the standard content material.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 6.1.2.4:

AP1000 COL Information Item

- *STD COL 6.1-2*

The NRC staff reviewed STD COL 6.1-2 included under Section 6.1.2.1.6 of the BLN COL FSAR related to COL Information Item 6.1-2. COL Information Item 6.1-2 states:

> *The Combined License applicants referencing the AP1000 will provide a program to control procurement, application, and monitoring of Service Level I and Service Level III coatings. The program for the control of the use of these coatings will be consistent with [DCD] subsection 6.1.2.1.6.*

This commitment was also captured as COL Action Item 6.1.2-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant will prepare a program to control procurement, application, and monitoring of Service Level I and Service Level III coatings.*

The added information in the BLN COL FSAR replaces the third paragraph under the section titled, "Service Level I and Service Level III Coatings," in AP1000 DCD Section 6.1.2.1.6 with the following:

> *During the design and construction phase the coatings program associated with selection, procurement and application of safety related coatings is performed to applicable quality standards. Regulatory Guide 1.54 and [American Society for Testing and*

Materials] ASTM D5144 form the basis for the coating program. During the operations phase, the coatings program is administratively controlled in accordance with the quality assurance program implemented to satisfy 10 CFR Part 50, Appendix B, and 10 CFR Part 52 requirements. The coatings program provides direction for the procurement, application, and monitoring of safety related coating systems. Coating system monitoring requirements for the containment coating systems are based on ASTM D5163, "Establishing Procedures to Monitor the Performance of Coating Service Level I Coating Systems in an Operating Nuclear Power Plant," and ASTM D7167, "Establishing Procedures to Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant." Any anomalies identified during coating monitoring are resolved in accordance with applicable quality assurance requirements.

The AP1000 DCD, which the applicant incorporates by reference, includes the following description of the quality assurance program:

The quality assurance program for Service Level I and Service Level III coatings conforms to the requirements of [American Society of Mechanical Engineers] ASME NQA-1-1983 as endorsed in Regulatory Guide 1.28 ["Quality Assurance Program Criteria (Design and Construction)"]. Safety related coatings meet the pertinent provisions of 10 CFR Part 50 Appendix B to 10 CFR Part 50. The service level classification of coatings is consistent with the positions given in Revision 1 of Regulatory Guide 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants." Service Level I and Service Level III coatings used in the AP1000 are tested for radiation tolerance and for performance under design basis accident conditions. Where decontaminability is desired, the coatings are evaluated for decontaminability. The coating applicator submits and follows acceptable procedures to control surface preparation, application of coatings and inspection of coatings. The painters are qualified and certified, and the inspectors are qualified and certified.

The inorganic zinc coating used on the inside surface (Service Level I coatings) and outside surface (Service Level III coatings) of the containment shell is inspected using a non-destructive dry film thickness test and a MEK rub test. These inspections are performed after the initial application and after recoating. Long term surveillance of the coating is provided by visual inspections performed during refueling outages. Other inspections are not required.

Section 6.1.2 of NUREG-0800 references RG 1.54 as providing an acceptable method of complying with the quality assurance requirements in regard to protective coatings applied to ferritic steels, aluminum, stainless steel,

zinc-coated (galvanized) steel, concrete, or masonry surfaces of nuclear facilities. RG 1.54 lists a number of ASTM standards that provide guidance on practices and programs that are acceptable to the NRC staff for the selection, application, qualification, inspection, and maintenance of protective coatings applied in nuclear power plants. Section 6.1.2 of NUREG-0800 also states that a coating system to be applied inside the containment vessel is acceptable if it meets the regulatory positions of RG 1.54 and the standards of ASTM D5144-00 and ASTM D3911-03. By contrast, the AP1000 DCD references RG 1.54, but only with respect to classification of coating service level as I, II, or III.

The AP1000 DCD text to be replaced with the COL information item stated that the procurement, application, and monitoring of Service Level I and Service Level III coatings are controlled by a program prepared by the COL applicant The information provided clarified that the applicant's coatings program, with respect to procurement, application, inspection, and monitoring, will be consistent with the recommendations of RG 1.54, which is endorsed in Section 6.1.2 of NUREG-0800 as an acceptable method of meeting the quality assurance requirements of 10 CFR Part 50, Appendix B for safety-related and nonsafety-related coatings. However, the information provided by the applicant to resolve the COL information item merely states that the protective coatings program complies with RG 1.54, when, in fact, the program was not yet developed. Therefore, the COL applicant had not provided a coatings program as committed in COL Information Item 6.1-2.

To resolve this issue, in request for additional information (RAI) 6.1.2-1, the staff requested the following information:

1. *The applicant should describe the standards to be applied to maintenance of the protective coatings in the program description. The description of the proposed coatings program should also describe the standards to be applied to selection and qualification of coatings, if the applicant intends to use coatings systems different than those described in the AP1000 DCD, either during construction or after plant operation commences.*

2. *The program description should describe the administrative controls that will be applied to the coatings program.*

3. *Provide the schedule for full implementation of the coatings program with respect to major milestones in the construction of the plant; for example, prior to application of coatings, prior to preparation of surfaces to be coated, or prior to procurement of coatings materials.*

In a letter dated May 23, 2008, the applicant provided the following response:

Item 1) The coating program will be based on Revision 1 of RG 1.54 and the referenced ASTM standards in ASTM D5144. Also, the guidance provided in ASTM D5163, "Establishing Procedures to Monitor the Performance of Coating Service Level I Coating Systems in an Operating

Nuclear Power Plant," and in ASTM D7167, "Establishing Procedures to Monitor the Performance of Coating Service Level III Coating Systems in an Operating Nuclear Power Plant," will be used to specify monitoring (maintenance) requirements for the safety-related coating systems pertaining to containment. While a change in coating systems (from those described in the AP1000 DCD) is not anticipated, if a different safety-related coating system is needed, it will be evaluated in accordance with the appropriate change process, i.e., 10 CFR 50.59 or 10 CFR Part 52, Appendix D, Section VIII.

Item 2) FSAR Section 6.1.3.2, Coating Program, will be revised to indicate compliance with 10 CFR Part 50, Appendix B, and 10 CFR Part 52 requirements implemented by the quality assurance program for the plant (see FSAR Chapter 17 and Part 11 of the COL application) for design, construction, and operation of the units.

Item 3) During the design and construction phase, the requirements for the coating program will be contained in certified drawings and/or standards and specifications controlling the coating processes of the designer (Westinghouse); these design documents will be available prior to the procurement and application of the coating material by the constructor of the plant. Prior to initial fuel loading, a consolidated plant coating program will be in place to address procurement, application, and monitoring (maintenance) of those coating system(s) for the life of the plant.

The staff finds the applicant's response to Item 1 acceptable because, pursuant to RG 1.54, ASTM D5163 provides guidelines that are acceptable to the NRC staff for establishing an in-service coatings monitoring program for Service Level I coating systems in operating nuclear power plants and for Service Level II and other areas outside containment (as applicable). The applicant also specified ASTM D7167 for monitoring (maintenance) requirements for the safety-related coating systems pertaining to containment. Although ASTM D7167 is not listed in RG 1.54 or ASTM D5144, the staff finds it an appropriate standard because it addresses maintenance of Service Level III coatings. Additionally, ASTM D7167 references ASTM D4541 and ASTM D3359, which are listed in RG 1.54 as acceptable standards for maintenance of protective coatings in nuclear power plants. Further, if a change in any of the originally specified coatings systems is necessary, the applicant will use an appropriate process, either the 10 CFR 50.59 or 10 CFR Part 52, Appendix D, Section VIII process, to evaluate the change. The staff finds the application of these regulations an appropriate alternative to control of the selection of coatings by the consolidated coatings program.

The BLN application references later versions of ASTM D5144 and ASTM D5163 than those referenced in RG 1.54, Revision 1. The use of the 2008 revision of ASTM D5144 is acceptable because it provides detailed requirements through reference to other coatings standards applicable to BLN. In this regard, it is not changed with respect to the 2000 revision referenced in the RG 1.54, Revision 1.

Similarly, the 2005 revision of ASTM D5163 is referenced in the BLN COL application rather than the 1996 revision referenced in RG 1.54, Revision 1. The staff finds this acceptable because the NRC staff has accepted the 2005 revision of ASTM D5163 as the basis for the Aging Management Program XI.S8 in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Volume 2, Revision 2 (license renewal). With respect to simulated design-basis accident qualification testing for coatings, the staff notes that the applicable version of ASTM D3911 is the 1995 revision, as indicated in Appendix 1A of the AP1000 DCD.

In response to Item 2, the applicant stated that the administrative controls spelled out in its Quality Assurance Program Document (QAPD) will be applied to the coatings program. The staff finds that this will ensure compliance with the requirements of 10 CFR Part 50, Appendix B, which is a regulatory acceptance criterion of Section 6.1.2 of NUREG-0800. However, the staff notes that the QAPD references ASME NQA-1-1994 as an acceptable means to implement the requirements of 10 CFR Part 50, Appendix B, rather than ASME NQA-1-1983 as referenced by AP1000 DCD Section 6.1.2.1.6. ASME NQA-1-1994 is used as the basis for NUREG-0800 Section 17.5, "Quality Assurance Program Description - Design Certification, Early Site Permit and New License Applicants," which is applicable to the quality assurance program for a COL. Therefore, the staff finds the use of ASME NQA-1-1994 acceptable with respect to quality assurance requirements for coatings.

The staff finds the response to Item 3 acceptable because the applicant indicated the consolidated plant coating program will be in place to address procurement, application, and monitoring (maintenance) of those coating system(s) for the life of the plant, prior to initial fuel loading. During the construction phase, the requirements for the coating program will be contained in certified drawings and/or standards and specifications controlling the coating processes, which meets the requirements of 10 CFR Part 50, Appendix B, Criterion III with respect to design control and instructions, Criterion IV with respect to procurement document control, and Criterion V with respect to procedures and drawings.

The applicant also provided proposed changes to BLN COL FSAR Section 6.1.2.1.6 to incorporate the information included in the response to RAI 6.1.2-1. The staff confirmed that FSAR Section 6.1.2.1.6 has been revised to include information on the quality assurance program. However, since the information proposed to be added does not include the detailed information on control of coatings during the design and construction phase, the staff identified Open Item 6.1.2-1 to ensure that BLN COL FSAR Section 6.1.2.1.6 is revised to include the information from the response to RAI 6.1.2-1, Item 3, related to control of the coating program during the design and construction phase and the schedule for full implementation of the consolidated coatings program.

Resolution of Standard Content Open Item 6.1.2-1

Standard Content Open Item 6.1.2-1 was identified by the staff because the information the BLN applicant provided about the control of coatings during the

design and construction phase, although acceptable, was not included in the BLN COL FSAR. In the July 2, 2010, letter, the VEGP applicant proposed inserting the three paragraphs below in Section 6.1.2.1.6 of the VEGP FSAR. These paragraphs would replace the third paragraph under "Service Level I and Service Level III Coatings" in DCD Section 6.1.2.1.6.

> *During the design and construction phase, the coatings program associated with selection, procurement and application of safety related coatings is performed to applicable quality standards. The requirements for the coatings program are contained in certified drawings and/or standards and specifications controlling the coating processes of the designer (Westinghouse) (these design documents will be available prior to the procurement and application of the coating material by the constructor of the plant). Regulatory Guide 1.54 and ASTM D5144 ([FSAR] Reference 201) form the basis for the coatings program.*
>
> *During the operations phase, the coatings program is administratively controlled in accordance with the quality assurance program implemented to satisfy 10 CFR Part 50, Appendix B, and 10 CFR Part 52 requirements. The coatings program provides direction for the procurement, application, inspection, and monitoring of safety related coating systems. Prior to initial fuel loading, a consolidated plant coatings program will be in place to address procurement, application, and monitoring (maintenance) of those coating system(s) for the life of the plant.*
>
> *Coating system monitoring requirements for the containment coating systems are based on ASTM D5163 ([FSAR] Reference 202), "Standard Guide for Establishing Procedures to Monitor the Performance of Coating Service Level I Coating Systems in an Operating Nuclear Power Plant," and ASTM D7167 ([FSAR] Reference 203), "Standard Guide for Establishing Procedures to Monitor the Performance of Safety-Related Coating Service Level III Lining Systems in an Operating Nuclear Power Plant." Any anomalies identified during coating inspection or monitoring are resolved in accordance with applicable quality assurance requirements.*

As discussed above in the portion of the staff's evaluation reproduced from Section 6.1.2.4 of the BLN SER, the staff found the COL information related to control of coatings during the design and construction phase acceptable. The staff finds that the FSAR revisions proposed above are consistent with the information reviewed for the BLN SER and applicable to VEGP. Therefore, the staff finds the FSAR revisions proposed in the July 2, 2010, letter, acceptable for closing Open Item 6.1.2-1. The incorporation of these proposed revisions is being tracked as Confirmatory Item 6.1-1.

Resolution of Standard Content Confirmatory Item 6.1-1

Confirmatory Item 6.1-1 is an applicant commitment to revise its FSAR Section 6.1.2.1.6 to provide information regarding Service Level I and Service Level III coatings. The Staff verified that the VEGP COL FSAR was appropriately revised. As a result, Confirmatory Item 6.1-1 is now closed.

Evaluation of Additional Design Information

As discussed above, AP1000 DCD Section 6.1.3.2 requires the COL applicants to provide a program for procurement, application, and monitoring of Service Level I and Service Level III coatings consistent with DCD Section 6.1.2.1.6. However, DCD Section 6.1.2.1.6 also states that COL applicants will also address the program for Service Level II coatings, and that coatings programs for Service Level I, II, and III will include inspection. Therefore, in a letter dated March 31, 2010, the AP1000 DCD applicant proposed the following revision to DCD Section 6.1.3.2:

> *The Combined License applicants referencing the AP1000 will provide programs to control procurement, application, inspection, and monitoring of Service Level I, Service Level II, and Service Level III coatings. The programs for the control of the use of these coatings will be consistent with subsection 6.1.2.1.6.*

In letters dated July 2 and August 13, 2010, the VEGP applicant addressed the addition of Service Level II to the COL information item by proposing the following additions to Section 6.1.2.1.6 of the VEGP COL FSAR. The first is a new second paragraph under "Service Level II Coatings" in DCD Section 6.1.2.1.6.

> *Such safety-related Service Level II coatings used inside containment are procured to the same standards as Service Level I coatings with regard to radiation tolerance and performance under design basis accident conditions as discussed below.*

The second addition replaces the second sentence of the third paragraph under "Service Level II Coatings" in DCD Section 6.1.2.1.6.

> *Coating system application, inspection, and monitoring requirements for the Service Level II coatings used inside containment will be performed in accordance with a program based on ASTM D5144 ([FSAR] Reference 201), "Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants," and the guidance of ASTM D5163 ([FSAR] Reference 202), "Standard Guide for Establishing Procedures to Monitor the Performance of Coating Service Level I Coating Systems in an Operating Nuclear Power Plant." Any anomalies identified during coating inspection or monitoring are resolved in accordance with applicable quality requirements.*

The NRC staff finds it acceptable to procure Service Level II coatings in containment to the same standards as Service Level I coatings because the staff, through RG 1.54, has endorsed the use of these standards to procure safety-related coatings inside containment. The staff also finds it acceptable to use ASTM D5144 and D5163 as a basis for application, inspection, and monitoring requirements for Service Level II coatings. As discussed in RG 1.54, ASTM D5144 is a top-level standard that provides general guidance on coating programs and detailed guidance by reference to other ASTM standards. Since it contains a single set of application requirements for all coatings, the staff finds it an acceptable basis for Service Level II coatings application and inspection. The staff finds ASTM D5163 acceptable for monitoring Service Level II coatings in containment because the use of ASTM D5163 conforms to the guidance in RG 1.54 for monitoring the performance of safety-related (Service Level I) coatings in containment, and there is no separate standard for Service Level II coatings. The incorporation of the proposed revisions to address Service Level II coatings into a future revision of the VEGP COL FSAR is being tracked as Confirmatory Item 6.1-2

Resolution of Standard Content Confirmatory Item 6.1-2

Confirmatory Item 6.1-2 is an applicant commitment to revise its FSAR Section 6.1.2.1.6 to provide information regarding the procurement of Service Level II coatings. The staff verified that the VEGP COL FSAR was appropriately revised. As a result, Confirmatory Item 6.1-2 is now closed.

6.1.2.5 *Post Combined License Activities*

There are no post COL activities related to this section.

6.1.2.6 *Conclusion*

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to protective coatings and other organic materials inside containment, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements. The staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the requirements of 10 CFR Part 50, Appendix B, and the guidance provided in RG 1.54, Revision 1. STD COL 6.1-2 is acceptable because the coating program meets a 10 CFR Part 50, Appendix B, quality assurance program, with the additional guidance provided in RG 1.54, Revision 1, and provides adequate controls over the programs to control procurement, application, inspection, and monitoring of Service Level I, Service Level II, and Service Level III coatings.

6.2 Containment Systems

6.2.1 Introduction

The containment systems (CSs), which include the primary containment, passive cooling system (heat removal system), isolation system, hydrogen control system, and leak rate test system, are discussed in this section. The containment encloses the reactor system and is 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 break, or feed water line break accidents. The containment structure must also maintain functional integrity in the long term following a postulated accident (i.e., it must remain a low leakage barrier against the release of fission products for as long as postulated accident conditions require).

6.2.2 Summary of Application

WLS COL FSAR, Revision 11, Section 6.1.2.4, incorporates by reference AP1000 DCD, Revision 19, Section 6.2. AP1000 DCD Section 6.2 includes Sections 6.2.1, "Containment Functional Design"; 6.2.2, "Passive Containment Cooling System"; 6.2.3, "Containment Isolation System"; 6.2.4, "Containment Hydrogen Control System"; and 6.2.5, "Containment Leak Rate Test System." AP1000 DCD Section 6.2.5, is evaluated by the staff in NUREG-1793, Section 6.2.6. NUREG-1793 also includes the staff's evaluation of fracture prevention of the containment pressure boundary in accordance with NUREG-0800, Section 6.2.7, and in-containment refueling water storage tank (IRWST) hydrodynamic loads. The staff's evaluation of fracture prevention of the containment pressure boundary is found in Section 3.8 of this report. With respect to the hydrodynamic loads, the staff's evaluation is discussed in NUREG-1793, Section 6.2.8. The staff's evaluation of the containment cleanliness program associated with Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on PWR [Pressurized-Water Reactor] Sump Performance," is evaluated in Section 6.3 of this report.

WLS COL FSAR Table 1.9-203, "Listing of Unresolved Safety Issues and Generic Safety Issues," includes a line item for Task Action Plan Item A-23, "Containment Leak Testing." This item is addressed in WLS COL FSAR Section 6.2.5.1. In addition, in WLS COL FSAR Section 6.2, and in WLS COLA Part 10, the applicant provided information to address the following:

Departures

- WLS DEP 6.2-1

The applicant provided additional information in Section 6.2.4.5.1 of the WLS COL FSAR about WLS DEP 6.2-1 related to changes to the acceptance criteria applied to a specific ITAAC design commitment and associated inspection, test, or analysis in Tier 1 Table 2.3.9-3, Item 3 (for control of containment hydrogen concentration for beyond-design-basis accidents) to establish consistency with the current detailed design of the plant. This information, as well as related

WLS DEP 6.2-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.4 of this SER.

AP1000 COL Information Item

- STD COL 6.2-1

The applicant provided information in STD COL 6.2-1 to address AP1000 COL Information Item 6.2-1, which addresses the containment leak rate test program.

In addition to addressing the AP1000 COL information item, STD COL 6.2-1 also addresses, WLS COL FSAR Table 1.9-203, "Listing of Unresolved Safety Issues and Generic Safety Issues," Task Action Plan Item A-23, "Containment Leak Testing." This item is discussed in WLS COL FSAR Sections 6.2.5.1, "Design Basis"; 6.2.5.2.2, "System Operation"; and 6.2.6, "Combined License Information for Containment Leak Rate Testing."

License Conditions

- WLS COLA Part 10, "Proposed License Conditions (Including ITAAC)," License Condition 3, "Operational Program Implementation," Section G "Fuel Loading," Item G.8 –"Containment Leakage Rate Testing"

This proposed license condition states that the COL holder shall implement the containment leakage rate testing program prior to initial fuel load, as stated in WLS COL FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations."

- WLS COLA Part 10, "Proposed License Conditions (Including ITAAC)," License Condition 6, "Operational Program Readiness."

This proposed license condition states that the COL holder shall provide an operational program implementation schedule to support NRC inspections. Specifically, the operational program relevant to this evaluation in Section 6.2 is WLS COL FSAR, Table 13.4-201, Item #7, "Containment Leakage Rate Testing Program."

6.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. The acceptance criteria associated with the relevant requirements of NRC regulations for containment functional design are given in NUREG-0800, Section 6.2.1.1A. The regulatory requirements related to this section are 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants"; General Design Criterion (GDC) 16, "Containment Design"; GDC 38, "Containment Heat Removal"; and GDC 50, "Containment Design Basis." The acceptance criteria associated with the relevant requirements of NRC regulations for containment leak rate testing are given in NUREG-0800, Section 6.2.6. The regulatory requirements related to this section are GDC 52, "Capability for Containment Leakage Rate Testing"; GDC 53, "Provisions for Containment Testing and Inspection"; GDC 54, "Piping System Penetrating Containment"; and 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." Compliance with the requirements of 10 CFR Part 50, Appendix J, Option A, or the requirements of 10 CFR Part 50,

Appendix J, Option B, and the provisions of RG 1.163, "Performance-Based Containment Leak-Test Program," constitutes an acceptable basis for satisfying the requirements of the GDC applicable to containment leakage rate testing. In addition, the staff used guidance in Nuclear Energy Institute (NEI) 94-01, as endorsed and modified by RG 1.163, "Performance-Based Containment Leak-Test Program." The staff used the guidelines of NuStart Technical Report, AP-TR-NS01-A, Revision 2, "Containment Leak Rate Test Program," to review the containment leakage rate testing operational program.

6.2.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 6.2, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the containment systems. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review to evaluate subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the VEGP reference COL application were equally applicable to the WLS COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from responses to RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed and that those changes were actualized in the WLS COL FSAR.

- The staff verified that the site-specific differences, if any, did not adversely affect any previous relevant evaluation or conclusion.

The staff completed its review and concluded that the evaluation performed for the standard content is directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the BLN COL application.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 6.2.4:

AP1000 COL Information Item

- *STD COL 6.2-1*

The NRC staff reviewed STD COL 6.2-1 related to COL Information Item 6.2-1 included under Section 6.2.5 of the BLN COL FSAR regarding the text added to Section 6.2.6 of the COL application. The added text references the program, which was reviewed and approved by the NRC in a letter from Stephanie Coffin, NRC, to Marilyn Kray, NuStart, "Final Safety Evaluation for AP1000 Technical Report No. AP-TR-NS01, Containment Leak Rate Test Program (TAC No. MD5136)," dated October 25, 2007.

License Conditions

- *Part 10, License Condition 3, Item G.8*
- *Part 10, License Condition 6*

The portion of License Conditions 3 and 6 relevant to this SER section is the containment leakage rate testing program listed in BLN COL FSAR Table 13.4-201. As noted in Section 13.4 of this SER, the containment leakage rate testing program meets the criteria for an operational program as specified in SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." Therefore, the NRC staff finds License Conditions 3 and 6 acceptable, with respect to the inclusion of the containment leakage rate testing program in Table 13.4-201.

Due to discrepancies in the implementation milestones provided in various locations in the BLN COL application, RAI 6.2.6-1 was forwarded to the applicant. The applicant's response was that the milestones were meant to reflect the implementation of an approved testing program and when the tests were actually to be performed. However, the applicant agreed that this was not consistently reflected. The discrepancies have been addressed in BLN COL FSAR, Table 13.4-201, Sheet 2 of 7, and Part 10, License Conditions and ITAAC. The changes indicate that the containment leak rate testing program will be implemented prior to initial fuel load. This RAI is closed.

6.2.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds the following license conditions related to the containment leakage rate testing program acceptable:

- License Condition (6-1) – The licensee shall implement the containment leakage rate testing program before initial fuel load.

- License Condition (6-2) – No later than 12 months after issuance of the COL, the licensee shall submit to the appropriate Director of the Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the containment

leakage rate testing program. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the containment leakage rate testing program has been fully implemented.

6.2.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the containment systems, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements. In addition, the staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and conforms to the guidance in NUREG-0800, Sections 6.2.1 and 6.2.6. The staff based its conclusion on the following:

- WLS DEP 6.2-1, related to changes to the acceptance criteria applied to a specific ITAAC design commitment and associated inspection, test, or analysis in Tier 1 Table 2.3.9-3, Item 3 (for control of containment hydrogen concentration for beyond-design-basis accidents) to establish consistency with the current detailed design of the plant, is reviewed and found acceptable by the staff in Section 21.4 of this SER.

- STD COL 6.2-1, as related to the containment leak rate testing program, is acceptable because the staff has determined that the requirements of 10 CFR Part 50, Appendix J, have been met.

6.3 Passive Core Cooling System

6.3.1 Introduction

The passive core cooling system is designed to provide emergency core cooling to mitigate design-basis events that involve a decrease in the reactor coolant system (RCS) inventory, such as a loss-of-coolant accident (LOCA), a decrease in heat removal by the secondary system, such as a feedwater system piping failure, or an increase in heat removal by the secondary system, such as a steam system piping failure. It also provides core cooling for shutdown events, such as a loss of the normal residual heat removal system during a shutdown operation. The passive core cooling system is designed to perform the following safety-related functions:

- emergency core decay heat removal
- RCS emergency makeup and boration
- safety injection
- containment sump pH control

During long-term operation, the AP1000 passive core cooling system must withstand the effects of debris loading on the containment recirculation screens IRWST screens and the fuel assemblies. The concern that debris may lead to unacceptable head loss for the recirculating flow was raised in GSI-191 and it is the topic of BL 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," and Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during

Design Basis Accidents at Pressurized-Water Reactors." Section 6.3 of the AP1000 DCD includes an evaluation of this issue and Section 6.2.1.8 of NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," includes the staff's review, which was performed in accordance with the NRC-approved evaluation methodology.

In order to support long term operation in a closed loop configuration, the AP1000 passive core cooling system must also achieve a sufficient condensate return rate such that inventory in the IRWST is maintained in order to retain the heat transfer capability of the passive residual heat removal (PRHR) heat exchanger (HX) (and return condensate to the sump during recirculation). Water is steamed from the IRWST during transients that require the PRHR-HX to remove decay heat from the RCS. The steam that reaches the containment shell condenses and returns to the IRWST through a gutter system. WLS DEP 3.2-1, a departure from the AP1000 DCD requested by the applicant reviewed in Section 21.1 of this report, proposes design changes to improve condensate return to the IRWST and quantifies the condensate losses associated with the pressurizing of the containment atmosphere, condensation on heat sinks within the containment, and from dripping or splashing from structures and components attached to the containment.

6.3.2 Summary of Application

WLS COL FSAR, Revision 11, Section 6.3, incorporates by reference AP1000 DCD, Revision 19, Section 6.3. In addition, in WLS COL FSAR Section 6.3.8.1, the applicant provided the following:

Departures

- WLS DEP 3.2-1 and WLS DEP 6.3-1

The applicant provided additional information in Section 6.3 of the WLS COL FSAR about WLS DEP 3.2-1 and WLS DEP 6.3-1 related to design modifications to the condensate return portion of the Passive Core Cooling System and quantifying the duration that the PRHR-HX can maintain safe shutdown conditions, respectively. This information, as well as related WLS DEP 3.2-1 and WLS DEP 6.3-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.1 of this SER.

AP1000 COL Information Items

- STD COL 6.3-1

The applicant provided information in STD COL 6.3-1 to address AP1000 COL Information Item 6.3-1 identified in AP1000 DCD Table 1.8-2, "Summary of AP1000 Standard Plant Combined License Information Items." STD COL 6.3-1 describes the features of the administrative procedures implementing a containment cleanliness program to limit the amount of debris that might be left in the containment following refueling and maintenance outages. STD COL 6.3-1 is discussed in WLS COL FSAR Section 6.3.8.1, "Containment Cleanliness Program." WLS COL FSAR Section 1.9, incorporates by reference AP1000 DCD Section 1.9, "Compliance with Regulatory Criteria." In addition, in WLS COL FSAR Section 1.9, the applicant provided the following information related to the effect of debris accumulation on long-term cooling:

- STD COL 1.9-2

The applicant provided information in STD COL 1.9-2 to address BL 03-01 and GL 04-02, both relating to the potential impact of containment debris on emergency recirculation during design basis accidents, identified in the AP1000 DCD Section 1.9.4.2.3, Table 1.9-2 and actualized in WLS COL FSAR Section 1.9.5.5, "Operational Experience," and Table 1.9-204, "Generic Communications Assessment."

- STD COL 1.9-3

The applicant provided information in STD COL 1.9-3 to address GSI-191, relating to the performance of a PWR sump during ECCS operation, identified in the AP1000 DCD Section 1.9.4.2.3, Table 1.9-2 and actualized in WLS COL FSAR Section 1.9.4.1, "Review of NRC List of Unresolved Safety Issues and Generic Safety Issues," and related Table 1.9-203.

6.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. In conducting its review of STD COL 6.3-1, the staff used the guidance and staff positions of RG 1.82, Revision 3, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," and the "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02," for NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology."

The changes proposed in WLS DEP 3.2-1 and WLS DEP 6.3-1 are also required to meet NRC general design criteria, which also apply to the AP1000 DCD, 10 CFR Part 50, Appendix A, GDC 34, "Residual heat removal," as it applies to the capability of the PRHR-HX to perform safety related safe shutdown cooling of the RCS. Additionally, WLS DEP 3.2-1 and WLS DEP 6.3-1 are required to meet GDC 44, "Cooling Water," as it applies to the ability of the containment systems to transfer heat from the PRHR-HX to the ultimate heat sink via the passive containment cooling system.

6.3.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 6.3, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the passive core cooling system. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review to evaluate subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the VEGP reference COL application were equally applicable to the WLS COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from responses to RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed and that those changes were actualized in the WLS COL FSAR.

- The staff verified that the site-specific differences, if any, did not adversely affect any previous relevant evaluation or conclusion.

The staff completed its review and concluded that the evaluation performed for the standard content is directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the BLN COL application.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 6.3.4:

AP1000 COL Information Items

- *STD COL 6.3-1*

The applicant provided additional information in STD COL 6.3-1 to address COL Action Item 6.2.1.8.1-1 identified in NUREG-1793 and COL Information Item 6.3-1 identified in Table 1.8-2 of the AP1000 DCD. The applicant added information to BLN COL FSAR Section 6.3.8.1, "Containment Cleanliness Program," providing details of the program and procedures to minimize the amount of debris that might be left in containment following refueling and maintenance outages, including requirements for cleanliness inspections and limits on materials introduced into containment. TVA states that the cleanliness program will be consistent with the evaluation discussed in the AP1000 DCD.

In its June 9, 2009, response to [RAI 30, Question 06.02.02-1], the applicant addressed the changes made to Revision 17 of the AP1000 DCD in APP-GW-GLE-002 and staff questions on cleanliness measurements with a modification to STD COL 6.3-1. This included adding that the cleanliness program will meet the DCD limits on latent debris, that housekeeping procedures will be implemented to return work areas to original conditions upon completion of work, and that a sampling program will be used to quantify the amount of latent debris. The sampling program is stated to be consistent with NEI 04-07 Volumes 1 (guidance report) and 2 (NRC safety evaluation). The sampling will be done after containment exit cleanliness inspections, prior to start up, and the results will be evaluated post-start up. Any non-conforming results will be addressed in the Corrective Action Program.

The resulting cleanliness program is consistent with the RG 1.82 recommendation that procedures be in place to regularly clean the containment and to control and remove foreign materials from containment. The sampling program included in STD COL 6.3-1 is required to demonstrate that the latent debris found in containment is within the AP1000 DCD specified limits of 130 pounds, of which, up to 6.6 pounds may be fibrous material. The DCD specified limits were demonstrated to be acceptable through scale testing and analysis. Thus, STD COL 6.3-1 is consistent with the RG 1.82 recommendation that the cleanliness program be correlated to the amount of debris used in the long term cooling analysis. It is appropriate that the sampling program be in accordance with NEI 04-07, Volumes 1 and 2, because these documents contain the most recent NRC-approved evaluation methodology for cleanliness programs. The response to [RAI 30, Question 06.02.02-1] is acceptable and incorporation of the changes to STD COL 6.3-1 in the BLN FSAR will be tracked as Confirmatory Item 6.3-1.

The staff reviewed the following information in the BLN COL FSAR as it relates to the effect of debris accumulation on long term cooling:

- *STD COL 1.9-3*

The applicant added information to Section 1.9.4.2.3, "New Generic Issues," regarding Issue 191. The applicant states that the design aspects are addressed by the AP1000 DCD and the COL applicant portions are the protective coatings program discussed in BLN COL FSAR Section 6.1.2.1.6 and the containment cleanliness program discussed in BLN COL FSAR Section 6.3.8.1. The staff agrees that these are the only two COL items identified in the staff's review of GSI-191 from Section 6.2.1.8 of NUREG-1793.

- *STD COL 1.9-2*

The applicant added line items for Bulletin 03-01 and GL 04-02 in Table 1.9-204, "Generic Communications Assessment." The new information states that the design aspects are addressed in the AP1000 DCD and that the COL applicant aspects are addressed in BLN COL FSAR Section 6.3 for Bulletin 03-01 and BLN COL FSAR Section 6.3.8.1 for GL 04-02. The staff agrees that the design aspects of these generic communications are addressed in the staff's review of GSI-191 from Section 6.2.1.8 of NUREG-1793. The COL applicant aspects are addressed in the staff's review of BLN COL FSAR Section 6.1.2.1.6 and BLN COL FSAR Section 6.3.8.1.

<u>Resolution of Standard Content Confirmatory Item 6.3-1</u>

Confirmatory Item 6.3-1 required the applicant to update its FSAR to include the information related to the cleanliness program provided in the BLN applicant's above-mentioned June 9, 2009, response to [RAI 30, Question 60.02.02-1] (which was endorsed by the VEGP applicant). The NRC staff verified that the VEGP COL FSAR was appropriately updated with this information. As a result, Confirmatory Item 6.3-1 is resolved.

6.3.5 Post Combined License Activities

There are no post COL activities related to this section.

6.3.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the passive containment cleanliness program, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements. In addition, the staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the regulatory requirements and guidance discussed in Section 6.3.3 of this report. The staff based its conclusion on the following:

- WLS DEP 3.2-1 and WLS DEP 6.3-1, related to design modifications to the condensate return portion of the Passive Core Cooling System and quantifying the duration that the PRHR-HX can maintain safe shutdown conditions, respectively, are reviewed and found acceptable by the staff in Section 21.1 of this SER.

- STD COL 6.3-1 is acceptable because the containment cleanliness program complies with the guidance in RG 1.82.

- STD COL 1.9-2, related to BL 03-01 and GL 04-02, is acceptable because the only two items that need to be addressed by the COL applicant have been resolved. The protective coatings program is evaluated in Section 6.1.2 of this report, and the containment cleanliness program is evaluated under STD COL 6.3-1.

- STD COL 1.9-3, related to GSI-191, is acceptable because the only two items that need to be addressed by the COL applicant have been resolved. The protective coatings program is evaluated in Section 6.1.2 of this report, and the containment cleanliness program is evaluated under STD COL 6.3-1.

6.4 Habitability Systems

6.4.1 Introduction

There are a set of systems which provide habitability functions in the design and for the operation of WLS. These systems include the nuclear island non-radioactive ventilation system (VBS), the main control room (MCR) emergency habitability system (VES), the radiation monitoring system (RMS), the plant lighting system (ELS), and the fire protection system (FPS).

6.4.2 Summary of Application

WLS COL FSAR, Revision 11, Section 6.4, incorporates by reference AP1000 DCD, Revision 19, Section 6.4. In addition, in WLS COL FSAR Section 6.4, the applicant provided information to address the following:

Departures

- WLS DEP 6.4-1

The applicant provided information about WLS DEP 6.4-1 in Section 6.4 of the FSAR related to design changes affecting habitability of the MCR and changes to the calculated doses to control room operators. This information, as well as related WLS DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this report.

- WLS DEP 6.4-2

The applicant provided information about WLS DEP 6.4-2 in Section 6.4 of the FSAR related to design changes affecting habitability of the MCR and changes to the maximum temperatures and heat generated in the MCR. This information, as well as related WLS DEP 6.4-2 information appearing in other chapters of the FSAR, is reviewed in Section 21.3 of this report.

AP1000 COL Information Items

- STD COL 6.4-1

The applicant provided a list of onsite chemicals to supplement the list of chemicals identified in AP1000 DCD Table 6.4-1. STD COL 6.4-1 is discussed in WLS COL FSAR Chapter 6, Sections 6.4.4, "System Safety Evaluation"; 6.4.4.2, "Toxic Chemical Habitability Analysis"; and 6.4.7, "Combined License Information," as well as in WLS COL FSAR Sections 2.2.3.1.1.4, 2.2.3.1.3, and 2.2.3.1.4. The chemicals in Table 6.4-202 associated with STD COL 6.4-1 (as annotated in the left margin) include: hydrogen (both in a gas and liquid form); nitrogen; carbon dioxide; hydrazine, morpholine; sulfuric acid; sodium hydroxide; fuel oil; sodium molybdate; sodium hexametaphosphate; sodium hypochlorite and ammonium comp. polyethoxylate. In a November 4, 2010, letter, the applicant endorsed the June 17, 2010, letter from VEGP regarding the storage of standard chemicals described under STD COL 6.4-1. In an April 25, 2011, letter, the WLS COL applicant endorsed the July 30, 2010, letter from the VEGP applicant that proposed modifications to the WLS COL FSAR related to the maximum size and stated location of the liquid hydrogen storage tank.

- STD COL 6.4-2

The applicant provided information in STD COL 6.4-2 to address AP1000 COL Information Item 6.4-2 regarding the procedures and training for control room (CR) habitability pursuant to the resolution of GSI-83, "Control Room Habitability." STD COL 6.4-2 is discussed in WLS COL FSAR Sections 6.4.3, "System Operation"; and 6.4.7, "Combined License Information."

- WLS COL 6.4-1 and WLS COL 9.4-1b

The applicant provided WLS COL 6.4-1 to address AP1000 COL Information Item 6.4-1. The applicant provided information in the WLS COL FSAR regarding the storage of plant-specific hazardous chemicals. WLS COL 6.4-1 is discussed in WLS COL FSAR Chapter 6, Sections 6.4.4, "System Safety Evaluation"; and 6.4.4.2, "Toxic Chemical Habitability Analysis"; and 6.4.7, "Combined License Information," as well as in WLS COL FSAR Sections 2.2.3.1.1.4, 2.2.3.1.3, and 2.2.3.1.4.

Supplemental Information

- STD SUP 6.4-1

The applicant provided information in STD SUP 6.4-1 to address Control Room (CR) doses for accident analyses in the downwind unit of a dual-unit site. STD SUP 6.4-1 is discussed in WLS COL FSAR Section 6.4.4.1, "Dual Unit Analysis."

6.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. The acceptance criteria associated with the relevant requirements of NRC regulations for habitability systems are given in NUREG-0800, Section 6.4. MCR habitability is addressed in the following:

- 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 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, 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), as it relates to evaluations and design provisions to preclude certain MCR habitability problems

- 10 CFR 52.80(a), which requires that a COL application 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 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

- NUREG-0737, "Clarification of TMI [Three Mile Island] Action Plan Requirements"

- TMI Action Plan, Item III.D.3.4, "Control Room Habitability"

- 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"

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

6.4.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 6.4, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the WLS COL application and incorporated by reference addresses the required information relating to habitability systems. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review to evaluate subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the VEGP reference COL application were equally applicable to the WLS COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR to the WLS COL FSAR, except for the evaluation of STD COL 6.4-1 and STD SUP 6.4-1. For these two items, the staff compared the BLN COL FSAR, Revision 2, to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from responses to RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed and that those changes were actualized in the WLS COL FSAR.

- The staff verified that the site-specific differences, if any, did not adversely affect any previous relevant evaluation or conclusion.

The staff completed its review and concluded that the evaluation performed for the standard content is directly applicable to the VEGP COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the BLN COL application. Any confirmatory items in the standard content material retain the numbers assigned in the VEGP SER.

Control Room Radiological Habitability

The staff evaluated the WLS COL FSAR incorporation by reference of the AP1000 DCD evaluation of control room habitability, taking into consideration the WLS site characteristics.

Compliance with the control room habitability dose requirements of GDC-19 requires that the applicant 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 Sv (5 radiation equivalent man (rem)) 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 did

not provide site-specific doses in the control room for the design basis accidents referenced in the AP1000 DCD, Revision 19, but instead incorporated by reference the analysis of the radiological control room habitability from the AP1000 DCD, Revision 19, Section 6.4.4, “System Safety Evaluation.”

AP1000 DCD, Revision 19, Chapter 6.4, provided the results of the analysis of the control room radiological consequences for the design basis accidents analyzed for offsite radiological consequences in AP1000 DCD Chapter 15. The details and assumptions used in modeling the radiological consequences to control room operators were described in detail in the AP1000 DCD Section 15.6.5.3. The staff’s technical evaluation of the information incorporated by reference related to the modeling of the control room in design basis accident radiological consequences analyses is documented in a supplement to NUREG-1793. The design basis accident control room radiological consequences analyses in the AP1000 DCD used design reference (site parameter) values for the atmospheric dispersion factors (χ/Qs), in place of site-specific values. The atmospheric dispersion factors are the only input to the design base accident (DBA) radiological consequences analyses that are impacted by the site characteristics. The applicant provided and discussed the WLS site-specific site characteristic control room χ/Qs in resolution of WLS COL 2.3-4. The WLS site characteristic control room χ/Qs are given in WLS COL FSAR Tables 2.3-222 and 2.3-223. In Section 2.3 of this report, the staff discusses its review of the resolution to WLS COL 2.3-4, related to the WLS site characteristic χ/Qs. All other inputs and assumptions in the radiological consequences analyses remain the same as in the AP1000 DCD. Smaller χ/Q values are associated with greater dilution capability, 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 site parameter χ/Q value. Such a comparison shows that the site has better dispersion characteristics than that required by the reactor design.

For each time averaging period, the WLS site-specific control room χ/Q values are less than the design reference control room χ/Q values used in AP1000 DCD, Revision 19, for the radiological consequence analyses for each of the design basis accidents. Since (1) the result of the radiological consequence analysis for a design basis accident 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 WLS site characteristic χ/Q values are less than the comparable design site parameter χ/Q values in the DCD for all time periods for each accident, the WLS site-specific total dose for each design basis accident is therefore less than the AP1000 DCD, Revision 19, reference total dose for each design basis accident.

Since the AP1000 DCD, Revision 19, analyses show that the radiological consequences in the control room meet the regulatory dose requirements of GDC-19 by resulting in a TEDE less than 0.05 Sv (5 rem), and since the WLS site-specific design basis accident control room radiological consequences are less than those for the AP1000 DCD, Revision 19, then the staff concludes that the applicant has adequately shown that the design basis accident control room radiological consequences meet the dose requirements of GDC-19, and is therefore acceptable.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 6.4.4:

AP1000 COL Information Items

- *STD COL 6.4-1*

The following portion of this technical evaluation section is reproduced from Section 6.4.4 of the BLN SER. The staff notes that Table 6.4-202 in the BLN FSAR, Revision 2, is equivalent to Table 6.4-201 in the VEGP COL FSAR. Information in the BLN COL FSAR having a left margin annotation STD SUP 6.4-2 was assigned a left margin annotation of STD SUP 6.4-3 in the VEGP COL FSAR, and revisions proposed by the applicant, described below, combined the information from STD SUP 6.4-3 and STD COL 6.4-1 under a single left margin annotation of STD COL 6.4-1. Therefore, the evaluation of STD COL 6.4-1 in this SER includes references to material identified as STD SUP 6.4-2 in the BLN COL FSAR.

- *STD SUP 6.4-2*

STD SUP 6.4-2 provides the chemical names, state of the chemical, quantity and location of the chemicals. The chemicals include: hydrogen (both in a gas and liquid form), hydrazine, morpholine, sulfuric acid, sodium hydroxide, fuel oil, sodium molybdate (molybdic acid, disodium salt), sodium hexametaphosphate, and sodium hypochlorite.

Subsequent to the issuance of Section 2.2.3 of this report, the staff reviewed the applicant's inventory of chemicals contained in STD SUP 6.4-2 for threats to CR habitability. The staff has determined, with the exception of hydrazine, that the STD SUP 6.4-2 chemicals do not warrant additional analysis for CR habitability because they do not exceed the immediate danger to life and health (IDLH) limit at ground level at the location of the CR.

Regarding hydrazine, a further analysis with the HABIT computer code (RG 1.78) confirms that the hydrazine may exceed the IDLH limit at ground level. However, additional analysis shows that the hydrazine concentrations at the CR intake and inside the CR will not exceed the IDLH limit when crediting the design of the CR ventilation intake located at the auxiliary building (57 ft. above ground), calculations show concentrations much less than the IDLH limit. These results are based on a temperature of 25 °C and a wind speed of 1 m/sec, with meteorology F class, which are the conditions used by the applicant and RG 1.78. Hence, it is determined that the hydrazine listed in STD SUP 6.4-2 will not pose a threat to CR habitability.

AP1000 COL Information Items

- *STD COL 6.4-1*

STD COL 6.4-1 information also provides the chemical names, state of the chemical, quantity and location of the chemicals. The chemicals include: nitrogen, carbon dioxide, and ammonium comp polyethoxylate.

Subsequent to the issuance of Section 2.2.3 of this report, the staff reviewed the applicant's inventory of chemicals listed in STD COL 6.4-1, and screened out the toxic chemicals that do not pose a threat to CR habitability. The staff has determined that with the exception of carbon dioxide the STD COL 6.4-1 chemicals do not warrant additional analysis because they do not exceed the IDLH limit at ground level at the location of the CR.

Regarding carbon dioxide, analysis with the HABIT computer code (RG 1.78) finds that carbon dioxide will not exceed the IDLH limit at ground level. This analysis is based on a temperature of 25 °C and a wind speed of 1 m/sec, with meteorology F class, which are the conditions used by the applicant and RG 1.78. Hence, it is determined that the carbon dioxide contained in STD COL 6.4-1 will not pose a threat to CR habitability.

The staff notes that the chemical analysis relied on by the COL applicant includes assumptions associated with design features, such as the intake location for the CR ventilation system. In RAI 6.4-8, the staff asked if any of the analyses of the chemicals in Table 6.4-202 credit design features, such as an elevated CR intake, to keep the chemical concentration in the CR below the IDLH levels, in which case a description of the design features credited in the safety analyses should be provided in the FSAR. This is Open Item 6.4-1.

Resolution of Standard Content Open Item 6.4-1

In a letter dated June 17, 2010, the applicant proposed modifications to Table 6.4-201 in the VEGP COL FSAR to address Open Item 6.4-1. The proposed modifications included addition of a column entitled "MCR Habitability Impact Evaluation" to the table that indicated when design features were considered in the impact evaluation, including either the MCR intake height or other design details beyond the intake height. The staff determined that the modifications sufficiently described the design assumptions considered by the applicant, and Open Item 6.4-1 is resolved. The incorporation of this modification to Table 6.4-201 into a future revision of the VEGP COL FSAR is being tracked as Confirmatory Item 6.4-1.

Resolution of Standard Content Confirmatory Item 6.4-1

Confirmatory Item 6.4-1 is an applicant commitment to revise its FSAR Table 6.4-201 to add a column entitled "MCR Habitability Impact Evaluation" that will indicate when design features are considered in the impact evaluation, including either the MCR intake height or other design details beyond the intake

height. The staff verified that VEGP COL FSAR Table 6.4-201 was appropriately revised. As a result, Confirmatory Item 6.4-1 is now closed.

Evaluation of Additional Revisions to STD COL 6.4-1

In the letter dated June 17, 2010, the applicant proposed additional voluntary revisions to Table 6.4-201 in the VEGP COL FSAR regarding the storage of standard chemicals described under STD COL 6.4-1. The proposed revisions included changes to the chemical quantities, evaluated distances, and storage locations, as well as changes to the table organization, column headings, and table notes. The proposed revisions also included combining the chemicals listed under separately STD COL 6.4-1 and STD SUP 6.4-3 under a single left margin annotation of STD COL 6.4-1, thereby eliminating STD SUP 6.4-3.

In a letter dated July 30, 2010, the applicant proposed additional revisions to STD COL 6.4-1 related to the evaluated maximum quantity and location of the liquid hydrogen storage tank.

On April 14 and June 7, 2010, the NRC staff audited the applicant's proprietary calculation notes, APP-VES-M3C-006, entitled "Main Control Room Emergency Habitability from Toxic Chemical Effluents," Revision 0 and Revision 1 to verify the information supporting STD COL 6.4-1 and VEGP COL FSAR Table 6.4-201. As a result of these audits, the staff issued RAI 6.4-5. The applicant subsequently prepared calculation notes APP-PGS-M3C-011, entitled "AP1000 Gas Spill or Release Effects on Control Room Habitability," Revision 0 and Revision 1 that were audited by the staff on July 26 and August 23, 2010. In a letter dated September 3, 2010, the applicant proposed the following changes to the FSAR and provided the following additional information about calculated concentrations of chemicals that would occur at the MCR intake to address RAI 6.4-5:

- *Proposed to change the evaluated minimum distance between the MCR and the storage locations for liquid hydrogen, nitrogen, and carbon dioxide.*

- *For hydrogen, nitrogen, and carbon dioxide, proposed to indicate that MCR design details were considered in evaluating the potential impact to the MCR.*

- *Proposed to clarify that the MCR design details considered included MCR volume, envelope boundaries, ventilation systems, and occupancy factor.*

- *Provided information about how the analysis considered the effect of wind speeds less than 1 meter/second.*

- *Provided information about concentrations occurring at the MCR intake more than two minutes after a potential release occurs.*

- *For hydrogen, nitrogen, and carbon dioxide, provided information about concentrations occurring at the MCR intake when no building wake effects are considered.*

- *For carbon dioxide, provided information about concentrations occurring in the MCR based on a corrected conservative value for the MCR outside air exchange rate.*

In the evaluation presented in Section 2.2.3 of this SER, the staff reviewed the applicant's revised chemical inventory information listed in STD COL 6.4-1, and screened out the toxic chemicals that do not pose a threat to MCR habitability. The staff determined that, with the exception of hydrazine and carbon dioxide, the STD COL 6.4-1 chemicals do not warrant additional analysis for MCR habitability because they would not exceed the IDLH limit at ground level below the MCR ventilation intake. Hydrazine and carbon dioxide are evaluated below.

Regarding hydrazine, the NRC staff used the HABIT computer code (as referenced in RG 1.78) to confirm that hydrazine concentration may exceed the IDLH limit at ground level below the MCR intake. The staff then conducted an additional analysis showing that the hydrazine concentration at the MCR intake and inside the MCR would not exceed the IDLH limit when crediting the design of the MCR ventilation intake located at the auxiliary building (which is located 17.37 m (57 ft) above ground). The applicant annotated "IH" in VEGP COL FSAR Table 6.4-201 to indicate that the credit of MCR ventilation intake height had been taken in the safety analysis.

Regarding carbon dioxide, the NRC staff used the HABIT computer code to confirm that the carbon dioxide concentration may exceed the IDLH limit at the MCR intake. The staff then conducted an additional analysis showing that the carbon dioxide concentration inside the MCR would remain below the IDLH limit.

Based on the FSAR revisions proposed and additional information provided by the applicant and the confirmatory analyses performed by the staff, the staff determined that the hydrazine and carbon dioxide would not pose a threat to MCR habitability, and RAI 6.4-5 is closed.

The incorporation of the revisions to STD COL 6.4-1 Table 6.4-201 into a future revision of the VEGP COL FSAR, as proposed in letters from the applicant dated June 17, July 30, and September 3, 2010, is being tracked as Confirmatory Item 6.4-2.

<u>Resolution of Standard Content Confirmatory Item 6.4-2</u>

Confirmatory Item 6.4-2 is an applicant commitment to revise its FSAR Table 6.4-201 to revise information related to standard chemicals. The staff verified that VEGP COL FSAR Table 6.4-201 was appropriately revised. As a result, Confirmatory Item 6.4-2 is now closed.

The following portion of this technical evaluation section is reproduced from Section 6.4.4 of the BLN SER:

- *STD COL 6.4-2*

The NRC staff reviewed STD COL 6.4-2, related to COL Information Item 6.4-2 and COL Action Item 6.4-1, included under Section 6.4.3 of the BLN COL FSAR. The applicant stated that procedures and training for CR habitability are written in accordance with Section 13.5 for CR operating procedures, and Section 13.2 for operator training. In Section 6.4.3 of the FSAR, the applicant states that the procedures and training will be verified to be consistent with the intent of GSI-83.

However, the level of detail provided in the standard portion of BLN COL FSAR Section 6.4.3 is not adequate to determine if the regulatory requirements are met. As a result, the staff issued RAI 6.4-7, which asked the applicant to provide in the FSAR the essential elements of the training and procedures necessary to demonstrate that the regulatory requirements are met. The staff questioned what the operators would be directed and trained to do to meet the recommendations in RG 1.196. Specifically, in RAI 6.4-7, the staff requested information addressing the following:

- *RG 1.78, Regulatory Position C.5, "Emergency Planning"*
- *RG 1.196, Regulatory Position 2.5, "Hazardous Chemicals"*
- *RG 1.196, Regulatory Position 2.2.1, "Comparison of System Design, Configuration, and Operation with the Licensing Basis"*
- *RG 1.196, Regulatory Position 2.7.1, "Periodic Evaluations and Maintenance"*

The resolution of RAI 6.4-7 is identified as Open Item 6.4-2.

<u>Resolution of Standard Content Open Item 6.4-2</u>

The BLN response to RAI 6.4-7 dated January 5, 2010, stated that the operational aspects of the identified guidance had been met as documented in BLN COL FSAR Appendix 1AA. The BLN applicant's response also stated that the additional information would be provided in a future revision to BLN COL FSAR Section 6.4.3, addressing how procedures, testing and training related to CR habitability would be consistent with the above stated regulatory positions in RG 1.78 and RG 1.196. The VEGP applicant endorsed the BLN response to RAI 6.4-7 in a letter dated June 17, 2010, and committed to appropriately update Section 6.4.3 of the VEGP COL FSAR. Therefore, Standard Content Open Item 6.4-2 is resolved for the VEGP application, and incorporation of the proposed revision to Section 6.4.3 of the VEGP COL FSAR is being tracked as Confirmatory Item 6.4-3.

<u>Resolution of Standard Content Confirmatory Item 6.4-3</u>

Confirmatory Item 6.4-3 is an applicant commitment to revise its FSAR Section 6.4.3 to include information regarding procedures, testing and training

related to CR habitability. The staff verified that VEGP COL FSAR Section 6.4.3 was appropriately revised. As a result, Confirmatory Item 6.4-3 is now closed.

- WLS COL 6.4-1 and WLS COL 9.4-1b

The applicant added Section 6.4.4.2, "Toxic Chemical Habitability Analysis," at the end of AP1000 DCD Section 6.4.4, "System Safety Evaluation." In WLS COL FSAR Section 6.4.4.2, the applicant added new text and a table for WLS COL 6.4-1 to address the issue of handling local toxic gas services and monitoring. The applicant determined that no toxic gas monitoring is required, while AP1000 DCD Section 6.4.7 states, "Combined License applicants referencing the AP1000 certified design are responsible for the amount and location of possible sources of hazardous chemicals in or near the plant and for seismic Category I Class 1E hazardous chemical monitoring, as required."

The staff reviewed the text added to AP1000 DCD Section 6.4, by WLS COL 6.4-1. WLS performed an analysis of a chlorine release event and concluded that chlorine monitors are not needed, as permitted by RG 1.78, because the results of the HABIT EXTRAN analysis indicate that under ideal conditions a pressurized liquid chlorine tractor-trailer burst-type accident would not elevate control room HVAC intake concentrations beyond IDLH values. The applicant incorporated Table 6.4-202 from the VEGP COL FSAR, which consists of an updated list of toxic chemicals and parameters that have been reviewed and determined acceptable with respect to impact on the control room. In RAI 19, Questions 06.04-1 through 06.04-7, the staff requested that the applicant provide the results of its analysis of an offsite accidental release of chlorine, the source and assumptions of the input values used in the HABIT analysis, the number of operators to be protected from toxic gas release, operator response during chlorine release, and the definition of "steam vent" where atmospheric dispersion factors were considered.

Regarding the chlorine analysis methodology, in a May 31, 2012, response, the applicant stated that alternative modeling software was used. The applicant used a combination of ALOHA and HABIT to properly analyze the accidental release of chlorine. ALOHA code is limited to a 1 hour run time and terminates prior to the chemical release reaching the control room intake 5100 meter (m) (3.2 miles (mi)) from the release point. Therefore, a two phase analysis approach was developed using ALOHA for the initial phase of the event when the release behaves as a heavier-than-air gas until the chlorine cloud concentration decreases to 10,000 parts per million (ppm), and using HABIT for the remaining distance because according to the user's manual for ALOHA, when the concentration of heavy gas drops below about 10,000 ppm, the chlorine behaves like a neutrally buoyant gas. HABIT treats the input chemical as neutrally buoyant and can be modified to allow for longer run times (while ALOHA is capped at 1 hour), therefore, HABIT can model long enough to capture the plume peak, the trailing plume edge, and the control room peak concentration. The staff finds the applicant's proposed modeling approach for accidental off-site releases of chlorine, described in the previous paragraph and in WLS COL FSAR Section 2.2.3.1.3.3, is acceptable and, therefore, considers RAI 19, Questions 06.04-1 through 06.04-7 resolved. With regard to the other chemical analysis provided, the staff finds the applicant's results also acceptable because the assumptions were conservative and the modeling approach reasonable, resulting in concentrations that remained below the IDLH.

The staff also issued RAI 103, Question 02.02.03-8, regarding analysis details on chemicals Methoxypropylamine (MPA) and Dimethylamine (DMA). In a March 28, 2012, response, the applicant provided information pertaining to the analysis of MPA and DMA. The applicant selected U.S. Environmental Protection Agency (EPA) code SLAB to conduct the analysis. The key points considered in the selection of SLAB are that the model is developed specifically to deal with dispersion of dense gases, and that the model has the capability of predicting concentrations at an elevated control room intake. The staff notes that the SLAB code enabled the applicant to correctly credit the heavy gas aspects of the release and also correctly account for the elevated intake in the AP1000 design. Also the applicant revised the WLS COL FSAR to indicate the credit for the elevated intake by modifying the table to add the "IH" for the chemicals in question. The staff finds the applicant's modeling approach acceptable and, therefore, considers RAI 103, Question 02.02.03-8, resolved. The applicant's WLS COL FSAR Sections 2.2.3.1.3, 6.4.4.2, and Table 6.4-202 reflect this discussion.

Supplemental Information

The following portion of this technical evaluation section is reproduced from VEGP SER Section 6.4.4:

> *The following portion of this technical evaluation section is reproduced from Section 6.4.4 of the BLN SER:*
>
> - *STD SUP 6.4-1*
>
> *The NRC staff reviewed STD SUP 6.4-1 related to the evaluation of CR doses in the other unit of a dual unit plant included under Section 6.4.4 of the BLN COL FSAR. The staff concludes that STD SUP 6.4-1 is acceptable because the dose to the CR operators at an adjacent AP1000 due to a radiological release from another unit is bounded by the dose to CR operators on the affected unit. Further, simultaneous accidents at multiple units at a common site are not considered to be a credible event, unless there is a reliance on shared systems between the two units. This is not the case for the AP1000 design.*

A portion of the standard technical evaluation from the VEGP COL SER is not included above. The staff concluded that the omitted portion was not relevant to WLS.

6.4.5 Post Combined License Activities

There are no post COL activities related to this section

6.4.6 Conclusion

The staff reviewed the WLS COL application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to MCR habitability, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements. Based on its review of the application, the staff concludes that the information presented in the WLS COL FSAR is acceptable because it meets the acceptance criteria

associated with the relevant requirements of NRC regulations for habitability systems given in NUREG-0800, Section 6.4. The staff based its conclusions on the following:

- WLS DEP 6.4-1, relating to design changes affecting habitability of the MCR and changes to the calculated doses to control room operators, is reviewed and found acceptable by the staff in Section 21.2 of this SER.

- WLS DEP 6.4-2, related to design changes affecting habitability of the MCR and changes to the maximum temperatures and heat generated in the MCR, is reviewed and found acceptable by the staff in Section 21.3 of this SER.

- STD COL 6.4-1 is acceptable because the chemicals do not exceed the IDLH limit at ground level at the intake of the MCR, using the regulatory guidance in RG 1.78.

- STD COL 6.4-2 is acceptable because the procedures, testing and training related to MCR habitability will be consistent with the stated regulatory positions in RG 1.78 and RG 1.196.

- WLS COL 6.4-1 and WLS COL 9.4-1b are acceptable, because the plant-specific chemicals do not exceed the IDLH limit at the intake of the MCR, using the regulatory guidance in RG 1.78.

- STD SUP 6.4-1 is acceptable because the dose to the MCR operators at an adjacent AP1000 due to a radiological release from another unit is bounded by the dose to MCR operators on the affected unit, using the regulatory guidance in NUREG-0800, Section 6.4.

6.5 Fission Product Removal and Control Systems

In the event of a design basis LOCA there is an assumed core degradation that results in a significant release of radioactivity to the containment atmosphere. This activity would consist of noble gases, particulates, and a small amount of elemental and organic iodine. Fission product removal and control systems are considered to be those systems for which credit is taken in reducing accidental release of fission products. The AP1000 design has no active system to control fission products in the containment following a postulated accident. The fission product control system is the primary containment. AP1000 DCD, Appendix 15B, “Removal of Airborne Activity from the Containment Atmosphere Following a LOCA,” discusses satisfactory removal of airborne activity (elemental iodine and particulates) from the containment atmosphere by natural removal processes (e.g., deposition and sedimentation) without the use of containment spray.

WLS COL FSAR, Revision 11, Section 6.5, incorporates by reference, with no departures or supplements, AP1000 DCD, Revision 19, Section 6.5. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The staff’s review confirmed that there is no outstanding issue related to this section. The results of the staff’s technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

6.6 Inservice Inspection of Class 2, 3, and MC Components

6.6.1 Introduction

Inservice inspection (ISI) programs must meet requirements of 10 CFR 50.55a, "Codes and Standards," in which American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV)) is incorporated by reference. This section addresses the ISI of ASME Code Class 2 and 3 components. ASME Code Class 2 and 3 components must meet the applicable inspection requirements set forth in ASME B&PV Code, Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," Subsections IWC and IWD." Subsection IWC and IWD also include requirements for preservice examinations prior to initial plant startup as provided in Subarticles IWC-2200 and IWD-2200.

6.6.2 Summary of Application

WLS COL FSAR, Revision 11, Section 6.6, incorporates by reference AP1000 DCD, Revision 19, Section 6.6. In addition, in WLS COL FSAR Section 6.6, the applicant provided information to address the following:

AP1000 COL Information Items

- STD COL 6.6-1

The applicant provided information in STD COL 6.6-1 to address AP1000 COL Information Item 6.6-1. The information relates to plant-specific preservice inspection (PSI) and ISI programs. STD COL 6.6-1 is discussed in WLS COL FSAR Sections 6.6, "Inservice Inspection of Class 2, 3, and MC Components"; 6.6.1, "Components Subject to Examination"; 6.6.3.1, "Examination Methods"; 6.6.3.2, "Qualification of Personnel and Examination Systems for Ultrasonic Examination"; 6.6.3.3, "Relief Requests"; 6.6.4, "Inspection Intervals"; 6.6.6, "Evaluation of Examination Results"; and 6.6.9.1, Inspection Programs."

- STD COL 6.6-2

The applicant provided information in STD COL 6.6-2 to address AP1000 COL Information Item 6.6-2. The information relates to preservation of component accessibility design considerations during the construction phase. This COL information item is discussed in WLS COL Sections 6.6.2, "Accessibility," and 6.6.9.2, "Construction Activities."

Supplemental Information

- STD SUP 6.6-1

The applicant provided information related to the design stage consideration of component accessibility to enable the performance of ISI examinations.

License Condition

- WLS COLA Part 10, "Proposed License Conditions (Including ITAAC)," License Condition 6, "Operational Program Readiness"

This proposed license condition states that the COL holder shall provide an operational program implementation schedule to support NRC inspections. For the purpose of the review of WLS COL FSAR Section 6.6, the relevant operational programs are the Inservice Inspection Program and the Preservice Inspection Program.

6.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements. The acceptance criteria associated with the relevant requirements of NRC regulations for ISI of ASME B&PV Code Class 2 and 3 components are given in NUREG-0800, Section 6.6. The applicable regulatory requirements for acceptance of the resolution of COL information items and supplementary information on ISI and testing of ASME B&PV Code Class 2 and 3 components are established in GDC 45, "Inspection of Cooling Water System" located in 10 CFR Part 50, Appendix A, as it relates to periodic inspection of important components, such as heat exchangers and piping to assure the integrity and capability of the system. The applicable policy for acceptance of COL information items, as it relates to fully describing an operational program, is located in SECY-05-0197.

6.6.4 Technical Evaluation

The staff reviewed Section 6.6 of the WLS COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the ISI of Class 2 and 3 components. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review to evaluate subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the VEGP reference COL application were equally applicable to the WLS COL application, the staff undertook the following reviews:

- The staff compared the VEGP to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed and that those changes were actualized in the WLS COL FSAR.

- The staff verified that the site-specific differences, if any, did not adversely affect any previous relevant evaluation or conclusion.

The staff has completed its review and found the evaluation performed for the standard content is directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the VEGP reference COL application includes evaluation material from the SER for the BLN COL application.

The following portion of this technical evaluation section is reproduced from Section 6.6.4 of the VEGP SER:

AP1000 COL Information Items

- *STD COL 6.6-1*

In Section 6.6 of the NRC staff FSER (NUREG-1793, dated September 2004), the staff concluded that the AP1000 ISI program for ASME 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 the ASME Code, Section XI used as the baseline Code in the AP1000 certified design, is the 1998 Edition up to and including the 2000 Addenda. It should be noted that the staff did not identify any portions of the AP1000 ISI program for Class 1, 2, and 3 components that were excluded from the scope of the staff's review of the AP1000 DC (as the staff did for inservice testing of valves in AP1000 FSER Section 3.9.6.4). Therefore, the staff's conclusions regarding the acceptability of the AP1000 ISI program based on the 1998 Edition up to and including the 2000 Addenda of the ASME Code, Section XI with regard to preservice and inservice inspectability of Class 2 and 3 components remains unchanged. The staff's evaluation of the operational program aspects of the ASME Code Class 2 and 3 ISI program is addressed with Class 1 ISI in Section 5.2.4 of this SER. The review of the COL applicant's supplemental information also includes the adequacy of the ISI program for reactor containment (Class MC). In Revision 17 of the AP1000 DCD, Class MC components were added to the DCD, Section 6.6, as being within the scope of the ISI Program. The COL applicant incorporated DCD Section 6.6 in its entirety under Revision 1 of its FSAR. Accordingly, the staff's evaluation of this section focused on the acceptability of the COL applicant's supplemental information and responses to AP1000 COL information items and action items as they relate to ISI of ASME Code Class 2, 3, and MC components.

As part of STD COL 6.6-1, the COL applicant added to the end of DCD Section 6.6.2 words to state that the initial ISI program will incorporate the latest Edition and Addenda of the ASME Code (Section XI) approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load. The COL applicant stated that successive 120-month inspection intervals must comply with the requirements of the latest Edition and Addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months before the start of the 120-month interval, subject to the limitations and modifications listed in 10 CFR 50.55a(b). The requirements in 10 CFR 50.55a(g) state that inservice examinations of components and system pressure tests conducted during the initial 120-month inspection interval must comply with the requirements in the latest Edition and

Addenda of the Code incorporated by reference in paragraph (b) of 10 CFR 50.55a on the date 12 months before the date scheduled for initial loading of fuel under a COL under 10 CFR Part 52. The staff concludes that the supplemental information provided by the COL applicant meets the NRC's regulations and is, therefore, acceptable.

As part of STD COL 6.6-1, the COL applicant added to the end of DCD Section 6.6.1 words to state that Class 2 and 3 components are included in the equipment designation list contained in the ISI program. The requirements in 10 CFR 50.55a(g)(3)(ii) state, in part, that Class 2 and 3 components be designed and provided with access to enable the performance of ISI examinations. In addition, the inclusion of Class 2 and 3 components is consistent with the requirements of an ISI program as defined under ASME Section XI, and is, therefore, acceptable. The staff concludes that the supplemental information provided by the COL applicant meets the NRC's regulations and is, therefore, acceptable.

In Section 6.6 of the FSER (NUREG-1793), the staff identified COL Action Item 6.6-1 in which the COL applicant will prepare a PSI program and an ISI program for ASME Code, Class 2 and 3 systems, components and supports. The PSI and ISI programs will address the equipment and techniques used. As part of STD COL 6.6-1, the COL applicant describes the use of visual, surface, ultrasonic, alternative examination techniques, and the use of automated equipment to perform the examinations. The COL applicant referenced the relevant portions of the ASME Code, Section XI to describe the nondestructive examination techniques and alternative examinations. The COL applicant also added information to describe the 120-month inspection interval as defined by IWB-2400 for Inspection Program B and the evaluation of examination results as defined by the ASME Code, Section XI, paragraphs IWC-, IWD-, IWE-, or IWF-3400 acceptance criteria. In addition, the COL applicant appropriately referenced 10 CFR 50.55a(b)(2)(xix) and IWA-2240 as described in the 1997 Addenda of the ASME Code, Section XI when applying alternative examination provisions. The supplemental information provided by the COL applicant meets the requirements in 10 CFR 50.55a, the ASME Code, Section XI, and the guidelines in RG 1.206, Section C.III.1, Chapter 6, C.I.6.6.3, and is, therefore, acceptable. Based on the discussion above, the staff concludes that the supplemental information under STD COL 6.6-1 is acceptable.

- *STD COL 6.6-2*

As part of STD COL 6.6-2, the COL applicant states that during the construction phase of the project, anomalies and construction issues are addressed using change control procedures. Modifications reviewed following DC will adhere to the same level of review as the certified design, thus, control of accessibility is maintained during post-DC activities. Control of accessibility for inspectability and testing during post-DC activities is provided via procedures for design control and plant modifications. In the NRC staff's FSER (NUREG-1793), the staff identified COL Action Item 6.6-2, which recommends COL applicants referencing the AP1000 certified design address the controls to preserve accessibility and

inspectability for ASME Code, Section III, Class 2 and 3 components and piping during construction or other post-DC activities. The NRC staff reviewed the applicant's proposed resolution of COL Action Item 6.6-2 using NUREG-0800, Section 6.6. The staff finds that the accessibility needed to perform PSI/ISI examinations is maintained during the design, construction and operational phases, which satisfies NUREG-0800, Section 6.6 recommendations for accessibility. In addition, the supplemental information meets the regulations under 10 CFR 50.55a(g)(3)(ii), which requires that Class 1, 2, and 3 components be designed and provided with access that enables the performance of ISI examinations, and the requirements under ASME Code, Section XI, IWA-1500. Based on the discussion above, the staff concludes that STD COL 6.6-2 is acceptable.

Supplemental Information

- *STD SUP 6.6-1*

As part of STD SUP 6.6-1, the COL applicant added supplemental information to the AP1000 DCD, Section 6.6.2, to address accessibility of Class 2, 3, and Class MC pressure retaining components to permit preservice and inservice examinations. Factors considered, such as examination requirements, techniques, accessibility, geometry, and material selections, are used in establishing the designs with the goals being to eliminate uninspectable components, reduce occupational radiation exposure, reduce inspection times, allow state-of-the-art inspection systems, and enhance detection and the reliability of flaw characterization.

The requirements in 10 CFR 50.55a(g)(3)(ii) state, in part, that Class 2 and 3 components be designed and provided with access to enable the performance of ISI examinations. ASME Code, Section XI, IWA-1500 requires that access be provided to enable the performance of ISI examinations, along with design considerations to render ISI practical. The staff finds that the supplemental information under STD SUP 6.6-1 meets the requirements of 10 CFR 50.55a and ASME Code, Section XI, and is, therefore, acceptable.

License Condition

- *Part 10, License Condition 6*

The COL applicant proposed a license condition for BLN for all operational programs requiring that the licensee shall submit to the appropriate Director of the NRC a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until either the operational program has been implemented or the plant has been placed into commercial service. A separate license condition for PSI and ISI program implementation requirements is not necessary in the BLN COL FSAR since it is a requirement under 10 CFR 50.55a. However, submittal of the schedule for the PSI and ISI program

development is necessary to plan for and conduct NRC inspections during construction. The staff finds that this schedule will enable the staff to adequately plan and schedule inspections of the PSI and ISI programs during the construction phase. This proposed license condition is consistent with the policy established in SECY-05-0197, and is acceptable.

6.6.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds the following license condition associated with the PSI and ISI programs acceptable:

- License Condition (6-3) – No later than 12 months after issuance of the COL, the licensee shall submit to the appropriate Director of NRO a schedule that supports planning for and conduct of NRC inspections of the PSI and ISI programs. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the PSI and ISI programs have been fully implemented.

6.6.6 Conclusion

The staff reviewed the application and checked the referenced AP1000 DCD. The staff's review confirmed that the applicant addressed the required information relating to ISI of ASME Code Class 2 and 3 components, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the requirements of GDC 45 and 10 CFR 50.55a. The staff based its conclusion on the following:

- STD COL 6.6-1 is acceptable because the staff concluded that the applicant's AP1000 ISI program for ASME Code Class 2, 3, and Metal Containment (MC) components is acceptable and meets the requirements of 10 CFR 50.55a with regard to the preservice and inservice inspectability of these components.

- STD COL 6.6-2 is acceptable because the staff concluded that the accessibility needed to perform PSI/ISI examinations is maintained during the design, construction and operational phases, and satisfies NUREG-0800, Section 6.6 acceptance criteria for accessibility.

- STD SUP 6.6-1 is acceptable because the staff concluded that accessibility to perform ISI examinations would be incorporated into the design, and satisfies the regulations under 10 CFR 50.55a(g)(3)(ii).