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LIST OF FIGURES

No figures were included in this chapter.

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3 DESIGN OF STRUCTURES, SYSTEMS, COMPONENTS, AND EQUIPMENT

3.0 INTRODUCTION

The staff reviewed the information in the U.S. EPR final safety analysis report (FSAR) Chapter 3, "Design of Structures, Components, Equipment and Systems," on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the design of structures, components, equipment, and systems incorporated by reference in the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 FSAR have been documented in the staff's safety evaluation report (SER) on the design certification application for the U.S. EPR. The staff on the U.S. EPR is not yet complete. The staff will update Chapter 3 of this report to reflect the final disposition of the U.S. EPR design certification application. Request for Additional Information **(RAI) 222, Question 01-5 is being tracked as an open item as part of this chapter.**

3.1 Compliance with Nuclear Regulatory Commission General Design Criteria

3.1.1 Introduction

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information in CCNPP Unit 3 FSAR Section 3.1, "Compliance with Nuclear Regulatory Commission General Design Criteria," to verify that the CCNPP Unit 3 design meets the relevant General Design Criteria (GDC) of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants."

The staff's review of structures, systems, and components (SSCs) relies, in part, on industry codes and standards that represent accepted industry practices. Where applicable codes and standards are identified the basis for their acceptability is discussed.

3.1.2 Summary of Application

Combined license (COL) FSAR Section 3.1 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.1, "Compliance with Nuclear Regulatory Commission General Design Criteria."

In addition, in COL FSAR Section 3.1, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.1.1.1.1, "U.S. EPR Compliance," to address COL Information Item 3.1-1 from U.S. EPR FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," as follows:

> A COL applicant that references the U.S. EPR design certification will identify the site-specific QA Program Plan that demonstrates compliance with GDC 1.

In response to this COL information item, the COL applicant stated that the Quality Assurance (QA) Program is provided in UniStar Nuclear Topical Report (TR) No. UN-TR-06-001-A, "Quality Assurance Program Description," (QAPD). The QAPD is applicable to the siting, design, fabrication, construction (including pre-operational testing), operation (including testing), maintenance and modification of the facility. The COL applicant stated that the QAPD demonstrates compliance with GDC 1, "Quality Standards and Records," as described in COL FSAR Chapter 17, "Quality Assurance and Reliability Assurance."

Supplemental Information

The COL applicant provided the following supplemental information in COL FSAR Section 3.1.1.5.1, "U.S. EPR Compliance":

The COL applicant stated that CCNPP Unit 3 shares the following SSCs with CCNPP Units 1 and 2:

- Offsite transmission system – The CCNPP Unit 3 substation is electrically integrated with the existing CCNPP Units 1 and 2, 500 kV substation. While the offsite transmission system is shared between CCNPP Unit 3 and CCNPP Units 1 and 2, CCNPP Unit 3 has onsite alternating current (AC) and direct current (DC) systems that are dedicated to its use. The offsite AC power sources are described in more detail in COL FSAR Section 8.2, and the onsite power sources are described in COL FSAR Section 8.3.

- Existing Chesapeake Bay intake channel and embayment consist of the:

    - Existing CCNPP Units 1 and 2 intake channel that extends 1,380 m (4,500 ft) offshore

    - Existing embayment that is defined by a deep curtain wall

    - CCNPP Unit 3 intake channel

    - Non-safety-related circulating water system (CWS) Makeup Water Intake Structure

    - Safety-related Ultimate Heat Sink (UHS) Makeup Water Intake Structure.

    CCNPP Units 1 and 2 and CCNPP Unit 3 share the CCNPP Units 1 and 2 intake channel and embayment. While the CCNPP Unit 3 CWS Makeup Water Intake Structure, UHS Makeup Water Intake Structure, and UHS Intake Channel are located within the embayment, they are structurally independent of the CCNPP Units 1 and 2 intake structures, and are located in a different part of the embayment. The UHS is described in more detail in COL FSAR Section 9.2.5. The CWS is described in more detail in Section 10.5 of this report.

    Meteorological tower – The meteorological tower provides meteorological data to CCNPP Units 1 and 2 and CCNPP Unit 3 to support operational and emergency response purposes. It is described in more detail in COL FSAR Section 2.3.3.

    Emergency Operations Facility (EOF) – The EOF is described in more detail in Part 5 of the COL application.

The COL applicant stated that SSCs are designed such that an accident in one unit would not impair their ability to perform their function for any other unit.

3.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the final safety evaluation report (FSER) related to the U.S. EPR FSAR.

The regulatory basis for the staff's review of the QAPD is addressed within the staff SER that approved UN-TR-06-001-A, Revision 0.

In addition, the relevant requirements of NRC regulations for the shared SSCs, and the associated acceptance criteria, are specified in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (hereafter referred to as NUREG-0800 or the SRP), Sections 8.2, "Offsite Power System," and 9.2.5, "Ultimate Heat Sink."

The applicable regulatory requirements for the shared SSCs are as follows:

- GDC 5, "Sharing of Structures, Systems, and Components," as to capability of shared systems and components important to safety to perform specified safety functions.

The related acceptance criteria are as follows:

1. Regulatory Guide (RG) 1.32, "Criteria for Power Systems for Nuclear Power Plants," as it relates to its endorsement of Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) No. 308, Section 7, relating to sharing of SSCs of the Class 1E power system at multi-unit stations and guidance related to the sharing of SSCs of the offsite power system (preferred power supply) at multi-unit stations.

2. RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants," describes staff positions on UHS design for sharing of SSCs. GDC 5 applies to any multi-unit facility in which an UHS portion is shared by two or more units.

3.1.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.1 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to compliance with NRC GDC has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.1-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.1.1.1.1. UniStar Nuclear Topical Report UN-TR-06-001-A,

"Quality Assurance Program Description," Revision 0, was approved by the NRC on March 14, 2007. Therefore, the staff finds that the information item requirement to identify the site-specific QA Program Plan that demonstrates compliance with GDC 1 has been met.

Supplemental Information

The staff reviewed supplemental information related to sharing of SSCs included under COL FSAR Section 3.1.1.5.1. This information is evaluated under Sections 2.3, 8.2, 8.3, 9.2 and 13.3 of this report.

3.1.5 Post Combined License Activities

There are no post COL activities related to this section.

3.1.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to compliance with NRC GDC, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to compliance with NRC GDC incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.1 of this report to reflect the final disposition of the design certification application.

In addition, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR 50 Appendix A, GDC 1, and GDC 5.

3.2 Classification of Structures, Systems, and Components

This section of the COL FSAR describes the classification of SSCs relative to safety function, seismic category, and quality standards.

COL FSAR Sections 3.2.1, "Seismic Classification," and 3.2.2, "System Quality Group Classification," incorporate by reference the content of the respective U.S. EPR FSAR sections without departures, but with the addition of the COL applicant's responses to COL information items and supplementary information.

3.2.1 Seismic Classification

3.2.1.1 *Introduction*

SSCs important to safety must be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. The earthquake against which these plant features are designed is defined as the safe-shutdown earthquake (SSE). The SSE is based upon an evaluation of the maximum earthquake potential and is the earthquake which produces

the maximum vibratory ground motion for which SSCs important to safety are designed to remain functional. Those plant features that are designed to remain functional if an SSE occurs are designated Seismic Category I in RG 1.29, "Seismic Design Classification."

The objective of the staff review is to determine that SSCs important to safety have been appropriately categorized and designed to withstand the effects of earthquakes without loss of capability to perform their safety functions.

3.2.1.2 *Summary of Application*

COL FSAR Section 3.2.1 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.2.1, "Seismic Classification."

In addition, in COL FSAR Section 3.2.1, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.2.1 to address COL Information Item 3.2-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will identify the seismic classification of applicable site-specific SSCs that are not identified in U.S. EPR FSAR Tier 2, Table 3.2.2-1.

The COL application provides COL FSAR Table 3.2-1, "Classification Summary for Site-Specific SSCs," containing the seismic classification of the CCNPP Unit 3 SSCs, in accordance with the categories described in U.S. EPR FSAR Tier 2, Section 3.2.1; an additional category is utilized for fire protection-related structures, systems, and components.

The seismic classification of the U.S. EPR SSCs uses the following categories: Seismic Category I, Seismic Category II, radwaste seismic, conventional seismic, and non-seismic. CCNPP Unit 3 utilizes an additional seismic classification: Seismic Category II-SSE. This classification is applicable to fire protection SSCs that support equipment necessary to remain functional during and following a seismic event to achieve safe-shutdown in accordance with RG 1.189, "Fire Protection for Nuclear Power Plants."

CCNPP Unit 3 included site-specific SSCs in the UHS makeup water system, circulating water system, raw water system, desalinization and water treatment system, sanitary waste water system, security access facility, central gas supply building, potable water system, fire water supply system, fire suppression system, and other site-specific structures.

There are no site-specific SSCs pertaining to RGs 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," and 1.151, "Instrument Sensing Lines."

3.2.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for seismic classification, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.2.1, "Seismic Classification."

The applicable regulatory requirements for seismic classification are as follows:

1. GDC 2, "Design for Protection Against Natural Phenomena," as it relates to the requirements that SSCs important to safety shall be designed to withstand the effects of earthquakes without loss of capability to perform necessary safety functions.

2. GDC 61, "Fuel Storage and Handling and Radioactivity Control," as it relates to the design of radioactive waste systems, and other systems that may contain radioactivity, to assure adequate safety under normal and postulated accident conditions.

3. 10 CFR Part 100, "Reactor Site Criteria," Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," and 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," as they relate to certain SSCs being designed to withstand the SSE and remain functional.

The related acceptance criteria are as follows:

1. RG 1.29 describes an acceptable method of identifying and classifying those plant features that should be designed to withstand the effects of the SSE. RG 1.29, Regulatory Position 1 states that site-specific safety-related SSCs, including their foundations and supports, must be designed to withstand the effects of the SSE and remain functional. These SSC are properly classified as Seismic Category 1. RG 1.29, Regulatory Position 2 states that those portions of non-seismic SSCs whose continued function is not necessary, but whose failure could reduce the functioning of any Seismic Category I SSC to an unacceptable level, or could result in an incapacitating injury to occupants of the control room, should be designed and constructed so that an SSE could not cause such failure. RG 1.29, Regulatory Position 3 provides guidelines for designing interfaces between Seismic Category I and non-seismic SSCs.

2. RG 1.151 provides guidance with regard to seismic design specifications and classification of safety-related instrumentation sensing lines.

3. RG 1.143 provides guidance used to establish the seismic design specifications of radioactive waste management SSCs to meet the requirements of GDC 2 and GDC 61 as they relate to designing these SSCs to withstand earthquakes. The guide identifies several radioactive waste SSCs requiring some level of seismic design consideration.

4. RG 1.189 provides guidance used to establish the design specifications of fire protection SSCs to meet the requirements of GDC 2 as it relates to designing these SSCs to withstand earthquakes. This is RG 1.29, Regulatory Position 5. This guide identifies portions of fire protection SSCs requiring some level of seismic design consideration.

3.2.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.2.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application

and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.2.1 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to seismic classification has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.2-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.2.1.

The staff reviewed the COL FSAR in accordance with NUREG-0800, Section 3.2.1 and the guidance contained in RG 1.29, RG 1.143, RG 1.151, and RG 1.189 identified in SRP Section 3.2.1. The review included evaluation of the criteria used to establish the seismic classification and the application of those criteria to the classification of principal components included in COL FSAR Table 3.2-1. Consistent with SRP Section 3.2.1, seismic classification of electrical items are not within the scope of this review and are to be addressed in Section 3.10 of this report. The staff's review of COL FSAR Section 3.2.1 concluded that the COL applicant appropriately incorporated by reference U.S. EPR FSAR Tier 2, Section 3.2.1.

List of SSCs Needed for Continued Operation

10 CFR Part 50, Appendix S, IV(a)(2)(i)(B)(1) states that SSCs necessary for continued operation without undue risk to the health and safety of the public must remain functional and within applicable stress, strain, and deformation limits when subject to the effects of the operating basis earthquake (OBE) Ground Motion. SRP Section 3.2.1 states that, if the COL applicant has set the OBE Ground Motion to the value one-third of the SSE Ground Motion, then the COL applicant should also provide a list of SSCs necessary for continued safe operation that must remain functional without undue risk to the health and safety of the public and within applicable stress, strain and deformation, during and following the OBE. U.S. EPR FSAR Tier 2, Section 3.7, "Seismic Design," states that the OBE for the U.S. EPR standard plant design is defined as one-third of the standard plant SSE. However, this list of SSCs necessary for continued operation is not provided in the U.S. EPR FSAR. Therefore, in RAI 109, Question 03.02.01-1, the staff requested that the COL applicant clarify whether the list of SSCs necessary for continued operation would be provided as part of the COL FSAR.

In a June 12, 2009, response to RAI 109, Question 03.03.01-1, the COL applicant stated that as noted in 10 CFR Part 50, Appendix S, Section IV(a)(2)(i)(A), if the OBE ground motion is set to one-third or less of the SSE, then the requirements associated with the OBE ground motion in 10 CFR Part 50, Appendix S, Section IV (a)(2)(i)(B)(I) can be satisfied without the COL applicant performing explicit response or design analyses. Since the U.S. EPR has set the OBE at one-third of the SSE (as discussed in U.S. EPR FSAR Tier 2, Section 3.7), no further explicit response is required in accordance with 10 CFR Part 50,Appendix S, Section IV(a)(2)(i)(A). Those SSCs that are designed to withstand an SSE are classified as Seismic Category I and are given in U.S. EPR FSAR Tier 2, Table 3.2.2-1, "Classification Summary." This classification is in accordance with SRP Section 3.2.2-1. Based on the COL applicant's statement that the list is addressed through U.S. EPR FSAR Tier 2, Table 3.2.2-1 and the staff finding that the table is acceptable, the staff considers RAI 109, Question 03.02.01-1 resolved.

COL FSAR Table 3.2-1

COL FSAR provided site-specific SSCs in Table 3.2-1. However, the definitions for some acronyms (e.g., PE, PEB, etc.) in COL FSAR Table 3.2-1 cannot be located in the acronym list in the COL FSAR or the U.S. EPR FSAR. Therefore, in RAI 109, Question 03.02.01-3, the staff requested that the COL applicant add these definitions to the list of acronyms in COL FSAR Table 1.1-1, "Acronyms Used in this Document," or add notes in COL FSAR Table 3.2-1 to define these acronyms. Additionally, the system title in COL FSAR Table 3.2-1 seems to be inconsistent with the component codes. As an example, there are no PE or PEB components given under system heading "PE, PEB, PED UHS Makeup System." Another example is the "PA, PAA, PAB, PAC, PAS Circulating Water System." There are no PA, PAA, PAB, or PAC components given under this system heading. Therefore, in RAI 109, Question 03.02.01-3, the staff requested that the COL applicant verify whether UPB (universal power bus) needs to be added to the system title. In an August 4, 2009, response to RAI 109, Question 03.02.01-3, the COL applicant stated that U.S. EPR FSAR Tier 2, Table 3.2.2-1 is incorporated by reference into the COL FSAR. PE is the generic system name for the essential service water system contained in U.S. EPR FSAR Tier 2, Table 3.2.2-1. PEB and PED are sub-system names for essential service water piping system and essential service water recirculation cooling system, respectively. PEB components are part of the generic essential service water system and are shown in U.S. EPR FSAR Tier 2, Table 3.2.2-1. PED is a sub-system name that includes the UHS makeup water system.

Similarly, PA is the generic system name for the circulating water system. PAA, PAB, and PAC are sub-system names for circulating water screening plant, circulating water piping system, circulating water pump system, respectively. COL FSAR Table 3.2-1 has been updated to only include Kraftwerks Kennzeichen System (KKS) and component codes contained in COL FSAR Table 3.2-1 and provide a description of the KKS codes and other acronyms used.

Only individual components as identified are provided with equipment identification numbers corresponding to those used throughout the COL FSAR. Generic components such as piping and valves are provided with component codes. Building structures that are assigned with component codes are indicated in the table. The remaining equipment and building structures will have the component code defined during the detailed design phase. UPB is a building code and is not indicated in the system name field. The definition of UPB is located in COL FSAR Table 3.2-1, Note 3. The staff finds that the COL applicant's August 4, 2009, response to RAI 109, Question 03.02.01-3 fully addressed the staff's concerns in that both issues are fully addressed in the COL FSAR. Therefore, the staff considers RAI 109, Question 03.02.01-3 resolved.

Definitions of Seismic Categories CS and NSC

Seismic categories conventional seismic and non-seismic are defined in the U.S. EPR FSAR. However, there is no definition in COL FSAR Table 3.2-1. Therefore, in RAI 109, Question 03.02.01-4, the staff requested that the COL applicant add the definition for seismic categories CS [Conventional Seismic] and NSC [Non-Conventional Seismic] in the notes for COL FSAR Table 3.2-1, for clarification and consistency.

In a June 12, 2009, response to RAI 109, Question 03.02.01-4, the COL applicant stated that COL FSAR Table 3.2-1 would be revised to include the definition of conventional seismic and non-seismic in Note 2. The staff confirmed that Revision 6 of the COL FSAR, dated September 30, 2009, contains the changes committed to in the RAI response. Accordingly, the

staff finds that the COL applicant has adequately addressed this issue and, therefore, the staff considers RAI 109, Question 03.02.01-4 resolved.

Seismic Category I SSCs

Since the Seismic Category I classification in the COL FSAR is the same as the seismic classification in the U.S. EPR FSAR which was completed in accordance with RG 1.29, Regulatory Position C.1, the design will ensure that the safety-related SSCs will remain functional during and after an SSE. Site-specific UHS makeup water system SSCs are added to COL FSAR Table 3.2-1. The safety-related UHS makeup water systems SSCs are properly classified as Seismic Category I to ensure that they will remain functional during and after an SSE. Therefore, the Seismic Category I classification of safety-related SSCs within the scope of SRP Section 3.2.1 is acceptable.

Seismic Category II SSCs

The miscellaneous piping and traveling screens are non-safety-related, and are classified as Seismic Category II to ensure that their failure during and after an SSE will not reduce the function of safety-related SSCs. The staff finds the classification of the UHS makeup water system SSCs acceptable and conforms to the guidelines in RG 1.29. Therefore, the staff also finds that the Seismic Category II classification of non-safety-related SSCs within the scope of SRP Section 3.2.1 is acceptable.

Seismic Category II SSEs

CCNPP Unit 3 utilizes an additional seismic classification, Seismic Category II-SSE. This classification is utilized to address fire protection SSCs that are necessary to remain functional during and following a seismic event to support equipment necessary to achieve safe-shutdown in accordance with RG 1.189. COL FSAR Table 9.5-1, "Fire Protection Program Compliance with Regulatory Guide 1.189," does not indicate any nonconformance with RG 1.189. The seismic categories of the fire protection system SSCs are properly classified according to guidelines in RG 1.189. The specific guidelines in RG 1.189 include Regulatory Position C.3.2.1 for seismic consideration for water supply piping system to at least two standpipes and hose connections for manual firefighting in areas containing equipment necessary for safe-shutdown and RG 1.189, Regulatory Position C.3.2.2 for seismic consideration of fire pumps. As discussed in COL FSAR Section 3.7.2.8, "Interaction of Non-Seismic Category I Structures with Seismic Category I Systems," the Seismic Category II-SSE fire protection system SSCs will be seismically analyzed to ensure that they will remain functional during and following an SSE.

Site-specific SSCs for the fire water supply system and the fire suppression system were added to COL FSAR Table 3.2-1. However, the site-specific piping and instrumentation diagrams (P&IDs) for the fire protection system cannot be located in the CCNPP Unit 3 FSAR. Therefore, in RAI 109, Question 03.02.01-2, the staff requested that the COL applicant provide the simplified fire protection system P&IDs in the COL FSAR showing the site-specific SSCs including seismic category.

In a June 12, 2009, response to RAI 109, Question 03.02.01-2, the COL applicant stated that simplified fire protection system P&IDs (COL FSAR Figures 9.5-2 and 9.5-3) showing the site-specific SSCs, were previously provided in the COL applicant's May 8, 2009, response to RAI 75, Question 09.05.01-4. The COL applicant proposed revisions to COL FSAR Figures 9.5-2, "CCNPP Unit 3 Fire Water Distribution System – Cooling Tower Loop," and 9.5-3,

"CCNPP Unit 3 Fire Water Distribution System – Intake Structure Loop," to identify the SSC seismic category, consistent with COL FSAR Table 3.2-1. In addition, COL FSAR Table 3.2-1 and COL Application Part 10 inspection, test, analysis, and acceptance criteria (ITAAC) Tables 2.4-26, "Fire Water Distribution System Inspections, Tests, Analyses, and Acceptance Criteria," and 2.4-27, "Fire Suppression Systems Inspections, Tests, Analyses, and Acceptance Criteria," were to be revised for clarity and consistency. The staff confirmed that Revision 6 of the CCNPP Unit 3 FSAR, dated September 30, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, considers RAI 109, Question 03.02.01-2 resolved.

Conventional Seismic Category

The Turbine Building is classified as conventional seismic and, as such, is designed to the International Building Code (IBC) seismic criteria. RG 1.29, Regulatory Position 2 states that those portions of SSCs of which continued function is not necessary but, of which failure could reduce the functioning of any safety-related SSCs to an unacceptable safety level, should be designed and constructed so that the SSE would not cause such failure. Therefore, in RAI 109, Question 03.02.01-5, the staff requested that the COL applicant explain the basis for categorizing the Turbine Building as CS. The staff also requested that the COL applicant clarify that the separation distance between the Turbine Building and safety-related SSCs is adequate to preclude the collapse of the Turbine Building from adversely affecting the function of the safety-related SSCs in a safe-shutdown earthquake.

In a January 4, 2010, response to RAI 109, Question 03.02.01-5, the COL applicant stated that the Switchgear Building (SB) is a steel framed structure located adjacent to the Turbine Building. The Turbine and Switchgear Buildings together comprise a common turbine island (TI) structure. The TI structure's lateral force resisting system (LFRS) provides restraint for seismic and tornado wind loading. As described in the COL applicant's December 29, 2009, responses to RAI 65, Questions 03.07.02-9, 03.07.02-18, and 03.07.02-19, and RAI 180, Question 03.07.02-41 (UniStar Nuclear Energy Update to CCNPP Unit 3 FSAR Section 3.7 and Response to COL FSAR Section 3.7, RAIs 19, 25, 58, 63, 65, 112, 113, 139, 158, 159, 167, 168, 179, 180, 181, and 193), the Turbine and Switchgear Buildings are classified as Seismic Category II. As such, the Turbine and Switchgear Buildings will be designed using conventional seismic codes and standards [International Building Code; American Concrete Institute (ACI) 318, "Building Code Requirements for Structural Concrete and Commentary"; American National Standards Institute/American Institute of Steel Construction (ANSI/AISC) 341, "Seismic Provision for Structural Steel Buildings"; and ANSI/AISC 360, "Specification for Structural Steel Buildings"], but will also be analyzed and designed using site-specific SSE spectrum to prevent seismic interaction with the adjacent Seismic Category I SSCs. An evaluation of the site-specific SSE responses will confirm that the separation distance between the TI structure and the Seismic Category I SSCs exceeds the sum of the maximum relative seismic displacement between the structures, construction tolerances and settlement effects by an appropriate factor of safety. This analysis methodology will confirm preclusion of seismic interaction of the TI with the adjacent Seismic Category I SSCs. COL FSAR Section 3.7.2.8 will be revised as indicated in the COL applicant's December 29, 2009, responses to RAI 65, Questions 03.07.02-9, 03.07.02-18, and 03.02.07-19, and RAI 180, Question 03.07.02-41. Also, COL FSAR Table 3.2-1 will be updated in a future COL application revision. The staff confirmed that Revision 7 of the COL FSAR, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds the COL applicant's December 29, 2009, response fully addressed the staff's concerns, because the COL applicant

changed the seismic category for the Turbine Building such that RG 1.29 acceptance criteria will be met. Therefore, the staff considers RAI 109, Question 03.02.01-5 resolved.

The staff notes that RG 1.29, Regulatory Position C.4 identifies that the pertinent quality assurance requirements of 10 CFR Part 50, Appendix B should be applied to all activities affecting safety-related functions of those portions of SSCs covered under RG 1.29 Regulatory Positions C.2 and C.3. The staff notes that SSCs classified as Seismic Category II are equivalent to those covered in RG 1.29, Regulatory Position C.2. The staff finds that the COL applicant's January 4, 2010, response to RAI 109 Question 03.02.01-5 clarified that the seismic classification of the Turbine Building and Switchgear Building will be revised from CS to Seismic Category II. However, the proposed revised COL FSAR Table 3.2-1 submitted with this RAI response and also included in Revision 7 of the COL FSAR identifies 10 CFR Part 50, Appendix B as "No" for the Turbine Building and Switchgear Building.

While the applicability of 10 CFR Part 50, Appendix B to Turbine Building and Switchgear Building was corrected to state "Yes" in the COLA Revision 8, there are several other Seismic Category II SSCs in COL FSAR Table 3.2-1 that still state the applicability of the 10 CFR Part 50, Appendix B as "No." As stated in COL FSAR Table 3.2-1, Note 5, pertinent requirements of 10 CFR Part 50, Appendix B apply to those SSCs classified as NS-AQ and classified as "Yes" for 10 CFR Part 50, Appendix B. Therefore, in follow up RAI 358, Question 03.02.01-6, the staff requested that the COL applicant clarify the basis for not applying 10 CFR Part 50, Appendix B to any SSC classified as Seismic Category II and clarify if this represents an exception to RG 1.29. If this is an exception to RG 1.29, the staff requested that the COL applicant also justify the basis for the exception. Alternatively, revise COL FSAR Table 3.2-1 to identify 10 CFR Part 50, Appendix B as "Yes" for any SSC classified as Seismic Category II to make it consistent with RG 1.29. **RAI 358, Question 03.02.01-6 is being tracked as an open item**.

3.2.1.5 *Post Combined License Activities*

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

3.2.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to seismic classification, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the seismic classification incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.2.1 of this report to reflect the final disposition of the design certification application.

On the basis of its review of COL FSAR Section 3.2.1, Table 3.2-1, the applicable simplified P&IDs, and other supporting information in the COL application, the staff concludes that the CCNPP Unit 3 site-specific safety-related SSCs, including their supports, are properly classified

as Seismic Category I, in accordance with RG 1.29, Regulatory Position C.1. In addition, the staff finds that the COL FSAR includes acceptable consistency with RG 1.29, Regulatory Position C.2 that the necessary site-specific SSCs are properly classified as Seismic Category II. Finally, the staff finds that necessary site-specific fire protection system SSCs are properly classified as Seismic Category II-SSE, consistent with the guidance in RG 1.189 and thus conforms to RG 1.29, Regulatory Position C.5.

There are no site-specific SSCs pertaining to RG 1.143 and RG 1.151.

As a result of the open item in RAI 358, Question 03.02.01 6, the staff is unable to finalize its conclusions on this section. However, staff finds that the COL applicant has provided sufficient information to satisfy the applicable regulatory requirements of 10 CFR Part 50, Appendix A, GDC 2 and GDC 61; 10 CFR Part 100, Appendix A; and 10 CFR Part 50, Appendix S, except for the open item discussed above in the technical evaluation. The staff finds this constitutes an acceptable basis for satisfying, in part, the portion of GDC 2 that requires that all SSCs important to safety be designed to withstand the effects of natural phenomena, including earthquakes.

3.2.2 System Quality Group Classification

3.2.2.1 *Introduction*

Nuclear power plant systems and components important to safety should be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. There are two approaches to classifying systems, a deterministic approach and a risk-informed approach. The deterministic approach for classification of fluid systems important to safety identifies the safety function to be performed and its importance. Once the safety function performed by the fluid system is identified and its importance to safety is determined, applicable construction codes and standards are identified.

The objective of the staff review is to determine if site-specific pressure retaining fluid systems and their supports important to safety have been identified and appropriately classified such that appropriate codes and standards for design, erection, fabrication, and testing have been selected commensurate with their importance to safety in accordance with the requirements of GDC 1 and the regulatory positions in RG 1.26, “Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants.”

3.2.2.2 *Summary of Application*

COL FSAR Section 3.2.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.2.2, “System Quality Group Classification.”

In addition, in COL FSAR Section 3.2.2, the COL applicant provided the following:

COL License Information Items

The COL applicant provided additional information in COL FSAR Section 3.2.2 to address COL Information Item 3.2-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will identify the quality group classification of site-specific SSCs that are not identified in U.S. EPR FSAR Table 3.2.2-1.

In response to this COL information item, the COL applicant stated that the quality group classifications of site-specific SSCs are provided in COL FSAR Table 3.2-1.

3.2.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the system quality group classification of site-specific SSCs, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.2.2, "System Quality Group Classification."

The applicable regulatory requirements for system quality group classification of site-specific SSCs are as follows:

- GDC 1, and the pertinent quality assurance (QA) requirements of "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and 10 CFR Part 50.55a, "Codes and Standards," as they relate to applying QA requirements to activities affecting the safety-related functions of SSCs designated as Seismic Category I commensurate with their importance to safety.

The related acceptance criteria are as follows:

- GDC 1 and 10 CFR 50.55a are met by conforming to the guidance in RG 1.26.

3.2.2.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.2.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.2.2 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to system quality group classification has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.2-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.2.2.

Specifically, the staff reviewed the information presented in COL FSAR Section 3.2.2 and the quality group classifications of site-specific systems and components in COL FSAR Table 3.2-1. For site-specific SSCs that are not identified in U.S. EPR FSAR Tier 2, Table 3.2.2-1, the staff determined that additional information was needed to evaluate this COL supplemental information and the following requests for additional information questions were submitted to the COL applicant pertaining to specific areas of review.

Codes and Standards

AREVA NP Technical Report ANP-10292, "U.S. EPR Conformance with Standard Review Plan (NUREG-0800) Technical Report," indicates that the U.S. EPR is consistent with SRP Section 14.3.2, Acceptance Criterion 10, concerning inspection, test, analysis, and acceptance criteria for the verification of codes and standards for American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 systems and no departures are identified in the COL application.

SRP Section 3.2.2 identifies that, consistent with SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," the staff should review applications using the newest codes and standards that have been endorsed by the NRC and unapproved editions will be reviewed on a case-by-case basis. COL FSAR Table 3.2-1 and COL FSAR Section 3.2.3, "References," do not define editions for codes and standards or applicable codes and standards for certain SSCs, such as the traveling screens. Therefore, in RAI 182, Question 03.02.02-1, the staff requested that the COL applicant clarify which editions of codes and standards apply to the SSCs included in COL FSAR Table 3.2-1 and, for SSCs with no commercial codes and standards shown, to identify what commercial codes and standards apply. If this information is to be determined later, the staff requested that the COL applicant indicate when this information would be available.

In a March 12, 2010, response to RAI 182, Question 03.02.02-1, the COL applicant provided an updated COL FSAR Table 3.2-1 and indicated that this table would be revised in a future revision to the COL FSAR to identify the code editions. The response also clarified that the quality group classification for electrical equipment would be revised in a future revision of the COL FSAR. Specific code editions are to be reviewed in other sections of this report that pertain to individual structures, systems, and components. SRP Section 3.2.2 and RG 1.26 do not address codes and standards for electrical equipment, and codes and standards for electrical equipment are to be reviewed in other sections of this report that pertain to such equipment. The revised COL FSAR Table 3.2-1 is to include appropriate commercial codes and standards for mechanical systems and equipment or otherwise indicate that the manufacturer's standard applies (e.g.; Note 6) if there are no applicable commercial codes or standards. The staff finds that the inclusion of this additional information on the codes and standards addressed the staff's concern. Subsequently, COL FSAR Table 3.2-1 was revised to be consistent with the COL applicant's March 12, 2010, response RAI 182, Question 03.02.02-1, to include notes, including Note 10 in the RAI response that specifies applicable code and standards editions. Accordingly, the staff considers all issues in RAI 182, Question 03.02.02-1 resolved.

ITAAC

AREVA NP Technical Report ANP-10292 indicates that U.S. EPR has ITAAC consistent with SRP Section 3.2.2, Acceptance Criterion 2, and SRP Section 14.3.3, Acceptance Criteria 1 and 2, pertaining to quality group classifications, generic piping design ITAAC, and safety classifications. No departures are identified in the COL application from these criteria, and site-specific ITAAC are added. ITAAC for site-specific systems and components are included in COL application Part 10, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) and ITAAC Closure," and COL FSAR Section 14.3, "Inspection, Test, Analysis, and Acceptance Criteria."

ITAAC are included in the COL FSAR for as-built inspections of certain important to safety site-specific SSCs including Seismic Category I SSCs, certain SSCs that are classified as

Seismic Category II and Seismic Category I structures that could be adversely affected by adjacent non-seismic category structures. For site-specific SSCs that are defined as risk-significant, in RAI 182, Question 03.02.02-2, the staff requested that the COL applicant clarify that ITAAC is in place to verify that the as-built SSC is consistent with the quality group classification. The staff also requested that the COL applicant specifically clarify if there are any important to safety SSCs classified as Seismic Category II or that are not selected for ITAAC and, if so, clarify why an ITAAC is not needed.

In a March 26, 2010, response to RAI 182, Question 03.02.02-2, the COL applicant stated that the site-specific SSCs that are considered for ITAAC are identified in COL FSAR Table 14.3-2, "Site Specific SSC ITAAC Screening Summary," and the associated ITAAC are provided in COL application Part 10, Appendix B, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)," Tables 2.4-1, "Structural Fill and Backfill Under Seismic Category I and Seismic Category II-SSE Structures Inspections, Tests, Analyses, and Acceptance Criteria," and 2.4-7, "Ultimate Heat Sink Makeup Water Intake Structure Inspections, Tests, Analyses, and Acceptance Criteria," through 2.4-31, "Class 1E Emergency Power Supply Components for Site-Specific Systems Inspections, Tests, Analyses, and Acceptance Criteria." The response states that ITAAC in COL application Part 10, Appendix B will be updated as indicated for certain Seismic Category II structures. The response further states that additional ITAAC are provided for the site-specific fire protection system and components that are classified as Seismic Category II. ITAAC for applicable site-specific systems and components considered important to safety that are Seismic Category II or CS, are provided in COL application Part 10, Appendix B, Tables 2.4-21 through 2.4-31, "Ultimate Heat Sink Makeup Water Intake Structure Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria,". The COL applicant's RAI response concludes that there are no important to safety systems or components classified as Seismic Category II or CS that are not selected for ITAAC. The COL applicant's March 26, 2010, response to RAI 161, Question 14.03.03-4 also addresses COL FSAR changes needed to address this ITAAC concern for Seismic Category II equipment. Subsequently, the COL FSAR was revised to include the additional ITAAC for Seismic Category II SSCs. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, the staff considers RAI 182, Question 03.02.02-2 resolved.

Quality Group for Structures

COL Information Item 3.2-2 indicates that the COL applicant will identify the quality group classification of applicable site-specific SSCs. Although SRP Section 3.2.2 specifically identifies that structures are excluded from the review, COL FSAR Table 3.2-1 identifies quality groups for site-specific SSCs, including structures. RG 1.26 and the U.S. EPR FSAR do not identify quality groups for non-pressure boundary items, such as structures or duct banks. Quality groups are only designated for pressure-retaining components within fluid systems or their supports. Therefore, in RAI 182, Question 03.02.02-3, the staff requested that the COL applicant clarify the basis for the quality group designation for structures and other non-pressure-retaining components and questioned what this means in terms of quality to satisfy GDC 1.

In a March 12, 2010, response to RAI 182, Question 03.02.02-3, the COL applicant stated that COL FSAR Table 3.2-1 would be updated in a future revision to delete quality groups for structures and appropriate non-pressure boundary items. Subsequently, the staff confirmed the COL FSAR was revised to include the updated COL FSAR Table 3.2-1, and quality group (QG) is shown as not applicable to structures. Therefore, the staff considers the issue in RAI 182, Question 03.02.02-3 resolved.

Piping and Instrumentation Diagrams

SRP Section 3.2.2 indicates that the review includes the COL applicant's presentation on suitable P&IDs of the system quality group classifications. Site-specific system P&IDs, such as COL FSAR Figure 9.2-3, "Normal Makeup, Emergency Makeup, Blowdown & Chemical Treatment," for the UHS makeup, do not show the system quality group classifications and appear to be conceptual. Therefore, in RAI 182, Question 03.02.02-4, the staff requested that the COL applicant clarify the quality group classifications on these figures and identify when the detailed P&IDs will be available for review.

In a March 12, 2010, response to RAI 182, Question 03.02.02-4, the COL applicant clarified that the raw water system and the UHS makeup water system are the only site-specific systems that are either important to safety or interface with systems important to safety. The response stated that COL FSAR Figure 9.2-3 would be updated to include appropriate quality group classification. Detailed P&IDs of systems important to safety are currently scheduled to be available in the fourth quarter of 2012. The proposed updated COL FSAR Figure 9.2-3 included with the response to RAI 182, Question 03.02.02-1 shows all safety-related SSCs in the emergency makeup as QG C. . Subsequently, the COL FSAR was revised and COL FSAR Figure 9.2-3 has been updated to include the QG classification. Accordingly, the staff considers all issues associated with RAI 182, Question 03.02.02-4 resolved.

Auditable Information

10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," requires, in part, that, prior to granting a combined license which references a standard design certification, information normally contained in certain specifications be available for audit if such information is needed to make the determination that the COL application is consistent with the certified design. Therefore, in RAI 182, Question 03.02.02-5, the staff requested that the COL applicant confirm that design information contained in procurement specifications concerning the quality group classification of all important to safety SSCs and the basis for the classification be made available for NRC audit or establish when such design information will be available. In addition, the staff requested that the COL applicant clarify what design basis classification information, such as design specifications, P&IDs, and Q List, is available for audit.

In a March 12, 2010, response to RAI 182, Question 03.02.02-5, the COL applicant stated that procurement specifications for SSCs important to safety are currently being developed, and these specifications will be available for audit prior to procurement of individual components. The response stated that equipment lists, valve lists, and line lists containing quality group classification and other design information as well as Design Specifications and P&IDs associated with SSCs important to safety are currently scheduled to be available in the fourth quarter of 2012. When these documents are available, the staff will have the opportunity to audit this detailed design information to validate that there is adequate design basis information for quality group classifications and if the regulatory requirements are being appropriately translated into procurement documents. The staff finds the COL applicant's response adequately describes the availability and schedule for these documents; however, additional information is needed to determine which specific classification documents and SSCs are to be subject to a COLA audit.

With regard to COL Information Item 3.9-2, the staff finds the COL applicant's August 10, 2009, response to RAI 124, Question 03.09.03-1, also provides dates for the expected availability of

design specifications for audit. In addition, the COL applicant clarifies that the design certification applicant will provide a sample of component design specifications to be audited.

The staff determined that the COL applicant's August 10, 2009, response to RAI 124, Question 03.09.03-1 does not entirely resolve the staff's concern for auditable information and which design documents were better addressed by the design certification applicant. If the issue is to be addressed by the design certification applicant, the COL information item should either be revised or withdrawn. If the issue is not addressed by the design certification applicant, the staff requested that the COL applicant to address the issue in follow-up RAI 362, Question 03.09.03-2. **RAI 362, Question 03.09.03-2 is being tracked as an open item.**

Augmented QA Requirements for Important to Safety SSCs

COL FSAR Table 3.2-1 for site-specific SSCs identifies that certain SSCs in important to safety systems such as the traveling screens and miscellaneous piping in the UHS makeup water system are classified as Safety Class non-seismic QG D, and Seismic Category II with no 10 CFR Part 50, Appendix B program applied. RG 1.26 does not assign system quality groups to SSCs such as the traveling screens that are not pressure-retaining components within fluid systems or their supports, but RG 1.29, Regulatory Position C.4 identifies that pertinent requirements of 10 CFR Part 50, Appendix B apply to all activities affecting the safety-related functions of these SSCs. For SSCs in systems that are considered important to safety, such as risk-significant SSCs or those classified as Seismic Category II, in RAI 182, Question 03.02.02-6, the staff requested that the COL applicant clarify the basis for the equipment classification as QG D with no augmented quality requirements rather than NS-AQ (Supplemented Grade) with pertinent quality requirements of the 10 CFR Part 50, Appendix B program applied.

In a March 12, 2010, response to RAI 182, Question 03.02.02-6, the COL applicant clarified that the safety classification for the UHS makeup water system and traveling screens will be changed to NS-AQ. The proposed update to COL FSAR Table 3.2-1, included in the COL applicant's March 12, 2010, response to RAI 182, Question 03.02.02-1 showed that quality requirements consistent with 10 CFR Part 50, Appendix B would be applied to important to safety site-specific mechanical systems and components designated as safety classification S (Safety-related) or NS-AQ such as the traveling screens and certain other Seismic Category II SSCs. Subsequently, the COL FSAR was revised to include the updated COL FSAR Table 3.2-1 as committed to in the RAI response. Quality assurance for Seismic Category II SSCs consistent with RG 1.29 is further addressed in Section 3.2.1 of this report. Accordingly, the staff finds that the COL applicant adequately addressed this issue for pressure retaining components and, therefore, considers RAI 182, Question 03.02.02-6 resolved.

Circulating Water System

SRP Section 10.4.5, "Circulating Water System," identifies that the circulating water system should be QG D. As defined in RG 1.26, QG D are those systems that contain or may contain radioactivity that are not included in QGs A, B, or C. The CWS is classified as QG E in COL FSAR Table 3.2-1 rather than QG D, but the code designated for CWS system is ASME B31.1, "Power Piping," which is consistent with RG 1.26 QG D. In addition, the staff expects that the CWS in a pressurized water reactor will not contain measurable amounts of radioactive material. Therefore, staff concurs that QG E is acceptable for the U.S. EPR CWS.

3.2.2.5 *Post Combined License Activities*

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

3.2.2.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to system quality group classification, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the system quality group classification incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.2.2 of this report to reflect the final disposition of the design certification application.

As a result of the open item identified above, the staff is unable to finalize its conclusions on whether the COL applicant has provided sufficient information to satisfy the applicable regulatory requirements of 10 CFR Part 50, Appendix A, GDC 1, and 10 CFR 50.55a,

3.3 Wind and Tornado Loadings

COL FSAR Sections 3.3, 3.3.1, and 3.3.2 incorporate the contents of the respective U.S. EPR FSAR sections by reference, with the addition of responses to COL information items.

3.3.1 Wind Loadings

3.3.1.1 *Introduction*

Safety-related structures need to meet GDC 2, which requires that safety-related structures be designed to withstand the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches, without loss of capability to perform their safety functions. This section describes the design wind speed and procedures used to transform this wind speed into an effective load on structures.

COL FSAR Section 3.3, "Wind and Tornado Loadings," contains the COL applicant's response to COL Information Item 3.3-1 from U.S. EPR FSAR Tier 2, Table 1.8-2. The staff's assessment of the adequacy of the COL applicant's response to this COL information item is discussed in Sections 3.3.1 and 3.3.2 2 of this report.

3.3.1.2 *Summary of Application*

COL FSAR Section 3.3.1, "Wind Loadings," incorporates by reference U.S. EPR FSAR Tier 2, Section 3.3.1, "Wind Loadings."

In addition, in COL FSAR Section 3.3.1, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.3 to address COL Information Item 3.3-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will determine site-specific wind and tornado characteristics and compare these to the standard plant criteria. If the site-specific wind and tornado characteristics are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

The COL applicant addressed this COL information item by stating that COL FSAR Table 2.0-1, "U.S. EPR Site Design Envelope Comparison," provides a comparison of site-specific wind parameters against the parameters identified in the U.S. EPR FSAR. The COL applicant concluded that the U.S. EPR FSAR wind parameters bound the CCNPP Unit 3 wind characteristics. The COL applicant also discusses COL Information Item 3.3-1 in COL FSAR Section 3.3.2.

The COL applicant provided additional information in COL FSAR Section 3.3.1, to address COL Information Item 3.3-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for wind loads, will not affect the ability of other structures to perform their intended safety functions.

In response to this COL information item, the COL applicant referred to COL FSAR Section 3.3.2.3, "Interaction of Non-Seismic Category I Structures with Seismic Category I Structures," for a discussion of site-specific, non-safety-related structures and their interaction with safety-related structures.

3.3.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for wind loadings, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.3.1, "Wind Loadings."

The applicable regulatory requirements for wind loadings are as follows:

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the requirement that SSCs, important to safety, shall be designed to withstand the effects of natural phenomena, such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches, without compromising their abilities to perform their specific safety functions. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accidental conditions, with the effects of natural phenomena.

3.3.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.3.1 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to wind loadings has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

Acceptability of COL Information Item 3.3-1

The staff reviewed COL Information Item 3.3-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.3. The COL applicant provided COL FSAR Table 2.0-1, which contains a comparison of the wind parameters for the U.S. EPR standard plant and the site-specific values. Additional information regarding the derivation of the site-specific wind parameters is provided in U.S. EPR FSAR Tier 2, Section 2.3.1, "Regional Climatology." A comparison of CCNPP Unit 3 FSAR site-specific parameters and U.S. EPR standard design parameters is presented in Table 3.3.1-1 below (generic and site-specific data as specified in COL FSAR Table 2.0-1).

Table 3.3.1-1 Evaluation of CCNPP Unit 3 Wind Site-Specific Design Parameters Versus U.S. EPR FSAR Standard Design Values

No.	Description of Design Values	Units	CCNPP Unit 3 Values	U.S. EPR Values	Differences	% Differences
1	MWS (1)	mph	95	145	50	53
2	MRI (2)	Year	50	50	0	-
3	IF (3)	-	1.15	1.15	0	-
4	WGS (4)	Sec	3	3	0	-
5	AG (5)	Ft	33	33	0	-
6	Exposure Category	-	C	C	-	-

1. Max. Wind Speed
2. Mean Recurrence Interval
3. Impotence Factor for Safety-related Structures to obtain 100 Year Mean recurrence interval
4. Wind Gust Speed
5. Above Ground (wind gust speed)

The staff reviewed COL FSAR Table 2.0-1 and determined that the extreme wind velocity for the CCNPP Unit 3 site is 153 km/hr (95 mph), which is approximately 53 percent less than the standard plant extreme wind velocity. Thus, the maximum wind velocity of the CCNPP Unit 3 site is bounded by that of the standard plant. CCNPP Unit 3 used the same importance factor (1.15) as was specified in the U.S. EPR FSAR for safety-related structures for the 100-year mean recurrence interval. Based on the above table, the staff concludes that the site-specific wind velocity and other design parameters are bounded by the standard design certification values, or are in the limit of the design safety margin.

Additionally, the COL applicant incorporated by reference from the U.S. EPR FSAR acceptable codes and standards to transform the wind speed to equivalent wind pressure on the structures.

The staff also evaluated the acceptability of the COL applicant's response to COL Information Item 3.3-1 in Section 3.3.2 of this report.

Acceptability of COL Information Item 3.3-2

The staff reviewed COL Information Item 3.3-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.3.1. To address this COL information item, the COL applicant referred to a discussion in COL FSAR Section 3.3.2.3, "Interaction of Non-Seismic Category I Structures with Seismic Category I Structures." In COL FSAR Section 3.3.2.3, the COL applicant provided the following 14 site-specific, non-safety-related structures: (1) Fire Protection Water Tanks; (2) Fire Protection Building; (3) Storage/Warehouse; (4) Central Gas Supply Building; (5) Security Access Facility; (6) Switchgear Building; (7) Grid System Control Building; (8) Circulating Water System Cooling Tower; (9) Circulating Water System Pump Building; (10) Circulating Water Makeup Water Intake Structure; (11) Circulating Water System Retention Basin; (12) Desalinization/Water Treatment Plant; (13) Waste Water Treatment Plant; and (14) Demineralized Water Tanks.

In COL FSAR Section 3.3.2.3, the COL applicant stated, "These non-safety-related structures are miscellaneous steel and concrete structures, which are not designed for high wind and tornado loadings. However, the Fire Water Storage Tanks and the Fire Protection Building are designated as Seismic Category II Safe-Shutdown Earthquake structures, and are designed to remain functional during and following a design basis seismic event. These structures are not located adjacent to safety-related structures. Thus, their collapse from high winds or tornado loadings would not result in an impact interaction with any safety-related structure."

The COL applicant's last statement, especially the use of the word "adjacent" as referring to the separation distances, was unclear to the staff. Therefore, in RAI 128, Question 03.03.02-1, the staff requested that the COL applicant provide additional information on the separation distances between each of the non-safety-related and Seismic Category I safety-related structures, as well as the height of each of the non-safety-related structures. Since the COL applicant indicated in COL FSAR Section 3.3.2.3 that the non-safety-related structures are not designed for high wind and tornado loadings and their failure will not adversely affect nearby adjacent Seismic Category I structures, the staff also requested that the COL applicant discuss the method used to mitigate potentially adverse interactions.

In a September 10, 2009, response to RAI 128, Question 03.03.02-1, Part 1, the COL applicant stated that the heights of many of the non-safety-related structures are not finalized at this time. To evaluate the potential for interaction of these structures with a safety-related structure due to the effects of wind and tornado loads, the COL applicant identified, in RAI response Table 1, conservative separation distances between the 15 non-safety-related structures and the

safety-related structures. The separation distances given in Table 1 of the RAI response vary from 18.3 m to 549 m (60 ft to 1,800 ft). As noted in RAI response Table 1 (Note 8), the COL applicant stated that due to the height of the non-safety-related structures, which are much smaller than the separation distances, there will be no potential for an adverse interaction with safety-related structures. Therefore, these structures are not designed for tornado loadings. For the Demineralized Water Tanks, the COL applicant stated that the height of the structure is 15.2 m (50 ft), which is also 3 m (10 ft) less than the separation distance between this non-safety-related structure and the nearest safety-related structure. Thus, there should be no potential for interaction with the nearest safety-related structures. The COL applicant stated that during detailed design of such structures, the heights and separation distances from safety-related structures will be maintained by the licensee, such that the failure of these structures due to wind and tornado loads will not affect the ability of safety-related structures to perform their intended safety functions.

In the September 10, 2009, response to RAI 128, Question 03.03.02-1, Part 1, Table 1, the COL applicant did not provide the separation distances for the Switchgear Building, the Circulating Water System Makeup Water Intake Structure (CWSMWIS), and the Forebay structures. For these three structures, the COL applicant indicated that they are in close proximity to and could potentially interact with a safety-related structure and so will be designed for tornado loading to preclude the adverse interaction. Furthermore, the COL applicant also discussed the design methodology for each of the above-mentioned three new non-safety-related structures to mitigate the adverse effects on safety-related structures. A discussion of the staff's acceptability of the design of these structures against tornado and wind loads is provided in Section 3.3.2 of this report.

Based on data provided in the COL applicant's September 10, 2009, response to RAI 128, Question 03.03.02-1, Part 1, Table 1, and the COL applicant's statements in this response, the staff concluded that the separation distances of the non-safety-related structures given above from safety-related structures are more than the heights of non-safety-related structures. The staff agrees with the COL applicant that adverse effects will not occur.

Therefore, the staff concludes that the COL applicant appropriately considered the most severe wind velocities recorded for the site with an appropriate margin. The COL applicant also designed the plant structures with sufficient margin of safety to prevent structural damage during the most severe wind loadings historically reported for the site. The staff finds that the COL FSAR safety-related structures, systems, and components, are adequately protected and will perform their intended safety functions during and after extreme wind events, and the COL applicant design parameters and responses are acceptable. Accordingly, based on the review of COL FSAR Sections 3.3 and 3.3.1, the staff finds that the COL applicant appropriately incorporated, by reference U.S. EPR FSAR Tier 2, Sections 3.3 and 3.3.1.

3.3.1.5 *Post Combined License Activities*

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

3.3.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to wind loadings,

and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the wind loadings incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.3.1 of this report to reflect the final disposition of the design certification application.

The staff concludes that COL Information Items 3.3-1 and 3.3-2 involving wind velocity characteristics at the site and site-specific structures not designed for wind loadings are adequately addressed in the COL FSAR. In conclusion, the staff finds that the COL applicant has provided sufficient information to show that the structures that are important to safety will be designed to meet the requirements of 10 CFR Part 50, Appendix A, GDC 2.

3.3.2 Tornado Loadings

3.3.2.1 *Introduction*

Safety-related structures need to meet GDC 2, which requires that they be designed to withstand the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches, without loss of capability to perform their safety functions. This section describes the design parameters applicable to tornadoes and the procedures used to transform tornado parameters into effective loads on structures. Also described is the staff's evaluation of the Non-seismic Category I structures that have potential for interacting with seismic Category I structures under tornado load conditions.

3.3.2.2 *Summary of Application*

COL FSAR Section 3.3.2, "Tornado Loadings," incorporates by reference U.S. EPR FSAR Tier 2, Section 3.2.2, "Tornado Loadings." In addition, in COL FSAR Section 3.3.2, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.3 to address COL Information Item 3.3-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will determine site-specific wind and tornado design parameters and compare these to the standard plant criteria. If the site-specific wind and tornado parameters are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

The COL applicant addressed this COL information item by stating that COL FSAR Table 2.0-1, "U.S. EPR Site Design Envelope Comparison," provides a comparison of site-specific tornado parameters against the parameters identified in the U.S. EPR FSAR. The COL applicant

concluded that the U.S. EPR FSAR tornado parameters bound the CCNPP Unit 3 site tornado characteristics. The COL applicant also discusses COL Information Item 3.3-1 in COL FSAR Section 3.3.1.

The COL applicant provided additional information in COL FSAR Section 3.3.2 to address COL Information Item 3.3-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for tornado loads, will not affect the ability of other structures to perform their intended safety functions.

To address COL Information Item 3.3-3, in COL FSAR Section 3.3.2.3 the COL applicant lists 14 non-safety-related steel and concrete structures located on the site, that are not included in the U.S. EPR FSAR Tier 2, Section 3.3.2.3, "Interaction of Non-Seismic Category I Structures with Seismic Category I Structures," and which are not designed for high wind and tornado loadings. The Fire Water Storage Tanks and the Fire Protection Building are designated as Seismic Category II-SSE structures, and are designed to remain functional during and following a design-basis seismic event. These structures are not located adjacent to any safety-related structures. Therefore, their collapse from high winds or tornado loadings should not result in an interaction with safety-related structures. The COL applicant stated that the missiles generated by the collapse of these structures during high winds or tornados are enveloped by the design basis tornado missile loads described in of the U.S. EPR FSAR Tier 2, Section 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds."

3.3.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for tornado loadings, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.2.2, "Tornado Loadings."

The applicable regulatory requirements for tornado loadings are as follows:

- 10 CFR Part 50, Appendix A, GDC 2 requires that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions, as it relates to natural phenomena. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accident conditions, with the effects of the natural phenomena.

3.3.2.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.3.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.3.2 has been reviewed by the staff under Docket No. 52-020.

The staff's technical evaluation of the information incorporated by reference related to tornado loadings has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed conformance of COL FSAR Section 3.3, "Wind and Tornado Loadings," and Section 3.3.2, "Tornado Loadings," to the guidance in RG 1.206, Section C.III.1, Section C.I.3.3.2, "Tornado Loadings." The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

Acceptability of COL Information Item 3.3-1

The staff reviewed COL Information Item 3.3-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.3. The COL applicant provided COL FSAR Table 2.0-1 which contains a comparison of the tornado parameters for the U.S. EPR standard plant and the site-specific values. Additional information regarding the derivation of the site-specific tornado parameters is provided in U.S. EPR FSAR Tier 2, Section 2.3.1. A comparison of CCNPP Unit 3 site-specific and U.S. EPR standard design tornado parameters is presented in Table 3.3.2-1 below (generic and site-specific data as specified in COL FSAR Table 2.0-1).

Table 3.3.2-1 Evaluation of CCNPP Unit 3 Tornado Site-Specific Design Parameter Versus U.S. EPR FSAR Standard Design Values

No.	Description of Design Values	Units	CCNPP Unit 3 Values	US EPR Values	Differences	Enveloped by %(1)
1	Max Wind Speed	mph	200	230	30	15
2	Max Rotational Speed	mph	160	184	24	15
3	Max Translational Speed	mph	40	46	6	15
4	Max Pressure and Rate of Drop	psi/ psi/sec	0.9/0.4	1.2/0.5	0.3/0.1	25
5	RMRS(2)	ft	150	150	0	0
6	Missile Spectra		-	-	No differences	All values enveloped

(1) Values presents additional margin to the design values
(2) RMRS denotes Radius of Maximum Rotational Speed.

The staff reviewed COL FSAR Table 2.0-1 and determined that the CCNPP Unit 3 site-specific tornado design parameters and maximum tornado site characteristics are bounded approximately by 15 to 25 percent of the U.S. EPR standard design as indicated in the above table. Based on the above table, the staff concludes that the site-specific tornado velocities and other design parameters are bounded by the standard design certification values, or are in the limit of the design safety margin.

Additionally, the COL applicant incorporated by reference from the U.S. EPR FSAR acceptable codes and standards to transform the tornado wind speed parameters to equivalent wind pressure on the structures.

The staff also evaluated the acceptability of the COL applicant's response to COL Information Item 3.3-1 in Section 3.3.1 of this report.

Acceptability of COL Information Item 3.3-3

The staff reviewed COL Information Item 3.3-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.3.2. To address this COL information item, the COL applicant referred to a discussion in COL FSAR Section 3.3.2.3. In COL FSAR Section 3.3.2.3, the COL applicant provided the following 14 site-specific structures as non-safety-related: (1) Fire Protection Water Tanks; (2) Fire Protection Building; (3) Storage/Warehouse; (4) Central Gas Supply Building; (5) Security Access Facility; (6) Switchgear Building; (7) Grid System Control Building; (8) Circulating Water System Cooling Tower; (9) Circulating Water System Pump Building; (10) Circulating Water Makeup Water Intake Structure; (11) Circulating Water System Retention Basin; (12) Desalinization/Water Treatment Plant; (13) Waste Water Treatment Plant; and (14) Demineralized Water Tanks. The COL applicant also stated that, except for the Switchgear Building and concrete portions of the Circulating Water System (CWS) Makeup Water Intake Structure (MWIS), these 14 non-safety-related structures are miscellaneous steel and concrete structures, which are not designed for high wind and tornado loadings.

The COL applicant identified the Fire Water Storage Tanks and the Fire Protection Building as Seismic Category II SSE structures that are designed to remain functional during and following a design basis seismic event. The COL applicant also indicated that since these structures are not located adjacent to safety-related structures, their collapse from high winds or tornado loadings would not result in an impact interaction with any safety-related structure.

The COL applicant's use of the word "adjacent," as referring to the separation distances, was unclear to the staff. Therefore, in RAI 128, Question 03.03.02-1, the staff requested that the COL applicant provide additional information on the locations and separation distances between each of the non-safety-related and Seismic Category I safety-related structures, as well as the height of each of the non-safety-related structures. Since the COL applicant indicated in COL FSAR Section 3.3.2.3, that the non-safety-related structures are not designed for high wind and tornado loadings and their failure will not adversely affect nearby adjacent Seismic Category I structures, the staff also requested that the COL applicant discuss the methods used to mitigate potentially adverse interactions.

In a September 10, 2009, response to RAI 128, Question 03.03.02-1, the COL applicant stated, "The heights of many of the non-safety-related structures are not finalized at this time." Although the COL applicant's response did evaluate the potential for interaction of these structures with the safety-related structures due to the effects of tornado loads as follows. In Table 1 of the RAI response, the COL applicant identified separation distances between 12 of the non-safety-related structures and the safety-related structures. Among these 12 distances, 11 are more conservative and vary from 61 m to 549 m (200 ft to 1,800 ft). In Table 1, Note 8 of the COL applicant's response stated that, due to the height of the non-safety-related structures which are much smaller than the separation distances there would be no potential for an adverse interaction with safety-related structures. The staff agrees with the COL applicant that the separation distances of these 11 non-safety-related structures will be sufficiently distant from the safety-related structures that no adverse effects on the safety-related structures will

occur. Therefore, these 11 structures do not need to be designed to withstand tornado loadings. The only non-conservative distance is provided for the Demineralized Water Tanks, which is 18.3 m (60 ft) from the nearest safety-related structures. In Table 1, Note 9 of the COL applicant's response indicates that the height of structure is about 15.25m (50 ft), which is less than 18.3m (60 ft) separation distance, therefore, no potential for interaction. Since the height of the Demineralized Water Tanks are 15.25 m (50 ft) which is smaller than 18.3 m (60 ft) separation distances from surrounding safety-related structures, the staff also agrees with the COL applicant statement that there will be no adverse interaction based on the SRP Acceptance Criteria indicated.

The COL applicant also indicated that during detailed design of such structures, the heights and separation distances from safety-related structures will be maintained by the licensee, such that the failure of these structures due to tornado loads will not affect the ability of safety-related structures to perform their intended safety functions.

In Table 1 of the RAI response, the COL applicant did not provide the separation distances for the Switchgear Building, Circulating Water System Makeup Water Intake, Forebay, Demineralized Water Tank structures. For these three structures, the COL applicant indicated that they are in close proximity to and could potentially interact with a safety-related structure and so will be designed for tornado loads to preclude adverse interactions. Furthermore, in the September 10, 2009, response to RAI 128, Question 03.03.02-1, the COL applicant also discussed the design methodology for each of the above-mentioned three new non-safety-related structures to mitigate the adverse effects on safety-related structures.

The staff identified insufficient and unclear information in the COL applicant's September 10, 2009, response to RAI 128, Question 03.03.02-1, in the design methodology discussion section for the three structures (Switchgear Building, Forebay, and Circulating Water System Makeup Water Intake Structure). For example, the COL applicant indicated the use of engineered pressure relief siding panels for the Switchgear Building, which could have potentially adverse effect on safety-related structures due to its mass if tornado loadings cause the panels to separate from their supports. The COL applicant also states that the Forebay structure is designed to withstand the tornado loadings in a manner similar to the design of safety-related structures. The statement "in a manner similar" is unclear to the staff and precludes the staff from determining whether the Forebay structure is designed as a safety-related structure or not. For the Circulating Water System Makeup Water Intake Structures, the COL applicant also uses the same phrase "in a manner similar" for the design of the concrete portion of the structure above grade. For this structure, the staff is also concerned about potentially adverse effects of the other, concrete, and non-concrete, components on safety-related structures.

Therefore, based on the COL applicant's September 10, 2009, response to RAI 128, Question 03.03.02-1, and the revisions made to COL FSAR Section 3.3.2.3 (i.e., in COLA Revision 6), the staff concluded that more information was needed to determine whether the Switchgear Building, Forebay, and Circulating Water System Makeup Water Intake are adequately designed for tornado loads.

In RAI 264, Question 03.03.02-4, the staff requested that the COL applicant provide a justification for eliminating the wind loading discussion in COL FSAR Section 3.3.2.3 as referenced by the COL applicant in COL FSAR Section 3.3.1, and clarify how the COL Information Item 3.3.2 is addressed. The staff requested this information to clarify whether any wind loadings are considered for the design of non-safety-related structures listed in COL FSAR Section 3.3.2.3.

In a June 10, 2011, response to RAI 264, Question 03.03.02-4, the COL applicant stated that the CCNPP Unit3 site-specific non-safety-related structures listed in COL FSAR Revision 7, Section 3.3.2.3, would be designed for site-specific wind loads. Further, the COL applicant indicated that COL FSAR Sections 3.3.1 and 3.3.2 would be revised to include the discussion on the site-specific wind parameters for the design of non-safety-related structures and reflect the changes.

The staff finds the COL applicant's response to RAI 264, Question 03.03.02-4 acceptable because the COL applicant has revised COL FSAR Section 3.3.1 to include a discussion on the site-specific wind parameters for the design of non-safety-related structures. First, in revised COL FSAR Section 3.3.1, the COL applicant appropriately addressed COL Information Item 3.3.2 by indicating that the site-specific non-safety-related structures not included in the U.S. EPR standard plant design are designed for CCNPP Unit 3 site-specific wind loads. Secondly, in COL FSAR Sections 3.3.1.1 and 3.3.1.2, the COL applicant provided specific design parameters values such as basic wind speed for CCNPP Unit site as 152.9 kilometers per hour (kmh) (95 miles per hour (mph)) increased by 7 percent to account for the 100-year mean recurrence interval and margin of safety, for the design of site-specific non-safety-related structures. Then the COL applicant calculated applied wind forces (pressure) on structures in accordance with the ASCE/SEI 7-05, "Minimum Design Loads for Buildings and Other Structures," using the 100-year recurrence interval wind speed multiplied by importance factor of 1.15. Therefore, the staff finds the COL applicant's design approach is in accordance with the guidance of SRP Section 3.3.1, Acceptance Criteria II.1, 2 and 3, and is acceptable. Based on the COL applicant's response, the staff considers RAI 264, Question 03.03.02-4 resolved.

In the September 10, 2009, response to RAI 128, Question 03.03.02-1, Part 1, regarding the separation distances between non-safety-related structures and safety-related structures, the COL applicant referenced COL FSAR Figures 2.4-2, 2.1-5, 2.4-51, and 9.2-4 and provided separation distances for the structures listed in Table 1 of the response. Although the separation distances between the above mentioned structures in Table 1 of the response appear to the staff to be much more than the height of the structures, the staff was unable to verify this information on the referenced Figures (drawings) due to lack of dimensioning and scale on the drawings. Additionally,COL FSAR, Revision 6, Figure 2.1-5,contained a Note: "Working this drawing with 3-P1-0010-00001." The staff concluded that the last referenced number is another drawing with detail identification of separation distances. Therefore, in RAI 264, Question 03.03.02-7, the staff requested that the COL applicant provide information regarding the referenced drawing, Figure 3-P1-0010-00001, or other sources so that the staff could verify the separation distances between the non-safety-related and safety-related structures listed in Section 3.3.2.3, and Table 1 of the September 10, 2009, response to RAI 128, Question 03.03.02-1. The staff requested this information to ensure that the separation distances on the design drawings between aforementioned structures comply with the COL FSAR Table 1 commitments, and safety-related structures are protected against adverse affects of non-safety-related structures not design for tornado loadings.

The staff finds the COL applicant's May 8, 2011, response to RAI 264, Question 03.03.02-7 acceptable, because the COL applicant provided scaled drawings of COL FSAR, Revision 7, Figure 2.1-5, Figure 2.4-2, and Figure 9.2-4, for the staff to verify the separation distances between non-safety-related structures and nearest safety-related structures provided in Table 1 of the September 10, 2009, response to RAI 128, Question 03.03.02-1. The staff compared these separation distances on the drawings and finds them adequate, and correlate with the distances provided in COL FSAR Table 1. Further, the COL applicant indicated that the drawing, 3-P1-00100-00001, was an internal reference to the source drawing for COL FSAR

Figure 2.4-2, which is removed from COL FSAR, Revision 7, Figure 2.1-5. Accordingly, the staff considers the design acceptable.

In the September 10, 2009, response to RAI 128, Question 03.03.02-1, Part 2, the COL applicant in the design methodology section for the Switchgear Building used the engineered pressure relief siding panels to mitigate the effect of tornado loading without providing sufficient information on primary structural elements, mass and properties of the system. The staff notes that for the Forebay structure there appeared to be inconsistency or confusing information regarding the design of Forebay structure (e.g., the COL applicant used the terms, "The Forebay is designed to withstand tornado loadings in a manner similar to the design of safety-related UHS MWIS," and in Table 1 of the response, the COL applicant indicated that the Forebay structure is a non-safety-related structure.) Therefore, to address these concerns in RAI 285, Question 03.03.02-8, the staff requested that the COL applicant provide additional information or clarification for the items listed above as described below.

Switchgear Building

The use of engineered pressure relief siding panels (EPRSPs) in the Switchgear Building structure, which is discussed by the COL applicant in the design methodology section of the September 10, 2009, response to RAI 128, Question 03.03.02-1, led the staff to identify a number of additional unclear items that were not described in sufficient detail, which created some concerns for the staff. These included: (1) Lack of detailed information regarding primary structural elements, mass and properties of the EPRSP system; (2) design bases assumptions for separation of panels from the wall; (3) basis for determination of magnitude of damages on safety-related structures; and (4) determination of panels mass, which is considered as a missile, and enveloped by the missile spectra of RG 1.76. The staff needed this information to establish the primary structural elements of engineered pressure relief siding panels, to be considered as a missile compare to RG 1.76 spectrum, the adequacy of the design bases assumption and mass of the panels as missile impact. The staff's concern was to ensure that the engineered pressure relief siding panels, generated as a missile by tornado loadings, would not adversely affect the safety-related structures.

The staff finds the COL applicant's May 4, 2011, response to RAI 285, Question 03.03.02-8, Items 1, 2 and 3, for the Switchgear Building acceptable, because the COL applicant evaluated the potential for missiles generated by separation of panels from the switchgear building walls during tornado events and subsequent panel impact as a missile on safety-related structures. The COL applicant indicated that the panels missiles envelopes by the RG 1.76, Region I tornado missile spectrum. Additionally, the COL applicant stated that these missiles are a conservative representation of those that could be generated by the less intense extreme wind conditions anticipated at the CCNPP Unit 3 site. The RG 1.76, Region I tornado missile spectrum utilized in the U.S. EPR FSAR was used for the safety-related structures at CCNPP Unit 3 as discussed in COL FSAR, Revision 7, Section 3.5.1.4. To address the second part of the question, the COL applicant indicated that in order to determine the magnitude of damages on safety-related structures due to possible impact of a detached siding panel, the global and local impact evaluations are conducted. The evaluation was based on the developed interface force-time function for a detached panel missile, compared the interface force-time functions of the Schedule 40 pipe design-basis tornado missile of RG 1.76. Based on impulse function using single-degree-of-freedom (SDOF) inelastic response charts, the COL applicant determined that the Schedule 40 pipe missile has a higher response ductility demand than the panel missile. For the local impact evaluation the COL applicant indicated that although the thin-walled siding panel structures, having aspect ratios of the panel dimensions to its thickness

between 120 and 1440, will buckle upon impact with a concrete target, but for this local impact evaluation, buckling effects were neglected and the panel was conservatively treated as a 25.4 mm (1-in.) solid steel rod with a mass equal to that of the panel. An impact velocity of 41.1 m/s (135 ft/s) was selected, in accordance with the RG 1.76 values specified for Region I pipe missile. For these conditions, the calculated maximum penetration depth on a concrete target is less than the minimum concrete barrier thickness for safety-related structures at the CCNPP Unit 3 site. Finally, to address RAI 285, Question 03.03.02-8, Item 3, the COL applicant provided dimension and calculation of maximum mass of panels as 81.6 kg (180 lb) which envelopes by the mass of schedule 40 pipe of RG 1.76 equal to 130.2 kg (287 lb). Based on the COL applicant's response, the staff considers RAI 285, Question 03.03.02-8 resolved.

Forebay

The design of the Forebay in resisting the tornado loadings could lead to significantly different performance and impacts on safety-related structures depending on whether the structure is designed as safety-related structure or not. In the design methodology section of the September 10, 2009, response to RAI 128, Question 03.03.02-1 for the Forebay structure, the COL applicant used the wording, "The Forebay is designed to withstand the tornado loadings in a manner similar to the design of safety-related UHS MWIS. Hence, there will be no adverse effect on the adjacent safety-related UHS MWIS and buried Intake Pipes." The use of wording "in a manner similar" was unclear for the staff. The staff needed additional information to resolve this apparent inconsistency to assure there is no adverse interactions between Seismic Category I and non-safety-related structures. Therefore, in follow-up RAI 264, Question 03.03.02-7, the staff requested that the COL applicant clarify the term, "in a manner similar," whether the non-safety-related Forebay structure is designed as a safety-related or non-safety-related structure.

The staff finds the COL applicant's May 8, 2011, response to RAI 264, Question 0.03.02-7 regarding the Forebay classification concerns and design of the structure as non-safety-related structure, acceptable because the COL applicant indicated that the Forebay structure is re-categorized as a safety-related Seismic Category I structure after submission of the September 10, 2009, response to RAI 128, Question 03.03.02-1. Therefore, the Forebay structure is designed for the tornado parameters presented in U.S. EPR FSAR Tier 2, Table 2.1-1, as described in COL FSAR Section 3.3 in response to COL Information Item 3.3-1. The staff notes this change was reflected in an update to COL FSAR Table 3.2-1, "Classification Summary for Site Specific SSCs," provided in the September 10, 2009, response to RAI 128, Question 03.03.02-1. However, the update to COL FSAR Table 3.2-1 did not remove the Forebay from the list of non safety-related structures in FSAR Section 3.3.2.3. In COL FSAR Revision 7, the COL applicant submitted a revised design for the intake structure, which combined the Ultimate Heat Sink Makeup Water Intake Structure and Electrical Building into a single structure. This analysis and COLA change addressed the Forebay as a safety-related Seismic Category I COL FSAR Section 3.3.2.3 was updated to remove the discussion of the Forebay as a non-safety-related structure. COLA Revision 7 incorporates the COL FSAR changes associated with all three of the above-mentioned RAI responses. Accordingly, the staff finds the design approach and response acceptable.

The staff review and evaluation of the COL applicant's June 10, 2011, responses to RAI 264, Question 03.03.02-4, the May 8, 2011, response to RAI 264, Question 03.03.02-7, and the May 4, 2011, response RAI 285, Question 03.03.02-8, concludes that the COL applicant design approach and responses are acceptable. Therefore, the staff considers these questions resolved.

Based on the above COL applicant's responses and commitments, the staff concludes that the COL applicant appropriately considered the most severe tornado wind parameters historically recorded for the CCNPP Unit 3 site with an appropriate safety margin, and designed the plant structures with a sufficient margin of safety to prevent structural damages during the most severe tornado loadings historically reported for the CCNPP Unit 3 site. Accordingly, the staff's review of COL FSAR Sections 3.3 and 3.3.2 finds that the COL applicant appropriately incorporated, by reference U.S. EPR FSAR Tier 2, Sections 3.3 and 3.3.2.

Therefore, the staff finds that the COL applicant provided sufficient information and reasonable assurance that the structures, systems and components of CCNPP Unit 3 is designed with sufficient margin of safety against tornado loadings and will perform their intended safety functions during tornado events. Accordingly, the staff finds the design acceptable.

3.3.2.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.3.2.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to tornado loadings, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to tornado loadings incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.3.2 of this report to reflect the final disposition of the design certification application.

The staff concludes that COL Information Items 3.3-1 and 3.3-3 involving wind velocity characteristics at the site and site-specific structures not designed for wind loadings are adequately addressed in the COL FSAR. Therefore, the staff finds that the COL applicant has provided sufficient information to show that the structures that are important to safety will be designed to meet the requirements of 10 CFR Part 50, Appendix A, GDC 2.

3.4 Water Level (Flood) Design

This section of the COL FSAR addresses the affects of internal and external flooding on CCNPP Unit 3 structures, systems, and components.

COL FSAR Section 3.4.4 incorporates the content of the U.S. EPR FSAR sections entirely by reference. COL FSAR Sections 3.4.1, 3.4.2 and 3.4.3 incorporate the content of the U.S. EPR FSAR sections by reference with the addition of COL Information Items.**Internal Flood Protection**

3.4.1.1 *Introduction*

Analysis methods and procedures are described for the design of U.S. EPR to assess that the maximum water levels considered due to natural phenomena or internal flooding do not jeopardize the safety of the plant or the ability to achieve and maintain safe shutdown conditions. The analytical approach in the consideration of external and internal flooding events is described in U.S. EPR FSAR Tier 2, Sections 3.4.1, 3.4.2, and 3.4.3.

3.4.1.2 *Summary of Application*

COL FSAR Section 3.4.3 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.4.3.

In addition, in COL FSAR Section 3.4.3, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.4.1 to address COL Information Item 3.4-4 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will perform internal flooding analyses prior to fuel load for the Safeguards Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguards Building or Fuel Building division of origin.

The COL FSAR states that an internal flooding analysis will be performed prior to fuel load for the Safeguards Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguards Building or Fuel Building division of origin. Features credited in the analysis will be verified by walk-down.

The COL applicant provided additional information in COL FSAR Section 3.4.1 to address COL Information Item 3.4-5 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level.

The COL FSAR states that an internal flooding analysis will be preformed prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level or is designed to withstand flooding. Locations of essential SSC and features provided to withstand flooding will be verified by walkdown.

The COL applicant provided additional information in COL FSAR Section 3.4.1 to address COL Information Item 3.4-6 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will include in its maintenance program appropriate watertight door preventive maintenance in accordance with manufacturer recommendations so that each Safeguards Building watertight door above elevation +0 feet remains capable of performing its intended function.

The COL FSAR states:

> The maintenance program will include preventive maintenance for Safeguards Building watertight doors above elevation +0 in the maintenance program in accordance with the manufacturer's recommendations.

3.4.1.3 *Regulatory Basis*

In addition, the relevant requirements of NRC regulations for external flood protection, and the associated acceptance criteria, are given in NUREG-0800, Section 3.4.2.

The applicable regulatory requirements for external flood protection are as follows:

- GDC 2, 10 CFR Part 50, Appendix A, as it relates to the to the requirement that SSCs important to safety are designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena.

- GDC 4, 10 CFR Part 50, Appendix A, as it relates to the SSCs important to safety being designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accident.

3.4.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.4.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the design certification FSAR and the information in the COL FSAR represent the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.4.3 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to internal flood protection will be documented in the staff's safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed COL FSAR Section 3.4.1 for conformance to the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I.3.4.1, "Internal Flood Protection."

COL Information Items

COL Information Item 3.4-4

COL Information Item 3.4-4 requires that the COL applicant perform internal flooding analyses prior to fuel load for the Safeguards Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguards Building or Fuel Building division of origin.

In COL FSAR Section 3.4.1, the COL applicant addressed the COL Information Item 3.4-4 without providing the required analyses. The COL applicant proposed walk-down to verify the features credited in the analyses. In addition, the staff found in the COL application Part 10 a

proposed license condition to perform the above plant-specific internal flood analyses and walk-down verification without a schedule.

Based on the review, the staff determined that the COL applicant has not adequately addressed COL Information Item 3.4-4 because the required analyses do not exist and the proposed walk-down can not be performed without the analyses. These analyses need the final design information. The staff determined the license condition to perform the required analyses without an acceptable schedule is not appropriate, since this information is needed to make the reasonable assurance finding regarding the internal flood protection aspects of the design prior to COL issuance. Therefore, in RAI 356, Question 03.04.01-1, the staff requested that the COL applicant update the COL application to include this information, and propose an ITAAC for the verification. **RAI 356, Question 03.04.01-1 is being tracked as an open item**.

COL Information Item 3.4-5

COL Information Item 3.4-5 requires that the COL applicant perform internal flooding analyses prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level.

In COL FSAR Section 3.4.1, the COL applicant addressed the COL Information Item 3.4-5 without providing the required analyses. The COL applicant proposed walk-down to verify the features credited in the analyses. In addition, the staff notes that COL application Part 10 proposed a license condition to perform the above plant-specific internal flood analyses and walk-down verification without a schedule.

In the staff's safety evaluation report for the design certification application for the U.S. EPR FSAR Tier 2, Section 3.4.1 with respect to meeting GDC 4 and GDC 2, in RAI 356, Question 03.04.01-1, the staff requested that the COL applicant demonstrate that all safety-related SSCs are above the internal flood level in Reactor Building and Reactor Building Annulus. The COL applicant proposed a COL license condition that would include walk-down and ITAAC to verify that all safe shutdown equipment is above the internal flood level. The analyses referred in COL Information Item 3.4-5 are used to establish the internal flood levels in Reactor Building and Reactor Building Annulus, which are necessary for the walk-down and ITAAC verification.

Based on the review, the staff determined that the license condition is not adequate to address COL Information Item 3.4-5, because the required analyses do not exist and the proposed walk-down can not be performed without the analyses. These analyses need the final design information. The license condition to perform the required analyses without an acceptable schedule is not appropriate, since this information is needed to make the reasonable assurance finding regarding the internal flood protection aspects of the design prior to COL issuance. Therefore, in RAI 356, Question 03.04.01-1, the staff requested that the COL applicant update the COL application to include this information, and propose an ITAAC for the verification. **RAI 356, Question 03.04.01-1 is being tracked as an open item**.

COL Information Item 3.4-6

The staff reviewed COL Information Item 3.4-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.1.

The staff notes that in the COL application, Part 10, the COL applicant proposed a license condition for watertight door preventive maintenance in accordance with manufacturer

recommendations. This program will be in place prior to fuel load. The staff finds the proposed license condition including implementation schedules acceptable in accordance with SRP Section 3.4.1, Subsection III.2 and RG 1.206, Section C.III.4.3.

3.4.1.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.4.1-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the sections listed below:

Table 3.4.1-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.4-4	A COL applicant that references the U.S. EPR design certification will perform internal flooding analyses prior to fuel load for the Safeguards Buildings and Fuel Building to demonstrate that the impact of internal flooding is contained within the Safeguards Building or Fuel Building division of origin.	3.4.1	3.4.1.4
3.4-5	A COL applicant that references the U.S. EPR design certification will perform an internal flooding analysis prior to fuel load for the Reactor Building and Reactor Building Annulus to demonstrate that the essential equipment required for safe shutdown is located above the internal flood level.	3.4.1	3.4.1.4
3.4-6	A COL applicant that references the U.S. EPR design certification will include in its maintenance program appropriate watertight door preventive maintenance in accordance with manufacturer recommendations so that each Safeguards Building watertight door above elevation +0 feet remains capable of performing its intended function.	3.4.1	3.4.1.4

3.4.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to the analysis of flooding events, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to tornado loadings incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete.

The staff will update Section 3.4.1 of this report to reflect the final disposition of the design certification application.

In addition, except for the open item discussed above, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of GDC 2 and GDC 4. The staff based its conclusion on the following:

COL Information Item 3.4-6 relating to the maintenance program for watertight doors is acceptable in accordance with SRP Section 3.4.1 and RG 1.206, Section C.III.4.3. However, as a result of the open item discussed above, the staff is unable to finalize its conclusions on COL Information Items 3.4-4 and 3.4-5 relating to plant-specific flood analyses in accordance with the requirements of GDC 2 and GDC 4.

3.4.2 External Flood Protection

3.4.2.1 *Introduction*

Seismic Category I structures must be designed to withstand the effects of the highest probable maximum flood (PMF) and maximum groundwater levels for the plant. To meet the requirements of GDC 2, consideration of external flooding must also include potential dynamic effects, such as currents, flood waves, and their hydrodynamic effects. This COL FSAR section describes the elevation of the Probable Maximum Flood (PMF), maximum groundwater elevation, and the measures implemented for Seismic Category I structures that provide protection from the effects of these natural phenomena.

Analysis methods and procedures are described for the design of U.S. EPR standard plant to assess that the maximum water levels considered, due to natural phenomena or internal flooding, do not jeopardize the safety of the plant or the ability to achieve and maintain safe shutdown conditions. The analytical approach in the consideration of external and internal flooding events is described in U.S. EPR FSAR Tier 2, Sections 3.4.1, 3.4.2, and 3.4.3.

The staff reviewed the COL FSAR Section 3.4.2 areas relating to the design of structures that have to withstand the effects of the design flood, specified for the plant to ensure conformance with the requirements of GDC 2. The review areas include:

1. The data of the highest flood and groundwater is reviewed. Appropriate loading to account for flood and groundwater on Seismic Category I structures are established. For plants where the flood level is higher than the proposed grade around the plant structures, considerations of the dynamic phenomena associated with flooding, such as currents and flood waves, including their hydrodynamic effects, are reviewed.

2. The analysis procedures that are utilized to transform the static and dynamic effects of the highest flood and groundwater levels into effective loads, applied to Seismic Category I structures, are reviewed.

3.4.2.2 *Summary of Application*

COL FSAR Section 3.4.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.4.2. In addition, in COL FSAR Section 3.4.2, the COL applicant provided the following:

COL License Information Item

The COL applicant provided additional information in COL FSAR Section 3.4.2 address COL Information Item 3.4-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will design the watertight seal between the Access Building and the adjacent Category I access path to the Reactor Building Tendon Gallery. Watertight seal design will account for hydrostatic loads, lateral earth pressure loads, and other applicable loads.

The COL applicant addressed this COL information item by stating that the seal between the Access Building and the adjacent Category I access path to the Reactor Building Tendon Gallery will be designed to be watertight. The watertight seal design will account for hydrostatic loads, lateral earth pressure loads, and other applicable loads. The COL applicant proposed a license condition that states that this seal will be in place prior to fuel load.

In COL FSAR Section 3.4.2, the COL applicant states that the maximum groundwater elevation in the design certification FSAR generic design is 1 m (3.3 ft) below finished grade, and that the maximum groundwater level at the CCNPP Unit 3 Powerblock is approximately 9.1 m (30 ft) below finished grade as discussed in COL FSAR Section 2.4.12.5. While the design certification FSAR requires the PMF elevation to be 0.3 m (1 ft) below finished yard grade, this requirement envelopes the CCNPP Unit 3 maximum flood level for all safety-related structures, except the UHS Makeup Water Intake Structure. Since the UHS Makeup Water Intake Structure is located along the shoreline, and is classified as a safety-related building, it will be designed to meet the requirements of RG 1.27. The UHS Makeup Water Intake Structure is designed to be watertight to prevent internal flooding of the buildings.

3.4.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the SER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for external flood protection, and the associated acceptance criteria, are given in NUREG-0800, Section 3.4.2.

The applicable regulatory requirements for external flood protection are as follows:

- GDC 2, 10 CFR Part 50, Appendix A, as it relates to the to the requirement that SSCs important to safety are designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena. Meeting the requirements of GDC 2 includes evaluating the effects of flooding from full circumferential failures of non-seismic, moderate-energy piping, which is not considered in SRP Section 3.6.2.

Acceptance criteria adequate to meet the above requirements include:

- The criteria necessary to meet the relevant requirements of GDC 2 are as follows:
    - The highest flood and groundwater levels and the associated static and dynamic effects, if any, used in the design shall be the most severe ones that have been historically reported for the site and surrounding area, with sufficient margin for

the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

- In most situations, the highest flood level is below the proposed plant grade and only its hydrostatic effects need be considered. Unless the hydrostatic head associated with the highest flood and groundwater levels is relieved by utilizing drainage or a pumping system around the foundations of a structure, hydrostatic pressure has to be considered as a structural load on basement walls and the foundation slab of a structure.

- Where the flood level is above the proposed plant grade, the dynamic loads of wave action should be considered. Procedures for determining such dynamic loads are acceptable if they are in accordance with or equivalent to those delineated in the U.S. Army Coastal Engineering Research Center, "Shore Protection Manual" (Vol. I, June 2002, reprinted from 1973 edition and Vol. II, June 2002, reprinted from 1973 edition) or in EM 1110-2-1100, Coastal Engineering Manual, Part II, Chapter 1, "Water Wave Mechanics," U.S. Army Corps of Engineers, April 30, 2002, as applicable.

- Guidance acceptable for meeting the seismic design and classification requirements of GDC 2 is found in RG 1.29, Regulatory Position C.1 for safety-related SSCs and RG 1.29, Regulatory Position C.2 for non-safety-related SSCs.

3.4.2.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.4.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the design certification FSAR and the information in the COL FSAR represent the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.4.2 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to external flood protection will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the information contained in U.S. EPR FSAR Tier 2, Section 3.4.2 "External Flood Protection." The staff reviewed COL FSAR Section 3.4.2 for conformance to the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I.3.4.2, "Analysis Procedures."

COL FSAR Section 3.4.2 describes the external flood protection, which incorporated the U.S. EPR FSAR by reference with supplemental information. The staff's review of the information discussed in the COL FSAR is discussed as follows:

COL Information Items

Acceptability of COL Information Item 3.4-7

The staff reviewed COL Information Item 3.4-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.2. In COL FSAR Section 3.4.2, addresses the COL Information Item 3.4-7 as follows: To address this COL information item, the COL applicant assured that the seal between the Access Building and the adjacent Seismic Category I access

path to the Reactor Building Tendon Gallery will be designed to be watertight. The watertight seal design will account for hydrostatic loads, lateral earth pressure loads, and other applicable loads. The staff concludes that this item is appropriately addressed by the proposed license condition that states that this seal will be in place prior to fuel load. Therefore, the staff finds this proposed license condition acceptable.

The staff notes that in COL FSAR Revision 6 the COL applicant provided insufficient information and justification for the departure from U.S. EPR design limits of groundwater table elevation (specified as at least 1 m (3.3 ft) below grade) for the Essential Service Water Cooling Tower 1 and Emergency Power Generating Buildings, which were slightly above the U.S. EPR FSAR requirements. The staff's concern was that the departure from the U.S. EPR ground water table will not cause internal flooding of these safety-related structures and the resulting additional buoyancy load will not induce any basemat uplifting, considering different load combinations (e.g., seismic). The staff addressed this concern in RAI 8, Question 03.04.02-1.

In a September 25, 2008, response to RAI 8, Question 03.04.02-1, the COL applicant stated that while the water table averages approximately 1.2 m (4.0 ft) below grade at the Essential Service Water Cooling Tower 1, the ground water under some areas of this structure is less than 1 m (3.3 ft) below grade, which does not comply with the U.S. EPR design ground water level of 1 m (3.3 ft) below grade. An applicant calculation demonstrated that the Essential Service Water Cooling Tower 1 can still perform its safety-related function with the ground water at this elevation. In addition, the COL applicant stated that the Emergency Power Generating Buildings 1 and 2 are located approximately 0.9 m (3.0 ft) above ground water level, which does not comply with the U.S. EPR FSAR design ground water level of 1 m (3.3 ft) below grade. The COL applicant's calculation demonstrated that the Emergency Power Generating Buildings 1 and 2 can still perform its safety-related function with the ground water at this elevation. Accordingly, the staff considers RAI 8, Question 03.04.02-1 resolved.

In previous COL FSAR revisions including Revision 6, for the UHS MWIS SSCs electrical supply, the COL applicant considered a separate Electrical Building located near the UHS MWIS as underground structure. In COL FSAR, Revision 7, Section 2.4.5 the COL applicant indicated that the maximum analyzed water level during design basis hurricane reaches elevation 10.1 m (33.2 ft) which, in the case of design basis hurricane the entire UHS MWIS and Electrical Building (EB), will be flooded and submerged underwater. Thus, the construction of an underground EB although is manageable, but causes many construction, maintenance and operation problems such as watertight issues, need of non-standard air cooling components for heating, ventilation, and air conditioning (HVAC) of the building, maintenance of seals and limited access during operation. Therefore, in COL FSAR Revision 7, the COL applicant reoriented and relocated the Electrical Building on top of the UHS MWIS and the Electrical Building became a part of UHS MWIS structure described as transformer room on top of the UHS MWIS structure.

The staff finds the COL applicant's approach for the design of COL FSAR, Revision 7, Section 3.4.2, for the external flood protection measures, acceptable because the COL applicant appropriately incorporated by reference the U.S. EPR FSAR Tier 2, Section 3.4.2 without departures. Based on a review of COL FSAR Section 3.4 and interface sections of COL FSAR Section 2.4, the staff concludes that the COL applicant provided reasonable assurance that all safety-related facilities are located in the power block area (at approximately 0.95 m (3.1 ft) above the design bases flood elevation), with the exception of the UHS MWIS and the Circulating Water System (CWS) structures, which are located on the shoreline. Additionally, the COL applicant followed the procedures and methods described in RG 1.59 and applied

industry codes, standards, and formulas to calculate the PMF and Probable Maximum Water Level (PMWL) historically reported for the CCNPP Unit 3 site and surrounding area with appropriate margin using ANSI/ANS 2.8-1992 codes, which is endorsed by the NRC.

In addition, the staff agrees that the relocation of the Electrical Building on top of UHS MWIS structure is more conservative approach, and the COL applicant eliminated the submergence flooding issues, maintenance and operation problems. The design of UHS MWIS and Electrical Building as one structure (transformer room on top of USH structure) is economically feasible and increases the margin of safety of the UHS MWIS.

The staff also considered and analyzed the COL applicant's previous flooding design approach, which, prior to the results of new multi-layer groundwater modeling, the COL applicant based its calculations and design analysis in COL FSAR Section 3.8.5.5.2, for the Emergency Power Generating Building 1 and 2, and in COL FSAR Section 3.8.5.5.3, for the Essential Service Water Building, on the ground water table of 0.91 m (3.0 ft) below grade elevation, which did not comply with the U.S. EPR requirements. However, the COL applicant performed separate foundation design calculations for both the U.S. EPR and CCNPP Unit 3 ground water level of 1 m (3.3 ft) and 0.91 m (3.0 ft), respectively, which showed a variation of less than 5 percent in soil bearing pressure and basemat design moments for the Emergency power Generating Building (EPGB) structures, and negligible for the Essential Service Water Building (ESWB) structures. Factor of safety against sliding and overturning remained at allowable values. Thus, the COL applicant showed that the U.S. EPR, EPGB, and ESWB structures' foundation designs are adequate for the CCNPP Unit 3 site ground water elevation. Therefore, the staff concludes that the COL applicant's revision of the groundwater table from 0.91 m (3.0 ft) to over 9.1 m (30 ft) became more conservative, which eliminates the effects of buoyancy, uplifting, internal and external flooding of Seismic Category I structures, due to the high ground water level. Thus, the COL applicant appropriately considered design analysis, methodology to increase the conservatism approach factors for the design of Seismic Category I safety-related structures system, and components against the design basis flood events. Accordingly, the staff finds the COL applicant's design approach acceptable.

3.4.2.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.4.2-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.4.2-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.4-7	The seal between the Access Building and the adjacent Category I access path to the Reactor Building Tendon Gallery will be designed to be watertight. The watertight seal design will account for hydrostatic loads, lateral earth pressure loads, and other applicable loads.	3.4.2	3.4.2.4

3.4.2.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to external flood protection, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to external flood protection incorporated by reference in COL FSAR will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update section 3.4.2 of this report to reflect the final disposition of the design certification application.

The staff concludes that COL Information Item 3.4-7 involving the design of the watertight seal between the Access Building and the adjacent Seismic Category I access path to the reactor Building tendon Gallery is adequately addressed in the COL FSAR. As a result of open items listed in the technical evaluation section, the staff is unable to finalize its conclusions on this section. However, the staff finds the information within the COL application related to the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 3.4.2, and other NRC regulatory guides acceptable and concludes that the COL applicant complies with NRC regulations. Except for the listed open items discussed above, the staff finds that the COL applicant provided sufficient information to satisfy 10 CFR Part 50, Appendix A, GDC 2 and other applicable regulations.

3.4.3 Analysis of Flooding Events

3.4.3.1 *Introduction*

Analysis methods and procedures are described for the design of U.S. EPR to assess that the maximum water levels considered due to natural phenomena or internal flooding do not jeopardize the safety of the plant or the ability to achieve and maintain safe shutdown conditions. The analytical approach in the consideration of external and internal flooding events is described in U.S. EPR FSAR Tier 2, Sections 3.4.1, 3.4.2 and 3.4.3.

3.4.3.2 *Summary of Application*

COL FSAR Section 3.4.3 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.4.3.

In addition, in COL FSAR Section 3.4.3, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.4.3.2 to address COL Information Item 3.4-1 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm the potential site-specific external flooding events are bounded by the U.S. EPR design basis flood values or otherwise demonstrate that the design is acceptable.

The COL application states that, with the exception of the UHS Makeup Water Intake Structure, the U.S. EPR design is bounding. Flooding of the UHS facilities is addressed as part of COL Information Item 3.4-2.

The COL applicant provided additional information in COL FSAR Section 3.4.3.10 to address COL Information Item 3.4-2 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will perform a flooding analysis for the ultimate heat sink makeup water intake structure based on the site specific design of the structure and the flood protection concepts provided herein.

The COL FSAR states that UHS Makeup Water Intake Structure is protected from external flooding by watertight rooms and that flooding due to internal equipment or piping failure in one division will not affect the other division. The maximum flood level at the UHS Makeup Water Intake Structure location is elevation 10.1 m (33.2 ft) because of the surge, wave heights, and wave run-up associated with the Probable Maximum Hurricane (PMH) as discussed in COL FSAR Section 2.4.5. The UHS Makeup Water Intake Structure would experience flooding during a PMH. This structure is designed to withstand the static and dynamic flooding forces, and the UHS Makeup Water pump room areas and electrical rooms are designed to be watertight.

In the event of flooding due to equipment or piping failure within a UHS Makeup Water pump room, the affected division of the UHS Makeup Water System is assumed to be lost. The flood protection measures for the UHS Makeup Water Intake Structure ensure that a flood in one division will not impact another division. Thus, there would be two divisions of the UHS Makeup Water System available for fulfillment of the safety function, if one division is assumed to be unavailable due to maintenance.

The COL applicant provided additional information in COL FSAR Section 3.4.3.11 to address COL Information Item 3.4-3 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will define the need for a site-specific permanent dewatering system.

The COL application states that a ground water dewatering system is not anticipated to be necessary at the CCNPP Unit 3 site.

3.4.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference and the supplemental information presented in this COL application is addressed within the SER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for external flood protection, and the associated acceptance criteria, are given in NUREG-0800, Section 3.4.2.

The applicable regulatory requirements for external flood protection are as follows:

- GDC 2, 10 CFR Part 50, Appendix A, as it relates to the to the requirement that SSCs important to safety are designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of

capability to perform their safety functions. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena.

3.4.3.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.4.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the design certification FSAR and the information in the COL FSAR represent the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.4.3 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to the analysis of flooding events will be documented in the staff's safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the information contained in the COL FSAR:

The staff reviewed COL FSAR Section 3.4.3 for conformance to the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I.3.4.2, "Analysis Procedures."

COL Information Items

The staff reviewed COL Information Item 3.4-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.3.2.

> A COL applicant that references the U.S. EPR design certification will confirm the potential site-specific external flooding events are bounded by the U.S. EPR design basis flood values or otherwise demonstrate that the design is acceptable.

In COL FSAR Section 3.4.3.2, the COL applicant indicated that U.S. EPR FSAR Tier 2, Section 3.4.3.2 states; "The Seismic Category I structures are not designed for dynamic effects associated with external flooding (e.g., wind, waves, currents) because the design basis flood level is below the finished yard grade." The staff finds that the design of the CCNPP Unit 3 safety-related structures is consistent with the U.S. EPR statement, except for the UHS Makeup Water Intake Structure, which is evaluated later in this section. Therefore, staff finds the COL applicant has acceptably addressed this information item.

The staff reviewed COL Information Item 3.4-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.3.10.

> A COL applicant that references the U.S. EPR design certification will perform a flooding analysis for the ultimate heat sink makeup water intake structure based on the site-specific design of the structure and the flood protection concepts provided herein.

The staff reviewed COL Information Item 3.4-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.3.11. The COL applicant indicated that, with the exception of the Ultimate Heat Sink Makeup Water Intake Structure, all other Seismic Category I structures are not designed for dynamic effects associated with external flooding, because the design basis flood level is below the finished yard grade.

Further, in COL FSAR Section 2.4.5.3.3 the COL applicant indicates that, because the grade elevation of the CCNPP Unit 3 power block is approximately 25.9m (85 ft) and the power block is located approximately 304.8 m (1,000 ft) from the shoreline, the CCNPP Unit 3 power block will not be impacted by the PMH-induced flood events.

The safety-related UHS MWIS will be flooded during the probable maximum storm surge (PMSS) and is designed to meet the requirements of RG 1.27. Access into the UHS MWIS below the maximum water level during the PMH is designed to be watertight to prevent the internal flooding of the structures.

The staff evaluation of the site-specific parameters in COL FSAR Table 2.0-1 confirmed that the U.S. EPR requires design flood level of 0.3 m (1ft) below grade, while the site-specific flood level of the CCNPP Unit 3 site is approximately 0.91 m (3.0 ft) below grade, except for the Forebay and UHS MWIS structures, which are designed to function under flood conditions. The COL applicant provided additional information and calculations in COL FSAR Sections 2.4.1 and 2.4.2, 2.4.10, 3.4.2, 3.4.3.10, 3.8.4.1.11, 3.8.4.3, and 9.2.5 to address structural and flood design issues of the UHS MWIS and Forebay structures. Based on SRP Section 3.4.2 Acceptance Criteria, the staff agrees with the COL applicant that the dynamic effects associated with external flooding cannot be considered in the design loading process, while the flood level is below grade.

In addition to the design basis flood level below the grade, the COL applicant designed the grading in the power block area around the safety-related facilities in such way that all grades slope away from the structures at a minimum of 1 percent towards runoff collection ditches. Additionally, in COL FSAR Section 2.4.10 the COL applicant provided information regarding the maximum estimated water surface elevations resulting from all design basis flood considerations discussed in COL FSAR Sections 2.4.2 through 2.4.7, which is approximately .95 m (3.1 ft) below the entrance and grade slab elevations of 25.8 m (84.6 ft) for the power block safety-related facilities. Therefore, flood protection measures are not required in the CCNPP Unit 3 power block area.

Also, in COL FSAR Section 2.4.5, by using SLOSH model for surge height, the COL applicant calculated and showed that the results of SLOSH model 6.1 m (19.9 ft) or 7.3 m (23.9 ft) accounting for the 20 percent uncertainty. Compared to RG 1.59 data for the site, 5.3 m (17.30 ft) is more conservative.

In addition, the COL applicant indicates that, in the event of flooding due to equipment or piping failure within a UHS Makeup Water pump room, the affected division of the UHS Makeup Water System is assumed lost. The flood protection measures for the UHS Makeup Water Intake Structure ensure that a flood in one division will not affect another division. Thus, if one division is assumed unavailable due to maintenance, there would be two divisions of the UHS Makeup Water System available for fulfillment of the safety function.

The staff reviewed COL Information Item 3.4-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.4.3.10.

> A COL applicant that references the U.S. EPR design certification will define the need for a site-specific permanent dewatering system

The COL applicant indicates that based on the ground water modeling of post-construction water elevations provided in COL FSAR Section 2.4.12.5, permanent ground water dewatering system is not anticipated to be a design feature of the CCNPP Unit 3.

The staff concludes that the COL applicant appropriately incorporated by reference the U.S. EPR Seismic Category I structures not designed for dynamic effects associated with external flooding. The COL applicant adequately designed the flood protection structures and systems for the UHS Makeup Water Intake, and provides sufficient margin of safety to prevent structural damages to the Seismic Category I safety-related SSCs. In addition, the COL applicant assures that in the event of flooding due to equipment or piping failure when one division of the UHS Makeup Water System is lost, a redundant system is provided for fulfillment of the safety function. The staff finds that the COL applicant followed RG 1.59 guidance and used appropriate codes and standards to determine the PMF level.

Therefore, the staff finds that the COL applicant meets the requirements of GDC 2 and provides reasonable assurance that, in the event of floods or high groundwater, the structural integrity of the plant Seismic Category I structures will not be impaired and, in consequence, safety-related systems and components located within these structures will be adequately protected and will perform necessary safety functions. Thus, the staff considers the COL applicant's design acceptable.

COL FSAR Section 3.4.3.2 states that none of the Seismic Category I structures are designed for dynamic effects associated with external flooding, because the design basis flood is below the finished grade of the yard with the exception of the UHS Makeup Water Intake Structure. The U.S. EPR requirement that the PMF elevation be 0.3 m (1 ft) below finished yard elevation envelopes the CCNPP Unit 3 maximum flood for all safety-related structures, except the UHS Makeup Water Intake Structure. COL FSAR Section 2.4.2 indicates that, with the exception of the UHS Makeup Water Intake Structure, the probable maximum precipitation (PMP), the design-basis flood for all safety-related facilities, water level associated with a safety-related structure is elevation 24.8 m (81.5 ft) which is 0.95 m (3.1 ft) below the reactor complex grade slab at elevation 25.8 m (84.6 ft).

UHS Makeup Water Intake Structure would experience flooding as a result of the surge, wave heights, and wave run-up associated with the PMH. Both of these structures are designed to withstand the static and dynamic effects of such flooding as well as water proofing measures to prevent the flooding of the interior of the structures.

COL FSAR Sections 3.8.4.1.11 and 2.4.10, respectively, discuss the design basis of the UHS Makeup Water Intake Structure to withstand static and dynamic effects of flooding as well as flood protection measures and water proofing.

Based on the ground water modeling of post-construction water table elevations provided in COL FSAR Section 2.4.12.5, permanent ground water dewatering system is not anticipated to be a design feature of CCNPP Unit 3.

The staff accepts the COL applicant's approach for the design of COL FSAR Section 3.4.2, external flood protection measures, because the COL applicant appropriately incorporated by reference the U.S. EPR FSAR Tier 2, Section 3.4.2 without departures. Based on a review of COL FSAR Section 3.4 and interface sections COL FSAR Section 2.4, the staff concludes that the COL applicant provided reasonable assurance that all safety-related facilities are located in the power block area (at approximately 0.95 m (3.1 ft) above the design bases flood elevation), with the exception of the UHS MWIS and the Circulating Water System (CWS) structures, which are located on the shoreline. Additionally, the staff notes that the COL applicant followed the procedures and methods described in RG 1.59 and applied industry codes, standards, and formulas to calculate the PMF and Probable Maximum Water Level (PMWL) historically

reported for the CCNPP Unit 3 site and surrounding area with appropriate margin using ANSI/ANS 2.8-1992 codes, which is endorsed by the NRC.

In addition, the staff agrees with the COL applicant that the relocation of the Electrical Building on top of UHS MWIS structure is more conservative approach, and the COL applicant eliminated the submergence flooding issues, maintenance and operation problems. The design of UHS MWIS and Electrical Building as one structure (transformer room on top of UHS structure) is economically feasible and increases the margin of safety of the UHS MWIS.

The staff also considered and analyzed the COL applicant's previous flooding design approach, which, prior to the results of new multi-layer groundwater modeling, the COL applicant based its calculations and design analysis in COL FSAR Section 3.8.5.5.2, for the Emergency Power Generating Building 1 and 2, and in COL FSAR Section 3.8.5.5.3, for the Essential Service Water Building, on the ground water table of 0.91 m (3.0 ft) below grade elevation, which did not comply with the U.S. EPR FSAR requirements. However, the COL applicant performed separate foundation design calculations for both the U.S. EPR and CCNPP Unit 3 ground water level of 1 m (3.3 ft) and 9.1 m (3.0 ft), respectively, which showed a variation of less than 5 percent in soil-bearing pressure and basemat design moments for the EPGB structure, and negligible for the ESWB structure. Factor of safety against sliding and overturning remained at allowable values. Thus, the COL applicant showed that the U.S. EPR, EPGB, and ESWB structures' foundation designs are adequate for the CCNPP Unit 3 site ground water elevation. Therefore, the staff concludes that the COL applicant's revision of the groundwater table from 0.91 m (3.0 ft) to over 9.1 m (30 ft) became more conservative, which eliminates the effects of buoyancy, uplifting, internal and external flooding of Seismic Category I structures, due to the high ground water level. Thus, the staff finds that the COL applicant appropriately considered design analysis, methodology to increase the conservatism approach factors for the design of Seismic Category I safety-related structures system, and components against the design basis flood events. Accordingly, the staff finds the COL applicant's design approach acceptable.

3.4.3.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.4.3.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to the analysis of flooding events, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the analysis of flooding events incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.4.3 of this report to reflect the final disposition of the design certification application.

In addition, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 2.

3.4.4 Analysis Procedures

COL FSAR Section 3.4.4 incorporates by reference, with no departures or supplements, U.S. EPR FSAR Tier 2, Section 3.4.4. The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that no issue relating to this section remained for review. The staff's review confirmed that there is no outstanding issue related to this subsection.

The staff is reviewing the information in U.S. EPR FSAR Tier 2, Section 3.4.4 on Docket No. 52-020. The results of the staff's technical evaluation of the information related to analysis procedures incorporated by reference in COL FSAR will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR FSAR is not yet complete. The staff will update Section 3.4.4 of this report to reflect the final disposition of the design certification application.

3.5 Missile Protection

Seismic Category I structures are analyzed and designed to be protected from a wide spectrum of missiles (e.g., missiles from rotating and pressurized equipment, gravitational missiles, and missiles generated from tornado winds). Once a potential missile is identified, its statistical significance is determined (a significant missile is one which could cause unacceptable consequences or violate the 10 CFR Part 100, "Reactor Site Criteria," limits).

COL FSAR Sections 3.5.2, "Structures, Systems, and Components to be Protected from Externally Generated Missiles," and 3.5.3, "Barrier Design Procedures," incorporate the content of the respective design certification FSAR sections by reference with no departures or supplements. COL FSAR Sections 3.5.1.1, "Internally Generated Missiles Outside Containment"; 3.5.1.2, "Internally Generated Missiles Inside Containment"; 3.5.1.3, "Turbine Missiles"; 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds"; 3.5.1.5, "Site Proximity Missiles (Except Aircraft)"; and 3.5.1.6, "Aircraft Hazards," incorporate the content of the respective design certification FSAR sections by reference with additional information provided to respond to COL information items.**Missile Selection and Description**

3.5.1.1 *Internally Generated Missiles Outside Containment*

3.5.1.1.1 Introduction

In support of GDC 4, "Environmental and Dynamic Effects Design Bases," safety-related SSCs located outside containment are protected from internally generated missiles. The failure of equipment such as pressurized components, high-energy piping, and rotating equipment outside the containment may generate missiles. An internally generated missile is a dynamic effect of such failures, and its impact on SSCs important to safety must be evaluated. Protecting SSCs important to safety from the effects of internally generated missiles ensures the integrity of the reactor coolant pressure boundary, the capability to shut down and maintain the reactor in a shutdown condition, and the capability to prevent significant uncontrolled release of radioactivity.

3.5.1.1.2 Summary of Application

COL FSAR Section 3.5.1.1 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.1, "Internally Generated Missiles Outside Containment."

In addition, in COL FSAR Section 3.5.1.1, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.1.3, "Missile Prevention and Protection Outside Containment," to address COL Information Item 3.5-8 from U.S. EPR FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," as follows:

> A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured compressed gas cylinders will be either removed or seismically supported when not in use to prevent them from becoming missiles.

To address this COL information item, the COL applicant stated that high-pressure gas cylinders permanently installed in safety-related areas of the plant are constructed to the criteria of ASME Code, Section III or Section VIII. Portable and temporary cylinders and cylinders which are periodically replaced in safety-related areas are constructed and handled in accordance with the applicable U.S. Department of Transportation (DOT) requirements for seamless steel cylinders.

The COL applicant also provided additional information in COL FSAR Section 3.5.1.1.3 to address COL Information Item 3.5-9 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be either removed or seismically supported when not in use to prevent it from becoming a missile.

To address this COL information item, the COL applicant stated that objects heavy enough to generate a secondary missile are postulated as a result of movement of a heavy load or from a non-seismically designed SSC during a seismic event. Movements of heavy loads are controlled to protect safety-related SSCs as described in COL FSAR Section 9.1.5, "Overhead Heavy Load Handling System." Seismic Class I safety-related SSCs are protected from non-Class I permanent SSCs by design. The COL applicant stated that safety-related SSCs in the vicinity of temporarily installed SSCs will be declared inoperable until the temporary equipment is removed or an evaluation is performed to demonstrate that no adverse impact can occur.

3.5.1.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for unsecured compressed gas cylinders and maintenance equipment that could become a missile, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.1, "Internally Generated Missiles (Outside Containment)."

The applicable regulatory requirements for unsecured compressed gas cylinders and maintenance equipment that could become a missile are as follows:

1. GDC 4, as it relates to the design of the SSCs important to safety if the design affords protection from the internally generated missile that may result from equipment failure.

2. 10 CFR 52.80(a), "Contents of applications; additional technical information," as it relates to the requirement that a COL application contain 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 combined license, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

The related acceptance criteria are as follows:

- NUREG/CR-3551, "Safety Implications Associated with In-Plant Pressurized Gas Storage and Distribution Systems in Nuclear Power Plants," as it relates to the storage and handling of compressed gases at nuclear power plants.

3.5.1.1.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.1 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to internally generated missiles outside containment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Items 3.5-8 and 3.5-9 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.5.1.1.3 as follows:

COL Information Item 3.5-8:

COL FSAR Section 3.5.1.1.3 addressed COL Information Item 3.5-8 by indicating that high-pressure gas cylinders that are permanently installed are protected by design from becoming a missile and portable and temporary cylinders and cylinders which are periodically replaced in safety-related areas are constructed and handled in accordance with the applicable DOT requirements. However, the use of ASME cylinders in accordance with DOT standards is defined in U.S. EPR FSAR Tier 2, Section 3.5.1.1.3, and the COL applicant's response to the COL information item appears to duplicate the U.S. EPR FSAR content. The staff notes that use of existing U.S. EPR FSAR content is not adequate to address the COL information Item.

During review of the U. S. EPR FSAR, similar wording was proposed and in U.S. EPR RAI 109, Question 03.05.01.01-1c, the staff requested that the design certification applicant provide additional content regarding control of gas cylinders to prevent missiles. In a February 13, 2009 response to U.S. EPR RAI 109, Question 03.05.01.01-5, the design certification applicant

created COL Information Item 3.5-8 that required that the COL applicant describe controls to protect unsecured gas cylinders from becoming missiles. In accordance with COL Information Item 3.5-8, the COL applicant must describe the controls used to prevent gas cylinders from becoming missiles. However, the staff is unable to locate a description of any controls in the COL FSAR. Therefore, in RAI 359, Question 03.05.01.01-1, the staff requested that the COL applicant describe controls which ensure that pressurized gas cylinders either be removed or seismically restrained when not in use to prevent them from becoming missiles.

In an August 3, 2012, response to RAI 359, Question 03.05.01.01-1, the COL applicant proposed additional content to address COL Information Item 3.5-8 that included a commitment to have procedures in place, prior to fuel load, that specify unsecured equipment, including gas cylinders, will be moved from containment to safe location or appropriately secured prior to operation. The staff finds procedural control is adequate to address COL Information Item 3.5-8 regarding control of pressurized gas cylinders becoming missiles. The staff finds the COL applicant's response to RAI 359, Question 03.05.01-1 acceptable. To track the incorporation of the COL applicant's proposed changes into the COL FSAR **RAI 359, Question 03.05.01-1 is being tracked as a confirmatory item.**

COL Information Item 3.5-9

During U.S. EPR design certification review, in U. S. EPR RAI 109, Question 03.05.01.01-1, the staff also requested that the design certification applicant provide additional content regarding the control of unsecured maintenance equipment from becoming a potential missile source. In a February 13, 2009 response to U.S. EPR RAI 109, Question 03.05.01.01-1a, Table 1.8-2 (COL Information Item 3.5-9) was modified to require that the COL applicant provide procedural controls for this maintenance equipment. While the COL FSAR response to COL Information Item 3.5-9 provides a description of how items can be prevented from becoming missiles, the staff is unable to locate any credit or commitment to any procedural controls. The staff's concern is whether procedures or other methods will be used to ensure maintenance equipment is in safe location to avoid becoming a missile. Therefore, in RAI 359, Question 03.05.01.01-2, the staff requested that the COL applicant describe controls that require unsecured maintenance equipment to be either removed or seismically supported when not in use to prevent it from becoming a missile.

In an August 3, 2012, response to RAI 359, Question 03.05.01.01-2, the COL applicant proposed additional content to address COL Information Item 3.5-9 that included a commitment to have procedures in place, prior to fuel load, that specify unsecured equipment following maintenance will be moved from containment to safe location or appropriately secured prior to operation. The staff finds procedural control adequate to address COL Information Item 3.5-9 regarding control of maintenance equipment becoming missiles. The staff finds the COL applicant's response to RAI 359, Question 03.05.01-2 acceptable. To track the incorporation of the COL applicant's proposed changes into the COL FSAR, **RAI 359, Question 03.05.01-2 is being tracked as a confirmatory item**.

3.5.1.1.5 Post Combined License Activities

There are no post COL activities that have not been addressed related to this section. As discussed above, having the above cited procedures issued prior to fuel load to address COL Information Item 3.5-9 is the only post-COL activity related to COL FSAR Section 3.5.1.1.

3.5.1.1.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to internally generated missiles outside containment. Except for the incorporation of confirmatory items discussed above into the COL FSAR, the staff finds this section of the COL FSAR acceptable.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the internally generated missiles outside containment incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.1 of this report to reflect the final disposition of the design certification application.

As a result of the confirmatory items discussed above, the staff is unable to finalize its conclusions on the protection of SSC's located outside of containment from internally generated missiles in accordance with the requirements of GDC 4.

3.5.1.2 *Internally Generated Missiles Inside Containment*

3.5.1.2.1 Introduction

In support of GDC 4, safety-related SSCs located inside containment are protected from internally generated missiles. Credible internally generated missiles include those produced from component overspeed failures, failures in high energy fluid systems, and missiles caused by gravitation effects. An internally-generated missile has a dynamic effect, and its impact on SSCs important to safety must be evaluated to ensure that they are protected adequately and will be capable of performing their safety functions. If a missile has a statistically significant probability of causing damage, it is considered credible. Protecting inside containment SSCs that are important to safety from the adverse effects of internally-generated missiles prevents both failure of systems required for safe-shutdown of the reactor facility and significant uncontrolled release of radioactivity.

3.5.1.2.2 Summary of Application

COL FSAR Section 3.5.1.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.2, "Internally Generated Missiles Inside Containment."

In addition, in COL FSAR Section 3.5.1.2, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.2.3, "Missile Prevention and Protection Inside Containment," to address COL Information Item 3.5-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be removed from containment prior to operation, moved to a location where it is not a

potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.

The COL applicant states that procedural controls will be established to ensure that unsecured maintenance equipment will be removed from containment prior to operation, moved to a safe location, or restrained to prevent it from becoming a missile.

3.5.1.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the unsecured maintenance equipment inside containment that could become a missile, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.2, "Internally Generated Missiles (Inside Containment)."

The applicable regulatory requirements for unsecured maintenance equipment inside containment that could become a missile are as follows:

- GDC 4, as it relates to the design of the SSCs important to safety if the design affords protection from the internally generated missile that may result from equipment failure.

3.5.1.2.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.2 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to internally generated missiles inside containment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.5-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.5.1.2.3.

COL FSAR Section 3.5.1.2.3 includes a commitment that, prior to initial fuel load, procedural controls will be established to ensure that unsecured maintenance equipment will be removed from containment prior to operation, moved to a safe location, or restrained to prevent it from becoming a missile.

Therefore, the staff finds that GDC 4 is met based on the commitment to implement controls ensuring that all unsecured maintenance equipment inside containment, including equipment required for maintenance and that undergoing maintenance, will not generate a potential missile hazard.

3.5.1.2.5 Post Combined License Activities

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.5.1.2-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.5.1-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.5-1	A COL applicant that references the U.S. EPR design certification will describe controls to confirm that unsecured maintenance equipment, including that required for maintenance and that are undergoing maintenance, will be removed from containment prior to operation, moved to a location where it is not a potential hazard to SSCs important to safety, or seismically restrained to prevent it from becoming a missile.	3.5.1.2.3	3.5.1.2.4

3.5.1.2.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to internally generated missiles inside containment, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to internally generated missiles inside containment incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.2 of this report to reflect the final disposition of the design certification application.

In addition, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meet the applicable requirements of GDC 4. The staff based its conclusion on the following:

Resolution of COL Information Item 3.5-1 is acceptable based on the license commitment to implement controls ensuring that all unsecured maintenance equipment inside containment, including equipment required for maintenance and that undergoing maintenance, will not generate a potential missile hazard.

3.5.1.3 *Turbine Missiles*

3.5.1.3.1 Introduction

GDC 4, "Environmental and Missile Dynamic Effects Design Bases," to 10 CFR Part 50 requires that SSCs important to safety shall be designed and protected against the effects of missiles that might result from equipment failures. The failure of a rotor in a large steam turbine may result in the generation of high energy missiles that could affect safety-related SSCs. The probability of a strike by a turbine missile should be sufficiently low so that the risk from turbine missiles on safety-related SSCs is acceptably small to ensure that the requirements of GDC 4 to 10 CFR Part 50 are met.

3.5.1.3.2 Summary of Application

COL FSAR Section 3.5.1.3 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.3, "Turbine Missiles."

In addition, in COL FSAR Section 3.5.1.3, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.3 to address COL Information Item 3.5-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm the evaluation of the probability of turbine missile generation for the selected turbine generator P_1, is less than $1 \times 10^{-4}$for turbine generators favorably oriented with respect to containment.

The COL FSAR describes an analysis which concludes that the probability of turbine missile generation is less than 1×10^{-4}. In addition, the COL FSAR states that the inspection requirements for the turbine rotors is described in the U.S. EPR FSAR Tier 2, Section 10.2 and is consistent with the turbine manufacturer's recommended inspection intervals required to meet the calculated failure probability of the turbine rotor.

The COL applicant provided additional information in COL FSAR Section 3.5.1.3 to address COL Information Item 3.5-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will assess the effect of potential turbine missiles from turbine generators within other nearby or co-located facilities.

The COL application states that since the probability of turbine missile generation for CCNPP Units 1 and 2 are below 1×10^{-5} the CCNPP Unit 3 safety-related SSCs are adequately protected from turbine missiles.

3.5.1.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the turbine missiles, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.3, "Turbine Missiles."

The applicable regulatory requirements for turbine missiles are as follows:

1. GDC 4, as it relates to the design of the SSCs important to safety if the design affords protection from the internally generated missile that may result from equipment failure.

2. GDC 4, as it relates to SSCs important to safety being appropriately protected against environmental and dynamic effects, including the effects of missiles that may result from equipment failure. The specific criteria necessary to meet the relevant requirements of GDC 4 to reduce the probability of turbine missile generation are as follows:

    - The integrity of the reactor coolant pressure boundary
    - The capability to shut down and maintain the reactor in a safe condition
    - The capability to prevent accidents that could result in potential offsite exposures, which represent a significant fraction of the guideline exposures specified in 10 CFR Part 100

The related acceptance criteria are as follows:

- RG 1.115, as it relates to the identification of low-trajectory missiles resulting from turbine failure.

3.5.1.3.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represent the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.3 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to turbine missiles has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed conformance of COL FSAR Section 3.5.1.3 with the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I. 3.5.1.3, "Turbine Missiles."

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.5-2, and 3.5-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under FSAR Section 3.5.1.3.

COL Information Item 3.5-2

The staff reviewed COL Information Item 3.5-2, related to the evaluation of the probability of turbine missile generation, P_1, for the selected turbine generator is less than 1×10^{-4} for turbine

generators favorably oriented with respect to containment. COL FSAR Section 3.5.1.3 states that a turbine missile analysis has been developed for the selected turbine design that includes charts on missile generation probabilities of turbine rotor failure versus service time for the high pressure/intermediate pressure (HIP) and low pressure (LP) turbine rotors consistent with the guidance in RG 1.115. The staff notes that COL FSAR Section 10.2 states that the turbine generator is an Alstom design that meets the requirements of U.S. EPR FSAR Tier 2, Section 10.2. To determine whether the turbine missile generation probability is less than 1×10^{-4}, which establishes the inspection interval of the turbine rotors, in RAI 29, Question 03.05.01.03-1, the staff requested that the COL applicant provide the turbine missile generation probability analysis. In a March 2, 2009, response to RAI 29, Question 03.05.03.01-1 the COL applicant provided Alstom Report No. TSDMF 07-018D, "Alstom Turbine Missile Analysis," May 30, 2007, as the bounding turbine missile analysis report. In a July 9, 2010, response to RAI 211, Question 03.05.01.03-3, the COL applicant proposed a revision to the COL FSAR Section 3.5.1.3 to reference this Alstom report. The change was included in Revision 7 of the COL FSAR. The staff finds this later RAI response acceptable since it provides the analysis for the turbine to be used, which is described in the U.S. EPR FSAR Tier 2, Section 10.2.

Provided below is the staff's evaluation of the Alstom Report No. TSDMF 07-018D, May 30, 2007, to satisfy COL Information Item 3.5-2 that the turbine missile generation probability is less than 1×10^{-4} The staff notes that the methodology used in the turbine missile analysis is consistent with other NRC-approved methodologies.

The Alstom turbine rotor is of a welded design, consisting of nine welds for the LP rotor and three welds for the HIP rotor. Alstom Report TSDMF 07 018 D, Section 5.1, May 30, 2007, states that the LP and HIP rotors are small forgings welded together using submerged arc welding (SAW) procedures to form the complete rotor. The advantage of the welded rotor is that these are small forgings which have homogenous material properties, and that the net operating stresses are highest in the internal cavities in the center of the rotor. When the small forgings are welded together, an inert gas atmosphere is pumped inside of the cavities, and once welded, the cavities are closed so there is no exposure to steam. In addition, the design of the rotor with low stress levels allows the use of a low yield strength material that has good stress corrosion cracking (SCC) resistance. In a July 9, 2010, response to RAI 211, Question 03.05.01.03-5, the COL applicant provided information on welding, inspection and post weld-heat treatment of the rotors. The root pass of the weld is performed using tungsten inert gas (TIG) welding process to ensure complete penetration and fusion. The quality of the weld is verified by radiographic examination. The interior cavity is filled with inert gas to ensure complete weld fusion and provides an inert atmosphere for the material with the highest stresses. The remainder of the weld is performed using SAW welding process, which is inspected by a surface examination and 100 percent ultrasonic inspection (UT). The welds are then stress-relieved by a heat-treatment process, and given a final UT inspection in the radial, longitudinal, and tangential directions as discussed in the COL applicant's July 9, 2010, response to RAI 211, Question 03.05.01.03-6. The acceptance criteria for the forgings meets or exceeds the ASME Code, Section III, Paragraph NB-2540, and the acceptance criteria for the welds meets or exceeds the ASME Code, Section III, Paragraph NB-5300 as discussed in the COL applicant's July 9, 2010, response to RAI 211, Question 03.05.01.03-17, and is consistent with U.S. EPR FSAR Tier 2, Section 10.2.3.5. This rotor design and the pre-service inspection provide a rotor that has minimum stresses on the outer surfaces, and a final product with minimal flaws thereby reducing the occurrence to initiate cracks.

The material used for the LP rotor is a low alloy NiCrMo steel that is vacuum-treated with lower nickel content and is specifically fabricated to ensure weldability. This material was first used in 1967 for a welded rotor design. This material has a lower yield strength than typical rotor materials, which improves the resistance to SCC. The material properties specified in U.S. EPR FSAR Tier 2, Section 10.2.3 and Tables 10.2-1 through 10.2-4 were used in the Alstom Report No. TSDMF 07-018D, May 30, 2007 and, therefore, is a bounding analysis. The impact strength of 81 J (60 ft-lbs) and minimum yield strength of 635 MPa (92 ksi) was used in deriving the fracture toughness properties of the LP rotor. The Begley and Logsdon methodology specified in SRP Section 10.2.3 was used to determine the fracture toughness at the minimum turbine operating temperature as clarified in a July 9, 2010, response to RAI 211, Question 03.05.01.03-7. The staff considers this method of determining fracture toughness acceptable for this material, and for use in the turbine missile analysis.

Alstom Report No. TSDMF 07-018D, Appendices 1 and 2, May 30, 2007, made reference to the material specifications and ordering requirements for the LP and HIP rotor materials. In a July 9, 2010, response to RAI 211, Question 03.05.01.03-13, the COL applicant stated that these were summaries of the material delivery instructions, which were renumbered. However, the staff noted that the location of the test specimens for impact testing was not specified in Alstom Report No. TSDMF 07-018D, Appendix 1, May 30, 2007. Therefore, in RAI 211, Question 03.05.01.01-14, the staff requested that the COL applicant specify that the impact test will be performed after heat treatment, and test specimens will be taken in the transverse direction from the forging direction to ensure that the appropriate testing is performed to produce accurate material properties of the actual turbine rotor. Since the Appendix of the analysis was only a summary and not the specific material requirements, the COL applicant provided the specific material requirements in Enclosures 4 through 6 of the July 9, 2010, response to RAI 211, Questions 03.05.01.03-14 and 03.05.01.03-15. The staff notes that Enclosure 7 of the COL applicant's July 9, 2010, response to RAI 211, Question 03.05.01.03-14 provided the specification for forging and mechanical testing requirements, which included tensile, impact and 50 percent fracture appearance transition temperature (FATT) testing. Enclosure 7 also included the location of the test specimens along with the requirement that impact testing will be performed after heat treatment, and test specimens will be taken in the transverse direction from the forging direction. Therefore, the staff finds that COL FSAR Section 5.2 provides the material properties, and Enclosure 7 of the July 9, 2010, response to RAI 211, Questions 03.05.01.03-14 provides the testing requirements to ensure that the appropriate testing is performed to produce accurate material properties of the actual turbine rotor.

U.S. EPR FSAR, Revision 2 did not include a description of the the turbine rotor material properties. However, the material properties were included in U.S. EPR FSAR, Revision 3 as Tables 10.2-3 through 10.2-5, and later updated as indicated in a March 26, 2012, COL applicant response to RAI 294, Question 10.02.03-17 to specify impact testing orientation and impact testing temperature (consistent with the turbine operating temperature). Therefore, the staff finds that Alstom Report No. TSDMF 07-018D, May 30, 2007, is a bounding analysis of the U.S. EPR standard turbine, since the material properties used in the analysis are the same material properties specified in U.S. EPR FSAR, Revision 3 in Tables 10.2-3 and 10.2-5, as revised by the COL applicant's March 26, 2012, response to RAI 294, Question 10.02.03-17.

The staff notes that Alstom Report No. TSDMF 07-018D, May 30, 2007, Appendices 1 and 2, Section 2.3.2 states that the K_{IC} values of the actual rotor material are for information only. However, SRP Section 10.2.3, Paragraph II.4, states that the fracture toughness K_{IC} is used to ensure that the ratio of K_{IC} of the rotor material to the maximum tangential stress due to design

overspeed is at least 10 √mm (2 √in.) at the minimum operating temperature. This ensures that the actual rotor material has sufficient toughness to minimize brittle fracture and the generation of a missile. The actual K_{IC} of the rotor material will also be used to ensure that the as-built rotor is bounded by this analysis. In a July 9, 2010, response to RAI 211, Question 03.05.01.03-16, the COL applicant stated that Alstom Report No. TSDMF 07-018D, May 30, 2007, Appendices 1 and 2, Section 2.3.2 will be modified to ensure that the fracture toughness K_{IC} will be performed for the as-built rotor. The staff finds this acceptable since it meets the guidance in SRP Section 10.2.3, Paragraph II.4 with regard to ensuring adequate fracture toughness K_{IC}. **RAI 69, Question 10.02.03-1 is being tracked in Section 10.02 of this report as a confirmatory item** to ensure the Alstom Report No. TSDMF 07-018D, May 30, 2007, is revised as stated in the COL applicant's July 9, 2010, response to RAI 211, Question 03.05.01.03-16.

Alstom Report TSDMF 07 018 D, May 30, 2007, Section 7.2 states that failure due to cyclic loading (fatigue) and brittle fracture is much more unlikely than failure due to SCC. The staff notes that meeting the guidance in SRP Section 10.2.3 for the ratio between fracture toughness and the maximum circumferential stress at design overspeed exceeding the value of 10 √mm (2 √in.) only demonstrates that the fracture toughness is acceptable, and not that failure due to cyclic loading (low and high cycle fatigue) and brittle fracture will not occur.

In RAI 211, Question 03.05.01.03-4, the staff requested that the COL applicant clarify that the probability of the rotor failing due to these mechanisms to quantify the probability of rotor failure due to these degradation mechanisms. This analysis should meet the guidance of SRP Section 10.2.3, Paragraph II.4.B. In addition, Alstom Report TSDMF 07-018 D, May 30, 2007, Section 5.1 states that welding procedures provides an inert-gas atmosphere inside the cavities and around the center of the discs, where the net stresses are highest during operation. However, the staff notes there was no evaluation of flaws on the inner-cavity surface area that could propagate radially outward, resulting in a turbine missile. Based on the stresses being highest at the center-cavity surfaces of the rotor, the staff notes that the greatest potential for a crack to grow appear to be on the interior surface of the rotor and not the outer surface of the rotor. Therefore, in RAI 211, Question 03.05.01.03-6, the staff requested that the COL applicant also include a crack initiating and growing on the interior surface of the rotor and growing radially outward.

In a July 9, 2010, response to RAI 211 Question 03.05.01.03-4, the COL applicant provided Alstom Report TNUD-EI 10-011, "Turbine Missile Analysis Fracture Mechanics Applied to the LP Rotor," June 30, 2010, which evaluates fatigue and brittle fracture for the LP rotor. This report evaluates the effect of cyclic fatigue and brittle fracture of an assumed flaw in the LP rotor. The analysis assumes a 6 mm (.236 in.) flaw located on the internal surface of the rotor cavity. The analysis is based on Paris Law equation for fatigue with an assumed 2,400 start/stop cycles. The stresses used in the analysis included thermal loads and centrifugal forces which included stresses up to design overspeed (120 percent of normal speed). Stresses from electric faults causing torsional momentum of the rotor along with the stresses associated with the weight of the rotor were also considered. In all cases, the maximum peak stress associated with each loading type was used along with the material properties discussed above. The staff finds that this analysis demonstrated that an assumed flaw of 6 mm (.236. in) in width, which is within the inspection detection capabilities, would not propagate to the critical crack size by either cyclic fatigue or brittle fracture.

Below is a discussion of the analysis of rupturing the turbine rotor due to SCC. Operating experience has shown that the wet steam stages of the turbine rotor where the blades attach to

the rotor are the primary site for SCC initiation and growth. As stated in Alstom Report No. TSDMF 07-018D, May 30, 2007, Paragraph 7.1.3, and as clarified in February 14, 2012, response to RAI 318, Question 03.05.01.03-19, the turbine blades are attached to the turbine rotor with pin root attachments, except for the last two stages (stages 4 and 5 or the last and penultimate LP blades), which are attached with a fir tree root. The CCNPP Unit 3 turbine will be a welded LP rotor of impulse type with pin root blade attachments, except for the last two LP stages which have a fir tree root attachment which is consistent with the analysis. The pin root attachments are conducive of using a surface examination of the external fingers in detecting SCC. If any flaws are detected, a UT inspection will be performed of the flaws to further characterize them once the turbine is de-bladed.

Earlier reaction type turbines used circumferential blade groove attachments (T-attachment blade design) which necessitated the use of UT to detect SCC. Operating experience of impulse type has shown no occurrences of SCC in 55 flows/discs. Reaction type turbines with circumferential blade grooves of past turbines have experienced 41 occurrences of SCC in 554 flows/discs. The analysis used the operating experience of the reaction type turbine to determine the probability of crack initiation, leading to a more conservative result that is six times higher than the probability of crack initiation in the impulse type turbine with pin root attachments. In addition, the U.S. EPR turbine was designed according to the Threshold Stress Approach (TSA) which calculates the allowable stresses in the turbine rotor for nuclear plants. This TSA approach was documented in Alstom Report, "Design Against SCC in Steam Turbines: Concept and Case Study," and was provided in the COL applicant's February 14, 2012, response to RAI 318, Question 03.05.01.03-20. This approach describes the principle of designing the turbine so that the stresses in the rotor are below the threshold for which SCC crack initiation would occur as a function of the temperature and material strength for the wet stages of the rotor. Residual stresses at the rotor surface and surface finish are also taken into account and influence the initiation of SCC. This design approach makes the assumption of SCC using past SCC initiating and growth even more conservative. As stated in Alstom Report No. TSDMF 07-018D, May 30, 2007, Section 8.1.2.5, and as clarified in a February 14, 2012, response to RAI 318, Question 03.05.01.03-22, the maximum crack growth rate was used based on the maximum yield strength of the material.

Alstom Report No. TSDMF 07-0178D, May 30, 2007, considers rupturing the turbine rotor due to SCC in Stages 2 and 3 of the LP turbine, since these stages have wet steam that is conducive to SCC. Alstom Report TSDMF 07-018D, May 30, 2007, Section 7.1.1 provides an illustration in Figure 6 regarding the propagation rate of stress-corrosion cracks for material specification ASTM A471 that is similar to the Alstom material specification B65A-S. In addition, Alstom Report TSDMF 07-018D, Section 7.1.1 states that the SCC growth rate increases until a plateau is reached over a wide range of stress intensity (K_I), and that this plateau range extends to at least K_I = 100 ksi $\sqrt{in}$. In a July 9, 2010, response to RAI 211, Question 03.05.01.03-9, the COL applicant stated that a European collaborative project concluded that for low alloy NiCrMoV type steels, SCC growth rates are insensitive to chemical composition (no measurable effect of phosphorus, manganese, silicon, molybdenum, nickel or sulphur content on crack propagation rates) and are predominately determined by the yield strength. The staff notes that this is consistent with other NRC approved turbine missile analysis methodologies. ASTM A471 and B65A-S material are comparable materials with similar yield strength. Therefore, the staff notes that for a source of plateau crack growth rates for the low strength condition, the use of the Speidel diagram (Alstom Report TSDMF 07-018D, Figure 6) is reasonable. Accordingly, the staff finds that the SCC growth rates are applicable to the U.S. EPR rotor material used in the analysis.

For the rotor to release a potential missile, the SCC failure mode would develop in the axial-radial rotor plane, where the circumferential stresses would propagate the crack. The stresses were determined by the COL applicant through finite element analysis. As clarified in a July 9, 2010, response to RAI 211, Questions 03.05.01.03-18, and in a February 14, 2012, response to RAI 318, Question 03.05.01.03-21, the COL applicant stated that the applicable stresses for the different stages that are susceptible to SCC based on past operating experience were used in the analysis. The probability of generating a missile was calculated based on a constant crack growth rate associated with the maximum stress intensity of 100 ksi $\sqrt{in}$., and conservatively assumed that any missile produced would penetrate the turbine casing.

As stated by the COL applicant in a July 9, 2010, response to RAI 211, Questions 03.05.01.03-10 and 03.05.01.03-11, the initial existing crack size used in the analysis was 112 mm (4.5 in.), which primarily consists of separating the turbine rotor disc fingers at the pin-root attachments to the turbine blade. Therefore, the crack can be detected by a surface examination during the inservice inspection, prior to failure of the rotor. The COL applicant clarified in a July 9, 2010, response to RAI 211 Questions 03.05.01.03-4 and 03.05.01.03-8, and in a February 14, 2012, response to RAI 318, Question 03.05.01.03-21, that the visual and surface examination of the pin-root attachments will detect a crack on the external face of the external disc fingers, but not on the internal faces of the internal and external disc fingers. Therefore, the turbine missile analysis assumes that at t = 0 (beginning of the period between two inspections), the initial crack is considered to go through the all of the disc fingers. The missile analysis demonstrates that with such an initial crack, the time to reach the critical size is longer than the time between two consecutive inservice inspections. Therefore, the crack can be detected by a surface examination during the inservice inspection prior to failure of the rotor. Based on the analysis which included failure modes caused by brittle fracture, fatigue and SCC, the probability of generating turbine missiles (P^1) is less than 1×10^{-5} for an inspection interval of 10 years. Accordingly, the staff finds that P^1 is less than 1×10^{-4} for the proposed 10–year inspection interval, which meets the criteria in RG 1.115.

Concerning destructive overspeed, the COL applicant provided an overspeed protection evaluation in Alstom Document 75RC10001, "Steam Turbine Protection System Overspeed Reliability Evaluation," March 2, 2010, in the July 9, 2010, response to RAI 211, Question 03.05.01.03-4. The COL applicant also stated that the overall failure rate of the overspeed protection system is 1.14×10^{-9} with a monthly valve test interval. The staff notes that the COL applicant proposed a monthly valve test interval in lieu of the weekly valve test interval specified in the U.S. EPR FSAR Tier 2, Section 10.2.2.12. The justification for the monthly test interval is based on the Alstom Document 75RC10001.

The destructive overspeed analysis, Alstom Document 75RC10001, is based on the reliability of the overspeed protection architecture and the probability of the failure of the electronic system and associated valves. The staff notes that most of the analysis is based on the reliability of electronic overspeed protection system. Alstom Document 75RC10001, Section 3.0 states that the reliability data for the electronic overspeed protection system is based on the Alstom standard supplier, Jaquet; therefore, the staff believes there is no reason why this data would not also apply to an alternative supplier. However, the COL applicant did not provide a justification as to why an alternative supplier's equipment would have similar reliability data. Therefore, in RAI 376, Question 03.05.01.03-23, the staff requested that the COL applicant provide justification as to why the Jaquet reliability data would also apply for an alternative supplier. Also, discuss whether the COL FSAR should supplement the U.S. EPR FSAR Tier 1, Table 2.8.1-3, ITAAC Commitment No. 2.5 to confirm that an alternative supplier's reliability

data would be verified to demonstrate that the alternative supplier's equipment would also be bounded by this analysis. **RAI 376, Question 03.05.01.03-23 is being tracked as an open item.**

Alstom Document 75RC10001, Section 4.0 states that the Arabelle nuclear steam turbine has 4 HP inlet lines and 4 IP inlet lines, with each steam inlet line fitted with two valves in series. Alstom Document 75RC10001, Section 4.0 also states that the U.S. EPR admission valves are similar to the design of valves used on series P4 and N4 turbines. The operating experience with the admission valves for the P4 and N4 series is provided in Alstom Document 75RC10001, Section 4.1. In RAI 376, Question 03.05.01.03-25, the staff requested that the COL applicant clarify how the Alstom Document 75RC10001 includes all of the relevant information such as valve types, valve control and overspeed protection systems, etc., that is included in the U.S. EPR FSAR standard steam turbine. The clarification should include at a minimum the following:

- Discuss and compare why the valves used in the P4 and N4 turbine series are similar to the valves used for the U.S. EPR valves, so that it can be concluded that the components are similar so that the failure rates (past operating experience) for the P4 and N4 turbine series can be used for the analysis of the U.S. EPR design.

- Specify what the turbine series and model number the CCNPP 3 is, and how it compares to the Arabelle nuclear steam turbine.

- Include the common cause failure modes occurred for each of the valve types, and how they have been corrected.

- Discuss how these corrective actions were included as part of the admission valve designed for the U.S. EPR.

- Provide similar operating experience for the extraction non-return valves to be used in the U.S. EPR design, to minimize the potential for turbine overspeed.

- Discuss whether the reheat stop valves and intercept valves should be included in this analysis for the probability of destructive overspeed.

RAI 376, Question 03.05.01.03-24 is being tracked as an open item.

Except for the open items discussed above, the staff concludes that the Alstom Document No. 75RC10001 demonstrates that the overall failure rate of the overspeed protection system is 1.14×10^{-9} for a monthly valve test frequency, which meets the guidance of less than 1×10^{-4} in RG 1.115 and SRP Section 3.5.1.3 for plants with favorable turbine orientation. The information provided for COL Information Item 3.5-2 only specifies Alstom Report No. TSDMF 07-018D, May 30, 2007, as the turbine missile probability analysis. However, Alstom Report No. TSDMF 07-018D, May 30, 2007, was supplemented by Alstom Report TNUD-EI 10-011, June 30, 2010, to evaluate the probability of fatigue, and Alstom Document 75RC10001 to evaluate the probability of destructive overspeed. Therefore, in RAI 376, Question 03.05.01.03-25, the staff requested that the COL applicant reference all of these reports in the COL FSAR to satisfy COL Information Item 3.5-2. **RAI 376, Question 03.05.01.03-25 is being tracked as an open item.**

With regard to the CCNPP 3 inservice inspection program, COL FSAR Section 3.5.1.3 COL FSAR states that the turbine rotor inspection program is described in the U.S. EPR FSAR

Tier 2, Section 10.2, and is consistent with the turbine manufacturer's recommended inspection intervals required to meet the calculated failure probability of the turbine rotor. However, the staff notes that U.S. EPR FSAR Tier 2, Section 10.2.3.6 states that the turbine rotor inservice inspection program uses visual, surface and volumetric examination to inspect the turbine rotor assembly. However, the staff notes an inconsistency within the U.S. EPR FSAR inservice inspection program description. Also ,in response to staff's U.S. EPR RAIs, the design certification applicant stated that U.S. EPR FSAR Tier 2, Section 10.2.3.6 will be changed to perform inservice inspections consistent with the inspection intervals from the turbine manufacturer's turbine missile analysis provided by the COL applicant. Therefore, a COL applicant that references the U.S. EPR FSAR will then provide a site-specific turbine rotor inservice inspection interval consistent with the turbine manufacturer's turbine missile analysis.

In a March 2, 2009, response to RAI 29, Question 03.05.01.03-02, the COL applicant stated that the description of the turbine rotor inspection program is already contained within the U.S. EPR FSAR Tier 2, Section 10.2.3.6, and that this description is consistent with the recommendations include in the manufacturer's turbine missile probability analysis provided in the COL applicant's response to RAI 29, Question 03.05.03.01-1 above. In addition, in a March 24, 2009, response to RAI 69, Question 10.02.03-2 the COL applicant stated that the CCNPP Unit 3 COL FSAR incorporates by reference, U.S. EPR FSAR Tier 2, Section 10.2.3.6, with no departures or supplements. Therefore, the inspections will be performed based on the U.S. EPR FSAR inservice inspection plan. However, the staff notes that there are open items for the inservice inspection plan in the U.S. EPR FSAR. Therefore, the CCNPP Unit 3 inservice inspection program is dependent on the satisfactory resolution of the U.S. EPR FSAR open items. The evaluation of the CCNPP Unit 3 inservice inspection program is discussed in Section 10.2.3 of this report.

Therefore, except for the open items discussed above, the staff finds that the effects of turbine missiles on safety-related SSCs are acceptably small for CCNPP Unit 3 because the probability of generating a turbine missile is less than $1x10^{-4}$ per year, which meets the guidance of RG 1.115 and SRP Section 3.5.1.3 for plants with favorable turbine orientation.

COL Information Item 3.5-3

The staff reviewed COL Information Item 3.5-3, related to the assessment of the effect of potential turbine missiles from turbine generators within other nearby or co-located facilities. The staff finds the COL applicant's evaluation of this item acceptable as discussed in Section 3.5.1.5 of this report.

3.5.1.3.5 Post Combined License Activities

There are no post COL activities related to this section.

3.5.1.3.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to turbine missiles, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to turbine missiles incorporated by reference in the COL FSAR have been documented in the staff safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.3 of this report to reflect the final disposition of the design certification application.

The staff concludes that the information pertaining to COL FSAR Section 3.5.1.3 is within the scope of the design certification and adequately incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.3, and is therefore acceptable.

As a result of open and confirmatory items discussed above, the staff is unable to finalize its conclusions on COL Information Item 3.5-2, in COL FSAR Section 3.5.1.3 in accordance with the requirements of GDC 4 with respect to protecting safety systems from turbine missiles. Except for the open items discussed in RAI 376, Questions 03.05.01.03-23, 03.05.01.03-24, and 03.05.01.03-25**,** the staff finds the COL Information Item 3.5-2, in COL FSAR Section 3.5.1.3 acceptable because the probability of generating a turbine missile is less than $1x10^{-4}$ per year, which meets the guidance of RG 1.115 and SRP Section 3.5.1.3 for plants with favorable turbine orientation.

3.5.1.4 *Missiles Generated by Tornadoes and Extreme Winds*

3.5.1.4.1 Introduction

In support of GDC 2, "Design Bases for Protection Against Natural Phenomena," and GDC 4, the design basis is reviewed to ensure that missiles generated by most severe tornado and extreme winds are identified based on site-specific parameters for the CCNPP Unit 3 combined license application.

3.5.1.4.2 Summary of Application

COL FSAR Section 3.5.1.4 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds."

In addition, in COL FSAR Section 3.5.1.4, the COL applicant provided the following:

Interface Requirements

The COL applicant provided an evaluation for the potential of missiles generated by hurricanes or extreme winds to demonstrate conformance to interface requirements identified in Interface Item 3-2, "Missiles generated by tornadoes or extreme winds," in U.S. EPR FSAR Tier 2, Table 1.8-1, "Summary of U.S. EPR Plant Interfaces with Remainder of Plant."

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.4 to address COL Information Item 3.5-4 from U.S. EPR FSAR Tier 2, Table 1.8-2, as follows:

> A COL applicant that references the U.S. EPR design certification will evaluate the potential for other missiles generated by natural phenomena, such as hurricanes and extreme winds, and their potential impact on the missile protection design features of the U.S. EPR.

The COL FSAR states that based on the site-specific estimated strongest wind speed from tornadoes or hurricanes, the missile spectrum from RG 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1, March 2007, as used in the COL FSAR analysis, is conservative for CCNPP Unit 3.

The COL applicant provided additional information in COL FSAR Section 3.5.1.4 to address COL Information Item 3.5-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> For sites with surrounding ground elevations higher than plant grade, a COL applicant that references the U.S. EPR design certification will confirm that automobile missiles cannot be generated within a 0.5 m radius of safety-related SSCs that would lead to impact higher than 30 ft above plant grade.

The COL application states that protection of safety-related SSCs against credible automobile missiles is provided by the hardened or reinforced concrete structure of Seismic Category I buildings.

3.5.1.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for missiles generated by tornadoes and extreme winds, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.4, "Missiles Generated by Tornados and Extreme Winds."

The applicable regulatory requirements for missiles generated by tornadoes and extreme winds are as follows:

1. GDC 2, as it relates to the requirement that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as tornadoes and hurricanes without loss of capability to perform their safety functions.

2. GDC 4, as it relates to the requirement that SSCs important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.

The related acceptance criteria are as follows:

- RG 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," describes acceptable design-basis tornado-generated missile spectrum for the design of nuclear power plants.

3.5.1.4.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.4 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.4 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related

to missiles generated by tornados and extreme winds has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in COL FSAR Section 3.5.1.4 is discussed as follows:

The staff acceptance of the design is based on meeting the requirements of GDC 2 and GDC 4. The staff considers that the CCNPP Unit 3 design complies with GDC 2 and GDC 4 if it meets the guidance in RG 1.76, Regulatory Positions C.1, "Design-Basis Tornado Parameters," and C.2, "Design-Basis Tornado-Generated Missile Spectrum."

In the event of a tornado strike, plant designs must consider the impact of tornado-generated missiles (i.e., objects moving under the action of aerodynamic forces induced by the tornado wind), in addition to the direct action of the tornado wind and the moving ambient pressure field.

The plant design must provide protection from a spectrum of missiles (ranging from a massive missile that deforms on impact to a rigid penetrating missile) to assure that the necessary structures, systems, and components will be available to mitigate the potential effects of a tornado on plant safety. The U.S. EPR is designed to the Region I missile spectrum of RG 1.76.

Interface Requirements

Interface Item 3-2 in U.S. EPR FSAR Tier 2, Table 1.8-1, identifies a site interface with missiles generated by tornadoes and extreme winds. U.S. EPR FSAR Tier 2, Section 3.5.1.4 identifies tornado-generated missiles that conform to the Region I missile spectrum presented in RG 1.76, Table 2, "Design Basis Tornado Missile Spectrum and Maximum Horizontal Speeds." Region I has associated tornado wind speeds of 370 km/h (230 mph). CCNPP Unit 3 is located in Region II which has associated tornado wind speeds of 322 km/h (200 mph). Therefore, the resulting missile spectrum used for the U.S. EPR standard is conservative with respect to CCNPP Unit 3.

COL Information Items

The staff reviewed COL Information Item 3.5-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.5.1.4. COL Information Item 3.5-4 specifies that the COL applicant should evaluate the potential for other missiles generated by natural phenomena, such as hurricanes and extreme winds and the impact on missile protection design features.

The COL applicant reviewed the relevant meteorological data, retained in the National Hurricane Center, for the CCNPP Unit 3 site to determine the potential for extreme winds.

National Hurricane Center statistics covering 1851 through 2004 found only two hurricanes that directly hit the area. These hurricanes were classified as a Category 2 or less on the Saffir-Simpson scale, with estimated wind speeds not exceeding 177 km/hr (110 mph).

- A review of wind data over the period from June 2, 1980, through 2006 for Calvert County, MD identified 17 events with wind speeds ranging from 93 km/hr (58 mph) to 167 km/hr (104 mph).

Since the U.S. EPR tornado-generated missiles are based on a wind speed of 370 km/hr (230 mph), the COL applicant concluded that the Region I tornado missile spectrum from

RG 1.76 is a conservative representation of those that could be generated by the less intense extreme wind conditions anticipated at the CCNPP Unit 3 site.

The staff concludes the COL applicant complies with GDC 2 and GDC 4 with respect to missiles generated by extreme winds, since the RG 1.76 Region 1 tornado generated missiles envelop those missiles generated by site-specific extreme winds.

Section 2.3.1, "Regional Climatology," of this report addresses the staff's evaluation of the CCNPP Unit 3 site-specific extreme winds.

The staff reviewed COL Information Item 3.5-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.5.1.4. COL Information Item 3.5-7 specifies that the COL applicant should evaluate the potential for automobile missiles generated within a 0.8 km (0.5 mi) radius that could impact higher than 9.1 m (30 ft) above plant grade.

The COL applicant stated that plant grade is approximately 25 m (82 ft). The highest elevation within the 0.8 km (0.5 mi) radius is 39.6 m (130 ft), which means all structural elements below elevation 48.8 m (160 ft) require evaluation for an automobile missile impact. This elevation corresponds to a height of 23.8 m (78 ft) above grade.

In addition, the COL applicant stated that Seismic Category I structures on the Nuclear Island (NI) basemat meet the Region I tornado missile protection requirements. The walls and roof slabs of all Seismic Category I structures outside the NI basemat meet the Region I tornado missile protection requirements including automobile missile impacts for all elevations except for the roof slab of the essential service water cooling tower (ESWCT) and pump structures. The COL applicant concluded that since the height of the ESWCT and pump structures is approximately 29 m (96 ft), which is 5.2 m (18 ft) above the maximum automobile missile impact height, the roof slabs on these structures would not require automobile missile evaluation.

As shown in U.S. EPR FSAR Tier 2, Figure 3.8-101, "Essential Service Water Building Section A-A," the staff determined that the elevation of the essential service water (ESW) pump structure roof slab is 19.2 m (63 ft) which is below the maximum automobile missile impact height. Therefore, in RAI 122, Question 03.05.01.04-1, the staff requested that the COL applicant verify that the ESW pump structure roof slab is capable of withstanding the impact of an automobile missile.

In an August 11, 2009, response to RAI 122, Question 03.05.01.04-1, the COL applicant confirmed that the ESW pump structure roof slab is at an elevation of 19.2 m (63 ft), and is designed to meet Region I tornado missile protection requirements, including the guidance of RG 1.76 for automobile missiles. The COL applicant revised COL FSAR Section 3.5.1.4 to reflect this confirmation. In addition, COL FSAR Section 3.5.1.4 indicates that the UHS makeup water intake structure is also designed to withstand the impact of the Region I design-basis missile spectrum, including the automobile. The staff finds the COL applicant's August 11, 2009, response to RAI 122, Question 03.05.01.04-1, acceptable, because its assessment of possible hazards attributable to automobile missiles conforms to the guidelines of RG 1.76. Therefore, the staff considers the questions described in RAI 122, Question 03.05.01.04-1 resolved.

3.5.1.4.5 Post Combined License Activities

There are no post COL activities related to this section.

3.5.1.4.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to missiles generated by tornadoes and extreme winds, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to missiles generated by tornadoes and extreme winds incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.4 of this report to reflect the final disposition of the design certification application.

The staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of GDC 2 and GDC 4. The staff based its conclusion on the fact that the RG 1.76 Region I tornado generated winds and missiles used for the design of the U.S. EPR envelop the winds and missiles that could be generated by site-specific extreme winds.

3.5.1.5 *Site Proximity Missiles (Except Aircraft)*

3.5.1.5.1 Introduction

GDC 4 requires, in part, that SSCs important to safety be protected against the dynamic effects, including the effects of missiles that may result from events and conditions outside the nuclear power unit.

The potential threat to the plant from site proximity missiles is site-specific and cannot be assessed at the design certification stage. Missiles generated from nearby facilities are identified as an interface item in the U.S. EPR FSAR Tier 2, Table 1.8-1 (Item 3-1). A COL applicant that references the U.S. EPR design certification FSAR will evaluate the potential for site proximity explosions and missiles generated by these explosions for their potential impact on missile protection design features.

3.5.1.5.2 Summary of Application

COL FSAR Section 3.5.1.5 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.5, "Site Proximity Missiles (Except Aircraft)."

In addition, in COL FSAR Section 3.5.1.5, the COL applicant provided the following:

Interface Requirements

The COL applicant provided an evaluation for the potential of missiles generated from nearby facilities to demonstrate conformance to site parameter interface requirements identified as Interface Item 3-1, "Missiles generated from nearby facilities," in U.S. EPR FSAR Tier 2, Table 1.8-1, "Summary of U.S. EPR Plant Interfaces with Remainder of Plant."

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.5 to address COL Information Item 3.5-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will evaluate the potential for site proximity explosions and missiles generated by these explosions for their potential impact on missile protection design features.

The COL application states that none of the potential site-specific external event hazards pose an unacceptable affect important to the safe operation of CCNP Unit 3.

3.5.1.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the site proximity missiles (except aircraft), and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.5, "Site Proximity Missiles (Except Aircraft)."

The applicable regulatory requirements for site proximity missiles (except aircraft) are as follows:

1. GDC 4, as it relates to the requirement that SSCs important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.

2. 10 CFR Part 100, 10 CFR 100.10, "Factors to be Considered When Evaluating Sites," 10 CFR 100.20, 10 CFR 100.21, "Non-seismic Siting Criteria," and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," as they relate to the factors to be considered in the evaluation of sites, which indicate that reactors should reflect through their design, construction, and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products.

3. 10 CFR 100.20, "Factors to Be Considered When Evaluating Sites," as it relates to the requirement that the site characteristics be evaluated to determine whether the risk to individuals and society of potential plant accidents is low that is, if the probability of site proximity missiles (except aircraft) having the potential for radiological consequences greater than 10 CFR 50.34(a)(1), "Contents of applications; technical information," exposure guidelines as required by 10 CFR Part 100, is less than about 1×10^{-7} per year.

3.5.1.5.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.5 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represent the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.5 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference

related to site proximity missiles (except aircraft) has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

Interface Requirements

Interface Item 3-1 in U.S. EPR FSAR Tier 2, Table 1.8-1, identifies a site interface with missiles generated from nearby facilities. COL FSAR Section 3.5.1.5 identifies the evaluation of potential for site proximity explosions and missiles generated by these explosions for their potential impacts. In COL FSAR Section 3.5.1.5 the COL applicant stated that the effects of potential accidents in the vicinity of the site from present and projected industrial, transportation, and military facilities and operations are evaluated in COL FSAR Sections 2.2. and 3.5.1.3 (turbine missile generation of CCNPP Units 1 and 2) of this report state that none of the potential site-specific external event hazards evaluated (except aircraft hazards that are addressed later in Section 3.5.1.6 of this report) resulted in an unacceptable effect important to the safe operation of CCNPP Unit 3.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.5-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.5.1.5.

The staff reviewed the COL applicant's response to COL Information Item 3.5-5 related to the potential for site proximity explosions and missiles generated by these explosions for their potential impact on missile protection design features as discussed in COL FSAR Section 3.5.1.5.

In RAI 73, Question 03.05.01.05-1, the staff requested that the COL applicant discuss the potential turbine missile effects due to CCNPP Units 1 and 2 as external hazards on Unit 3 operation. In an April 6, 2009, response to RAI 73, Question 03.05.01.05-1, the COL applicant stated that the orientation of the CCNPP Units 1 and 2 turbines places the CCNPP Unit 3 SSCs important to safety outside of the low-trajectory turbine missile strike zones. As a result, the COL applicant concluded that CCNPP Unit 3 safety-related SSCs are acceptably protected against high-energy, low-trajectory turbine missiles from CCNPP Units 1 and 2. Based on the review of the COL applicant's response and independent evaluation, the staff finds the COL applicant's response adequate and the COL applicant's conclusion acceptable since it satisfies the guidance provided in RG 1.115. Therefore, the staff considers RAI 73, Question 03.05.01.05-1 resolved.

In COL FSAR Section 2.2, the COL applicant evaluated the effects of potential accidents in the vicinity of the CCNPP Unit 3 site from present and projected industrial, transportation, and military facilities and operations. The COL applicant evaluated each transportation mode and facility with regard to the effects from potential accidents relating to explosions, flammable vapor cloud (delayed ignition), and toxic chemical (vapors and gases), including liquid spills. The COL applicant performed the evaluations in accordance with guidance provided in RG 1.91 and RG 1.78. The staff's review of these evaluations is documented in Section 2.2.3 of this report. The COL applicant provided additional information requested by the staff pertaining to COL FSAR Section 2.2.3 to allow the staff to independently determine whether any of the potential site-specific external event hazards are unacceptable. The staff reviewed the information provided by the COL applicant, performed independent confirmatory calculations, and finds the COL applicant's methodology reasonable and acceptable since the evaluations followed the

guidance provided and satisfied the acceptance criteria. The staff finds that none of the external events have the potential to generate site proximity missiles that would adversely affect the safe operation of the plant.

3.5.1.5.5 Post Combined License Activities

There are no post COL activities related to this section.

3.5.1.5.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to site proximity missiles (except aircraft), and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to site proximity missiles (except aircraft) incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.5 of this report to reflect the final disposition of the design certification application.

The staff concludes that the relevant information presented within the COL FSAR Section 3.5.1.5 is acceptable and meets the requirements of 10 CFR 100.20, 10 CFR 100.21 and 10 CFR 52.79, and satisfies the guidance provided in RG 1.206 and NUREG-0800, Section 3.5.1.5.

3.5.1.6 *Aircraft Hazards*

3.5.1.6.1 Introduction

GDC 3, "Fire Protection," requires, in part, that SSCs important to safety be appropriately protected against the effects of fires. GDC 4 requires, in part, that SSCs important to safety be protected against the dynamic effects, including the effects of missiles that may result from events and conditions outside the nuclear power unit. The potential threat to the plant from aircraft hazards is site-specific and cannot be assessed at the design certification stage. Aircraft hazards are identified as an interface item in U.S. EPR FSAR Tier 2, Table 1.8-1 (Item 3-3). A COL applicant that references the U.S. EPR design certification will evaluate site-specific aircraft hazards and their potential impact on plant SSCs.

3.5.1.6.2 Summary of Application

COL FSAR Section 3.5.1.6 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.1.6, "Aircraft Hazards."

In addition, in COL FSAR Section 3.5.1.6, the COL applicant provided the following:

Interface Requirements

The COL applicant provided an evaluation for the potential from aircraft hazards to demonstrate conformance to site parameter interface requirements identified as Interface Item 3-3, "Aircraft hazards," in U.S. EPR FSAR Tier 2, Table 1.8-1, "Summary of U.S. EPR Plant Interfaces with Remainder of Plant."

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.5.1.6 to address COL Information Item 3.5-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will evaluate site-specific aircraft hazards and their potential impact on plant SSCs.

The COL applicant addressed and evaluated potential aircraft hazards following the approach and methodology outlined in SRP Section 3.5.1.6 and determined that the risks due to an aircraft crash into the effective plant areas of the safety-related structures on the site are sufficiently low. The probability of aircraft accidents resulting in radiological consequences greater than the 10 CFR Part 100 exposure guidelines is determined by the COL applicant in COL FSAR Section 2.2.2.7.2, "Aircraft and Airways," based on the following:

- Two Federal airways, V31 and V93, passing within two miles of the plant
- Two airports, Captain Walter Francis Duke Regional Airport and Patuxent River Naval Air Station, located between 8.05 km (5 mi) to 16.1 km (10 mi) of the CCNPP Unit 3 plant center

Based on the discussion in this section, the COL applicant concludes that the aircraft crash hazard probability based on the probabilistic risk assessment (PRA) for core damage frequency (CDF), and resulting low containment release frequency, the aircraft hazards pose no undue risk to the health and safety of the public.

3.5.1.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for aircraft hazards, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.5.1.6, "Aircraft Hazards."

The applicable regulatory requirements for aircraft hazards are as follows:

1. GDC 3, as it relates to the requirement that SSCs important to safety be appropriately protected against the effects of fires.
2. GDC 4, as it relates to the requirement that SSCs important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.
3. 10 CFR Part 100, 10 CFR 100.10, 10 CFR 100.20, 10 CFR 100.21, and 10 CFR Part 52, as they relate to the factors to be considered in the evaluation of sites, which indicate

that reactors should reflect through their design, construction, and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products. In addition, 10 CFR 100.10 and 10 CFR 100.20 indicate that the site location, in conjunction with other considerations, should ensure a low risk of public exposure.

The related acceptance criteria are as follows:

- 10 CFR 100.10, 10 CFR 100.20, 10 CFR 100.21, 10 CFR 52.17, and 10 CFR 52.79 requirements are met if the probability of aircraft accidents resulting in radiological consequences greater than the 10 CFR Part 100 exposure guidelines is less than an order of magnitude of 10^{-7} per year.

3.5.1.6.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.5.1.6 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.5.1.6 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to aircraft hazards has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

Interface Requirements

U.S. EPR FSAR Tier 2, Table 1.8-1, Interface Item 3-3 identifies a site interface with respect to aircraft hazards. COL FSAR Section 3.5.1.6 describes the aircraft hazards evaluation. In COL FSAR Section 2.2, the COL applicant addressed the site-specific aircraft and airway hazard evaluations. Due to the number of annual aircraft operations at nearby two airports and close proximity of airways V31 and V93, the COL applicant performed the probabilistic risk assessment of the aircraft hazard. The calculated annual probability of aircraft crash exceeded the acceptance criteria specified in the guidance provided in NUREG-0800. Therefore, the COL applicant performed a PRA to determine the CDF from aircraft hazards. The resulting containment radioactivity release frequency was calculated by the COL applicant and meets the design acceptance criteria of NUREG-0800, Section 3.5.1.6.

COL Information Items

The staff reviewed COL Information Item 3.5-6 from U.S. EPR FSAR Tier 2, Table 1.8-2, included under COL FSAR Section 3.5.1.6.

The staff reviewed the COL applicant's response to COL Information Item 3.5-6 related to site-specific aircraft hazards and their potential impact on plant SSCs as discussed in COL FSAR Section 3.5.1.6. The acceptance criterion guidance in NUREG-0800, Section 3.5.1.6 states that the plant needs to be at least 3.22 km (2 mi) beyond the nearest edge of any Federal airway. Due to the close proximity of airways V31 and V93 to the CCNPP Unit 3 site, this acceptance criterion guidance is not met. Therefore, the COL applicant performed the probability of aircraft accidents analysis and estimated the total aircraft impact

frequency of 6.13×10^{-6} per year. The COL applicant did not provide details regarding how this probability was calculated. Therefore, in RAI 10, Question 02.02.01-02.02.02-2, the staff requested that the COL applicant clarify how this probability was calculated. In an October 6, 2008, response to RAI 10, Question 02.02.01-02.02.02-2, the COL applicant did not provide the bases for the aircraft crash probability in calculating impact frequency due to airport operations. Therefore, in RAI 48, Question 03.05.01.06-1 and RAI 136, Question 03.05.01.06-2, the staff requested that the COL applicant provide crash rates and aircraft crash location conditional probabilities along with a sample calculation. In a February 26, 2009, response to RAI 48, Question 03.05.01.06-1, and an October 23, 2009, response to RAI 136, Question 03.05.01.06-2, the COL applicant provided the requested crash rates and aircraft crash location conditional probabilities along with a sample calculation. The calculation performed in the response resulted in slightly higher probability of 6.79×10^{-6} per year. The staff finds the COL applicant's approach reasonable and acceptable. This change is to be reflected in the COL FSAR Section 2.2.2.7.2, "Aircraft and Airways."

Since the calculated aircraft hazard probability exceeded the NUREG-0800 acceptance criteria (acceptable guideline probability of 1×10^{-7} per year), a probabilistic risk assessment was performed by the COL applicant to assess the core damage frequency from the hazard. The PRA results show that the total CDF from the site airplane crash scenarios, and resulting containment release frequency meets NUREG-0800, Section 3.5.1.6. This item is discussed in the Chapter 19, "Severe Accidents," section of this report. The COL applicant performed PRA reviewed by the staff separately for its acceptability, as part of COL FSAR Section 19.1.5.4.4. Therefore, the staff finds that the aircraft hazard meets the guidance of NUREG-0800, Section 3.5.1.6 acceptance criteria.

3.5.1.6.5 Post Combined License Activities

There are no post COL activities related to this section.

3.5.1.6.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to aircraft hazards, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the aircraft hazards incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.5.1.6 of this report to reflect the final disposition of the design certification application.

The staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR 100.20, 10 CFR 100.21 and 10 CFR 52.79, and satisfies the guidance provided in RG 1.206 and NUREG-0800, Section 3.5.1.6. The PRA analysis is reviewed and documented by the staff in Section 19.1.5.4.4, "Aircraft Crash Hazard Risk Evaluation." of this report and final conclusion is contingent upon the completion of the review and acceptance of COL FSAR Section 19.1.5.4.4.

3.5.2 Structures, Systems, and Components To Be Protected From Externally Generated Missiles

COL FSAR Section 3.5.2 incorporates by reference, with no departures or supplements, U.S. EPR FSAR Tier 2, Section 3.5.2, "Structures, Systems, and Components to be Protected from Externally Generated Missiles."

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that no issues relating to this section remained for review. The staff's review confirmed that there are no outstanding issues related to this section.

The staff reviewed the information in U.S. EPR FSAR Tier 2, Section 3.5.2 on Docket No. 52-020. The results of the staff's technical evaluation of the information related to SSCs to be protected from externally generated missiles incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The SER on the U.S. EPR FSAR is not yet complete. The staff will update Section 3.5.2 of this report to reflect the final disposition of the design certification application.

3.5.3 Barrier Design Procedures

3.5.3.1 *Introduction*

The integrity of safety-related structures and components relies on missile barriers and protective structures to be designed with adequate strength and margin of safety to withstand and absorb missile impact loads and prevent damage to safety-related components.

The Modified National Defense Research Committee (NDRC) formulas are used for the calculations of missile penetration into concrete barriers. The Ballistic Research Laboratory (BRL) formula and the Stanford Research Institute (SRI) equation are used for the calculation of missile penetration into steel barriers.

3.5.3.2 *Summary of Application*

In COL FSAR Section 3.5, "Missile Protection," the COL applicant incorporated by reference U.S. EPR FSAR Tier 2, Section 3.5, "Missile Protection," with no departures or supplemental information. COL FSAR Section 3.5 also does not contain any COL information items related to U.S. EPR FSAR Tier 2, Section 3.5.3. COL FSAR Section 3.5 3, "Barrier Design Procedures," addresses SRP Section 3.5.3, "Barrier Design Procedures."

3.5.3.3 *Regulatory Basis*

Seismic Category I SSCs in water-cooled nuclear power plants that are important to safety must be designed to withstand the following:

1 The effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions based on requirements in 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena"

2 The dynamic effect, including the effects of missiles, pipe whipping, and discharging fluids that may result from equipment failures and from events and conditions outside the

nuclear power unit, based on the requirements in 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases"

3.5.3.4 *Technical Evaluation*

The staff reviewed the COL applicant's conformance of COL FSAR Section 3.5 to the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I.3.5.3, "Barrier Design Procedures," and SRP Section 3.5.3, "Barrier Design Procedures." The staff finds that COL FSAR Section 3.5 appropriately incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.

During the evaluation of COL FSAR Section 3.5.1.4, the staff noted that the COL applicant identified Safeguards Buildings 1 and 4 as Seismic Category I structures, but these structures were not protected against tornado-generated automobile missile impact loads. In the U.S. EPR FSAR, the design certification applicant stated that all wall and roof slab sections of these structures meet the minimum acceptable tornado missile barrier guidance of SRP Section 3.5.3 but did not provide sufficient information for the staff to verify this conclusion. Therefore, in RAI 8, Question 03.04.02-2, the staff requested that the COL applicant provide an assessment of the structural capacity of the Safeguards Buildings 1 and 4 structures for protection against tornado-generated missiles based on the empirical equations of SRP Section 3.5.3, and confirm the calculated structural thickness against SRP Section, 3.5.3, Table 1.

In a September 25, 2009, response to RAI 8, Question 03.04.02-2, the COL applicant stated that the U.S. EPR standard design concrete wall and roof slab sections for the Safeguards Buildings 1 and 4 were evaluated to determine the minimum missile barrier requirements. The COL applicant used the local damage prediction from the empirical equations in SRP Section XX, Acceptance Criteria 3.5.3 (II) 1 to establish the minimum barrier thicknesses for the design basis tornado generated missiles as specified in RG 1.76. The COL applicant calculated the minimum thickness for concrete missile barrier protection as 0.53 m (21 in.) for the walls and 0.43 m (17 in.) for the roof slabs based on Region I missile requirements and a concrete strength of 351.62 kg/in (5000 psi), which is bounding for all regions. The COL applicant compared these against the SRP Section 3.5.3 acceptance criteria and showed that the actual (or design) thicknesses of the Safeguards Buildings 1 and 4 walls and roof slabs exceed the SRP Section 3.5.3 calculated minimum tornado missile barrier requirements (i.e., 0.4 m (16 in.) for the walls and 0.30 m (11.7 in.) for the roof slabs). The design thicknesses of the Safeguards Buildings 1 and 4 walls and roof slabs are shown in the dimensional arrangement drawings in U.S. EPR FSAR, Appendix 3B.

The staff finds the COL applicant's approach for the design of CCNPP U3 missile barrier acceptable because the COL applicant appropriately incorporated by reference the U.S. EPR barrier design procedures without departures and supplements. Additionally, the COL applicant followed the procedures and applied industry codes, standards and formulas to calculate (1) missile penetration into the concrete and steel barriers as referenced by SRP Section 3.5.3, Acceptance Criteria 3.5.3(II)1 and (2) to calculate the wall and roof thicknesses of the subject structures, which are greater thicknesses than required by the SRP Section 3.5.3, Table 1.

Therefore, the staff concluded that the procedure used to determine the walls and roofs thicknesses of Safeguards Buildings 1 and 4 provides a reasonable assurance that the structural integrity of Safeguards Buildings 1 and 4 will not be impaired in the event of a tornado-generated missile striking the structure. Accordingly, the staff considers RAI 8, Question 03.04.02-2 resolved.

3.5.3.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.5.3.6 *Conclusion*

The staff reviewed the information in the U.S. EPR FSAR Tier 2, Section 3.5.3 on Docket No. 52-020. The results of the staff's technical evaluation of the information related to barrier design procedures incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The SER on the U.S. EPR FSAR is not yet complete. The staff will update Section 3.5.3 of this report to reflect the final disposition of the design certification application

The staff concludes that the information pertaining to COL FSAR Section 3.5.3 is within the scope of the design certification and adequately incorporates by reference U.S. EPR FSAR Tier 2, Section 3.5.3 with no departures or supplements and is therefore acceptable.

In addition, the staff concludes the relevant information presented in the COL FSAR is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 2 and GDC 4.

3.6 Protection Against Dynamic Effects Associated with Postulated Rupture of Piping

3.6.1.1 *Introduction*

This section evaluates design bases for locating postulated breaks and cracks in high- and moderate-energy piping systems outside the containment. The objective of the staff's review is to verify that adequate protection has been provided such that the effects of the postulated pipe breaks do not adversely affect the functionality of SSCs relied upon for safe reactor shutdown or to mitigate the consequences of the postulated pipe rupture.

3.6.1.2 *Summary of Application*

COL FSAR Section 3.6.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.6.1, "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside of Containment." In addition, in COL FSAR Section 3.6.2, the COL applicant provided the following:

COL Information Item

The COL applicant provided additional information in the COL FSAR to address COL Information Item 3.6-1 from U.S. EPR FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," which states:

> A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.

3.6.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for postulated pipe ruptures and the associated acceptance criteria are specified in NUREG-0800, Section 3.6.1, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping."

The applicable regulatory requirements for postulated pipe ruptures are as follows:

1. 10 CFR Part 50, Appendix A, GDC 2, as it relates to protection against natural phenomena, such as seismically-induced failures of non-seismic piping. The application of 10 CFR Part 50, Appendix A, GDC 2 to this section incorporates environmental effects of full-circumferential ruptures of non-seismic moderate energy piping in areas where effects are not already bounded by failures of high energy piping.

2. 10 CFR Part 50, Appendix A, GDC 4, as it relates to structures, systems, and components important to safety being designed to accommodate the dynamic effects associated with postulated pipe rupture.

The related acceptance criteria are as follows:

1. Branch Technical Position (BTP) 3-3, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment," Revision 2, provides acceptance criteria to define postulated pipe rupture locations and configurations inside containment, pipe rupture locations and plant layout considerations for postulated pipe ruptures outside containment, and pipe-whip dynamic analysis including determination of forcing functions of jet thrust and impingement.

2. BTP 3-4, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment," provides acceptance criteria to identify postulated pipe rupture locations and configurations inside containment, as well as pipe rupture locations and plant layout considerations for postulated pipe ruptures outside containment,

3.6.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.6.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information related to this section. U.S. EPR FSAR Tier 2, Section 3.6.1, has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to postulated pipe rupture locations and dynamic effects has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

COL Information Item 3.6-1

The staff reviewed COL Information Item 3.6-1 from U.S. EPR FSAR Tier 2, Table 1.8-2, included under COL FSAR Section 3.6.1. This COL information item specifies that the COL applicant perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis. In response to this COL information item, in COL FSAR Section 3.6.1, the COL applicant stated that a pipe break analysis will be performed as part of the piping design, and that a final reconciliation of pipe break hazards will be completed before fuel load. However, this does not satisfy the COL information item in that the as-designed pipe break hazard analysis and reconciliation of deviations in the as-built configuration will not be completed and submitted to the staff for review before the COL has been issued. Therefore, the COL applicant has proposed the following license condition for COL Information Item 3.6-1 in COL application, Part 10, "Inspections, Tests, Analysis, and Acceptance Criteria (ITAAC) and ITAAC Closure," Appendix A, "Proposed Combined License Conditions," to provide assurance that the actions specified by this COL information item will be completed:

> Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall perform a pipe break hazard analysis as part of the piping design. It is used to identify postulated break locations and layout changes, support, design, whip restraint design, and jet shield design. The final design for these activities shall be completed prior to fabrication and installation of the piping and connected components. The as-built reconciliation of the pipe break hazards analysis shall be completed prior to fuel load.

As part of the U.S. EPR FSAR evaluation, the staff reviewed the proposed methodology to be used in the completion of the pipe break hazards analysis and found it acceptable. The staff reviewed the license condition that the reference combined license applicant (RCOL) applicant proposed and determined that completing the pipe break hazard analysis prior to fabrication and installation of the piping and connected components will allow the staff the opportunity to confirm that the COL applicant properly applied the approved methodology. Therefore, the staff finds that the proposed license condition addresses this COL information item, and considers COL Information Item 3.6-1 closed.

3.6.1.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant are required to address. The following COL information items in Table 3.6.1-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.6.1-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.6-1	A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.	3.6.1	3.6.1.4

3.6.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to postulated pipe ruptures and associated dynamic effects, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to postulated pipe ruptures and associated dynamic effects incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.6.2 of the report to reflect the final disposition of the U.S. EPR design certification application.

The COL applicant addressed COL Information Item 3.6-1 by affirming that the pipe break hazard analysis and specified diagrams will be completed in accordance with the approved methodology prior to fabricating and installing piping and connected components. The information needed to complete the COL Information Item is dependent on the completion of the piping design acceptance criteria (DAC), therefore, the report that is required by this COL information item will not be available for staff inspection or audit until after the COL has been issued. The COL applicant proposed separate license conditions for COL Information Item 3.6-1 in Part 10 of the COL application that will ensure that the specified actions will be completed by the COL applicant and made available for staff consideration. The staff considers the use of COL license conditions acceptable for this purpose.

The staff is concludes that the COL applicant's determination of pipe rupture locations and associated dynamic effects is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 4.

3.6.2 Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping

3.6.2.1 *Introduction*

This section evaluates design bases for locating postulated breaks and cracks in high- and moderate-energy piping systems inside and outside the containment; the procedures used to define the jet thrust reaction at the break location; the procedures used to define the jet impingement loading on adjacent essential structures, systems, or components; pipe whip restraint design; and the protective assembly design. Pipe breaks in several high-energy systems, including the reactor coolant loop and surge line, are replaced by small leakage cracks when the leak-before-break criteria are applied. Jet impingement and pipe whip effects are not evaluated for these small leakage cracks.

The objective of the staff's review is to verify that adequate protection has been provided such that the effects of the postulated pipe breaks do not adversely affect the functionality of SSCs relied upon for safe reactor shutdown or to mitigate the consequences of the postulated pipe rupture.

3.6.2.2 *Summary of Application*

COL FSAR Section 3.6.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping."

In addition, in COL FSAR Section 3.6.2, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.6.2.1, "Criteria Used to Define Break and Crack Location and Configuration," to address COL Information Item 3.6-2 from U.S. EPR FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," which states:

> A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.

The COL applicant provided additional information in COL FSAR Section 3.6.2.5.1, "Pipe Whip Restraints," to address COL Information Item 3.6-4 from U.S. EPR FSAR Tier 2, Table 1.8-2, which states:

> A COL applicant that references the U.S. EPR design certification will provide diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system.

3.6.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for postulated pipe ruptures and the associated acceptance criteria are specified in NUREG-0800, Section 3.6.2, "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping."

The applicable regulatory requirements for postulated pipe ruptures are as follows:

- 10 CFR Part 50, Appendix A, GDC 4, as it relates to structures, systems, and components important to safety being designed to accommodate the dynamic effects associated with postulated pipe rupture.

The related acceptance criteria are as follows:

- Branch Technical Position (BTP) 3-4, "Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment," Revision 2, provides acceptance criteria to define postulated pipe rupture locations and configurations inside containment, pipe rupture locations and plant layout considerations for postulated pipe ruptures outside containment, and pipe-whip dynamic analysis including determination of forcing functions of jet thrust and impingement.

3.6.2.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.6.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information related to this section. U.S. EPR FSAR Tier 2, Section 3.6.2, has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to postulated pipe rupture locations and dynamic effects has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

COL Information Item 3.6-2

The staff reviewed COL Information Item 3.6-2 from U.S. EPR FSAR Tier 2, Table 1.8-2, included under COL FSAR Section 3.6.2.1. This COL information item specifies that the COL applicant perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis. In response to this COL information item, in COL FSAR Section 3.6.2.1, the COL applicant stated that a pipe break analysis will be performed as part of the piping design, and that a final reconciliation of pipe break hazards will be completed before fuel load. However, this does not satisfy the COL information item in that the as-designed pipe break hazard analysis and reconciliation of deviations in the as-built configuration will not be completed and submitted to the staff for review before the COL has been issued. Therefore, the COL applicant proposed the following license condition for COL Information Item 3.6-2 in COL application, Part 10, "Inspections, Tests, Analysis, and Acceptance Criteria (ITAAC) and ITAAC Closure," Appendix A, "Proposed Combined License Conditions," to provide assurance that the actions specified by this COL information item will be completed:

> Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall perform a pipe break hazard analysis as part of the piping design. It is used to identify postulated break locations and layout changes, support, design, whip restraint design, and jet shield design. The final design for these activities shall be completed prior to fabrication and installation of the piping and connected components. The as-built reconciliation of the pipe break hazards analysis shall be completed prior to fuel load.

The staff agrees that a license condition can be used to address this COL information item.

COL Information Item 3.6-4

The staff reviewed COL Information Item 3.6-4 from U.S. EPR FSAR Tier 2, Table 1.8-2, included under COL FSAR Section 3.6.2.5.1. This COL information item specifies that the COL applicant provide diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system. In response to this COL information item, in COL FSAR Section 3.6.2.5.1, the COL applicant stated that the specified diagrams will be provided prior to fabricating and installing the piping system. However, this does not satisfy the COL information item in that the specified diagrams

will not be provided before the COL has been issued. Therefore, the COL applicant proposed the following license condition for COL Information Item 3.6-4 in COL application, Part 10, "Inspections, Tests, Analysis, and Acceptance Criteria (ITAAC) and ITAAC Closure," Appendix A, "Proposed Combined License Conditions," to provide assurance that the actions specified by this COL information item will be completed:

> Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall provide the diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system prior to fabrication and installation of the piping system.

The staff agrees that a license condition can be used to address this COL information item.

3.6.2.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.6.2-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.6.2-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.6-2	A COL applicant that references the U.S. EPR design certification will perform the pipe break hazards analysis and reconcile deviations in the as-built configuration to the as-designed analysis.	3.6.2.1	3.6.2.4
3.6-4	A COL applicant that references the U.S. EPR design certification will provide diagrams showing the final as-designed configurations, locations, and orientations of the pipe whip restraints in relation to break locations in each piping system.	3.6.2.5.1	3.6.2.4

3.6.2.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to postulated pipe ruptures and associated dynamic effects, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to postulated pipe ruptures and associated dynamic effects incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on

the U.S. EPR is not yet complete. The staff will update Section 3.6.2 of the report to reflect the final disposition of the U.S. EPR design certification application.

The COL applicant addressed COL Information Items 3.6-2 and 3.6-4 by affirming that the pipe break hazard analysis and specified diagrams will be completed prior to fabricating and installing piping and connected components; and that reconciliation of the pipe break hazard analysis with the as-built design will be completed prior to loading fuel. Since the information that is called for by these COL information items will not be available for staff review until after the COL has been issued, the COL applicant proposed separate license conditions for COL Information Items 3.6-2 and 3.6-4 in Part 10 of the COL application that will ensure that the specified actions will be completed by the COL applicant. The staff considers the use of COL license conditions acceptable for this purpose and satisfies GDC 4 requirements.

In addition, the staff concudes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 4.

3.6.3 Leak-Before-Break Evaluation Procedures

3.6.3.1 *Introduction*

10 CFR Part 50, Appendix A, GDC 4 allows the use of analyses reviewed and approved by the NRC to eliminate from the design basis, the dynamic effects of postulated pipe ruptures. A staff-approved leak-before-break (LBB) analysis which permits licensees to remove protective hardware such as pipe whip restraints and jet impingement barriers; to redesign pipe connected components, their supports, and their internals; and to make other related changes in operating plants. Likewise, dynamic effects for plants under construction or being designed can be similarly eliminated as discussed in SECY-93-087, “Policy,Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor(ALWR) Designs.” The staff’s review ensures that adequate consideration has been given to direct and indirect pipe failure mechanisms and other degradation sources which could challenge the integrity of piping. The evaluations demonstrate that piping will leak at a detectable rate from postulated flaws prior to growth of the flaw to a size that would fail due to applied loads resulting from normal conditions, anticipated transients, and a postulated safe shutdown earthquake.

3.6.3.2 *Summary of Application*

COL FSAR Section 3.6.3 incorporates by reference U.S. EPR FSAR Tier 2, Revision 1, Section 3.6.3.

In addition, in COL FSAR Section 3.6.3, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.6.3 to address COL Information Item 3.6-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms.

In response to this COL Information Item, the COL applicant indicated that it will confirm that the LBB analysis remains bounding for each piping system. The COL applicant stated that a summary of the results of the actual as-built, plant-specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms will be provided prior to fuel load.

The COL applicant provided additional information in COL FSAR Section 3.6.3 to address COL Information Item 3.6-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

A COL applicant that references the U.S. EPR design certification will implement the inservice inspection (ISI) program as augmented with NRC-approved ASME Code cases that are developed and approved for augmented inspections of Alloy 690/152/52 material to address PWSCC concerns.

3.6.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the as-built, plant-specific LBB analysis, and the associated acceptance criteria, are given in NUREG-0800, Section 3.6.3.

The applicable regulatory requirements for the as-built, plant-specific LBB analysis are as follows:

- 10 CFR Part 50, Appendix A, GDC 4, which permits the use of analyses to eliminate from the design basis, the dynamic effects of pipe ruptures.

3.6.3.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.6.3 and checked the referenced design certification FSAR to ensure that the combination of the design certification and the information in the COL FSAR represents the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL `application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.6.3 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to the LBB analysis will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed conformance of COL FSAR Section 3.6 with the guidance of RG 1.206, Section C.III.1, Chapter C. 1.3.6.3, "Leak-Before-Break Evaluation Procedures."

The staff reviewed the information contained in the COL FSAR:

COL Information Items

The staff reviewed COL Information Item 3.6-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.6.3.

This COL information item requires the COL applicant to confirm that the as-designed LBB analysis remains bounding for each piping system that was addressed by the COL applicant

under COL FSAR Section 3.6.3. In its review, the staff used the applicable sections of the NUREG-0800 and RG 1.206 as guidance.

COL Information Item 3.6-3 states:

> A COL applicant that references the U.S. EPR design certification will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant specific LBB analysis, including material properties of piping and welds, stress analysis, leakage detection capability, and degradation mechanisms.

COL FSAR Section 3.6.3 states:

> Calvert Cliffs 3 Nuclear Project LLC and Unistar Nuclear Operating Services, LLC shall confirm that the design Leak-Before-Break (LBB) analysis remains bounding for each piping system. A summary of the results of the actual as built, plant specific LBB analysis, including material properties of the piping welds, stress analyses, leakage detection capability, and degradation mechanisms will be provided prior to fuel load.

Based upon a review of COL FSAR Section 3.6.3, the staff determined that the timeline for submitting the confirmatory as-designed LBB analyses to assure they are bounding for each piping system is unclear. Therefore, in RAI 41, Question 03.06.03-1, the staff requested that the COL applicant provide as-designed LBB analyses for each LBB piping system prior to COL issuance or provide the bases for concluding that as-designed LBB analyses remain bounding for each piping system. In a January 9, 2009, response to RAI 41, Question 03.06.03-1, the COL applicant stated that it is their responsibility to confirm that the as-designed LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant-specified LBB analysis, including material properties of piping of welds, stress analyses, leakage detection capability, and degradation mechanisms. The COL applicant stated that they expect the design LBB analysis to remain bounding, but acknowledges the need to perform the appropriate reconciliation with the as-built plant. The COL applicant noted that, consistent with the ITAAC that has been established for LBB in the design certification application (U.S. EPR FSAR Tier 1, Table 2-2.1.5, Item 3.7), the confirmation and related information will be provided prior to fuel load.

In a January 29, 2009, follow-up response to RAI 41, Question 03.06.03-1, the COL applicant stated that the COL FSAR Section 3.6.3 will be revised as shown below:

> Calvert Cliffs 3 Nuclear Project, LLC, and Unistar Nuclear Operating Services, LLC, shall confirm that the design Leak-Before-Break (LBB) analysis remains bounding for each applicable as-built piping system. A summary of the results of the actual as-built, plant-specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms will be provided prior to fuel load.

The staff considers the COL applicant's January 29, 2009, response to RAI 41, Question 03.06.03-1 acceptable, since the results of the LBB analysis will be provided in a summary and the actual analysis will be confirmed by an ITAAC. **RAI 41, Question 03.06.03-1 is being tracked as a confirmatory item.**

During the staff's review of the U.S. EPR FSAR LBB analysis, the design certification applicant's LBB analysis had difficulty in meeting the staff's safety factor of 2 on dynamic loadings, and the design certification applicant is proposing to use a safety factor of 1.7. The U.S. EPR generic design is now being proposed to envelope all current sites' seismic loadings, and the design certification applicant is proposing to revise its generic seismic design response spectra. This could cause an increase in seismic loadings, thereby impacting the LBB design and possibly causing a further decrease in the LBB dynamic loading safety factor. The staff has not approved this proposal and is still reviewing this item under the U.S. EPR design certification docket.

In RAI 150, Question 03.06.03-2, the staff requested that the COL applicant provide an analysis or evaluation that demonstrates that the main steam piping inside containment (which has the least safety margin for dynamic loads in the generic design) meets the safety factor of 2 using site-specific seismic response spectra. In an October 19, 2009, response to RAI 150, Question 03.06.03-2, the COL applicant stated that a similar question was asked by the NRC during the U.S. EPR design certification review. As part of the response, the COL applicant stated that the U.S. EPR design has now increased the safety factor from 1.7 to 2.0 on dynamic loadings for LBB for the main steam line (MSL) piping. Since the design certification applicant now uses a safety factor of 2.0 for LBB qualification of the MSL for the generic design as specified in NUREG-1061, Volume 3, the staff considers RAI 150, Question 03.06.03-2 resolved since the COLA meets the safety factor of 2 using site-specific seismic response spectra.

The staff reviewed COL Information Item 3.6-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.6.3.

This COL information item requires the COL applicant to implement an ISI program for augmented materials inspections to address PWSCC concerns. In its review, the staff used the applicable sections of the NUREG-0800 and RG 1.206 as guidance.

COL Information Item 3.6-5 states:

> A COL applicant that references the U.S. EPR design certification will implement the ISI program as augmented with NRC approved ASME Code cases that are developed and approved for augmented inspections of Alloy 690/152/52 material to address PWSCC concerns.

COL FSAR Section 3.6.3 states:

> An ISI program will be implemented and will include NRC approved ASME Code cases that are developed and approved for augmented inspections of Alloy 690/152/52 material to address PWSCC concerns.

Based upon a review of COL FSAR Section 3.6.3, the staff concluded the actions proposed by the COL applicant meet regulatory requirements, and are therefore acceptable.

3.6.3.5 *Post Combined Operating License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.6.3-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which

will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.6.3-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.6-3	A COL applicant that references the U.S. EPR design certification will confirm that the design LBB analysis remains bounding for each piping system and provide a summary of the results of the actual as-built, plant specific LBB analysis, including material properties of piping and welds, stress analyses, leakage detection capability, and degradation mechanisms.	3.6.3	3.6.3.4
3.6-5	A COL applicant that references the U.S. EPR design certification will implement the ISI program as augmented with NRC approved ASME Code cases that are developed and approved for augmented inspections of Alloy 690/152/52 material to address PWSCC concerns.	3.6.3	3.6.3.4

3.6.3.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to the as-built, plant-specific LBB analysis, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the LBB analysis incorporated by reference in the COL FSAR will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR. The staff will update this SER to reflect the final disposition of the design certification application.

As a result of the confirmatory item discussed above, the staff is unable to finalize its conclusions that this section of the COL FSAR meets the requirements of 10 CFR Part 50, Appendix A, GDC 4. However, the staff concludes that the COL applicant's proposed resolution to the COL information item in COL FSAR Section 3.6.3 meets the relevant guidelines of NUREG-0800, Section 3.6.3 and RG 1.206, Section C. III.1, Chapter 3, C.I.3.6.3, and is therefore acceptable. The staff finds that conformance to these guidelines provides an acceptable basis for satisfying, in part, the requirements of 10 CFR Part 50, Appendix A, GDC 4.

3.7 Seismic Design

3.7.1 Seismic Design Parameters

3.7.3 Seismic Subsystem Analysis

3.8 Design of Category I Structures

The staff prepared Section 3.8 of this report in accordance with the review procedures described in the NUREG-0800, Sections 3.8.1 through 3.8.5, using information presented in COL FSAR revisions through Revision 7, and responses to staff RAIs. Among the COL applicant's COL FSAR revisions, Revision 7 reflects significant design changes, including the change that the Ultimate Heat Sink Electrical Building (UHS EB) is combined with the Ultimate Heat Sink Makeup Water Intake Structure.

This section of the COL FSAR describes the CCNPP Unit 3 Seismic Category I structures, which include the Reactor Containment Building (RCB), Reactor Building Internal Structures (RBIS), Reactor Shield Building (RSB), Fuel Building (FB), Safeguards Buildings, Emergency Power Generating Buildings (EPGBs), Essential Service Water Buildings (ESWBs), Forebay, UHS MWIS, buried electrical duct banks, and buried pipes. The RCB, RBIS, RSB, FB, and Safeguards Buildings are located on the NI common basemat foundation. The Forebay and UHS MWIS share a common basemat foundation with the Circulating Water System Makeup Water Intake Structure (CWSMWIS), which is classified as a Seismic Category II structure. The EPGBs and ESWBs have their own independent basemat foundations.

COL FSAR Section 3.8.2 incorporates the content of its referenced design certification FSAR section entirely by reference. COL FSAR Sections 3.8.1, 3.8.3, 3.8.4, and 3.8.5 incorporate the content of the respective design certification FSAR sections by reference with the addition of COL information items, Supplemental Information, and U.S. EPR FSAR Tier 2 Departures.

3.8.1 Concrete Containment

3.8.1.1 *Introduction*

COL FSAR Section 3.8.1 covers the description of the containment; applicable codes, standards, and specifications; loads and load combinations; design and analysis procedures; structural acceptance criteria; materials, quality control, and special construction techniques; and testing and inservice inspection requirements.

3.8.1.2 *Summary of Application*

COL FSAR Section 3.8.1 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.8.1, “Concrete Containment.”

In addition, in COL FSAR Section 3.8.1, the COL applicant provided the following:

Interface Requirements

The COL applicant provided an evaluation of site-specific loads that lie within the standard plant design envelope to demonstrate conformance to interface requirements identified in COL

Interface Item 3-4, “Site-specific loads that lie within the standard plant design envelope for Seismic Category I structures,” in U.S. EPR FSAR Tier 2, Table 1.8-1, “Summary of U.S. EPR Plant Interfaces with Remainder of Plant.”

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.8.1.3, “Loads and Load Combinations,” to address COL Information Item 3.8-1 from U.S. EPR FSAR Tier 2, Table 1.8-2, “U.S. EPR Combined License Information Items,” as follows:

> A COL applicant that references the U.S. EPR design certification will confirm that site-specific loads lie within the standard plant design envelope for the Reactor Containment Building, or perform additional analyses to verify structural adequacy.

The COL FSAR states that the CCNPP Unit 3 RCB is the standard U.S. EPR design, and the site-specific loads are bounded by the certification analysis. The COL FSAR also states, “Site-specific seismic, RSB, and buoyancy conditions are addressed in Sections 3.7.2, 3.8.4, and 3.8.5, respectively.”

3.8.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR. In addition, the relevant requirements of NRC regulations for the concrete containment, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.8.1, “Concrete Containment.” Review interfaces with other NUREG-0800 sections also can be found in NUREG-0800, Section 3.8.1.

The applicable regulatory requirements for concrete containment are as follows:

1. 10 CFR 50.55a, “Codes and Standards,” and GDC 1, “Quality Standards and Records,” as they relate to containment structures being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

2. GDC 2, “Design Bases for Protection against Natural Phenomena,” as it relates to the design of containment structures being able to withstand the most severe natural phenomena such as winds, tornadoes, floods, and earthquakes and the appropriate combination of all loads.

3. GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to containment structures being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

4. GDC 16, “Containment Design,” as it relates to the capability of the containment to act as a leak-tight barrier to prevent the uncontrolled release of radioactive effluents to the environment.

5. GDC 50, “Containment Design Basis,” as it relates to containment structures being designed with sufficient margin of safety to accommodate appropriate design loads.

6. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” as it relates to the quality assurance criteria for nuclear power plants.

7. 10 CFR 50.34(f), “Contents of applications; technical information,” as it relates to demonstrating containment integrity of applicable plants for loads associated with an accidental release of hydrogen generated from metal-water reaction of the fuel cladding, accompanied by hydrogen burning or added pressure from post-accident inerting.

8. 10 CFR 50.44, “Combustible Gas Control for Nuclear Power Reactors,” as it relates to demonstrating the structural integrity of future water-cooled reactors for loads associated with combustible gas generation.

The related acceptance criteria are as follows:

1. RG 1.206, “Combined License Applications for Nuclear Power Plants,” as it relates to concrete containment design.

2. RG 1.70, “Standard Content and Format of Safety Analysis Reports for Nuclear Power Plants,” as it relates to concrete containment design.

3. RG 1.7, “Control of Combustible Gas Concentrations in Containment Following LOCA” (loss-of-coolant accident), as it relates to concrete containment design.

4. RG 1.35, “Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containments,” as it relates to concrete containment design.

5. RG 1.35.1, “Determining Prestressing Forces for Inspection of Prestressed Concrete Containments,” as it relates to concrete containment design.

6. RG 1.90, “Inservice Inspection of Prestressed Concrete Structures with Grouted Tendons,” as it relates to concrete containment design.

7. RG 1.91, “Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants,” as it relates to concrete containment design.

8. RG 1.107, “Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures,” as it relates to concrete containment design.

9. RG 1.115, “Protection Against Low Trajectory Turbine Missiles,” as it relates to concrete containment design.

10. RG 1.136, “Materials, Constructions, and Testing of Concrete Containments,” as it relates to concrete containment design.

11. NUREG-0800, Section 3.8.1, Subsection II provides additional details for determining acceptability of the COL application.

3.8.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.8.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to

this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.8.1 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to concrete containment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

Interface Requirements

U.S. EPR FSAR Tier 2, Table 1.8-1, Interface Item 3-4 identifies a site interface to provide an evaluation of site-specific loads that lie within the standard plant design envelope for Seismic Category I structures. COL FSAR Section 3.8.1.3 addresses this evaluation as part of the COL applicant's discussion of COL Information Item 3.8-1. This information item is evaluated below.

COL Information Items

The staff reviewed COL Information Item 3.8-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.8.1.3.

To address this COL information item shown in Section 3.8.1.2 of this report, in COL FSAR Revision 3, Section 3.8.1.3, "Loads and Load Combinations" (for containment), the COL applicant stated, "Relative site-specific seismic, RSB, and buoyancy conditions are addressed in Sections 3.7.2, 3.8.4, and 3.8.5, respectively." In RAI 107, Question 03.08.01-1, the staff requested that the COL applicant clarify exactly what is meant by this sentence, and explain (1) explain why the term "relative" is used; (2) clarify the meaning of "RSB" when discussing loading conditions; (3) explain why COL FSAR Section 3.7.2 is referenced, which does not appear to provide any information to demonstrate that for the containment (as well as some of the other structures), the site-specific seismic loads lie within the standard plant design envelope as required by the U.S. EPR FSAR COL information item in COL FSAR Section 3.8.1.3. The staff's request was based on the review of COL FSAR Revision 3.

In a May 22, 2009, response to RAI 107, Question 03.08.01-1, the COL applicant explained that the purpose of the passage in COL FSAR Section 3.8.1.3 was to provide references to site-specific conditions described in other sections that could affect the containment response, but were not explicitly described in COL FSAR Section 3.8.1.3. The COL applicant also explained that (1) the term "relative" used in the passage was intended to indicate comparison of the U.S. EPR design and the site-specific conditions of the CCNPP Unit 3, and it will be deleted from the sentence for clarity; (2) the reference to the RSB regarding the containment loading conditions was made for consideration of structural interaction between the RCB and the RSB due to loads not described in COL FSAR Section 3.8.1.3; (3) COL FSAR Section 3.7.2, "Seismic System Analysis," will be revised to identify that COL FSAR Section 3.7.1.1, "Design Ground Motion," provides a discussion to show that the CCNPP Unit 3 site-specific seismic parameters are bounded by the U.S. EPR standard design. The staff finds this information addresses the questions raised by the RAI and, thus, are considered technically acceptable.

The staff confirmed that COL FSAR Revision 6, dated September 30, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, considers RAI 107, Question 03.08.01-1 resolved.

3.8.1.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.8.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to concrete containment, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to concrete containment incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.8.1 of this report to reflect the final disposition of the U.S. EPR design certification application.

In addition, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR 50.55a, GDC 1, GDC 2, GDC 4, GDC 16, GDC 50, 10 CFR 50, Appendix B, 10 CFR 50.34(f), and 10 CFR 50.44.

3.8.2 Steel Containment

COL FSAR Section 3.8.2 incorporates by reference, with no departures or supplements, U.S. EPR FSAR Tier 2, Section 3.8.2, "Steel Containment."

The staff reviewed the COL application and checked the referenced design certification FSAR section to ensure that no issues relating to this section remained for review. The staff's review confirmed that there are no outstanding issues related to this section.

The staff reviewed the information in the U.S. EPR FSAR Tier 2, Section 3.8.2 on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the steel containment incorporated by reference in the COL FSAR have been documented in the staff SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR FSAR is not yet complete. The staff will update Section 3.8.2 of this report to reflect the final disposition of the U.S. EPR design certification application.

3.8.3 Concrete and Steel Internal Structures of Concrete Containments

3.8.3.1 *Introduction*

The RBISs are Seismic Category I structures that provide support for the reactor coolant system (RCS), pressurizer, steam generators, and other components housed within the RCB. The RBIS also provide radiation shielding for the RCS, as well as shielding during refueling operations. This section of the COL FSAR discusses the description of the RBIS; applicable codes, standards, and specifications; loads and load combinations; design and analysis procedures; structural acceptance criteria; materials, quality control, and special construction techniques; and testing and inservice inspection requirements.

3.8.3.2 *Summary of Application*

COL FSAR Section 3.8.3 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.8.3, "Concrete and Steel Internal Structures of Concrete Containment."

In addition, in COL FSAR Section 3.8.3, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.8.3.3, "Loads and Load Combinations," to address COL Information Item 3.8-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm that site-specific loads lie within the standard design envelope for RB internal structures, or perform additional analyses to verify structural adequacy.

The COL FSAR states that the CCNPP Unit 3 RBIS design is the standard design as described in the U.S. EPR FSAR without departures. Site-specific loads are confirmed to lie within the standard U.S. EPR design certification envelope, and relative site-specific conditions are addressed in COL FSAR Section 3.7.2.

3.8.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR. In addition, the relevant requirements of NRC regulations for the concrete and steel internal structures of concrete containment, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.8.3, "Concrete and Steel Internal Structures of Steel or Concrete Containments." Review interfaces with other NUREG-0800 sections also can be found in NUREG-0800, Section 3.8.3.

The applicable regulatory requirements for concrete and steel internal structures of concrete containment are as follows:

1. 10 CFR 50.55a and GDC 1, as they relate to containment and containment internal structures being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

2. GDC 2, as it relates to the design of the containment and containment internal structures being able to withstand the most severe natural phenomena such as winds, tornadoes, floods, and earthquakes and the appropriate combination of all loads.

3. GDC 4, as it relates to the containment and containment internal structures being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

4. GDC 5, "Sharing of Structures, Systems, and Components," as it relates to the design of containment internal structures not being shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

5. GDC 50, as it relates to the containment and containment internal structures being designed with sufficient margin of safety to accommodate appropriate design loads.

6. 10 CFR Part 50, Appendix B, as it relates to the quality assurance criteria for nuclear power plants.

The related acceptance criteria are as follows:

1. RG 1.206, "Combined License Applications for Nuclear Power Plants," as it relates to concrete and steel internal structures of concrete containments.

2. RG 1.70, "Standard Content and Format of Safety Analysis Reports for Nuclear Power Plants," as it relates to concrete and steel internal structures of concrete containments.

3. RG 1.57, "Design Limits and Loading Combinations for Metal Primary Containment," as it relates to concrete and steel internal structures of concrete containments.

4. RG 1.69, "Concrete Radiation Shields for Nuclear Power Plants," as it relates to concrete and steel internal structures of concrete containments.

5. RG 1.136, "Materials, Constructions, and Testing of Concrete Containments," as it relates to concrete and steel internal structures of concrete containments.

6. RG 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants," as it relates to concrete and steel internal structures of concrete containments.

7. RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components in LWR Plants," as it relates to concrete and steel internal structures of concrete containments.

8. RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," as it relates to concrete and steel internal structures of concrete containments.

9. RG 1.199, "Anchoring Components and Structural Supports in Concrete," as it relates to concrete and steel internal structures of concrete containments.

10. NUREG-0800, Section 3.8.3, Subsection II provides additional details to determine acceptability of the COL application.

3.8.3.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.8.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.8.3 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to concrete and steel internal structures of concrete containment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.8-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.8.3.3.

COL Information Item 3.8-6 requires that:

> A COL applicant that references the U.S. EPR design certification will confirm that site-specific loads lie within the standard design envelope for RB internal structures, or perform additional analyses to verify structural adequacy.

The COL applicant indicated that the internal structural design is the standard design as described in the U.S. EPR FSAR without departures. Site-specific loads are confirmed to lie within the standard U.S. EPR design certification envelope and site-specific conditions are addressed in COL FSAR Section 3.7.2, which the staff finds acceptable.

3.8.3.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.8.3.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating concrete and steel internal structures of concrete containment, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the concrete and steel internal structures of concrete containment incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.8.3 of this report to reflect the final disposition of the U.S. EPR design certification application.

In addition, the staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR 50.55a, GDC 1, GDC 2, GDC 4, GDC 5, GDC 50, and 10 CFR Part 50, Appendix B.

3.8.4 Other Seismic Category I Structures

3.8.4.1 *Introduction*

This section of the COL FSAR describes the CCNPP Unit 3 other Seismic Category I structures including the RSB, FB, SBs, and Vent Stack (VSTK), all located on the NI common foundation basemat, as well as the EPGBs and the ESWBs, which have their own independent basemat foundations. In addition, site-specific Seismic Category I structures at CCNPP Unit 3 include the Forebay and the UHS MWIS, both located on a common basemat foundation, as well as buried electrical duct banks and buried pipes. As reflected in COL FSAR Revision 7, the UHS EB has been combined with the UHS MWIS. COL FSAR Section 3.8.4 covers the description of the other Seismic Category I structures; applicable codes, standards, and specifications; loads

and load combinations; design and analysis procedures; structural acceptance criteria; materials, quality control, and special construction techniques; and testing and inservice inspection requirements.

3.8.4.2 *Summary of Application*

COL FSAR Section 3.8.4 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.8.4, "Other Seismic Category Structures."

In addition, in COL FSAR Section 3.8.4, the COL applicant provided the following:

Interface Requirements

The COL applicant provided an evaluation of buried conduit, piping, and associated ducting to demonstrate conformance to interface requirements identified in U.S. EPR FSAR Tier 2, Table 1.8-1, Interface Item 3-5, "Buried conduit and duct banks, and pipe and pipe ducts," "Summary of U.S. EPR Plant Interfaces with Remainder of Plant."

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.8.4.1, "Description of the Structures," to address COL Information Items 3.8-2 and 3.8-8, respectively, as follows:

> A COL applicant that references the U.S. EPR design certification will describe any differences between the standard plant layout and design of Seismic Category I structures required for site-specific conditions.
>
> A COL applicant that references the U.S. EPR design certification will address site-specific Seismic Category I structures that are not described in this section.

The COL application identifies buried electrical duct banks and buried pipes, the Forebay, and the UHS MWIS as being site-specific.

The COL applicant provided additional information in COL FSAR Section 3.8.4.1.8, "Buried Conduit and Duct Banks," to address COL Information Item 3.8-4 as follows:

> A COL applicant that references the U.S. EPR design certification will provide a description of Seismic Category I buried conduit and duct banks.

The COL application includes figures and descriptive text to address this item. This section of the COL FSAR indicates that no Seismic Category I buried conduits exist at the CCNPP Unit 3 site.

The COL applicant provided additional information in COL FSAR Section 3.8.4.1.9, "Buried Pipe and Pipe Ducts," to address COL Information Item 3.8-5 as follows:

> A COL applicant that references the U.S. EPR design certification will provide a description of Seismic Category I buried pipe and pipe ducts.

The COL applicant stated that buried pipes run below final grade and that buried pipe ducts are not used at the CCNPP Unit 3 site. COL FSAR Figure 3.8-3, "Schematic Site Plan of Seismic Category I Buried Utilities (Underground Piping)," and COL FSAR Figure 3.8-4, "Schematic Site

Plan of Seismic Category I Buried Utilities (Underground Piping)," provide detailed plans for the pipe runs.

The COL applicant provided additional information in COL FSAR Section 3.8.4.3, "Loads and Load Combinations," to address COL Information Item 3.8-3 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm that site-specific loads lie within the standard design envelope for other Seismic Category I structures, or perform additional analyses to verify structural adequacy.

COL FSAR Revision 3 stated that there was an exception of average ground water elevation at the EPGBs and a localized ground water level at a corner of an ESWB. COL FSAR Revision 7 indicates that the above exception no longer applies, according to the most recent modeling of post-construction groundwater in the powerblock area. The latest COL FSAR revision also indicates that, except for the site-specific safe-shutdown earthquake (SSE), the CCNPP Unit 3 site-specific load characteristics are bounded by the standard design certification. Additional information is provided on the site-specific SSE.

The COL applicant provided additional information in COL FSAR Section 3.8.4.4.5, "Buried Conduit and Duct Banks, and Buried Pipe and Pipe Ducts," to address COL Information Items 3.8-14, 3.8-15, and 3.8-16, respectively, as follows:

> A COL applicant that references the U.S. EPR design certification will describe the design and analysis procedures used for buried conduit and duct banks, and buried pipe and pipe ducts.
>
> A COL applicant that references the U.S. EPR design certification will use results from site-specific investigations to determine the routing of buried pipe and pipe ducts.
>
> A COL applicant that references the U.S. EPR design certification will perform geotechnical engineering analyses to determine if the surface load will cause lateral and/or vertical displacement of bearing soil for the buried pipe and pipe ducts and consider the effect of wide or extra heavy loads.

The COL application references the U.S. EPR design certification and AREVA NP Topical Report ANP-10624NP-A, "U.S. EPR Piping Analysis and Pipe Support Design, November 2008," for the design and analysis procedures used for buried conduit and duct banks, and buried pipes and pipe ducts. The COL applicant also states that terrain topography and the results from the CCNPP Unit 3 geotechnical site investigation will be used as design input to confirm the routing of buried pipes and duct banks reflected in COL FSAR Figures 3.8-1, "Schematic Site Plan of Seismic Category I Buried Utilities (Electrical Duct Banks)," through 3.8-4. Furthermore, the COL applicant indicates that the design of buried duct banks and buried pipes will consider the strains due to seismic ground motion, surface loads, ground water effects, and tornado missiles.

The COL applicant provided additional information in COL FSAR Section 3.8.4.5, "Structural Acceptance Criteria," to address COL Information Item 3.8-7 as follows:

> A COL applicant that references the U.S. EPR design certification will confirm that site-specific conditions for Seismic Category I buried conduit, electrical duct

banks, pipe, and pipe ducts satisfy the requirements specified in Section 3.8.4.4.5 and those specified in AREVA NP Topical Report ANP-10624NP-A.

The COL applicant indicates that design of all safety-related, Seismic Category I buried electrical duct banks and pipe follows the U.S. EPR FSAR and the AREVA NP topical report. The COL applicant also identifies other industry standards for additional acceptance criteria.

Supplemental Information

COL FSAR Section 3.8.4.1.11, "Forebay and UHS Makeup Water Intake Structure," provides supplemental information on the Seismic Category I Forebay and UHS MWIS.

COL FSAR Section 3.8.4.4.7, "Forebay and UHS Makeup Water Intake Structure," provides descriptions of the finite element model, computer codes, loads and analysis procedures used to evaluate the Forebay and the UHS MWIS for reinforced concrete design.

COL FSAR Section 3.8.4.6.1, "Materials," provides additional information on the protection of below-grade concrete material at the CCNPP Unit 3 site.

COL FSAR Section 3.8.4.7, "Testing and Inservice Inspection Requirements," addresses the testing and inservice testing requirements pertaining to ground water chemistry and concrete degradation potential.

3.8.4.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR. In addition, the relevant requirements of NRC regulations for the other Seismic Category I structures, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.8.4, "Other Seismic Category I Structures." Review interfaces with other NUREG-0800 sections also can be found in NUREG-0800, Section 3.8.4.

The applicable regulatory requirements for other Seismic Category I structures are as follows:

1. 10 CFR 50.55a and GDC 1, as they relate to other Seismic Category I structures being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

2. GDC 2, as it relates to the design of other Seismic Category I structures being able to withstand the most severe natural phenomena such as winds, tornadoes, floods, and earthquakes and the appropriate combination of all loads.

3. GDC 4, as it relates to other Seismic Category I structures being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

4. GDC 5, as it relates to the design of other Seismic Category I structures not being shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

5. 10 CFR Part 50, Appendix B, as it relates to the quality assurance criteria for nuclear power plants.

The related acceptance criteria are as follows:

1. RG 1.206, “Combined License Applications for Nuclear Power Plants,” as it relates to Seismic Category I structures.

2. RG 1.70, “Standard Content and Format of Safety Analysis Reports for Nuclear Power Plants,” as it relates to Seismic Category I structures.

3. RG 1.69, “Concrete Radiation Shields for Nuclear Power Plants,” as it relates to Seismic Category I structures.

4. RG 1.91, “Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants,” as it relates to Seismic Category I structures.

5. RG 1.115, “Protection Against Low Trajectory Turbine Missiles,” as it relates to Seismic Category I structures

6. RG 1.127, “Inspection of Water control Structures Associated With Nuclear Power Plants,” as it relates to Seismic Category I structures.

7. RG 1.142, “Safety-Related Concrete Structures for Nuclear Power Plants,” as it relates to Seismic Category I structures.

8. RG 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components in LWR Plants,” as it relates to Seismic Category I structures.

9. RG 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” as it relates to Seismic Category I structures.

10. RG 1.199, “Anchoring Components and Structural Supports in Concrete,” as it relates to Seismic Category I structures.

11. NUREG-0800, Section 3.8.4, Subsection II provides additional details to determine acceptability of the COL application.

3.8.4.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.8.4 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.8.4 has been reviewed by the staff under Docket No. 52-020. The staff’s technical evaluation of the information incorporated by reference related to other Seismic Category I structures has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff’s review of the information contained in the COL FSAR is discussed as follows:

Interface Requirements

U.S. EPR FSAR Tier 2, Table 1.8-1, Interface Item 3-5 identifies a site interface to provide an evaluation of buried conduit and duct banks, and pipe and pipe ducts. COL FSAR Section 3.8.4.1 addresses this evaluation as part of the COL applicant's discussion of COL Information Items 3.8-4 and 3.8-5. These information items are evaluated below.

COL Information Items

COL FSAR Section 3.8.4.1 provides a description of the Seismic Category I structures. During its review of this section, the staff identified the following items that needed additional information: (1) COL Information Item 3.8-2, which is described in Section 3.8.4.2 of this report, was not addressed; (2) several structural features shown in COL FSAR Figure 9.2-4, "General Area – UHS Makeup Water and CW Intake Structures," are not included in the structure list in COL FSAR Section 3.8.4.1; (3) the CWSMWIS is classified as Conventional Seismic (CS); however, it is near a Seismic Category I structure; and (4) neither the U.S. EPR FSAR nor the COL FSAR provide a description of the analysis and design results of the Nuclear Auxiliary Building (NAB) and the Radioactive Waste Processing Building (RWPB). Therefore, in RAI 144, Question 03.08.04-1, the staff requested that the COL applicant address these items. The request was based on the review of COL FSAR Revision 3.

In a July 23, 2010, response to RAI 144, Question 03.08.04-1, the COL applicant provided the following information: (1) COL Information Item 3.8-2 would be addressed by revising the FSAR to state that there are no departures with the U.S. EPR FSAR; (2) among the intake area structures shown in the revised COL FSAR Figure 9.2-4 and not included in COL FSAR Section 3.8.4.1 at the time of the review, (a) the Forebay had been reclassified as Seismic Category I and would be included in the list in COL FSAR Section 3.8.4.1, (b) other structures are either classified as CS or Seismic Category II structures, and their potential interaction with Seismic Category I structures is described in COL FSAR Section 3.7.2.8; (3) the CWSMWIS was reclassified as a Seismic Category II structure and its potential interaction with Seismic Category I structures is discussed in the response to Item 2 above; and (4) the NAB and the RWPB are non-safety-related structures, therefore, a description of the analysis and design results for these structures is not required to be addressed in the COL FSAR other than for interaction with Seismic Category I structures.

The July 23, 2010, response to RAI 144, Question 03.08.04-1, Items 1, 3 and Item 2 regarding the Forebay addresses the staff's concerns. In addition, the staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response to Items 1, 3, and Item 2 regarding the Forebay, therefore, the staff considers these parts of RAI 144, Question 03.08.04-1 resolved.

Regarding the response to Item 4 above, the staff notes that NAB and RWPB have safety-related functions, since they are waste storage facilities. However, according to the latest revision of the U.S. EPR FSAR, it is now clear to the staff that the design of these two structures is within the scope of the U.S. EPR design certification. Therefore, the staff considers Item 4 of the response to RAI 144, Question 03.08.04-1 resolved.

Regarding the remainder of the RAI response to Item 2, the staff determined that, for the Sheet Pile Walls and the above ground steel structure of the CWSMWIS, the NUREG-0800, Section 3.7.2 acceptance criteria used to address the interactions of the structures with Seismic Category I SSCs are inconsistent with COL FSAR Section 3.7.2.8, "Interaction of Non-Seismic Category I Structures with Seismic Category I Systems," and an October 26, 2010, response to RAI 256, Question 14.03.02-7. Therefore, in follow-up RAI 298, Question 03.08.04-16, the staff requested that the COL applicant explain the inconsistencies and revise the FSAR accordingly.

In a July 8, 2011, response to RAI 298, Question 03.08.04-16, the COL applicant stated that the above ground steel structure of the CWSMWIS will be designed to the same requirements as a Seismic Category I structure; therefore, its design methodology meets NUREG-0800, Section 3.7.2, Acceptance Criterion 8.C. The COL applicant also indicated that the Sheet Pile Wall is located so distant from any Seismic Category I SSC that its collapse will not cause it to strike a Seismic Category I SSC, thus meeting the NUREG-0800, Section 3.7.2, Acceptance Criteria 8.A. The response also provided markups to COL FSAR Section 3.7.2.8 and combined license application (COLA) Part 10, Appendix B, ITAAC Table 2.4-18, "Circulating Water Makeup Intake Structure Inspections, Tests, Analyses, and Acceptance Criteria." The staff finds that the RAI response addresses the staff's concerns, and the proposed markups consistent with the RAI response. Therefore, the staff finds this part of the RAI response acceptable. **RAI 144, Question 03.08.04-1 and the related follow-up RAI 298, Question 03.08.04-16 are being tracked as confirmatory items**, until COL FSAR Section 3.7.2.8 and COLA Part 10, Appendix B, ITAAC Table 2.4-18, are revised accordingly as stated in the RAI response.

COL FSAR Section 3.8.4.3.1, "Design Loads," describes the design loads used for Seismic Category I structures. As a result of its review, in RAI 144, Question 03.08.04-2, the staff requested that the COL applicant provide the following additional information: (1) For the Standard Project Hurricane (SPH) and the Probable Maximum Hurricane (PMH), provide information on the development of the parameters, the calculation of the pressures on the intake structures, and the calculation of wind loads in and not in conjunction with the SPH and PMH; (2) explain the basis for determining the peak overpressure of at least .069 bar (1 psi) used to design the UHS MWIS; and (3) for site-specific structures, describe all applicable loads.

In a February 8, 2010, response to RAI 144, Question 03.08.04-2, Item 2 , and in a July 23, 2010, response to RAI 144, Question 03.08.04-2, Items 1 and 3, the COL applicant explained that (1) the SPH is a smaller storm than a PMH, which is defined in COL FSAR Section 2.4.5, "Probable Maximum Surge and Seiche Flooding"; in addition, the wave pressure distributions on intake structures are obtained using the methodology available in the Coastal Engineering Manual (CEM). Furthermore, the wind loads in, and not in, conjunction with the SPH and PMH are calculated utilizing the procedures presented in American Society of Civil Engineers (ASCE) 7-05, Minimum Design Loads for Buildings and Other Structures," based on the U.S. EPR standard wind speeds of 233.4 kph (145 mph) and 370.1 kph (230 mph) which are conservative for the SPH and PMH; (2) the peak overpressure of at least .069 bar (1 psi) used to design the UHS MWIS is conservatively determined in accordance with RG 1.91, Revision 1, based on applicable distances from the structures to explosions; and (3) for the site-specific Seismic Category I structures, a description of applicable loads other than those already in COL FSAR Revision 6, is provided.

The staff finds the COL applicant's response to RAI 144, Question 03.08.04-2, Items 2 and 3 addresses their concerns. Later, the staff noted that, in a proposed COL FSAR markup, the reference to CEM for the methodology to calculate the hurricane wave pressure is changed to ASCE 7-05. The staff finds this methodology acceptable. In addition, the staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response to Item 3 and the proposed markup. Therefore, the staff considers these parts of the RAI response resolved.

The staff also determined that the response to RAI 144, Question 03.08.04-2, Item 1 addresses most of the staff's concerns; however, the RAI response as to which walls of the UHS MWIS are subject to breaking wave pressure (including hydrostatic and hydrodynamic water pressures) is inconsistent with COL FSAR Revision 7, Section 3.8.4.3.1. Therefore, in follow-up RAI 310,

Question 03.08.04-27, the staff requested that the COL applicant explain whether all the exterior walls of UHS MWIS are subject to breaking wave pressures and revise COL FSAR Section 3.8.4.3.1 accordingly.

In an August 26, 2011, response to RAI 310, Question 03.08.04-27, the COL applicant indicated that only the East Wall, which is facing the Chesapeake Bay, is subject to the breaking wave pressure. However, the COL applicant provided no explanation on the change from multiple walls to one single wall being subject to breaking wave pressure. In addition, COL FSAR, Revision 7, Section 2.4.5.3.2, "Wave Height and Run-up," and COL FSAR Figure 9.2-4, "General Area – UHS Makeup Water and CW Intake Structures," indicate a run-up water elevation of 10.12 m (33.2 ft), which is higher than the elevation of the crest of the wave based on the COL applicant's calculations which utilize ASCE 7-05 for wave pressure calculations. Based on a review of COL FSAR Revision 7, Section 3.8 and related RAI responses, the staff is unable to determine whether the run-up water elevation has been taken into account in the wave pressure calculations.

Therefore, in follow-up RAI 333, Question 03.08.04-32, the staff requested that the COL applicant provide additional information, justify the assumption that only the East Wall is subject to breaking wave pressure, and clarify that the run-up water elevation has been taken into account in the design of the exterior walls of the UHS MWIS. The staff also requested that the COL applicant correlate the run-up water elevation used in the design with the water run-up elevations described in COL FSAR Figure 2.4-26, "Schematic Diagram Wave Runup on the UHS Makeup Water Intake Structure (MWIS)." The staff needs the information to be able to conclude that there is reasonable assurance that design loads for the site-specific Seismic Category I structures have been adequately addressed in the COL FSAR. **RAI 144, Question 03.08.04-2, RAI 310, Question 03.08.04-27, and follow-up RAI 333, Question 03.08.04-32 are being tracked as open items**.

COL FSAR, Revision 3, Sections 3.8.4.3.1, 3.8.5.5.2, "Emergency Power Generating Buildings Foundation Basemats," and 3.8.5.5.3, "Essential Service Water Buildings Foundation Basemats," identify that the U.S. EPR certified design groundwater level is exceeded in two instances, based on site-specific groundwater analyses. Based on the information provided in the license renewal application for CCNPP Units 1 and 2, the staff is aware that there is an underground drain system for CCNPP Units 1 and 2, whose purpose is to maintain the groundwater at a level lower than would naturally occur. However, COL FSAR, Revision 3, Section 3.8, "Design of Category 1 Structures," does not provide any information on a drain system for CCNPP Unit 3. Therefore, in RAI 144, Question 03.08.04-3, the staff requested that the COL applicant provide information on any drain system that may be used for CCNPP Unit 3.

In a July 23, 2010, response to RAI 144, Question 03.08.04-3, the COL applicant explained that a drain system (existing or new) to maintain the CCNPP Unit 3 groundwater level lower than would occur naturally post-construction is not required, because the most recent modeling of post-construction groundwater shows that the water table in the powerblock area will be approximately 9.14 m (30 ft) below the finished grade, well below the specified U.S. EPR FSAR groundwater level of 1.0 m (3.3 ft) below finished grade. The staff confirmed that COL FSAR, Revision 7, Sections 3.8.4.3.1, 3.8.5.5.2 and 3.8.5.5.3 reflect the RAI response. Since the COL applicant has stated that it does not plan to use a drain system for CCNPP Unit 3, the staff finds that the COL applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-3 resolved.

COL FSAR Sections 3.8.4.6.1 and 3.8.5.6.1, “Materials,” states, “all natural soils at the site are considered aggressive to concrete.” As a result of its review, the staff determined that there is insufficient information provided in the COL FSAR regarding how the waterproofing system and the improved concrete mix design will adequately protect the below-grade structures from the aggressive environment over the design life of the plant. Therefore, in RAI 144, Question 03.08.04-4, the staff requested that the COL applicant provide the following information: (1) Details of the waterproofing system used; (2) more details on the specific measures ensuring no degradation of below grade concrete structures over plant design life; (3) operating experience on the use of a similar waterproofing system at the same site; and (4) vendor test data or other operating experience that prove the qualification of the waterproofing system. The request was based on the review of COL FSAR Revision 3.

In a July 23, 2010, response to RAI 144, Question 03.08.04-4, (1) the COL applicant provided details of the waterproofing system to minimize water intrusion and eliminate direct contact of aggressive groundwater with the buried concrete, including type, material, thickness, type of joints, and installation process; (2) the RAI response provided quantitative information of the soil/groundwater aggressiveness, including pH values, sulfate and chloride concentrations, and indicated that the waterproofing system, specific concrete mixture design, and the replacement of onsite aggressive soils with non-aggressive structural fill will ensure no degradation of below grade concrete structures over plant design life; (3) the COL applicant also explained that CCNPP Units 1 and 2 do not have a similar waterproofing system and are not exposed to the same groundwater chemistry expected to exist at CCNPP Unit 3, therefore, no operating experience is considered relevant for CCNPP Unit 3; (4) the COL applicant indicated that studies show that the high density polyethylene (HDPE) geomembrane is resistant to a wide variety of chemicals and has an expected useful life many times that of the 60-year design life of the power plant.

As a result of its RAI response review, the staff determined that the RAI response addressed most of the staff's concerns. However, the staff concluded that both the above RAI response and the latest COL FSAR indicated that waterproofing is not needed for some Seismic Category I structures or some portions of below grade concrete of Seismic Category I structures. This is inconsistent with the design certification applicant’s RAI response (to U.S. EPR design certification RAI 354, Question 03.08.05-21), which states, “Waterproofing and dampproofing systems are required for Seismic Category I foundations below grade.” Furthermore, U.S. EPR FSAR Tier 2, Revision 3 Section 3.4.2, indicated the same. Therefore, in follow-up RAI 301, Question 03.08.04-22, the staff requested that the COL applicant explain the inconsistency, and revise the RAI response and the COL FSAR accordingly if necessary.

In a September 22, 2011, response to RAI 301, Question 03.08.04-22, the COL applicant stated that waterproofing and dampproofing systems, in accordance with the guidance in 2009 International Building Code (IBC) Sections 1805.2 and 1805.3, will be applied to Seismic Category I foundations below grade at CCNPP Unit 3, to be consistent with the final response to U.S. EPR RAI 354, Question 03.08.05-21, and U.S. EPR FSAR Tier 2, Revision 3, Section 3.4.2. The staff determined that the COL applicant’s September 22, 2011, response to RAI 301, Question 03.08.04-22 addresses most of the staff's concern. However, the staff's review of the proposed COL FSAR markups determined that not all COL FSAR sections related to the use of the waterproofing system are indicated (e.g., a markup to COL FSAR Section 3.8.5.5 is not provided). Therefore, in follow-up RAI 333, Question 03.08.04-30, the staff requested that the COL applicant provide COL FSAR updates for all applicable COL FSAR Section 3.8 subsections related to the use of waterproofing and dampproofing systems.

RAI 144, Question 03.08.04-4, RAI 301, Question 03.08.04-22, and follow-up RAI 333, Question 03.08.04-30 are being tracked as open items.

COL FSAR Section 3.8.4.3.2, "Loading Combinations," presents two additional load combinations for the UHS MWIS to address the hurricane loadings SPH and PMH. These load combinations appear to the staff to correspond to one of the Service Load Combinations and Factored Load Combinations that are presented in the U.S. EPR FSAR and ACI 349, when the wind load W is replaced by the hurricane loads SPH and PMH. To ensure that the load combinations discussed in COL FSAR Section 3.8.4.3.2 sufficiently meet the pertinent provisions of NUREG-0800, Section 3.8.4, in RAI 144, Question 03.08.04-5, the staff requested that the COL applicant address the following items: (1) Explain why the two load combinations with SPH and PMH are only applicable to the UHS MWIS; (2) explain why a load combination with wind load W included in the U.S. EPR FSAR and ACI 349 is not considered by replacing W with SPH; and (3) explain why temperature effect is not included in the load combination involving PMH.

In a September 28, 2009, response to RAI 144, Question 03.08.04-5, the COL applicant explained that, corresponding to the RAI items, (1) The site-specific SPH and PMH wind loads are enveloped by the U.S. EPR standard wind loads; PMH and SPH flood loads are not applicable to the design of Seismic Category I structures in the power block area, because the structures are located above the flood water elevation associated with the hurricane events; the COL FSAR would be revised to indicate that Seismic Category I buried duct banks and piping in the intake area are subjected to PMH and SPH flood loads; (2) the load combination with wind load W is enveloped by another load combination; and (3) temperature effect is deemed negligible for the UHS MWIS as per ACI 349.1R-07, Section 1.3, and therefore omitted.

As a result of the RAI response review, the staff determined that the RAI response addressed most of the staff's concern, except that the justification for omitting the temperature effect was insufficient. The staff notes that the ACI 349 code, as endorsed by RG 1.142, requires that temperature effect be included in the load combinations. Therefore, in follow-up RAI 230, Question 03.08.04-15, the staff requested that the COL applicant submit its technical basis for concluding that temperature effect is negligible for the UHS MWIS.

In a June 8, 2010, response to RAI 230, Question 03.08.04-15, the COL applicant provided quantitative temperature information of the UHS MWIS, and showed that both the temperature gradient and the uniform temperature change are within the ACI 349.1R-07, Section 1.3 limits for ignoring temperature effect. The staff finds that the COL applicant provided sufficient technical basis for concluding that temperature effect is negligible. In addition, the staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-5 and the related follow-up RAI 230, Question 03.08.04-15 resolved.

The first COL information item given in COL FSAR Section 3.8.4.4.5 indicates that a COL applicant will describe the design and analysis procedures for buried duct banks and buried pipes. The staff's review of COL FSAR Revision 3 determined that it provided a limited description of the analysis and design procedures for buried duct banks and buried pipes. COL FSAR Section 3.8.4.4.5 refers to COL FSAR Section 3.7.3, "Seismic Subsystem Analysis," for the seismic design of buried duct banks and buried pipes; however, the staff determined that information for the analysis and design procedures for all of the other loads was lacking. Therefore, in RAI 144, Question 03.08.04-6, the staff requested that the COL applicant provide

a detailed description of the analysis and design procedures for all of the other loads imposed on the buried duct banks and buried pipes. In addition, since the ground water table is probably above the buried electrical duct banks, the staff also requested that the COL applicant explain what types of joints are used and what provisions are made to prevent water intrusion.

In a July 23, 2010, response to RAI 144, Question 03.08.04-6, the COL applicant indicated: (1) For buried pipes, the analysis and design procedures used are the same as described in U.S. EPR FSAR Tier 2, Section 3.8.4.4.5 and AREVA NP Topical Report, "U.S. EPR Piping Analysis and Pipe Support Design," Section 3.10, Revision 0 (ANP-10264NP-A, Reference 37 of the U.S. EPR FSAR); (2) for buried electrical duct banks, the analysis and design procedures are in accordance with U.S. EPR FSAR Tier 2, Section 3.8.4.4.5 and the loads are described in ANP-10264NP-A, Section 3.10. The COL applicant also provided information on the type of joints used and provisions made to prevent water intrusion, such as water stops, drain pipes, sumps, and pumps.

As a result of the review, the staff finds that U.S. EPR FSAR Tier 2, Section 3.8.4.4.5, supplemented by report ANP-10264NP-A, provides sufficient details of the analysis and design procedures for buried banks and buried pipes for various loadings, considering that report ANP-10264NP-A had been reviewed and accepted by the NRC during the review process of the U.S. EPR design certification application. In addition, the staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in this part of the RAI response. Therefore, the staff considers this part of the RAI response acceptable and resolved.

The staff also determined that the July 23, 2010 response to RAI 144, Question 03.08.04-6 is inconsistent with COL FSAR Section 3.8.4.1.8 regarding construction joints utilizing water stops in the buried electrical duct banks below the groundwater table. Therefore, in follow-up RAI 301, Question 03.08.04-17, the staff requested that the COL applicant address this issue. In an August 11, 2011, response to this RAI 301, Question 03.08.04-17, the COL applicant proposed a markup for COL FSAR Section 3.8.4.1.8 that is consistent with the RAI response and which the staff finds acceptable. **RAI 144, Question 03.08.04-6 and the related RAI 301, Question 03.08.04-17 are being tracked as confirmatory items**, until COL FSAR Section 3.8.4.1.8, is revised accordingly, as stated in the RAI response.

COL FSAR Sections 3.8.4.4.6, "Design Report," and 3.8.5.4.5, "Design Report," state "No departures or supplements." Since there are multiple site-specific Seismic Category I structures defined in the COL FSAR, a design report is required for each of these structures. Therefore, in RAI 144, Question 03.08.04-7, the staff requested that the COL applicant provide a design report for all site-specific Seismic Category I structures including the buried electrical duct banks and buried piping. The design reports should be prepared in accordance with the guideline described in NUREG-0800, Section 3.8.4, Appendix C.

In a July 23, 2010, response to RAI 144, Question 03.08.04-7, the COL applicant stated that design information and design results required in the design report in accordance with NUREG-0800, Section 3.8.4, Appendix C for the UHS MWIS and the Forebay are updated and expanded in the revised COL FSAR. The COL applicant also indicated that the analysis and design of buried duct banks and buried pipes will be performed during detailed design engineering, and the design report will be incorporated into the revised FSAR, prior to closure of their ITAAC.

As a result of its review, the staff determined that the RAI response and the revised FSAR do not provide sufficient information as requested by the RAI. Since buried duct banks and buried

pipes are also Seismic Category I structures, the design reports with the same level of design information as that for other Seismic Category I structures, such as the UHS MWIS and the Forebay, should be provided for these structures. Additionally, as requested by the original RAI, the design reports should be prepared in accordance with the guidelines described in NUREG-0800, Section 3.8.4, Appendix C, which indicates that the design information should include structural geometry and dimensions, key structural elements and description, engineering drawings, tabulation of capacities, etc. The staff needs the information prior to the closure of this report. The staff requested that the COL applicant provide the specific date when the design reports will be provided. Furthermore, the staff also requested that the COL applicant should explain the inconsistencies between COL FSAR Section 3.8 and COL FSAR Appendix 3E regarding load combinations and the number of critical sections for the UHS MWIS and the Forebay. Therefore, in follow-up RAI 301, Question 03.08.04-23 and RAI 333, Question 03.08.04-29, the staff requested that the COL applicant provide the information discussed above. The staff needs the information in order to conclude that there is reasonable assurance that COL FSAR Section 3.8.4 sufficiently meets the pertinent provisions of NUREG-0800, Section 3.8.4. **RAI 144, Question 03.08.04-7, the related follow-up RAI 301, Question 03.08.04-23 and RAI 333, Question 03.08.04-29 are being tracked as open items**.

COL FSAR Section 3.8.4.4.7 provides information about the design and analysis procedures for site-specific Seismic Category I intake structures, which include the UHS MWIS and the UHS EB in the COL FSAR prior to Revision 7, and the UHS MWIS and the Forebay in COL FSAR Revision 7. The staff's review of this section determined that the design and analysis procedures for the site-specific Seismic Category I intake structures need to be expanded to provide more detailed information. Therefore, in RAI 144, Question 03.08.04-8, the staff requested that the COL applicant provide additional information for the following items: (1) The finite element model (FEM) and analysis, (e.g., information on soil representation, application of equivalent static loads, structural local dynamic amplification, seismic load application); (2) a description of how the water contained within the structure and outside the structure was considered in the model for developing member forces; (3) the modeling of the sloped UHS MWIS exterior walls; (4) a description of how all the loads were determined and applied to the model; and (5) references in the COL FSAR to ACI 349-01 and ACI 350-06, which have not been endorsed by the NRC.

In a July 23, 2010, response to RAI 144, Question 03.08.04-8, the COL applicant provided the following additional information for Items (1), (2), and (3) as follows: (1) (a) The FEM utilizes soil springs to represent soil; (b) seismic accelerations are computed considering soil-structure interaction (SSI) and the effects of all soil profiles, then, they are applied to the FE model to generate design forces and moments; (c) a mesh of thick shell elements is used for slabs and walls to capture local dynamic amplification in seismic analysis; (d) seismic loads were applied separately in three directions, and the resulting design forces and moments are combined using the 100-40-40 percent rule; (2) effects of hydrodynamic loads associated with the water inside the intake structures are calculated in the SSI analysis by including the corresponding water mass and springs in the System for Analysis of Soil-Structure Interaction (SASSI) model, as discussed in COL FSAR, Revision 7, Section 3.7.2; and (3) the sloped UHS MWIS exterior walls are modeled as vertical because the effect is negligible, and the localized impact will be addressed during the detailed design engineering. For RAI Item (4), the COL applicant provided details on how all the loads were determined. Regarding RAI Item (5), the COL applicant explained that (a) the discussion on the use of ACI 349-01 is provided in a design certification applicant’s response to a U.S. EPR FSAR RAI; (b) the ACI 350.3 -06 equations/concepts used are the same as identified in NUREG-0800, Section 3.7.3, and the reference to this code has been deleted from COL FSAR Section 3.8 and related Appendix 3E.

The staff notes that the word “thick” used in the RAI response Item (1) (c) is a typo, because COL FSAR Section 3.7.2.3 indicates that “thin shell element” is used. The staff also notes that a question is raised under RAI 301, Question 03.08.04-18, regarding the combination rule to calculate maximum seismic nodal accelerations. The staff notes that the original RAI also requested that the COL applicant provide a description of how the water outside the structure was considered in the model for developing member forces. However, the staff concluded it is acceptable not to include a discussion of this issue in COL FSAR Section 3.8, “Design of Category 1 Structures,” since it is a part of the seismic modeling that is discussed in COL FSAR Section 3.7, “Seismic Design.” The staff also noted that the discussion regarding the modeling of the sloped concrete wall is included in COL FSAR, Revision 7, Section 3.7.2.3, “Procedures Used for Analytical Modeling,” and is evaluated by the staff reviewers of this section. Regarding the reference to ACI 349-01, the staff concluded during the review of the U.S. EPR FSAR that the use of ACI 349-01 for the design of concrete structures is acceptable with the only exception of anchorage design, which will follow ACI 349-06. Furthermore, the staff concluded that the RAI response regarding the use of ACI 350.3-06 is adequate, since the same equations/concepts used are identified in NUREG-0800, Section 3.7.3. Therefore, the staff finds that the July 23, 2010, response to RAI 144, Question 03.08.04-8, provided adequate information as requested. In addition, the staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-8 resolved.

COL FSAR Section 3.8.4.5 indicates that U.S. EPR FSAR, Appendix 3E, Section 3E.4 provides the details for the design of the basemat and typical wall for site-specific Seismic Category I intake structures, which include the UHS MWIS and the UHS EB in the COL FSAR prior to Revision 7, and the UHS MWIS and the Forebay in the COL FSAR Revision 7. The staff noted that there is a typical wall selected for each structure. To ensure that the design report for each site-specific Seismic Category I structure conforms to NUREG-0800, Section 3.8.4, Appendix C, in RAI 144, Question 03.08.04-9, the staff requested that the COL applicant explain the technical basis for only selecting a typical wall for each structure and why other concrete walls and slabs were not considered. In addition, since the buried electrical duct banks and buried piping are also site-specific Seismic Category I structures, the staff requested that the COL applicant provide corresponding analysis and design information for critical sections of electrical duct banks to represent this group of structures/components.

In a July 23, 2010, response to RAI 144, Question 03.08.04-9, the COL applicant provided an explanation for the selection of one critical section for the UHS MWIS. For the buried duct banks and pipes, the COL applicant referenced the response to RAI 144, Question 03.08.04-7 that their analysis and design will be performed during detailed design engineering, and the design report will be incorporated into the revised COL FSAR, prior to closure of the ITAAC.

As discussed above in this report regarding the COL applicant’s response to RAI 144, Question 03.08.4-7, the staff requested that the COL applicant provide design reports for the buried duct banks and pipes prior to the closure of this report. However, since this issue is being tracked by RAI 144, Question 03.08.4-7, the staff considers this part of RAI 144, Question 03.08.04-9 resolved.

Also, as a result of its review, the staff determined that the RAI response did not address the questions as to why only one wall critical section was selected for the UHS MWIS and why other concrete walls and slabs were not considered. Without the information, the staff is unable to determine whether this one critical section can represent all of the important portions of the

safety-related structures in terms of differences in functionality, loading conditions, structural dimensions, and other key design features. Therefore, in follow-up RAI 310, Question 03.08.04-24, the staff requested that the COL applicant provide the details of the design for key critical wall and critical floor slab sections of the UHS MWIS, unless it can be demonstrated that one critical section can adequately represent the design of the entire combined UHS MWIS. The technical basis for the selection of the key critical sections should be provided. The staff needs the information to be able to conclude that there is reasonable assurance that the design report for site-specific Seismic Category I structures conforms to NUREG-0800, Section 3.8.4, Appendix C. **RAI 144, Question 03.08.04-9 and the related follow-up RAI 310, Question 03.08.04-24 are being tracked as open items**.

COL FSAR Sections 3.8.4.6.1 and 3.8.5.6.1 refer to the use of dense concrete with a low water cement ratio and improved concrete mixture design. The compressive strength of the concrete for the foundation of the UHS MWIS is f'c = 351.62 kg/cm^2 (5,000 psi). The staff's review of COL FSAR Section 3.8 and COLA Part 10, Appendix B, ITAAC determined that additional information is needed for the water cement ratio and concrete compressive strength used in the design, to ensure that the improved concrete mixture design for concrete structures is adequate for the site-specific aggressive soil/water conditions and meets NUREG-0800, Section 3.8.4, Acceptance Criteria 3.8.4.II.6 and Section 3.8.5, Acceptance Criteria 3.8.5.II.6. Therefore, in RAI 144, Question 03.08.04-10, the staff requested that the COL applicant (1) identify any specific water-cement ratios needed for the concrete mix for all Seismic Category I, II, and II-SSE structures; and explain why COLA Part 10, Appendix B, ITAAC tables specify a maximum water to cement ratio of 0.45 for below grade concrete sections; (2) explain the determination of the minimum concrete compressive strength for Seismic Category I, II, and II-SSE structures.

In a July 23, 2010, response to RAI 144, Question 03.08.04-10, the COL applicant indicated that, for Seismic Category I, II, and II-SSE structures, water-cement ratios and minimum compressive strength will be determined in accordance with the requirements of the design codes for special exposure conditions such as concrete exposure to brackish water, chloride, and sulfate. The COL applicant also indicated that COL FSAR Section 3.8 and COLA Part 10, Appendix B, ITAAC tables will be revised to meet the requirements, as shown in the proposed markups.

The staff reviewed COL FSAR Revision 7 and noted that COL FSAR Section 3.8.4.6.1 has been revised to indicate that concrete mixtures for site-specific other Seismic Category I structures, as well as the ESWBs will have a maximum water-cement ratio of 0.4. The staff also noted that water-cement ratios for all Seismic Category I, II, and II-SSE concrete structures are presented in corresponding ITAAC tables. The staff concluded that the values meet code requirements and are consistent with those provided in the RAI response. Therefore, the staff finds the part of RAI response regarding water-cement ratios acceptable.

The staff's review of the RAI response and COL FSAR Revision 7 also determined that code requirements for the minimum compressive strength have been addressed adequately in both the RAI response and the COL FSAR for all Seismic Category I, II, and II-SSE concrete structures, except the ESWBs, which can be exposed to brackish water as indicated by COL FSAR, Revision 7, Section 3.8.4.6.1. It is unclear to the staff whether a minimum concrete compressive strength of 351.62 kg/cm^2 (5,000 psi) is specified for the foundations of the ESWBs. Therefore, in follow-up RAI 310, Question 03.08.04-25, the staff requested that the COL applicant clarify that a minimum compressive strength of 351.62 kg/cm^2 (5,000 psi) is used for the ESWB foundations, as well as all other foundations for Seismic Category I concrete

structures exposed to brackish water; explain why other Seismic Category I structures adjacent to the ESWBs will not be exposed to the brackish water; and revise the RAI response and the COL FSAR accordingly.

In a September 23, 2011, response to RAI 310, Question 03.08.04-25, the COL applicant indicated that the minimum compressive strength shall be 351.62 kg/cm^2 (5,000 psi) for concrete exposed to brackish water, and this includes ESWBs and their foundations. In addition, the COL applicant explained that the ESWBs can be subjected to brackish water, since these buildings take the brackish water from the intake area, while other Seismic Category I structures in the powerblock area do not have this design consideration and are, therefore, not exposed to brackish water. The RAI response addresses the staff's concerns. Furthermore, the staff confirmed that the proposed markup for the COL FSAR Section 3.8.4.6.1 reflects the RAI response. **RAI 144, Question 03.08.04-10 and the related follow-up RAI 310, Question 03.08.04-25 are being tracked as confirmatory items**, until COL FSAR Section 3.8.4.6.1, is revised accordingly, as stated in the RAI response.

U.S. EPR FSAR Tier 2, Sections 3.8.4.6.1 and 3.8.5.6.1 state, "A COL applicant that references the U.S. EPR design certification will evaluate and identify the need for the use of waterproofing membranes and epoxy coated rebar based on site-specific groundwater conditions." The staff reviewed COL FSAR, Revision 3, Section 3.8, but did not find any discussion on the use of epoxy coated rebar. To ensure that the COL information item is adequately addressed, in RAI 144, Question 03.08.04-11, the staff requested that the COL applicant describe the evaluation performed which determines whether epoxy coated rebar is needed in accordance with the referenced COL information item.

In a July 23, 2010, response to RAI 144, Question 03.08.04-11, the COL applicant indicated: (1) CCNPP Unit 3 site soils contain three aggressive agents that can affect the performance and durability of reinforced concrete: acidic groundwater in the power block area, chloride, and sulfate; (2) a waterproofing membrane system and a dense, impermeable concrete mixture will be used for the protection of concrete from the acidic groundwater and the sulfate-rich environments, respectively; and (3) protection of the reinforcing steel from chloride can be provided by either an epoxy coating or a dense impermeable concrete mixture; the epoxy coated reinforcing has potential for coating damage during placement of the reinforcing and the concrete, therefore, it is less desirable and less reliable than the use of a suitably proportioned concrete mixture.

The staff finds the COL applicant's evaluation of the use of epoxy coated rebar acceptable, considering that a waterproofing membrane system and a dense/impermeable concrete mixture will be used to ensure the service of reinforced concrete in the aggressive site-specific soil or groundwater conditions. In addition, the use of epoxy rebar is not a mandatory requirement by the concrete codes referenced by the COL FSAR. The staff also noted that COL FSAR, Revision 7, Section 3.8.5.6.1 had been revised to reflect the RAI response by stating that epoxy coated rebar is not used.

Based on the above discussion, the staff finds that the COL applicant adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-11 resolved.

COL FSAR Sections 3.8.4.7 and 3.8.5.7, "Testing and Inservice Inspection Requirements," describe testing and inservice inspection requirements. The CCNPP Unit 3 below-grade concrete degradation program for aggressive ground water/soil provides a surveillance program to monitor the condition of normally inaccessible below-grade concrete for signs of degradation. This program includes below-grade walls and buried duct banks addressed in COL FSAR

Sections 3.8.4.7 and 3.8.5.7. This inservice inspection program is limited to examination of exposed portions of below-grade concrete for signs of degradation when adjacent soil is excavated for any reason. To determine that the inservice inspection program is adequate for CCNPP Unit 3 structures subjected to aggressive groundwater/soil conditions, the staff determined that additional information is needed. Therefore, in RAI 144, Question 03.08.04-12, the staff requested that the COL applicant address the following items: (1) Explain why the inservice inspection program, to examine below-grade concrete when exposed during an excavation for any reason, is considered adequate for below-grade concrete foundations when subjected to aggressive soil conditions, while the program has been used and accepted at sites where the soil is not aggressive; (2) explain why the COL FSAR does not describe any inservice inspection program for buried piping; (3) describe the inspection program for waterproofing membrane beneath the foundation basemats and on the below grade walls; and (4) explain whether the monitoring and maintenance of the CCNPP Unit 3 structures will be performed in accordance with the requirements of 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," RG 1.160, and RG 1.127, Revision 1.

In a July 23, 2010, response to RAI 144, Question 03.08.04-12, the COL applicant indicated: (1) (a) the inservice inspection program, to examine below-grade structures when exposed during an excavation for any reason, is applicable for below-grade concrete to be placed in non-aggressive structural fill above the post-construction groundwater table, as well as for Seismic Category I intake area structures not exposed to aggressive groundwater; (b) for below-grade concrete beneath the aggressive low-pH groundwater table, water inside the waterproofing geomembrane will be monitored; (c) groundwater levels in the powerblock area will be monitored; (d) the buried concrete duct banks that may be exposed to low pH groundwater will be inspected periodically; (2) the inservice inspection of buried piping will be performed when exposed during an excavation for any reason; (3) prior to subsequent backfill placement, full-time/on-site monitoring of geomemberane installation, non-destructive leak testing of field seams, and detailed inspection of the completed installation will be required; after construction completion, geomembranes will be inspected when below-grade concrete is excavated for any reason; (4) inservice inspection program and performance monitoring will be designed and conducted to comply with the requirements of 10 CFR 50.65, RG 1.160, and RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," Revision 1, March, 1978.

Since the inservice inspection program, to examine below-grade concrete when exposed during an excavation for any reason, is applicable for below-grade concrete not exposed to aggressive groundwater/soil, and groundwater and water in the waterproofing system in aggressive environment will be monitored, the staff concluded that this inservice inspection program is acceptable. The staff also concluded that the RAI response addresses most of the staff's concerns, except the inservice inspection program for buried piping, since some buried piping, like the buried duct banks, may be subjected to low pH groundwater. Therefore, in follow-up RAI 310, Question 03.08.04-26, the staff requested that the COL applicant explain whether the periodic monitoring program, for buried concrete duct banks that may be exposed to low-pH groundwater, also covers buried piping.

In an October 3, 2011, response to RAI 310, Question 03.08.04-26, the COL applicant indicated: (1) Only buried Seismic Category I steel pipes will be exposed to low-pH groundwater; (2) the steel pipes will be protected by wrappings/coatings, an additional thickness, and a cathodic protection system; (3) in addition to the inservice inspection that will be performed when exposed during an excavation for any reason, periodic inservice testing of buried piping will be performed using flow or pressure tests at a 4-year frequency.

Since the buried Seismic Category I steel pipes will be protected by several measures, and the inservice inspection program of buried piping is supplemented with the periodic inservice testing, the staff concluded that the inservice inspection program is adequate and the RAI response addresses most of the staff's concern. The staff notes that both the RAI 310, Question 03.08.04-26 and COL FSAR Section 3.8.4.7 apply to all buried piping. However, the proposed markup for COL FSAR Section 3.8.4.7 references COL FSAR Section 9.2.5.6, "Inspection and Testing Requirements," which discusses only the UHS makeup water system components, for the description of the periodic inservice testing of buried piping using flow or pressure test. Therefore, in follow-up RAI 333, Question 03.08.04-31**,** the staff requested that the COL applicant clarify that the discussion in the proposed markup for COL FSAR Section 3.8.4.7 is for all buried piping and revise the COL FSAR markup accordingly. The staff needs the information to be able to conclude that there is reasonable assurance that inservice inspection requirements for buried Seismic Category I structures and piping conform to NUREG-0800, Section 3.8.4, Acceptance Criteria 3.8.4.II.7. **RAI 144, Question 03.08.04-12, RAI 310, Question 03.08.04-26, and its follow-up RAI 333, Question 03.08.04-31 are being tracked as open items.**

COL FSAR Table 3E.4-1, "Governing Design Load Combinations," presents the governing design load combinations for the UHS MWIS and UHS EB. To ensure that the design load combinations conform to NUREG-0800, Section 3.8.4.II.3 and are adequate, in RAI 144, Question 03.08.04-13, the staff requested that the COL applicant confirm that, for the site-specific structures, all of the load definitions and the methods utilized to determine the individual loads are consistent with those defined/utilized in the U.S. EPR FSAR; also confirm that the effect of any load that reduces the effects of other loads, and the effects of buoyancy force and permanent surcharges for stability evaluation, have been properly considered; and explain why the load combinations in COL FSAR Table 3E.4-1 are considered to bound all of the other load combinations tabulated in the U.S. EPR FSAR.

In a July 23, 2010, response to RAI 144, Question 03.08.04-13, the COL applicant indicated COL FSAR Table 3.E.4-1 had been removed, and the structural loads and load combinations are specified in revised COL FSAR Sections 3.8.4.3.1, 3.8.4.3.2, and 3.8.5.3, "Loads and Load Combinations." In addition, the COL applicant confirmed that, for the site-specific structures, (1) other than the site-specific loads identified in the response to RAI 144, Question 03.08.04-2, the load definitions and the methods utilized to determine the individual loads are the same as those defined/utilized in the U.S. EPR FSAR; (2) if any load reduces the effects of other loads, a load factor of 0.9 or zero is used for that load; (3) the effects due to buoyancy forces and permanent surcharge loads are considered for stability evaluation. Furthermore, for the design of site-specific Seismic Category I concrete structures, the COL applicant explained that the load combinations are those specified in the U.S. EPR FSAR Tier 2, Section 3.8.4, in addition to those defined for site-specific SPH and PMH loads; therefore, they bound those identified in the U.S. EPR FSAR.

Since both the RAI response and COL FSAR, Revision 7, Section 3.8.4.3.2 indicate that the load combinations for the design of site-specific Seismic Category I concrete structures are those specified in U.S. EPR FSAR Tier 2, Section 3.8.4.3.2, plus the two defined for site-specific SPH and PMH loads, the staff finds that the COL applicant's statement that they bound those identified in the U.S. EPR FSAR is acceptable. In addition, the staff's previous review of the response to RAI 144, Question 03.08.04-2 discussed above concluded that the site-specific loads identified are acceptable. As a result of the RAI review, the staff finds that the COL applicant's response to RAI 144, Question 03.08.04-13 provided sufficient information and satisfactory explanation.

The staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-13 resolved.

COL FSAR, Revision 3, Section 3E.4, provides a description of the analysis and design of the site-specific structures and some limited information about the results in terms of demand member forces for several critical sections (basemats and walls). To ensure that the design of the site-specific structures is adequate, in RAI 144, Question 03.08.04-14, the staff requested that the COL applicant, for the most critical sections of basemats and walls of the site-specific Seismic Category I intake structures, provide the resulting member forces and comparisons to the section strengths, which would show the steel areas provided and the level of margin existing in the design.

In a July 23, 2010, response to RAI 144, Question 03.08.04-14, the COL applicant stated that member forces for design load combinations for the critical concrete sections of the site-specific Seismic Category I intake structures are provided in revised COL FSAR Section 3E.4 tables, and section strength, demand/capacity ratios, and corresponding steel reinforcement are also presented in these tables.

The staff reviewed the referenced tables in COL FSAR Revision 7, and concluded that the tables adequately provide the information requested by RAI 144, Question 03.08.04-14. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 03.08.04-14 resolved.

COL FSAR, Revision 7, Section 3.8.4.4.7, "Forebay and UHS Makeup Water Intake Structure," provides updated information about the design and analysis procedures for the Forebay and the UHS MWIS. To ensure that COL FSAR Section 3.8.4.4.7 conforms to NUREG-0800, Section 3.8.4 Acceptance Criteria 3.8.4.II.4.A and B, in RAI 301, Question 03.08.04-18, the staff requested that the COL applicant provide the following additional information for COL FSAR Section 3.8.4.4.7: (1) Explain why the loads of buoyancy (other than that associated with hurricane events) and pipe reactions are not included; (2) explain the use of the combination rules to calculate the maximum nodal accelerations and member forces in seismic analysis, since these rules are different from those used in the latest U.S. EPR FSAR; and (3) explain where the discussion of the referenced procedure for bearing pressure calculation is provided in the COL FSAR.

In an October 31, 2011, response to RAI 301, Question 03.08.04-18, the COL applicant stated that (1) COL FSAR Section 3.8.4.4.7 will be updated to include buoyancy and pipe reaction loads; (2) the use of the Square Root of the Sum of the Squares (SRSS) method complies with RG 1.92 for combining the accelerations due to three components of earthquake motion; the SRSS method will be used to replace the 100-40-40 rule for combining member forces due to three components of earthquake motion; (3) bearing pressures are determined using support node reaction forces from analyses utilizing the STAAD Pro FE model.

The staff notes that the updated COL FSAR Section 3.8.4.4.7 includes buoyancy and pipe reaction loads, and as such, COL FSAR Section 3.8.4.4.7 is consistent with the load combinations in U.S. EPR FSAR Tier 2, Section 3.8.4.3 and the COL FSAR Section 3.8.4.3. Regarding the procedure for bearing pressure calculation, the evaluation of the response will be included in the assessment of the response to RAI 301, Question 03.08.04-20, since this response provides the same information on the bearing pressure calculation procedure and results for the Forebay and the UHS MWIS. Based on the discussions, the staff finds the

response to Item (1) above acceptable and the response to Item (3) above is considered resolved.

Regarding the methods to determine the design member forces due to seismic loads, the major difference between the U.S. EPR FSAR Revision 3 and the CCNPP Unit 3 methods is that the U.S. EPR design certification application uses algebraic summation to combine the accelerations due to three components of earthquake motion for all Seismic Category I structures. Furthermore, in the U.S. EPR design certification application, confirmatory analyses were performed to verify the conservatism of the U.S. EPR method to determine the design member forces due to seismic loads. Since the CCNPP Unit 3 method is different than the U.S. EPR method, which has been accepted by the staff, in RAI 339, Question 03.08.04-33, the staff requested that the COL applicant provide the technical basis that the CCNPP Unit 3 method, to determine the design member forces due to seismic loads for the design and analysis for the Forebay and the UHS MWIS, is at least as conservative as the U.S. EPR method or more detailed methods which utilize time history analysis or response spectrum analysis. Guidance on the need for justification for the use of equivalent static load methods for seismic analysis is discussed in the SRP Section 3.7.2, Acceptance Criteria 3.7.2.II.1.B.i. In addition, since CCNPP Unit 3 no longer follows the U.S. EPR method to combine accelerations, any COL FSAR reference to the U.S. EPR FSAR for the U.S. EPR method should be updated, and a detailed description of the methodology utilized by CCNPP Unit 3 should be included in an applicable section of the COL FSAR. **RAI 301, Question 03.08.04-18, and its follow-up RAI 339, Question 03.08.04-33 are being tracked as open items**.

In RAI 301, Question 03.08.04-19, the staff identified several editorial changes that may be needed for COL FSAR, Revision 7, Section 3.8.

In a May 13, 2011, response to RAI 301, Question 03.08.04-19, the COL applicant indicated all editorial changes identified by the RAI had been corrected. The staff reviewed the RAI response, and concluded that all the editorial changes proposed for COL FSAR Section 3.8 are acceptable to the staff, and the proposed changes adequately addressed the RAI questions. Therefore, **RAI 301, Question 03.08.04-19 is being tracked as a confirmatory item** until COL FSAR Sections 3.8.4.1.11, 3.8.4.4.5, 3.8.4.4.7, and 3.8.5.1.4, “Forebay and UHS Makeup Water Intake Structure and Basemats,” are revised as stated in the RAI response.

COL FSAR, Revision 7, Section 3.8.4.5 provides structural acceptance criteria (design limits) for structures. Specific structural acceptance criteria are provided for the buried UHS makeup water pipes and CCNPP Unit 3 intake pipes. However, no specific structural acceptance criteria are provided for buried essential service water pipes. As indicated in COL FSAR Section 3.8.4.4.5, Seismic Category I buried pipes include buried essential service water pipes, buried UHS makeup water pipes, and buried CCNPP Unit 3 intake pipes. Furthermore, COL FSAR, Revision 3, Section 3.8.4.5 included the acceptance criteria for essential service water pipes. Therefore, in RAI 310, Question 03.08.04-28, the staff requested that the COL applicant explain why the acceptance criteria for buried essential service water pipes were removed from COL FSAR, Revision 7, Section 3.8.4.5. The staff needs the above information to be able to conclude that there is reasonable assurance that COL FSAR Section 3.8.4.5 follows the guidance of NUREG-0800, Section 3.8.4 II.5.

In a September 23, 2011, response to RAI 310, Question 03.08.04-28, the COL applicant stated that the acceptance criteria for the buried essential service water pipes will be the same as the criteria for other buried Seismic Category I pipes. The COL applicant also indicated that COL FSAR Section 3.8.4.5 will be updated to reflect the RAI response. The staff finds that the

RAI response addresses the RAI question, and the proposed markup is consistent with the RAI response. Therefore, the staff finds this RAI response acceptable. **RAI 310, Question 03.08.04-28 is being tracked as a confirmatory item** until the COL FSAR is revised as stated in the RAI response.

3.8.4.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.8.4.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to other Seismic Category I structures, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the other Seismic Category I structures incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.8.4 of this report to reflect the final disposition of the U.S. EPR design certification application.

As a result of the open and confirmatory items, the staff is unable to finalize its conclusions on other Seismic Category I structures in accordance with the requirements of 10 CFR 50.55a, GDC 1, GDC 2, GDC 4, and GDC 5.

3.8.5 Foundations

3.8.5.1 *Introduction*

The foundations for Seismic Category I structures include the Nuclear Island common foundation basemat, as well as the foundations for the Emergency Power Generating Buildings and the Essential Service Water Buildings. In addition, site-specific foundations at CCNPP Unit 3 include the common basemat foundation for the site-specific Seismic Category I UHS MWIS, the Forebay, and Seismic Category II CWSMWIS. As reflected in COL FSAR Revision 7, the UHS EB has been combined with the UHS MWIS. This section of the COL FSAR covers the description of the foundations; applicable codes, standards, and specifications; loads and load combinations; design and analysis procedures; structural acceptance criteria; materials, quality control, and special construction techniques; and testing and inservice inspection requirements.

3.8.5.2 *Summary of Application*

COL FSAR Section 3.8.5 incorporates by reference U.S. EPR FSAR Section 3.8.5. "Foundations."

In addition, in COL FSAR Section 3.8.5, the COL applicant provided the following COL information items and departure from the U.S. EPR FSAR Tier 2, as noted in Part 7, Section 7.1.2 of the COL application:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.8.5.1 to address COL Information Item 3.8-9 as follows:

> A COL applicant that references the U.S. EPR design certification will describe site-specific foundations for Seismic Category I structures that are not described in this section.

The COL application provides plans and details for the UHS structures as referenced in COL FSAR Section 3.8.4.1.11 and in COL FSAR Figures 9.2-4 through 9.2-6, "UHS Makeup Water Intake Structure – Section View," and Figure 3.8-1.

The COL applicant provided additional information in COL FSAR Section 3.8.5.5 to address COL Information Item 3.8-10 as follows:

> A COL applicant that references the U.S. EPR design certification will evaluate site-specific methods for shear transfer between the foundation basemats and underlying soil for site-specific soil characteristics that are not within the envelope of the soil parameters specified in Section 2.5.4.2.

The COL FSAR states that there is a departure from the friction coefficient of 0.7 specified in the U.S. EPR FSAR, and a site-specific sliding evaluation for SSE loads is performed to confirm the sliding stability of NI common basemat structures, EPGBs and ESWBs. The COL FSAR also describes potential sliding interfaces under the NI common basemat structures, EPGBs, and ESWBs, and states that passive soil pressure is not utilized for the sliding evaluation.

The COL applicant provided additional information in COL FSAR Section 3.8.5.6.1 to address COL Information Item 3.8-11 as follows:

> A COL applicant that references the U.S. EPR design certification will evaluate the use of epoxy coated rebar for foundations subjected to aggressive environments, as defined in ACI 349-01, Chapter 4. In addition, the waterproofing system of Seismic Category I foundations subjected to aggressive environments will be evaluated for use in aggressive environments. Also, the concrete of Seismic Category I foundations subjected to aggressive environments will meet the durability requirements of ACI 349-01, Chapter 4 or ASME, Section III, Division 2, Article CC-2231.7, as applicable.

The COL application references COL FSAR sections for the descriptions of the waterproofing membrane and concrete mix design to be used to protect structure foundations at the CCNPP Unit 3 site from aggressive environments. The COL applicant also states that epoxy coated rebar is not used.

The COL applicant provided additional information in COL FSAR Section 3.8.5.7 to address COL Information Items 3.8-12 and 3.8-13, respectively, as follows:

A COL applicant that references the U.S. EPR design certification will describe the program to examine inaccessible portions of below-grade concrete structures for degradation and monitoring of ground water chemistry.

A COL applicant that references the U.S. EPR design certification will identify if any site-specific settlement monitoring requirements are required for Seismic Category I foundations based on site-specific soil conditions.

The COL application states that although foundation settlement is not likely to affect the SSCs of the U.S. EPR standard design, a site-specific settlement monitoring program will be implemented as a prudent measure. In addition, a site-specific below-grade concrete degradation monitoring program will be implemented, as described in the FSAR.

Supplemental Information

COL FSAR Section 3.8.5.4.6, "Forebay and UHS Makeup Water Intake Structure Basemats," provides additional description of the design and analysis procedures of the basemats used in the UHS MWIS and the Forebay. The staff notes that the UHS EB was combined with the UHS MWIS in COL FSAR Revision 7.

COL FSAR Section 3.8.5.5.4, "Forebay and UHS Makeup Water Intake Structure Basemats," provides supplemental information on the UHS structures relative to foundation settlement, concluding that settlement values are acceptable.

FSAR Tier 2 Departures

A departure is identified from the friction coefficient of 0.7 specified in the U.S. EPR FSAR for the sliding stability evaluation of NI common basemat structures, EPGBs, and ESWBs. A site-specific sliding evaluation for SSE loads is performed to confirm the sliding stability of NI common basemat structures, EPGBs, and ESWBs.

Another departure is identified in COL FSAR Sections 3.8.5.5.1, "Nuclear Island Common Basemat Structure Foundation Basemat," 3.8.5.5.2, and 3.8.5.5.3, which address the increased value of Seismic Category I foundation settlement at the CCNPP Unit 3 site relative to the U.S. EPR standard design. An analysis is described, and the COL applicant concludes that the site-specific settlement values are structurally acceptable. COL application, Part 7, Section 1.1.1 provides the COL applicant's justification and evaluation of this departure; an exemption request is contained in COL application Part 7, Section 1.2.1.

3.8.5.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR. In addition, the relevant requirements of NRC regulations for the foundations, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.8.5, "Foundations." Review interfaces with other NUREG-0800 sections also can be found in Section 3.8.5 of NUREG-0800.

The applicable regulatory requirements for foundations are as follows:

1. 10 CFR 50.55a and GDC 1, as they relate to foundations of safety-related structures being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

2. GDC 2, as it relates to the design of foundations of safety-related structures being able to withstand the most severe natural phenomena such as winds, tornadoes, floods, and earthquakes and the appropriate combination of all loads.

3. GDC 4, as it relates to foundations of safety-related structures being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

4. GDC 5, as it relates to the design of foundations of safety-related structures not being shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

5. 10 CFR Part 50, Appendix B as it relates to the quality assurance criteria for nuclear power plants.

Acceptance criteria adequate to meet the above requirements include:

1. RG 1.206, "Combined License Applications for Nuclear Power Plants," as it relates to foundations.

2. RG 1.70, "Standard Content and Format of Safety Analysis Reports for Nuclear Power Plants," as it relates to foundations.

3. RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," Revision 1, March 1978, as it relates to foundations.

4. RG 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants," as it relates to foundations.

5. RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," as it relates to foundations.

6. NUREG-0800, Section 3.8.5, Subsection II provides additional details for determining acceptability of the COL application.

3.8.5.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.8.5 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.8.5 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to foundations has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.8-10 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.8.5.5.

COL FSAR Section 3.8.5.5, "Structural Acceptance Criteria," provides an explanation of how COL Information Item 3.8-10, related to shear transfer between the foundation basemats and underlying soil, is addressed. To ensure that the COL information item is adequately addressed, in RAI 145, Question 03.08.05-1, the staff requested that the COL applicant provide the following additional information: (1) Explain why a list of sliding resistant items is not provided for the NI, and why the list for EPGBs and ESWBs does not include the frictions between the mud mat and waterproofing and within the soil; (2) clarify whether the concrete surface of the mud mat will need to be roughened; (3) explain where the vendor testing required by the U.S. EPR FSAR is in the COL FSAR for achieving the required friction coefficient for the waterproofing membrane beneath the basemat; (4) explain how the coefficient of friction for the critical soil layer will be determined and what type of testing will be performed to determine the coefficient of frictions for soil-soil and soil-concrete interfaces.

The staff notes that the original RAI 144, Question 03.08.05-1 was based on staff's review of COL FSAR Revision 3 and focused on issues related to achieving a coefficient of friction of 0.7 for the soil-soil and soil-concrete interfaces, as required by U.S. EPR FSAR. In COL FSAR, Revision 7, Section 3.8.5.5, a departure is identified from the friction coefficient of 0.7 specified in the U.S. EPR FSAR, for the NI common basemat structures, the EPGBs, and the ESWBs. Related COL FSAR sections have been updated accordingly. As a result, some of the original COL RAI questions regarding the coefficient of friction of 0.7 requirement do not apply any longer and are not discussed in this section of the report. In addition, the RAI response is based on the updated COL FSAR Revision 7.

In a July 23, 2010, response to RAI 145, Question 03.08.05-1, the COL applicant indicated (1) the list of the potential sliding interfaces had been updated in the COL FSAR; shear resistance within the soil is addressed in terms of internal friction angle and friction coefficient; (2) the surface of the mud mat would not be intentionally roughened; instead, the basemat will be cast directly on the hardened mud mat; according to ACI 349-01, this provides a coefficient of friction of 0.6, which is adequate as shown by site-specific seismic stability evaluation; (3) vendor testing would be performed prior to construction to confirm the coefficient of friction for the waterproofing membrane, and the corresponding ITAAC is provided in a new ITAAC Table; and (4) internal friction angles of various in-situ soil layers and the structural fill are based on laboratory tests described in updated COL FSAR Section 2.5.4; the coefficient of friction between mud mat and sand is based on the internal friction angle of sand and coefficients of friction at the Sand/Backfill and Backfill/Soil interfaces were determined based on the smaller internal friction angle of the two interfacing soil layers.

The staff reviewed the COL applicant's July 23, 2010 response to RAI 145, Question 03.08.05-1, and the latest COL FSAR revision. Regarding Item 1, the staff verified that a list of the potential sliding interfaces had been provided in COL FSAR, Revision 7, Section 3.8.5.5 for the NI common basemat structures and the staff finds the list acceptable. The staff also noted that the COL FSAR states, "No waterproofing is used for the EPGBs and ESWBs...." This statement explains why the list for the EPGBs and the ESWBs in the FSAR still does not include the interface between sand and waterproofing membrane. The staff notes that the requirement of waterproofing membrane for all Seismic Category I structures, including EPGBs and the ESWBs, was addressed in RAI 301, Question 03.08.04-22. As discussed

earlier in this report, in the response to RAI 301, Question 03.08.04-22, the COL applicant stated that waterproofing and dampproofing systems will be applied to Seismic Category I foundations below grade at CCNPP Unit 3. Consequently, in the follow-up RAI to RAI 301, Question 03.08.04-22, (RAI 333, Question 03.08.04-30), the staff requested that the COL applicant update all related COL FSAR sections accordingly (e.g., COL FSAR Section 3.8.5.5 which provides the potential sliding interfaces under the EPGBs and the ESWBs). Since this issue of the potential sliding interface list for the EPGBs and the ESWBs has been addressed in RAI 333, Question 03.08.04-30, the staff finds this part of the RAI response to RAI 145, Question 03.08.05-1 acceptable.

Regarding Item 2, since the COL applicant stated that the coefficient of friction specified in ACI 349-01 for a mud mat with a not-roughened surface is adequate, as shown by the site-specific seismic stability evaluation, the staff considers the RAI response acceptable. The staff will also review the stability evaluation under RAI 301, Question 03.08.04-21. During the review of the stability evaluation, the adequacy of the coefficient of friction used will be confirmed.

Regarding Item 3, the staff finds the RAI response adequate and acceptable, because the ITAAC for the coefficient of static friction at the horizontal interface of the waterproofing membrane and sand is provided in a new ITAAC table.

Regarding Item 4, the staff could not correlate the values in COL FSAR Table 3.8-1, “Static Frictional Parameters,” showing the coefficients of friction used for design and analysis, with the corresponding values referenced by COL FSAR Section 2.5.4, “Stability of Subsurface Materials and Foundations,” (e.g., the values in COL FSAR Table 2.5-58, “Earth Pressure Coefficients”). Since COL FSAR Section 2.5.4 discusses data from laboratory tests, it is important to ensure the consistency between the values in COL FSAR Table 3.8-1 and the corresponding values in COL FSAR Section 2.5.4, so as to ensure that appropriate coefficients of friction are used for design and analysis. Therefore, in follow-up RAI 308, Question 03.08.05-7, the staff requested that the COL applicant explain how the coefficients of friction given in COL FSAR Table 3.8-1 for the interfaces of soil-soil and soil-concrete, correlate with the corresponding coefficients shown in COL FSAR Table 2.5-58.

In an August 25, 2011, response to RAI 308, Question 03.08.05-7, the COL applicant stated that there is no correlation between the coefficient of friction values given in COL FSAR, Revision 7, Tables 3.8-1 and 2.5-58, in which, the values are based on a design manual. The COL applicant also indicated that COL FSAR Table 2.5-58 will be revised by removing the values of coefficients of friction. In addition, COL FSAR Section 2.5.4.2.5.7, “Coefficient of Friction,” will be revised to include the reference to COL FSAR Table 3.8-1 instead of COL FSAR Table 2.5-58. The RAI response further explained that the values provided in COL FSAR Table 3.8-1 are based on strengths developed from site-specific laboratory testing and empirical relationships developed from site-specific correlations, and a geotechnical calculation was prepared to formally document the friction coefficient values provided in COL FSAR Table 3.8-1. In addition, the RAI response provided references to the laboratory test reports that provide the technical basis for the coefficients of friction and adhesion values related to the soil properties used for sliding analysis.

The staff agrees with the removal of the coefficient of friction values from COL FSAR Table 2.5-58, because they are not site-specific values and are not used in foundation stability analysis for CCNPP Unit 3 structures. Furthermore, the referenced laboratory test reports and the geotechnical calculation for the friction coefficient values are available for the staff's review if

necessary, and any possible finding from the review can be resolved in conjunction with the resolution of RAI 301, Question 03.08.04-21. As discussed later in this section, in RAI 301, Question 03.08.04-21, the staff requested that the COL applicant provide a detailed description of the sliding analysis for each Seismic Category I structure; the description should include the values of itemized lateral forces applied and values of itemized shear resistance calculated for all applicable load combinations. The response to RAI 301, Question 03.08.04-21 is scheduled to be submitted by the COL applicant on April 12, 2013.

As discussed above, the inconsistencies with the values of coefficients of friction between two COL FSAR tables was resolved by the removal of the coefficient of friction values from COL FSAR Table 2.5-58. Therefore, the staff notes that all the original questions raised in RAI 145, Question 03.08.05-1 have been adequately addressed. Therefore, **RAI 145, Question 03.08.05-1 and the related follow-up RAI 308, Question 03.08.05-7 are being tracked as confirmatory items** until COL FSAR Table 2.5-58, Sections 2.5.4.2.5.7 and 2.5.4.13 are revised accordingly, as stated in the RAI response.

COL FSAR Section 3.8.5.5.1 states that the site-specific differential settlements of the NI foundation basemat are expected to be 2.54 cm (1 in.) in 15.24 m (50 ft). This exceeds the 1.27 cm (0.5 in.) in 15.24 m (50 ft) considered in the standard design for the U.S. EPR. Some limited information was provided on the evaluation for the higher site-specific differential settlements; however, a more detailed description is needed. Therefore, in RAI 145, Question 03.08-05-2, the staff requested that the COL applicant provide the following additional information on the site-specific settlement analysis for the NI common basemat structure: (1) Details on the structural model(s) used for the NI settlement analysis; (2) how the site-specific differential settlement of 2.54 cm (1 in.) in 15.24 m (50 ft) was considered in the model; (3) consideration of increased flexure in the foundation due to differential settlements; and (4) consideration of the effects of horizontal variations in soil properties. This request was based on the review of COL FSAR Revision 3.

In a February 22, 2011, response to RAI 145, Question 03.08.05-2, the COL applicant indicated that: (1) Site-specific differential settlement values from the CCNPP Unit 3 FSAR are reconciled to the U.S. EPR differential settlement model, and the model detail is given in the U.S. EPR FSAR; (2) the tilt settlement is modeled as rigid body rotation in one direction; (3) the U.S. EPR standard design limit for differential settlement of 1.27 cm (0.5 in.) in 15.24 m (50 ft) accounts for increased flexure and shear in the foundation due to elastic and consolidation settlements, and is verified for acceptance on a site-specific basis; for the COL FSAR, flexure was not increased, since the site-specific flexure producing differential settlement was found to be enveloped by the softest U.S. EPR soil case; and (4) the U.S. EPR is designed for application at sites where the foundation conditions do not have extreme variation within the foundation footprints.

The staff noted that the issue of differential settlements of Seismic Category I structures was also discussed in the U.S. EPR design certification application. According to design certification applicant's April 18, 2011, response to U.S. EPR RAI 354, Question 03.08.05-22, (1) it will be clarified that the control criterion of 1.27 cm (0.5 in.) in 15.24 m (50 ft) is for tilt settlement only, and is to ensure that equipment can be installed and operated as designed; (2) new COL information items will be proposed to require that the COL applicant provide an assessment of predicted settlement values across the basemats of Seismic Category I structures both during and post construction, considering tilt and flexural settlement effects and accounting for the construction sequence, building stiffness, etc., and compare the predicted angular distortion to the angular distortion considered in the U.S. EPR design throughout the basemat in both

horizontal directions, using methods described in U.S. Army Engineering Manual 1110-1-1904, "Settlement Analysis"; (3) soil springs are developed using 3-dimensional (3D) foundation software to capture tilt and flexural settlement effects, and are applied to 3D finite element structural models to obtain the forces and moments throughout the structure due to settlement.

The design certification applicant's RAI response provided information on how tilt and flexural settlement effects on structural design are considered. The information addresses most of the staff's concerns presented in the original COL applicant's RAI 145, Question 03.08.05-2 and may supersede the corresponding information provided in the February 22, 2011, response to RAI 145, Question 03.08.05-2.

Regarding the original RAI 145, Question 03.08.05-2, regarding the considerations for the effects of horizontal variations in soil properties, the staff noted that COL FSAR, Revision 7, Section 2.5.4.10.3, "Uniformity and Variability of Foundation Support Media," states, "the settlement analysis accounts for the variability in the soil media with the implementation of a FEM model...." Furthermore, COL FSAR Section 2.5.4.10.2, "Settlement," states, "Differential settlement or tilt depends on (1) the asymmetric nature of loads, (2) the irregular thickness of the subsurface strata, and (3) the asymmetry in surface topography. The first two are naturally captured by the FEM simulation. The third influence of asymmetric topography is captured by means of sensitivity analysis." The information explains how the settlement analysis accounts for the effects of horizontal variations in soil properties, and therefore, it addresses the staff's concern.

Due to the new COL information item updates discussed in the design certification applicant's April 18, 2011, response to U.S. EPR RAI 345, Question 03.08.05-22, the staff needs additional information from the COL applicant. In follow-up RAI 308, Question 03.08.05-8, the staff requested that the COL applicant, after the official publication of the new COL information items proposed by the design certification applicant's RAI response, (1) explain how the new COL information item regarding settlements of the NI common basemat structure will be addressed; (2) confirm that the same U.S. EPR models, methodology, and procedures will be used for the site-specific analysis; and (3) explain what site-specific conditions will be considered. The staff needs the information to conclude that there is reasonable assurance that the foundation design of the Seismic Category I structure complies with NUREG-0800, Section 3.8.5 Acceptance Criteria 3.8.5.II.4, and has been adequately addressed in the COL FSAR. **RAI 145, Question 03.08.05-2 and the related follow-up RAI 308, Question 03.08.05-8 are being tracked as open items**.

COL FSAR Table 3.8-1 provides a summary table for evaluation of the UHS MWIS basemat for soil bearing pressure and stability evaluation (sliding and overturning). To ensure that the evaluation and evaluation results conform to the guidance presented in NUREG-0800, Section 3.8.5, in RAI 145, Question 03.08.05-3, the staff requested that the COL applicant provide additional information on load and load combinations, and evaluation procedure/results for evaluation of site-specific Seismic Category I structures for soil bearing pressure and stability evaluation. This request was based on the review of COL FSAR Revision 3.

The staff noted that, since the issuance of the RAI 145, Question 03.08.05-3, the UHS MWIS had been re-analyzed and redesigned, and the design and analysis procedure, as well as results, have been updated and incorporated into COL FSAR Revision 7. The analysis results that used to be in COL FSAR Table 3.8-1 are updated and provided in COL FSAR, Revision 7, Table 3.8-2 for stability evaluation and COL FSAR Table 3.8-3 for bearing capacity evaluation.

In a July 23, 2010, response to RAI 145, Question 03.08.05-3, the COL applicant indicated that (1) the load combinations for the stability evaluation of the Common Basemat Intake Structure (CBIS), including the UHS MWIS, conform to those presented in NUREG-0800, Section 3.8.5, Acceptance Criteria II.3, and those defined in CCNPP Unit 3 and U.S. EPR FSAR Tier 2, Section 3.8.5.3; and (2) procedures to evaluate sliding, overturning, and floatation of the CBIS, as well as the corresponding results, are presented in the revised COL FSAR; specifically, the methods to evaluate the seismic sliding and overturning demands, are discussed in the revised COL FSAR Section 3.7.2.14.2, "EPGB and ESWB."

To determine the load combination consistency as stated in the RAI response, the staff compared the load combinations shown in COL FSAR, Revision 7, Table 3.8-2, "Stability Evaluation Results for the CBIS," with those in NUREG-0800, Section 3.8.5, Acceptance Criteria II.3, as well as those defined in COL FSAR and U.S. EPR FSAR Tier 2, Section 3.8.5.3. The staff noted that the additional loads F (hydrostatic loads) and F_b (or F', buoyancy) presented in U.S. EPR FSAR Tier 2, Revision 2, Section 3.8.5.3, are not shown in most of the applicable load combinations in COL FSAR, Revision 7, Table 3.8-2. These findings are explained by the facts that (1) hydrostatic loads are included in Dead Load according to NUREG-0800 definition of Dead Load for concrete structures; (2) COL FSAR, Revision 7, Section 3.8.5.4.4, indicates that buoyancy is considered in the calculation of sliding and overturning resistances. Based on the comparisons and with the above facts taken into account, the staff concluded that the load combinations shown in COL FSAR Table 3.8-2 comply with those in NUREG-0800, Section 3.8.5 and those defined in COL FSAR and U.S. EPR FSAR Tier 2, Section 3.8.5.3 and are therefore acceptable.

The staff also reviewed the referenced COL FSAR sections related to the evaluation procedure/results for the stability evaluation, and noted that the COL FSAR sections provide descriptions on the stability evaluation of the CBIS, information on the development of demand SSE loading for horizontal shear and overturning moment, information on the determination of the resisting forces for shear and overturning moment, and methods to evaluate the seismic sliding and overturning demands. The staff concluded that the information provided in the referenced COL FSAR Section 3.8 addresses the related RAI questions and, thus are considered acceptable. In addition, the staff noted that, RAI 301, Question 03.08.04-20 addresses bearing capacity evaluation issues, and in RAI 301 Question 03.08.04-21, the staff requested that the COL applicant provides calculation details of sliding analysis for all Seismic Category I structures.

The staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant adequately addressed the issues raised in this RAI and, therefore, considers RAI 145, Question 03.08.05-3 resolved.

COL FSAR, Revision 3, Section 3.8.5.5.1 for the NI; COL FSAR Section 3.8.5.5.2 for the EPGBs; and COL FSAR Section 3.8.5.5.3 for the ESWBs, acknowledge that there are some differences in the soil bearing pressures, stresses in the basemat, and stability evaluations due to site-specific settlements and groundwater conditions. The extent of these differences is sometimes identified as negligible, within allowable values, or less than the corresponding section capacity. To ensure that the differences are adequately addressed, quantitative comparisons or results are needed. Therefore, in RAI 145, Question 03.08.05-4, the staff requested that the COL applicant quantify these differences. This request was based on the review of COL FSAR Revision 3.

In July 23, 2010, and February 22, 2011, responses to RAI 145, Question 03.08.05-4, the COL applicant indicated that, (1) for the NI, the effect of saturated soils from groundwater is taken into account by considering moist/saturated soil unit weight, drainage conditions, the dissipation of the excess pore pressures generated under undrained conditions, and a parametric study on the SSI response; for the EPGBs and the ESWBs, the groundwater level will be below the foundation basemats of both, therefore, the potential effects of saturated soils are not applicable to these structures; (2) differential settlement issue for NI is addressed in RAI 145, Question 03.08.05-2; according to settlement analyses, the increases in the basemat flexure response are less than three percent and five percent, for the EPGBs and the ESWBs, respectively; and (3) the methodologies used for site-specific stability evaluation for SSE loading are described in updated COL FSAR Section 3.7.2.14, and the results are given in COL FSAR, Revision 7, Table 3.8-4, "Factors of Safety for NI Common Basemat Structure, EPGB, and ESWB under SSE Loading."

The staff notes that updates had been made to the analyses of site-specific differential settlement, stability evaluations, as well as ground water level, since the issuance of RAI 145, Question 03.08.05-4. Some updates have been incorporated into COL FSAR Revision 7, according to which, based on the most recent modeling of post-construction groundwater, the water table in the power block area will be approximately 9.14 m (30 ft) below the finished grade, and it is well below the specified U.S. EPR FSAR groundwater level of 1.0 m (3.3 ft) below finished grade. Since the water table in the power block area is now well below the specified U.S. EPR FSAR groundwater level, and also well below the groundwater level assumed in COL FSAR Revision 3, the potential effect of saturated soils from groundwater is no longer significant. Considering the above facts, the staff concluded that the RAI response regarding the consideration of the potential effect of saturated soils from groundwater adequately addressed the staff's concerns and is acceptable.

Regarding effects of groundwater and differential settlement on site-specific stability evaluations of the NI common basemat structure, the EPGBs, and the ESWBs, these issues are addressed in RAI 301, Question 03.08.04-21, in which, the staff requested that the COL applicant provide a detailed description of sliding analysis for these structures.

Regarding the effects of differential settlement, the issue for NI common basemat structure is addressed in RAI 145, Question 03.08.05-2 and its follow-up RAI 308, Question 03.08.05-8. As discussed in the evaluation for RAI 145, Question 03.08.05-2 in this report, new COL information items are proposed by the design certification applicant's response to U.S. EPR RAI 354, Question 03.08.05-22. The design certification applicant's response requires that the COL applicant provide an assessment of predicted settlement values across the basemats of Seismic Category I structures both during and post construction, and compare the predicted angular distortion to the angular distortion considered in the U.S. EPR design throughout the basemat in both horizontal directions, using methods described in U.S. Army Engineering Manual 1110-1-1904.

Therefore, due to the new COL information items discussed above, in follow-up RAI 308, Question 03.08.05-9, the staff requested that after the official publication of the new COL information items, the COL applicant, (1) explain how the new COL information item regarding settlements of the EPGBs and the ESWBs will be addressed; (2) whether the same U.S. EPR models, methodology and procedures will be used; (3) what site-specific conditions will be considered; and (4) in addition, explain whether the methodology and procedures used for the settlement evaluation of the CBIS foundation will be comparable to those used for the EPGB and the ESWB foundations. The staff needs the information in order to be able to conclude that

there is reasonable assurance that the foundation design of the Seismic Category I structures complies with NUREG-0800, Section 3.8.5, Acceptance Criteria 3.8.5.II.4, and has been adequately addressed in the COL FSAR. **RAI 145, Question 03.08.05-4 and the related follow-up RAI 308, Question 03.08.05-9 are being tracked as open items**.

In COL FSAR, Revision 3, Section 3.8, there are several statements indicating the reliance of structural design/analysis on future geotechnical site investigations. Based on the review of COL FSAR, Revision 3, in RAI 144, Question 03.08.05-5, the staff requested that the COL applicant explain why such assumptions are necessary rather than utilizing bounding/conservative assumptions.

In a July 23, 2010, response to RAI 145, Question 03.08.05-5, the COL applicant stated that final geotechnical site investigations had been performed, site-specific parameters had been used in analysis, and confirmatory assumption statements which relied on future geotechnical site investigations had been deleted from revised COL FSAR Section 3.8 and COL FSAR Appendix 3E. This information addresses the questions raised by the RAI and thus are considered technically acceptable.

The staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Since the COL applicant has deleted from the FSAR the statements indicating the reliance of structural design/analysis on future geotechnical site investigations, the staff finds that the COL applicant has adequately addressed this issue. Therefore, the staff considers RAI 145, Question 03.08.05-5 resolved.

COL FSAR, Revision 3, Section 3E.4.1 indicated that the seismic analysis model for the UHS MWIS did not consider basemat extensions. Thus, the staff concluded that the analysis and design of the site-specific structures presented in the FSAR did not correspond to the actual configuration that will be constructed. Therefore, in RAI 145, Question 03.08.05-6, the staff requested that the COL applicant provide the sufficient technical basis for this, or re-model and re-design the structure to consider basemat extensions. This request was based on the review of COL FSAR Revision 3.

In a July 23, 2010, response to RAI 145, Question 03.08.05-6, the COL applicant indicated that the configuration of the UHS MWIS had been changed. The COL applicant also indicated that the new configuration did not include the basemat extensions, and the seismic analysis of the new configuration was presented in the updated FSAR. The staff finds this information addresses the questions raised by the RAI and thus are considered technically acceptable.

The staff confirmed that COL FSAR Revision 7, dated December 20, 2010, contains the changes committed to in the RAI response. Accordingly, the staff finds that the COL applicant has adequately addressed this issue and, therefore, the staff considers RAI 145, Question 03.08.05-6 resolved.

COL FSAR, Revision 7, Section 3.8.5.3 provides a list of load combinations for bearing pressure evaluation. To ensure that the foundation design of the Seismic Category I structures complies with NURE-0800, Section 3.8.5, Acceptance Criteria 3.8.5.II.2 and 3, in RAI 301, Question 03.08.04-20, the staff requested that the COL applicant: (1) Explain why soil load/lateral earth pressure (H) is not included in the load combinations given in COL FSAR, Revision 7, Section 3.8.5.3 for bearing pressure evaluation; and (2) explain the large differences between the corresponding values given in COL FSAR, Revision 6, Table 3.8-1 and COL FSAR, Revision 7, Table 3.8-3, “Bearing Capacity Evaluation Results for the CBIS,” for maximum bearing pressure and bearing capacities under UHS MWIS.

In a November 4, 2011, response to RAI 301, Question 03.08.04-20, the COL applicant indicated that (1) the load combinations listed in COL FSAR Section 3.8.5.3 for bearing pressure evaluation will be updated to include soil load/lateral earth pressure (H) and buoyancy load (F_b); (2) bearing pressures are determined using support node reaction forces from analyses utilizing the STAAD Pro FE model; the maximum bearing pressure reported for the CBIS is the maximum of the average pressures under each of the three intake structures: the UHS MWIS, the Forebay and the Circulating Water Makeup Intake Structure; the differences in building configurations and methods used in calculating bearing pressures lead to differences in the respective versions of the COL FSAR: the approach in COL FSAR Revision 7 considered the basemat stiffness, as well as the stress redistribution. The staff notes that the RAI response to item (2) above regarding bearing pressure calculation procedure for the CBIS is the same as the response to RAI 301, Question 03.08.04-18.

Based on a review of the proposed COL FSAR markups, the staff noted that the updated COL FSAR includes soil load/lateral earth pressure (H) and buoyancy load (F_b) in the load combinations in COL FSAR Section 3.8.5.3 for bearing pressure evaluation. The staff finds that the load combinations proposed are consistent with the load combinations provided in U.S. EPR FSAR Tier 2, Section 3.8.4.3 and COL FSAR Section 3.8.4.3. Therefore, the staff considers the response to item (1) above acceptable.

Regarding the bearing pressure calculation, the COL applicant's RAI response indicated that the maximum bearing pressures (static and dynamic) of the CBIS are the maximum of the average pressures under each of the three intake structures, not the localized pressures such as the pressures at the toe of the CBIS basemat. Therefore, in RAI 339, Question 03.08.04-34, the staff requested that the COL applicant provide the values of the maximum pressures considering all locations of the CBIS basemat design (e.g., maximum pressures that may occur at the toe/edge/corner of the basemat) under worst-case static and dynamic loads, and explain how they are obtained. In addition, the staff requested that the COL applicant explain whether the CCNPP Unit 3 bearing capacities provided in COL FSAR Table 3.8-3, as well as those in COL FSAR, Revision 7, Table 2.5-65, are bearing capacities for localized pressure. If they are bearing capacities for localized pressure, explain why the calculated average pressures of the CBIS are compared with the bearing capacities for localized pressure. If they are bearing capacities for average pressure, explain why in COL FSAR, Revision 7, Table 2.0-1, the CCNPP Unit 3 bearing capacities are compared with the U.S. EPR bearing capacities for localized pressure. **RAI 301, Question 03.08.04-20, and its follow-up RAI 339, Question 03.08.04-34 are being tracked as open items.**

COL FSAR, Revision 7, Section 3.8.5.5 provides updated information about the structural acceptance criteria for foundations. The staff determined that this section is unclear as to how the sliding analysis is performed for each Seismic Category I structure. To ensure that the foundation design of the Seismic Category I structures complies with NUREG-0800, Section 3.8.5, Acceptance Criteria 3.8.5 II.5 and has been adequately addressed in the COL FSAR, in RAI 301, Question 03.08.04-21, the staff requested that the COL applicant (1) provide a detailed description of the sliding analysis for each Seismic Category I structure; the description should include the values of itemized lateral forces applied and values of itemized shear resistance calculated for all applicable load combinations; and (2) explain how the contribution of soil adhesion to overall soil shear resistance is considered and combined with the contribution to the soil shear resistance derived from soil internal friction. The staff needs the information to determine whether the foundation design of the Seismic Category I structures conforms to NUREG-0800, Section 3.8.5, Acceptance Criteria 3.8.5 II.5 and has been

adequately addressed in the COL FSAR. **RAI 301, Question 03.08.04-21 is being tracked as an open item**.

3.8.5.5 *Post Combined License Activities*

There are no post COL activities related to this section.

3.8.5.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to foundations, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to foundations incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.8.5 of this report to reflect the final disposition of the U.S. EPR design certification application.

As a result of the open and confirmatory items, the staff is unable to finalize its conclusions on foundations in accordance with the requirements of 10 CFR 50.55a, GDC 1, GDC 2, GDC 4, and GDC 5.

3.9 Mechanical Systems and Components

3.9.1 Special Topics for Mechanical Components

3.9.1.1 *Introduction*

COL FSAR Section 3.9.1, "Special Topics for Mechanical Components," describes design transients and methods of analysis for all Seismic Category I components, component supports, core support structures, and reactor internals designated as ASME Boiler and Pressure Vessel Code (B&PV Code), Section III, Class 1, 2, 3, and CS Also included are the assumptions and procedures used for the inclusion of transients in the design and fatigue evaluation of ASME Code Class 1 and core support components, and the computer programs used in the design and analysis of Seismic Category I components and their supports, as well as experimental and inelastic analytical techniques.

Special topics reviewed by the staff for component design include the following:

- design transients
- computer program used in analyses
- experimental stress analysis
- considerations for the evaluation of the faulted conditions

- module interaction, coupling, and other issues

3.9.1.2 *Summary of Application*

COL FSAR Section 3.9.1 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.9.1.

In addition, in COL FSAR Section 3.9.1, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.9.1.2, "Computer Programs Used in Analyses," to address COL Information Items 3.9-9 and 3.9-10, respectively, as follows:

> A COL applicant that references the U.S. EPR design certification will either use a piping analysis program based on the computer codes described in Section 3.9.1 and Appendix 3C or will implement a U.S. EPR benchmark program using methods specifically selected for the U.S. EPR.
>
> Pipe stress and support analysis will be performed by a COL applicant that references the U.S. EPR design certification.

The COL applicant states that it will perform the required pipe stress and support analysis based on the computer codes described in U.S. EPR FSAR Tier 2, Section 3.9.1 and U.S. EPR FSAR Tier 2, Appendix 3C.

3.9.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed in the staff safety-evaluation related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the pipe stress and support analysis, and the associated acceptance criteria, are given in NUREG-0800, Section 3.9.1.

1. GDC 1, "Quality Standards and Records," and 10 CFR 50.55a, "Codes and Standards," as they relate to the design, fabrication, erection, construction, testing, and inspection of components important to safety in accordance with the requirements of applicable codes and standards commensurate with the importance of the safety function to be performed.

2. GDC 2, "Design Bases for Protection Against Natural Phenomena," as it relates to the design of mechanical components of systems being designed to withstand the effects of earthquakes without loss of capability to perform their safety function.

3. GDC 14, "Reactor Coolant Pressure Boundary," as it relates to the design of the reactor coolant pressure boundary so as to have an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture.

4. GDC 15, "Reactor Coolant System Design," as it relates to the design of mechanical components of the RCS with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary (RCPB) are not exceeded during any condition of normal operation, including anticipated operational occurrences (AOOs).

5. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” as it relates to design quality control.

6. 10 CFR Part 100, Appendix A, “Seismic and Geologic Siting Criteria for Nuclear Power Plants,” as it relates to the suitability of the plant design bases for mechanical components established in consideration of site seismic characteristics.

The related acceptance criteria are as follows:

- ASME B&PV Code, Section III, as it relates to the dynamic testing and analysis of systems, components, and equipment within the scope of this section.

3.9.1.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.9.1 and checked the referenced design certification FSAR to ensure that the combination of the information in the design certification application and the information in the COL application represents the complete scope of information relating to this review topic. The staff’s review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.9.1 is being reviewed by the staff under Docket No. 52-020. The staff’s technical evaluation of the information incorporated by reference related to special topics for mechanical components will be documented in the staff safety-evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the information contained in the COL FSAR:

COL Information Items

To meet the requirements of the regulations identified above, the COL FSAR must include the following information:

1. A complete list of transients shall be used in the design and fatigue analysis of ASME B&PV Code, Section III, ASME Code Class 1 and Class Conventional Seismic components within the RCPB.

2. A list of computer programs that will be used to determine the structural and functional integrity of Seismic Category I mechanical components, including a description of the methods used for computer program qualification.

3. If experimental stress analysis methods are used in lieu of analytical methods for any Seismic Category I mechanical components, sufficient information to allow the staff to determine its acceptability when compared to the requirements of the ASME B&PV Code, Section III, Appendix II.

4. If inelastic analysis methods, including ASME Code, Section III, Service Level D limits, are used for any Seismic Category I mechanical components, conformance of the analytical methodology used to calculate stresses and deformations to the methods specified in the ASME B&PV Code, Section III, Appendix F.

U.S. EPR FSAR Tier 2, Section 3.9.1 includes COL Information Item 3.9-10 stating that the pipe stress and support analyses will be performed by a COL applicant that references the U.S. EPR design certification. In addition, this section also includes COL Information Item 3.9-9 which

states that it will either use a piping analysis program based on the computer codes described in COL FSAR Section 3.9.1 and COL FSAR Appendix 3C or will implement an NRC-approved benchmark program using methods specifically selected for the U.S. EPR. The COL applicant provided a list and description of the supplemental computer codes it will use in COL FSAR Section 3.9.1.2.

In RAI 138, Question 03.09.01-1, the staff requested that the COL applicant provide a list of computer codes, including the versions and dates, to be used for design and construction of CCNPP Unit 3 piping and supports, including identification of computer codes that will be used for CCNPP Unit 3, but not given in the U.S. EPR FSAR.

In a September 14, 2009, response to RAI 138, Question 03.09.01-1, the COL applicant provided two tables listing computer programs to be used for the design and construction of CCNPP Unit 3 piping and supports. The staff reviewed COL FSAR Revision 7 and noted that COL FSAR Section 3.9.1.2 has been revised to incorporate the CCNPP COL-specific computer codes as indicated in the COL applicant's response including those not listed in U.S. EPR FSAR, but that will be used for the design and construction of CCNPP Unit 3 piping and supports.

COL FSAR Revision 7 addressed the COL information Items as follows:

> Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall perform the required pipe stress and support analysis and shall utilize a piping analysis program based on the computer codes described in U.S. EPR FSAR Section 3.9.1 and U.S. EPR FSAR Appendix 3C. In addition, CCNPP Unit 3 will utilize the piping analysis programs supplemented as listed in CCNPP 3 FSAR Revision 7, Section 3.9.1.2.

In a follow-up question to RAI 138, Question 03-09-01-1, (RAI 352, Question 03.09.01-2), the staff requested that the COL applicant make available the verification and validation documentation for staff audit regarding the additional computer codes that are neither included in the U.S. EPR FSAR, nor previously reviewed and approved by the staff to ensure they meet the quality assurance program required in accordance with 10 CFR Part 50, Appendix B and ASME NQA-1 Code. **RAI 352, Question 03.09.01-2 is being tracked as an open item.**

3.9.1.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.9.1-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER sections listed below:

Table 3.9.1-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.9-9	A COL applicant that references the U.S. EPR design certification will either use a piping analysis program based on the computer codes described in	3.9.1	3.9.1.4

Item No.	Description	COL FSAR Section	COL SER Section
	Section 3.9.1 and Appendix 3C or will implement a U.S. EPR benchmark program using models specifically selected for the U.S. EPR		
3.9-10	Pipe stress and support analysis will be performed by a COL applicant that references the U.S. EPR design certification	3.9.1	3.9.1.4

3.9.1.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to special topics for mechanical components, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the special topics for mechanical components incorporated by reference in the COL FSAR will be documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update this report to reflect the final disposition of the design certification application.

As a result of the the open item discussed above, the staff is unable to finalize its conclusion that the information pertaining to COL FSAR Section 3.9.1 is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 14, and GDC 15; 10 CFR Part 50, Appendix B; and 10 CFR Part 100, Appendix A,

3.9.2 Dynamic Testing and Analysis of Systems, Components, and Equipment

3.9.2.1 *Introduction*

The staff reviewed COL FSAR, Revision 7, Section 3.9.2, in accordance with Standard SRP Revision 3, Section 3.9.2. The purpose was to determine whether the criteria, testing procedures, and dynamic analyses employed by the COL applicant will ensure the structural and functional integrity of piping systems, mechanical equipment, reactor internals, and their supports (including supports for conduit and cable trays, and ventilation ducts) under vibratory loadings, including those due to fluid flow (especially loading caused by adverse flow conditions, such as instabilities over standoff pipes and branch lines in the steam system) and postulated seismic events. Compliance with the specific acceptance criteria described in SRP Section 3.9.2, Subsection II, will provide reasonable assurance of the appropriate dynamic testing and analysis of systems, components, and equipment.

3.9.2.2 *Summary of Application*

COL FSAR Section 3.9.2 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.9.2, "Dynamic Testing and Analysis of Systems, Components, and Equipment," with supplemental information in COL FSAR Section 3.9.2.4 ,"Preoperational Flow-Induced Vibration Testing of Reactor Internals." In COL FSAR Section 3.9.2.4, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.9.2.4 to address COL Information Item 3.9-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will submit the results from the vibration assessment program for the U.S. EPR RPV internals and piping systems specified in U.S. EPR FSAR Tier 2, Section 3.9.2.1, in accordance with RG 1.20.

The COL application provided a description of the CCNPP Unit 3 reactor internals classification, vibration assessment program, and the milestones for implementation in accordance with RG 1.20.

Supplemental Information

The COL applicant provided the following supplemental information:

The COL applicant provided information to address RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007, Section C.I.3.9.2.4, "Preoperational Flow-Induced Vibration Testing of Reactor Internals." The RG in this section states in part: "For a prototype reactor, if the Flow-Induced Vibration (FIV) testing of reactor internals is incomplete at the time the COL application is filed, the COL applicant should provide documentation describing the implementation program, including milestones, completion dates and expected conclusions."

3.9.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for COL Information Item 3.9-1 related to the dynamic testing and analysis of reactor internals, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.9.2, "Dynamic Testing and Analysis of Systems, Structures, and Components."

The applicable regulatory requirements that pertain to COL Information Item 3.9-1 are as follows:

1. 10 CFR Part 50, Appendix A, GDC 1, which requires, in part, that components important to safety be designed, fabricated, erected, and, tested to quality standards commensurate with the importance of the safety functions to be performed.

2. 10 CFR Part 50, Appendix A, GDC 4, as it relates to systems, structures, and components important to safety being designed to accommodate the effects of and to be

compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents and being protected from the dynamic effects of discharging fluids.

The related acceptance criteria are specified in RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing."

3.9.2.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.9.2 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.9.2 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to dynamic testing and analysis of systems, components and equipment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

The staff reviewed COL Information Item 3.9-1 identifying the classification of the CCNPP Unit 3 reactor internals. The CCNPP Unit 3 reactor internals are currently classified as the U.S. EPR prototype for reactor internals testing. However, should a comprehensive vibration assessment program for an U.S. EPR unit other than CCNPP Unit 3 be completed and approved by the U.S. NRC prior to preoperational testing at CCNPP Unit 3, CCNPP Unit 3 reactor internals will be reclassified as a non-prototype Seismic Category I. COL Information Item 3.9-1 is listed as a license condition in Part 10 of the COLA. This license condition will ensure that the COL applicant implements a preoperational and initial startup vibration assessment program and prepares the final report consistent with guidance of RG 1.20, Revision 3. The COL applicant is committed to providing the preliminary and final reports of the results of the vibration assessment program to the NRC within 60 and 180 days, respectively, following completion of vibration testing according to RG 1.20, Regulatory Position C.2.5.

Based on the above review, the staff concludes that the license condition adequately addressed COL Information Item 3.9-1. The staff finds that the information related to reactor internals classification and testing is adequate to meet NRC regulatory requirements, and thus is acceptable.

3.9.2.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2, contains a COL information item that the COL applicant is required to address. The following COL information item in Table 3.9.2-1 of this report includes the proposed combined license activity which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER section listed below.

Table 3.9.2-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.9-1	A COL applicant that references the U.S. EPR design certification will submit the results from the vibration assessment program for the U.S. EPR RPV internals and piping systems specified in U.S. EPR FSAR Tier 2, Section 3.9.2.1, in accordance with RG 1.20.	3.9.2.4	3.9.2.4

3.9.2.6 *Conclusions*

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to COL Information Item 3.9-1, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52 020. The results of the staff's technical evaluation of the information related to the dynamic testing and analysis of systems, components, and equipment incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.9.2 of this report to reflect the final disposition of the U.S. EPR design certification application.

The staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 1 and GDC 4. The staff based its conclusion on the COL applicant meeting the relevant regulatory requirements with regard to the reactor internals being tested to quality standards commensurate with the importance of the safety functions being performed and being appropriately protected against dynamic effects by meeting the guidance of prototype or non-prototype, Seismic Category I reactor internals test and/or inspection as specified in RG 1.20. A preoperational vibration measurement and inspection program will confirm that unexpected, abnormal vibrations do not occur, and will ensure that the vibration response of the reactor internals are sufficiently small compared to an acceptance criterion based on the design fatigue curves in the ASME Code Section III. The combination of preoperational test program, analysis of test results, and post-test inspection program and acceptance criteria provides adequate assurance that the reactor internals will, during their service life, withstand the flow-induced vibration of reactor operation without loss of structural integrity.

3.9.3 ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures

3.9.3.1 *Introduction*

The structural integrity and functional capability of pressure-retaining components, their supports, and core support structures are ensured by designing them in accordance with ASME Code, Section III, or other industrial standards. This section addresses the loading

combinations and their respective stress limits, the design and installation of pressure-relief devices, and the design and structural integrity of ASME Code Class 1, 2, and 3 components and component supports.

The criteria for the SSC design include the following considerations:

- loading combinations, design transients, and stress limits
- pump and valve operability assurance
- design and installation criteria of ASME Code Class 1, 2, and 3 pressure-relieving devices
- component and piping supports

3.9.3.2 *Summary of Application*

COL FSAR Section 3.9.3 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.9.3, "ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures."

In addition, in COL FSAR Section 3.9.3, the COL applicant provided the following:

COL Information Items

COL Information Item 3.9-2

The COL applicant provided additional information in COL FSAR Section 3.9.3 to address COL Information Item 3.9-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports, and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.

This additional information is consistent with information contained in COL application, Part 10, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) and ITAAC Closure," Appendix A, "Proposed Combined License Conditions," Section 2, "COL Items."

The COL FSAR states that the COL applicant shall prepare the design specifications and design reports for ASME Code Class 1, 2, and 3 components, piping, supports, and core support structures that comply with and are certified to the requirements of ASME Code, Section III. The COL FSAR states that the design specifications will be prepared prior to procurement of the components, while the ASME Code reports will be prepared during as-built reconciliation of the systems and components, conducted prior to fuel load.

COL Information Item 3.9-11

The COL applicant provided additional information in COL FSAR Section 3.9.3.1, “Loading Combinations, System Operating Transients, and Stress Limits,” to address COL Information Item 3.9-11 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, the COL applicant will provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range. The COL applicant will also provide the maximum total stress and deformation values for each operating condition for ASME Code Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.

The COL applicant stated that this information would be provided prior to procurement of ASME Code Class 1 components.

COL Information Item 3.9-5

The COL applicant provided additional information in COL FSAR Section 3.9.3.1.1, “Loads for Components, Component Supports, and Core Support Structures,” to address COL Information Item 3.9-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> As noted in ANP-10264(NP)-A, should a COL applicant that references the U.S. EPR design certification find it necessary to route Class 1, 2, and 3 piping not included in the U.S. EPR design certification so that it is exposed to wind and tornadoes, the design must withstand the plant design-basis loads for this event.

The COL applicant states that ASME Code Class 1, 2, and 3 piping not included in the U.S. EPR design certification shall be routed in a manner such that it is not exposed to wind or tornadoes.

COL Information Items 3.9-3 and 3.9-4

The COL applicant provided additional information in FSAR Section 3.9.3.1.1 to address COL Information Item 3.9-3 and 3.9-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will examine the feedwater line welds after hot functional testing prior to fuel loading and at the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13.
>
> As noted in ANP-10264(NP), a COL applicant that references the U.S. EPR design certification will confirm that thermal deflections do not create adverse conditions during hot functional testing.

The COL FSAR states that the COL applicant shall confirm that thermal deflections do not cause adverse conditions during hot functional testing and shall examine the feedwater line welds, as stated in the COL information item.

3.9.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the ASME Code Class 1, 2, and 3 components, component supports, and core support structures, and the associated acceptance criteria, are specified in NUREG-0800, Section 3.9.3, "ASME Code Class 1, 2, and 3 Components, and Component Supports, and Core Support Structures."

The applicable regulatory requirements for ASME Code Class 1, 2, and 3 components, component supports, and core support structures are as follows:

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," GDC 1, "Quality Standards and Records," as it relates to the requirement that components important to safety be designed, fabricated, erected, and, tested to quality standards commensurate with the importance of the safety functions to be performed.

2. GDC 2, "Design Bases for Protection Against Natural Phenomena," as it relates to the requirement that components important to safety be designed to withstand seismic events without loss of capability to perform their safety functions.

3. GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to systems, structures, and components important to safety being designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents, including being protected against the dynamic effects of discharging fluids.

4. GDC 14, "Reactor Coolant Pressure Boundary," as it relates to the requirement that the reactor coolant pressure boundary be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

5. GDC 15, "Reactor Coolant System Design," as it relates to the requirement that the reactor coolant system and associated auxiliary, control and protection systems be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences.

6. 10 CFR 50.55a, "Codes and Standards," as it relates to the testing of systems and components to quality standards commensurate with the importance of the safety function to be performed.

7. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," as it relates to the requirements that the components and component supports, and core support structures will be designed and built in accordance with the certified design.

The related acceptance criteria are as follows:

1. RG 1.124, "Service Limits and Loading Combinations for Class 1 Linear Type Component Supports," as it relates to the design of component supports.

2. RG 1.130, "Service Limits and Loading Combinations for Class 1 Plate and Shell-Type Component Supports," as it relates to the design of component supports.

3. ASME Code, Section III, Division 1, Appendix O, "Rules for Design of Safety Valve Installations," as it relates to the design and installation of pressure relief devices.

3.9.3.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.9.3 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.9.3 has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to ASME Code Class 1, 2, and 3 components, component supports, and core support structures has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

COL Information Item 3.9-2

The staff reviewed COL Information Item 3.9-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.9.3.

> COL FSAR Section 3.9.3 states that the COL applicant shall prepare the design specifications and design reports for ASME Code Class 1, 2, and 3 components, piping, supports, and core support structures that comply with and are certified to the requirements of ASME Code, Section III (ASME 2004). In addition, the COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.

The staff noted design specifications are prepared prior to procurement of the components, while the ASME Code design reports are available after procurement of equipment.

In view of the guidance provided in NUREG-0800, Section 3.9.3, in RAI 124, Question 03.09.03-1, the staff requested that the COL applicant provide a specific schedule when the staff can audit the design specifications of risk-significant ASME Code Class 1, 2, and 3 components, so as to make a safety determination for the COL application.

In an August 10, 2009, response to RAI 124, Question 03.09.03-1, the COL applicant provided dates for the expected availability of design specifications for audit. In addition, the COL

applicant clarified that the design certification applicant will provide a sample of component design specifications to be audited.

The staff determined that the COL applicant's response to RAI 124, Question 03.09.03-1 did not to address the staff's concern. However, the COL applicant's response indicated that the design documents were better addressed by the design certification applicant. Upon review of COL Information Item 3.9-2, if the issue is addressed in the design certification application, the COL information item should be either revised or withdrawn. The staff will update Section 3.9.3 of this report to reflect the final disposition of the design certification application. In RAI 362, Question 03.09.03-2, the staff requested that the COL applicant address the issue if it is not addressed in the design certification application. **RAI 362, Question 03.09.03-2 is being tracked as an open item.**

The safety evaluation for the reactor internals material reliability programs with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling are detailed in Section 4.5.2.1 of this report.

COL Information Item 3.9-11

The staff reviewed COL Information Item 3.9-11 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under FSAR Section 3.9.3.1.

COL FSAR Section 3.9.3.1 states that the COL applicant will provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, the COL applicant will provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range. In addition, the COL applicant will also provide the maximum total stress and deformation values for each operating condition for ASME Code Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.

The staff determined that the COL applicant's commitment to provide the information later did not adequately address the COL information item. Upon review, the staff notes the information could not have been provided at this stage in the design and should have been addressed through an ITAAC in the COL FSAR. Therefore, in RAI 363, Question 03.09.03-3, the staff requested that the COL applicant develop a site-specific ITAAC to address the issue. **RAI 363, Question 03.09.03-3 is being tracked an open item.**

COL Information Item 3.9-5

The staff reviewed COL Information Item 3.9-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.9.3.1.1.

COL FSAR Section 3.9.3.1.1 states that the COL applicant shall route ASME Code Class 1, 2, and 3 piping not included in the U.S. EPR design certification in a manner such that it is not exposed to wind or tornadoes. The staff finds this commitment adequately addresses COL Information Item 3.9-5 in that the COL applicant has committed to protect the piping, and is therefore acceptable.

COL Information Item 3.9-3 and 3.9-4

The staff reviewed COL Information Item 3.9-3 and 3.9-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.9.3.1.1.

The COL FSAR states that the COL applicant shall confirm that thermal deflections do not cause adverse conditions during hot functional testing. In addition, the COL applicant will examine the feedwater line welds after hot functional testing prior to fuel loading and the first refueling outage, and will report the results of the inspections to the U.S. NRC, in accordance with NRC Bulletin 79-13, "Cracking in Feedwater System Piping."

The staff determined that the COL applicant's commitment to provide the information later did not adequately address the COL information item. Upon review, the staff notes the issue could not have been provided at this stage in the design and should have been addressed through an ITAAC in the COL FSAR. If this is being addressed with the design certification applicant, this will be dispositioned with the COL applicant once the design is finalized. The staff will update Section 3.9.3 of this report to reflect the final disposition of the design certification application. In RAI 364, Question 03.09.03-4 the staff requested the COLA applicant to develop a site-specific ITAAC to address the issue. **RAI 364, Question 03.09.03-4 is being tracked as an open item.**

3.9.3.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.9.3-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER section listed below:

Table 3.9.3-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.9-2	A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports, and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.	3.9.3	3.9.3.4

Item No.	Description	COL FSAR Section	COL SER Section
3.9-3	A COL applicant that references the U.S. EPR design certification will examine the feedwater line welds after hot functional testing prior to fuel loading and at the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13.	3.9.3.1.1	3.9.3.4
3.9-4	As noted in ANP-10264NP-A, a COL applicant that references the U.S. EPR design certification will confirm that thermal deflections do not create adverse conditions during hot functional testing.	3.9.3.1.1	3.9.3.4
3.9-5	As noted in ANP-10264NP-A, Should a COL applicant that references the U.S. EPR design certification find it necessary to route Class1, 2, and 3 piping not included in the U.S. EPR design certification so that it is exposed to wind and tornadoes, the design must withstand the plant design-basis loads for this event	3.9.3.1.1	3.9.3.4
3.9-11	A COL applicant that references the U.S. EPR design certification will provide a summary of the maximum total stress, deformation (where applicable), and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components. For those values that differ from the allowable limits by less than 10 percent, the COL applicant will provide the contribution of each of the loading categories (e.g., seismic, pipe rupture, dead weight, pressure, and thermal) to the total stress for each maximum stress value identified in this range. The COL applicant will also provide the maximum total stress and deformation values for each operating condition for Class 2 & 3 components required for safe shutdown of the reactor, or mitigation of consequences of a postulated piping failure without offsite power. Identification of those values that differ from the allowable limits by less than 10 percent will also be provided.	3.9.3.1	3.9.3.4

3.9.3.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review

confirmed that the COL applicant addressed the required information relating to ASME Code Class 1, 2, and 3 components, component supports, and core support structures, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the ASME Code Class 1, 2, and 3 components, component supports, and core support structures incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.9.3 of this report to reflect the final disposition of the design certification application.

The staff finds the proposed license conditions listed in Section 3.9.3.5, Table 3.9.3-1 of this report and evaluated in Section 3.9.3.4 of this report acceptable for addressing all of the COL information items associated with this section of the report.

As a result of the open items discussed above, the staff is unable to finalize its conclusions on COL FSAR Section 3.9.3 in accordance with the requirements of 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 4, GDC 14, and GDC 15; and 10 CFR 50.55a.

3.9.4 Control Rod Drive System

The Control Rod Drive System (CRDS) consists of the control rods and the related mechanical components that provide the means for mechanical movement, including the control rod drive mechanisms (CRDMs), and rod cluster control assemblies (RCCAs). The electromagnetic systems include control rod mechanism up to the coupling interface with the reactivity control elements. Control rod drive mechanisms are located on the head of the reactor vessel. The mechanisms are coupled to RCCAs that have neutron absorber material over the active length of the control rods. The CRDS will be capable of reliably controlling reactivity changes either under conditions of anticipated normal plant operational occurrences or under postulated accident conditions.

COL FSAR Section 3.9.4 incorporates by reference, with no departures or supplements, U.S. EPR FSAR Tier 2, Section 3.9.4. The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that no issue relating to this section remained for review. The staff's review confirmed that there is no outstanding issue related to this subsection.

The staff is reviewing the information in the U.S. EPR FSAR Tier 2, Section 3.9.4 on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the control rod drive system incorporated by reference in the COL FSAR will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR FSAR is not yet complete. The staff will update Section 3.9.4 of this report to reflect the final disposition of the design certification application.

3.9.5 Reactor Pressure Vessel Internals

3.9.5.1 *Introduction*

The reactor internals consist of two major assemblies: The lower internals and the upper internals. The reactor internals provide the protection, alignment, and support for the core,

control rods, and gray rods to provide safe and reliable reactor operation. In addition, the reactor internals help to accomplish the following: Direct the main coolant flow to and from the fuel assemblies; absorb control rod dynamic loads, fuel assembly loads, and other loads and transmit these loads to the reactor vessel; support instrumentation within the reactor vessel; provide protection for the reactor vessel against excessive radiation exposure from the core; and position and support reactor vessel radiation surveillance specimens.

3.9.5.2 *Summary of Application*

COL FSAR Section 3.9.5 FSAR incorporates by reference U.S. EPR FSAR Tier 2, Section 3.9.5.

In addition, in COL FSAR Section 3.9.5, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.9.5 to address COL Information Item 3.9-14 from the U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME section III Subsection NG.

The COL FSAR states this information shall be provided later and proposed License Condition 3.9-14 in Part 10 of the COL application.

3.9.5.3 *Regulatory Basis*

In addition, the relevant requirements of NRC regulations for reactor pressure vessel internals, and the associated acceptance criteria, are given in NUREG-0800, Section 3.9.5.

The applicable regulatory requirements for external flood protection are as follows:

1 GDC 1 and 10 CFR 50.55a, as it relates to the requirement that reactor internals be designed to quality standards commensurate with the importance of the safety functions performed.

2 GDC 2, as it relates to the requirement that reactor internals be designed to withstand the effects of natural phenomena such as earthquakes without loss of capability to perform safety functions.

3 GDC 4, as it relates to the requirement that reactor internals be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operations, maintenance, testing, and postulated pipe ruptures, including LOCAs. Dynamic effects associated with postulated pipe ruptures may be excluded from the design basis when analyses demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for piping.

4 GDC 10, as it relates to the requirement that reactor internals be designed with appropriate margin to assure that specified acceptable fuel design limits are not

exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

Related acceptance criteria are discussed in SRP Section 3.9.5.

3.9.5.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.9.5 and checked the referenced design certification FSAR to ensure that the combination of the information in the design certification FSAR and the information in the COL FSAR represent the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.9.5 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to reactor pressure vessel internals will be documented in the staff's safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the information contained in the COL FSAR:

The staff reviewed COL FSAR Section 3.9.5 for conformance to the guidance in RG 1.206, Section C.III.1, Chapter 3, "Reactor Pressure Vessel Internals," states that a COL applicant that references the U.S. EPR design certification will provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition. The staff notes that limitation of stresses, deformations, and the cumulative usage factor values under ASME NG loading combinations is an acceptable basis for the design of these structures and components to withstand the most adverse loading events postulated to occur during service lifetime without loss of structural integrity or impairment of function.

The staff notes that COL FSAR Section 3.9.5 does not provide a summary of the total stress, deformation, and cumulative usage values, but indicates that this summary shall be provided. License Condition 3.9 -14 was added to Part 10 of the COL application to provide this information after the license is issued. A license condition is not appropriate as this information is needed for review prior to COL issuance to meet reasonable assurance for the design of reactor internals as discussed in SRP Section 3.9.5, "Reactor Pressure Vessel Internals". Therefore, in RAI 355, Question 03.09.05-1, the staff requested that the COL applicant clarify when this information will be available. **RAI 355, Question 03.09.05-1 is being tracked as an open item.**

COL Information Items

The staff reviewed COL Information Item 3.9-14 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.9.5

3.9.5.5 *Post Combined License Activities*

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.9.5-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the sections listed below:

Table 3.9.5-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.9-14	A COL applicant that references the U.S. EPR design certification will provide a summary of reactor core support structure maximum total stress, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Section III, Subsection NG.	3.9.5	3.9.5.4

3.9.5.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to the analysis of flooding events, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to tornado loadings incorporated by reference in the COL FSAR have been documented in the staff's safety evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update Section 3.9.5 of this report to reflect the final disposition of the design certification application.

As a result of the open item discussed above, the staff is unable to conclude that the information pertaining to COL FSAR Section 3.9.5 is meets the requirements of 10 CFR 50.55a, GDC 1, GDC 2, GDC 4, and GDC 10.

3.9.6 Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints

3.9.6.1 *Introduction*

In this section, the staff describes its review of the functional design, qualification, and inservice testing (IST) programs for pumps, valves, and dynamic restraints as required by 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," and 10 CFR 50.55a, "Codes and standards," for CCNPP Unit 3. RG 1.206 discusses the position of the Commission provided in SECY-05-197, "Review of Operational Programs in a Combined License Application and General Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," that operational programs should be fully described in COL applications to avoid the need for ITAAC related to those programs. The COL applicant relies on the U.S. EPR FSAR and supplemental information provided in the COL FSAR to fully describe the IST, Motor-Operated Valve (MOV) Testing, and other related operational programs in support of the COL application.

3.9.6.2 *Summary of Application*

COL FSAR Section 3.9.6 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.9.6 with supplemental information but no departures.

In COL FSAR Section 3.9.6, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.9.6 to address COL Information Items 3.9-7 and 3.9-13 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will submit the preservice testing (PST) program and inservice testing (IST) program for pumps, valves, and snubbers as required by 10 CFR 50.55a.
>
> A COL applicant that references the U.S. EPR design certification will identify the implementation milestones and applicable ASME OM Code for the preservice and inservice examination and testing programs. These programs will be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

In response to COL Information Items 3.9-7 and 3.9-13, the COL applicant states that the UHS makeup water system is a site-specific safety-related system that is subject to PST and IST program requirements identified in 10 CFR 50.55a. COL FSAR Table 3.9-1, "Site-Specific Inservice Pump Testing Program Requirements," and COL FSAR Table 3.9-2, "Site-Specific Inservice Valve Testing Program Requirements," provide a list of plant-specific pumps and valves included in the PST and IST programs for CCNPP Unit 3. The COL applicant states that it shall submit the PST and IST programs prior to performing these tests and following the start of construction and prior to the anticipated date of commercial operation, respectively. The implementation milestones for these programs are provided in COL FSAR Table 13.4-1, "Operational Programs Required by NRC Regulations and Program Implementation." The COL applicant states that these programs shall include the implementation milestones and applicable ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) and shall be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

COL FSAR Section 3.9.6.1, "Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints," provides supplemental information on the functional design and qualification of pumps, valves, and dynamic restraints for the UHS makeup water system. For example, component manufacturing will be accomplished in accordance with quality program requirements that verify component physical and material requirements. The UHS makeup water system layout will be completed with consideration of maintenance and repair efforts, parameters to be monitored during operation, and periodic inspection and testing. The UHS makeup water system pumps, valves, and piping components will incorporate the necessary test and monitoring connections to demonstrate the capacity of the pumps and valves to perform their intended function through the full range of system differential pressures and flows at ambient temperatures and available voltages. The COL applicant notes that the UHS makeup water system does not include snubbers. The COL applicant states that particular design attention will be given to flow-induced loading and degraded flow conditions to account for the debris, impurities, and contaminants in the water.

In COL FSAR Section 3.9.6.2, “Inservice Testing Program for Pumps,” the COL applicant provides additional information to address the following COL Information Item 3.9-8:

> A COL applicant that references the U.S. EPR design certification will identify any additional site-specific pumps in Table 3.9.6-2 to be included within the scope of the IST program.

The COL applicant states that COL FSAR Table 3.9-1 identifies the additional site-specific pumps that are included in the IST program.

In COL FSAR Section 3.9.6.3, “Inservice Testing Program for Valves,” the COL applicant provides additional information to address the following COL Information Item 3.9-6:

> A COL applicant that references the U.S. EPR design certification will identify any additional site-specific valves in Table 3.9.6-2 to be included within the scope of the IST program.

The COL applicant states that COL FSAR Table 3.9-2 identifies the additional site-specific valves that are included in the IST program. The COL applicant also states that the UHS makeup water system Class 3 site-specific valves (motor-operated, manually-operated, check, safety, and relief valves) will be tested in accordance with ASME OM Code 2004, Section ISTC.

In various other subsections of COL FSAR Section 3.9.6.3, the COL applicant states that in the UHS makeup water system there are no power-operated valves (other than MOVs), no ASME B&PV Code Class 3 site-specific containment isolation valves, and no ASME Code Class 3 site-specific explosive valves.

In COL FSAR Section 3.9.6.4, “Inservice Testing Program for Dynamic Restraints,” the COL applicant provides additional information to address the following COL Information Item 3.9-12:

> A COL applicant that references the U.S. EPR design certification will provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function (shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, the COL applicant shall indicate whether the snubber or component was evaluated for fatigue strength.

The COL applicant states that a table of safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type, applicable standard, and function shall be provided prior to installation of any of the snubbers. The COL applicant states that for snubbers identified as either a dual-purpose or vibration arrester type the table will indicate whether the snubber or component was evaluated for fatigue strength.

3.9.6.3 *Regulatory Basis*

The regulatory basis of the design-related information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the supplemental information related to the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints, and the associated acceptance criteria, are given in NUREG-0800, Section 3.9.6.

The applicable regulatory requirements for the supplementary information related to the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints are as follows:

1. 10 CFR 50.55a and 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," GDC 1, "Quality Standards and Records," as they relate to pumps, valves, and dynamic restraints important to safety-being designed, fabricated, tested, and inspected to quality standards commensurate with the importance of the safety functions to be performed.

2. GDC 2, "Design Bases for Protection Against Natural Phenomena," as it relates to pumps, valves, and dynamic restraints important to safety to withstand the effects of natural phenomena combined with the effects of normal and accident conditions.

3. GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to designing pumps, valves, and dynamic restraints important to safety to accommodate the effects of and to be compatible with the environment conditions associated with normal operation, maintenance, testing, and postulated accidents.

4. 10 CFR 52.79(a)(11), "Contents of applications; technical information in final safety analysis report," as it relates to the requirement that a COL application provide a description of the programs and their implementation necessary to ensure that the systems and components meet the requirements of the ASME B&PV Code and the ASME OM Code in accordance with 10 CFR 50.55a.

The related acceptance criteria are as follows:

1. RG 1.206 provides guidance for a COL applicant to prepare and submit its COL application in accordance with the NRC regulations. For example, RG 1.206, Section C.IV.4 discusses the requirement in 10 CFR 52.79(a) for descriptions of operational programs that need to be included in the COL FSAR for a COL application to allow a reasonable assurance finding of acceptability.

2. Commission Paper SECY-05-197, indicates that a COL applicant should fully describe the IST, MOV Testing, and other operational programs to avoid the need for ITAAC for the implementation of those programs. The Commission approved the use of a license condition for operational program implementation milestones that are fully described or referenced in the COL FSAR as discussed in the staff requirements memorandum (SRM) for SECY-05-0197, February 22, 2006.

The regulatory basis for the staff's review of the COL FSAR is provided by 10 CFR Part 50 and 10 CFR Part 52. Specifically, 10 CFR 52.79(a) requires that the COL application include information at a level sufficient to enable the NRC to reach a final conclusion on all safety matters that must be resolved by the Commission before COL issuance. For example, 10 CFR 52.79(a), Paragraph (4) requires that a COL application include the design of the facility with specific reference to the GDC in 10 CFR Part 50, Appendix A which establish the necessary design, fabrication, construction, testing, and performance requirements for SSCs that provide reasonable assurance that the facility can be operated without undue risk to the

health and safety of the public. 10 CFR 52.79(a), Paragraph (11) requires that a COL application provide a description of the programs and their implementation necessary to ensure that the systems and components meet the requirements of the ASME B&PV Code and the ASME OM Code in accordance with 10 CFR 50.55a. 10 CFR 52.79(a), Paragraph (29)(i) requires that a COL application provide plans for conduct of normal operations, including maintenance, surveillance, and periodic testing of SSCs. 10 CFR 52.79(a), Paragraph (37) requires that a COL application provide the information necessary to demonstrate how operating experience insights have been incorporated into the plant design.

RG 1.206 provides guidance for a COL applicant to prepare and submit its COL application in accordance with NRC regulations. For example, RG 1.206, Section C.IV.4 discusses the requirement in 10 CFR 52.79(a) for descriptions of operational programs that need to be included in the FSAR for a COL application to allow a reasonable assurance finding of acceptability. In particular, a COL applicant should fully describe the IST, MOV testing, and other operational programs as defined in Commission Paper SECY-05-0197 to avoid the need for ITAAC for the implementation of those programs. The term "fully described" for an operational program should be understood to mean that the program is clearly and sufficiently described in terms for scope and level of detail to allow a reasonable assurance finding of acceptability. Further, operational programs should be described at a functional level and an increasing level of detail where implementation choices could materially and negatively affect the program effectiveness and acceptability. The Commission approved the use of a license condition for operational program implementation milestones that are fully described or referenced in the COL FSAR as discussed in the staff requirements memorandum (SRM) for SECY-05-0197, February 22, 2006.

The staff followed NUREG-0800, Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints in its review of the CCNPP Unit 3 COL application. The staff also compared the COL FSAR information with the guidance provided in RG 1.206. COL FSAR Section 1.9.1, "Conformance with Regulatory Guides," and COL FSAR Section 1.9.2, "Conformance with the Standard Review Plan," do not indicate any exceptions to RG 1.206 or SRP Section 3.9.6.

3.9.6.4 *Technical Evaluation*

The staff reviewed COL FSAR Section 3.9.6 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of information relating to this review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. The staff reviewed U.S. EPR FSAR Tier 2, Section 3.9.6 under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to functional design, qualification, and IST programs for pumps, valves, and dynamic restraints is documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the COL FSAR and the referenced design certification FSAR to determine whether the COL application meets the regulatory requirements to provide reasonable assurance that the applicable safety-related components at CCNPP Unit 3 will be capable of performing their safety functions. For the most part, the COL applicant relies on the U.S. EPR FSAR in describing the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints in support of the COL application. Based on its review, the staff finds that the COL FSAR, with the incorporation by reference of the U.S. EPR FSAR, contains an

acceptable description of the functional design, qualification, and IST programs for CCNPP Unit 3 that provides reasonable assurance that the safety-related components within the scope of the CCNPP Unit 3 IST program will be capable of performing their safety functions in accordance with NRC regulations and ASME Code requirements, pending resolution of the open items identified in this SER section.

10 CFR 52.79(a)(11) requires that a COL applicant provide a description of the program(s), and their implementation, necessary to ensure that the systems and components meet the requirements of the ASME B&PV Code and the ASME OM Code in accordance with 10 CFR 50.55a. The Statement of Consideration associated with this requirement clarifies that an ITAAC for an operational program should not be necessary if the program and its implementation are "fully described" in the COL application, and which the staff finds acceptable at the COL stage. In this context, "fully described" should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to allow a reasonable assurance finding of acceptability. Required programs should always be described at a functional level and at an increased level of detail where implementation choices could materially and negatively affect the program effectiveness and acceptability (see also SECY-05-0197 and RG 1.206, Section C.IV.4).

10 CFR Part 50, Appendix A, GDC 4 requires, in part, that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. As documented in numerous NRC generic communications and issuances (e.g., Generic Letters (GLs) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves"; Regulatory Issue Summary (RIS) 2000-03; Information Notice (IN) 96-48; and NUREG-1275, "Operating Experience Feedback Report,"), weaknesses in licensees' equipment qualification programs have lead to situations in which valves might not have been able to perform their safety-related functions under design-basis conditions as required by GDC 4. As a result of these lessons learned from operating experience, NUREG-0800, Section 3.9.6; RG 1.206; and ASME Standard QME-1, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," have been revised to provide guidance related to the functional design and equipment qualification of safety-related pumps, valves, and dynamic restraints. The provisions of the ASME OM Code alone do not adequately assess the functional design and qualification of safety-related pumps and valves. Specifically, the ASME OM Code does not require testing and/or analysis to ensure that each pump and valve is capable of performing its intended function for a full range of system differential pressure and flow, ambient temperatures, and available voltages (as applicable) under all conditions ranging from normal operating to design-basis accident conditions. Therefore, in RAI 46, Question 03.09.06-1, the staff requested that the COL applicant fully describe its functional design and qualification program pursuant to 10 CFR 52.79(a)(11), or specify implementation of QME-1-2007, including example descriptions of component qualification.

In a March 30, 2009, response to RAI 46, Question 03.09.06-1, the COL applicant stated that at a January 16, 2009, U.S. EPR Design Center Working Group (DCWG) meeting, the DCWG agreed that a "fully described" program for the functional design and qualification of pumps, valves, and dynamic restraints would be included within the U.S. EPR FSAR by the design certification applicant (AREVA). The staff plans to conduct a sample review of the design and procurement specifications being prepared by the COL applicant or design certification applicant, as applicable, for U.S. EPR components to demonstrate the implementation of the U.S. EPR FSAR provisions for the functional design and qualification of pumps, valves, and

dynamic restraints in support of the U.S. EPR design certification and CCNPP Unit 3 COL FSAR as required by 10 CFR 52.79(a)(11) in NRC regulations. **RAI 46, Question 03.09.06-1 is being tracked as an open item** in order to conduct the planned audit. The staff conducted a pilot audit of the U.S. EPR design and procurement specifications on September 18, 2012, at the AREVA office in Bethesda, MD. The staff discussed the pilot audit results with AREVA for use in preparing for the full audit. In RAI 46, Question 03.09.06-2, the staff requested that COL applicant fully describe the IST and MOV testing programs pursuant to 10 CFR 52.79(a)(11). In a March 30, 2009, response to RAI 46, Question 03.09.06-2, the COL applicant stated that at a March 4, 2009, meeting between the NRC and the U.S. EPR DCWG, the DCWG agreed that the U.S. EPR FSAR will fully describe the IST and MOV testing programs in support of the COL application. The COL applicant also stated that COL FSAR Section 3.9.6 will be revised to reflect this reliance on the U.S. EPR FSAR. Subsequently, COL FSAR (Revision 5 and later) Section 3.9.6 states that CCNPP Unit 3 will implement the PST and IST programs for pumps, valves, and dynamic restraints described in the U.S. EPR FSAR. The staff finds that the incorporation by reference of the description in the U.S. EPR FSAR of the PST and IST programs for pumps, valves, and dynamic restraints in the CCNPP Unit 3 FSAR acceptable based on the staff review of the PST and IST program descriptions as described in the FSER on the U.S. EPR design certification application. Therefore, the staff considers RAI 46, Question 03.09.06-2 resolved.

In COL FSAR Section 3.9.6.1, the COL applicant states that particular attention will be given to flow-induced loading and degraded flow conditions in the UHS makeup water system to account for the debris, impurities, and contaminants in the water. The UHS makeup water system design should take into consideration flow-induced loading and degraded flow conditions that could occur as a result of debris, impurities, and contaminants in the water. Therefore, in RAI 340, Question 03.09.06-3, the staff requested that the COL applicant indicate where in the U.S. EPR FSAR or the COL FSAR the provisions for the UHS makeup water system design features that address flow-induced loading and degraded flow conditions (e.g., design features to alleviate debris, impurities, and contaminants in the water) are located, or specify these provisions in the COL FSAR. In a July 26, 2012, response to this RAI, the COL applicant provided a description of the design features of the UHS makeup water system that address flow-induced loading and degraded flow conditions. In addition, the COL applicant provided a planned modification to Section 9.2.5.3.2, “Piping, Valves, and Fittings,” in COL FSAR Chapter 9 that will specify the sizing of the traveling screens to resist high flow-induced loading to the screens. The staff finds that the RAI response clarifies the design features of the UHS makeup water system with respect to flow-induced loading and degraded flow conditions, and that the planned modification to the COL FSAR is acceptable to resolve this RAI. Therefore, **RAI 340, Question 03.09.06-3 is being tracked as a confirmatory item.**

COL FSAR Revisions 7 and 8 include numerous changes to the description of the site-specific IST Program in Table 3.9-2, “Site-Specific Inservice Valve Testing Program Requirements.” In RAI 340, Question 03.09.06-5, the staff requested that the COL applicant describe these IST table changes and their justification. In a July 26, 2012, response to this RAI, the COL applicant described the basis for the changes made to COL FSAR Table 3.9-2 for site-specific valves, including valve descriptions, OM Code category, active versus passive functions, safety position, and additional valves. The staff finds that the COL applicant has justified the changes to COL FSAR Table 3.9-2 in previous revisions to the COL FSAR to be consistent with the IST provisions in the ASME OM Code as incorporated by reference in 10 CFR 50.55a. Therefore, the staff considers RAI 340, Question 03.09.06-5 resolved.

In the COL FSAR, the COL applicant incorporates by reference the U.S. EPR FSAR including the IST tables for pumps and valves to assist in describing the IST program to be developed for CCNPP Unit 3. The U.S. EPR FSAR references the application of NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," in developing IST programs for U.S. EPR plants. Following approval and issuance of the CCNPP Unit 3 SER, the guidance in NUREG-1482 can be used to develop the IST program for CCNPP Unit 3, including the specific information to be included in IST program documentation and tables for NRC inspection.

COL Information Items

In response to COL Information Item 3.9-6 that a COL applicant will identify any additional site-specific valves to be included within the scope of the IST program, COL FSAR Table 3.9-2 lists 16 safety-related UHS makeup water system valves. COL FSAR Table 3.9-2, Note 10 states that table entries for manual valves will be developed during detailed design engineering. In RAI 340, Question 03.09.06-4, the staff requested that the COL applicant include the appropriate entries in COL FSAR Table 3.9-2 for the UHS makeup water system manual valves, or justify deferral of the specification of this IST program information for the UHS makeup water system manual valves until COL issuance. In a July 26, 2012, response to this RAI, the COL applicant provided its planned modification to COL FSAR Table 3.9-2 to specify additional information on the site-specific manual valves in the UHS makeup water system, and to remove Note 10 from the table. The COL applicant indicated that additional manual valves might be identified during the detailed design process. The COL applicant also provided a planned modification to COL FSAR Section 9.2.5.3.2 to correct a specific manual valve number in the UHS makeup water system. The staff finds that the COL applicant has provided planned modifications to COL FSAR Table 3.9-2 and COL FSAR Section 9.2.5.3.2 that are consistent with the IST provisions in the ASME OM Code as incorporated by reference in 10 CFR 50.55a. Therefore, **RAI 340, Question 03.09.06-4 is being tracked as a confirmatory item.**

In response to COL Information Item 3.9-7 that a COL applicant will submit its PST and IST programs for pumps, valves, and snubbers, the COL applicant states that it would implement the PST and IST programs for pumps, valves, and dynamic restraints described in U.S. EPR FSAR Tier 2, Section 3.9.6. That is, the CCNPP Unit 3 PST and IST programs incorporate by reference the PST and IST programs described in the U.S. EPR FSAR Tier 2, Section 3.9.6. The COL applicant also indicates that the UHS makeup water system is a site-specific safety-related system that is subject to the PST and IST programs. The UHS makeup water system pumps and valves to be included in the CCNPP Unit 3 PST and IST programs are identified in COL FSAR Tables 3.9.1 and 3.9-2, respectively. The staff considers the reliance on the U.S. EPR FSAR by the COL applicant to fully describe the PST and IST programs for pumps, valves, and dynamic restraints to be sufficient for CCNPP Unit 3.

In response to COL Information Item 3.9-8 that a COL applicant will identify any additional site-specific pumps to be included within the scope of the IST program, COL FSAR Table 3.9-1 lists the four safety-related UHS makeup water system pumps. The staff finds the COL applicant's identification of additional pumps included within the scope of the CCNPP Unit 3 IST program conforms to the guidance in NUREG-1482, and is therefore acceptable.

In response to COL Information Item 3.9-12 that a COL applicant will identify and describe any safety-related systems and components that use snubbers in their support systems, the COL applicant states that this information will be provided prior to the installation of any of the snubbers. Since the detailed piping system design is not available at the time of the COL application, the staff finds acceptable the performance of this activity following COL

issuance prior to snubber installation. The staff concluded that this information may need to be made available for staff inspection following COL issuance, but prior to snubber installation.

In response to COL Information Item 3.9-13 that a COL applicant will identify implementation milestones and applicable ASME OM Code for its PST and IST programs for pumps, valves, and snubbers, the COL applicant states that it will submit the PST and IST programs prior to performing the tests and following the start of construction and prior to the anticipated date of commercial operation, respectively. Further, the COL applicant states that the implementation milestones for these programs are provided in the COL FSAR Table 13.4-1. COL FSAR Table 13.4-1 indicates that the PST and MOV testing programs will be implemented prior to initial fuel load as required by a license condition. The IST program will be implemented after the generator is online on nuclear heat as required by 10 CFR 50.55a(f) and the ASME OM Code. The COL FSAR states that these programs will be consistent with the latest edition and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load. The staff finds the implementation milestones and applicable ASME OM Code conform to the guidance provided in RG 1.206 related to the implementation of operational programs and, are therefore acceptable.

In its review, the staff noted that an early revision to the COL FSAR incorrectly included a specific date for 10 CFR 50.55a; however, this date was removed from COL3 FSAR, Revision 6 (and later). In RAI 341, Question 13.04-1**,** the staff requested that the COL applicant include a note in COL FSAR Table 13.4-1 for the milestone of full implementation of the IST program after generator online on nuclear heat specifying that appropriate portions of the IST program will be implemented as necessary to support the system operability requirements of the technical specifications. In a June 8, 2012, response to RAI 341, Question 13.04-1, the COL applicant provided a planned modification to COL FSAR Table 13.4-1 to include the requested note. The staff finds the planned modification to COL FSAR Table 13.4-1 to clarify the need to implement the IST program to support system operability requirements acceptable. **RAI 341, Question 13.04-1, is being be tracked as a confirmatory item.**

License Conditions

COL application, Part 10, Appendix A, "Proposed Combined License Conditions," discusses license conditions that the COL applicant proposes to be included in the COL FSAR. The proposed license conditions related to the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints are as follows:

> [The licensee] shall submit the Preservice Testing Programs and Inservice Testing Programs to the NRC prior to performing the tests and following the start of construction and prior to the anticipated date of commercial operation, respectively. The implementation milestones for these programs are provided in {CCNPP Unit 3} FSAR Table 13.4-1. These programs shall include the implementation milestones and applicable ASME OM Code and shall be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load. [Paragraph 2 (COL Items): COL Information Item 3.9-7 in Section 3.9.6]
>
> [The licensee] shall provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function

(shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, [the licensee] shall denote whether the snubber or component was evaluated for fatigue strength. This information shall be provided prior to installation of any of the snubbers. [Paragraph 2 (COL Items): COL Item 3.9-12 in Section 3.9.6.4]

[The licensee] shall implement the programs or portions of programs identified in FSAR Table 13.4-1 on or before the associated milestones in FSAR Table 13.4-1. [Paragraph 3 (Operational Program Implementation)]

[The licensee] shall submit to the appropriate Director of the NRC, a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program FSAR Table 13.4-1. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until either the operational programs in the FSAR table have been fully implemented or the plant has been placed in commercial service, whichever comes first. [Paragraph 6 (Operational Program Readiness)]

10 CFR 50.55a(f)(4)(i) states that inservice tests conducted during the initial 120-month interval to verify operational readiness of pumps and valves, whose function is required for safety, must comply with the requirements in the latest edition and addenda of the ASME Code, incorporated by reference in 10 CFR 50.55a(b) on the date 12 months before the date scheduled for initial fuel loading, under a COL issued in accordance with 10 CFR Part 52 (or the optional ASME Code cases listed in RG 1.192) subject to the limitations and modifications listed in 10 CFR 50.55a. A license condition will require the licensee to submit a schedule that supports planning and conducting NRC inspections of operational programs. The COL applicant will be responsible for satisfying NRC regulatory requirements and COL license conditions to enable the staff to perform inspections related to the functional design, qualification, and IST programs for safety-related pumps, valves, and dynamic restraints for CCNPP Unit 3 in a timely manner prior to plant operation.

The staff finds these proposed license conditions consistent with NRC regulatory guidance in RG 1.206. The staff addresses a note regarding the IST program implementation milestone in COL FSAR Table 13.4-1 as part of RAI 341, Question 13.04-1, discussed above.

3.9.6.5 *Post Combined License Activities*

The following items were identified as the responsibility of the COL applicant. The COL applicant addressed these items as license conditions in Part 10 of the COL application:

Table 3.9.6-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.9-7	A COL applicant that references the U.S. EPR design certification will submit the PST and IST programs for pumps, valves, and snubbers as required by 10 CFR 50.55a.	3.9.6	3.9.6.4

Item No.	Description	COL FSAR Section	COL SER Section
3.9-12	A COL applicant that references the U.S. EPR design certification will provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function (shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, the COL applicant shall indicate whether the snubber or component was evaluated for fatigue strength.	3.9.6.4	3.9.6.4

3.9.6.6 *Conclusions*

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints incorporated by reference in the COL FSAR will be documented in the staff safety-evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update this report to reflect the final disposition of the design certification application.

As a result of the open and confirmatory items discussed in this section, the staff is unable to finalize its conclusion regarding the functional design, qualification, and IST programs for safety-related pumps, valves, and dynamic restraints to be used at CCNPP Unit 3 in accordance with the requirements of 10 CFR 50.55a; 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 4; 10 CFR Part 50, Appendix B; and 10 CFR 52.47(a)(11).

3.10 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

3.10.1 Introduction

Seismic and dynamic qualification of mechanical and electrical equipment other than piping includes the following equipment types:

- Safety-related instrumentation and electrical equipment and certain monitoring equipment.
- Safety-related active mechanical equipment that performs a mechanical motion, while accomplishing a system safety-related function. These devices include the control rod drive mechanisms, HVAC and fluid system valves.

- Safety-related, non-active mechanical equipment whose mechanical motion is not required while accomplishing a system safety-related function, but whose structural integrity must be maintained in order to fulfill its design safety-related function.

Mechanical equipment, electrical equipment, instrumentation, and, where applicable, their supports classified as Seismic Category I are demonstrated to be capable of performing their designated safety-related functions under the full range of normal and accident (including seismic) loadings. This equipment includes devices associated with systems essential to safe shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment or in mitigating the consequences of accidents.

The criteria for the seismic and dynamic qualification include the following considerations:

- seismic and dynamic qualification criteria
- methods and procedures for qualifying electrical equipment, instrumentation, and mechanical components
- methods and procedures for qualifying supports of electrical equipment, instrumentation, and mechanical components
- documentation

3.10.2 Summary of Application

COL FSAR Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment," incorporates by reference U.S. EPR FSAR Tier 2, Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment."

In addition, in COL FSAR Section 3.10, the COL applicant provided the following:

COL Information Items

In the COL FSAR, the COL applicant stated that the seismic qualification of equipment located in the NI, Emergency Power Generating Buildings (EPGBs) and Essential Service Water Buildings (ESWBs) is performed using the In-Structure Response Spectra (ISRS) provided in COL FSAR Sections 3.7.2.5.1 and 3.7.2.5.2, and they are bounded by the corresponding U.S. EPR FSAR ISRS.

The COL applicant provided additional information in COL FSAR Section 3.10.4 to address COL Information Item 3.10-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will create and maintain the SQDP file during the equipment selection and procurement phase.

In response to this COL information item, the COL applicant stated, "Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall create and maintain the SQDP file. This activity shall be initiated during the equipment selection and procurement phase. The SQDP file shall be maintained for the life of the plant."

The COL applicant provided additional information in COL FSAR Section 3.10.1.1 to address COL Information Item 3.10-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will identify any additional site-specific components that need to be added to the equipment list in Table 3.10-1.

In response to this COL information item, the COL applicant stated, "A list of site-specific seismically and dynamically qualified mechanical, electrical, and instrumentation and control equipment is provided in COL FSAR Table 3.10-1. Table 3.10-1 also identifies the type of environment to which the equipment is subjected."

The COL applicant provided additional information in COL FSAR Section 3.10.4 to address COL Information Item 3.10-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> If the seismic and dynamic qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S. EPR design certification will submit an implementation program, including milestones and completion dates for NRC review and approval prior to installation of the applicable equipment.

In response to this COL information item, the COL applicant stated, "The seismic and dynamic qualification implementation program, including milestones and completion dates, shall be developed and submitted for U.S. NRC approval prior to installation of the applicable equipment."

3.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is documented in U.S. EPR FSAR Tier 2, Section 3.10. The regulatory basis of the information incorporated by reference is addressed in the U.S. EPR SER. In addition, the relevant requirements of NRC regulations for the seismic and dynamic qualification of mechanical and electrical equipment, and the associated acceptance criteria, are given in NUREG-0800, Section 3.10 and are based on meeting the relevant requirements of the following regulations:

1 GDC 1 and GDC 30, as they relate to qualifying equipment to appropriate quality standards commensurate with the importance of the safety functions to be performed.

2 GDC 2 and 10 CFR Part 50, Appendix S, as they relate to designing equipment to withstand the effects of natural phenomena such as earthquakes.

3 GDC 4, as it relates to qualifying equipment as capable of withstanding the dynamic effects associated with external missiles and internally generated missiles, pipe whip, and jet impingement forces.

4 GDC 14, as it relates to qualifying equipment associated with the reactor coolant boundary so that there is an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

5 10 CFR Part 50, Appendix B, as it relates to qualifying equipment using the quality assurance criteria provided.

6 10 CFR part 50, Appendix B, Criterion III, as it relates to verifying and checking the adequacy of design, such as by the performance of a suitable test program, among other things, and which specifically requires that a test program used to verify the adequacy of a specific design feature shall include suitable qualifications testing of a prototype unit under the most adverse design conditions.

Acceptance criteria adequate to meet the above requirements include:

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the regulations identified above are described in SRP Section 3.10.

3.10.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.10 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.10, has been reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to seismic and dynamic qualification of mechanical and electrical equipment has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed as follows:

COL Information Items

COL Information Item 3.10-1

The staff reviewed COL Information Item 3.10-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.10.4. This COL information states:

> A COL applicant that references the U.S. EPR design certification will create and maintain the SQDP file during the equipment selection and procurement phase.

This COL information item is addressed by the COL applicant as follows:

> CCNPP Unit 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall create and maintain the SQDP file. This activity shall be initiated during the equipment selection and procurement phase. The SQDP file shall be maintained for the life of the plant.

The requirements for the SQDP are noted in a proposed license condition for COL Information Item 3.10-1 in COL application, Part 10, Appendix A. The staff reviewed the license condition and finds it consistent with the COL applicant's discussion of the COL information item. Therefore the staff finds that the COL applicant adequately addressed COL Information Item 3.10-1.

COL Information Item 3.10-2

The staff reviewed COL Information Item 3.10-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.10.1.1. This COL information item states:

> A COL applicant that references the U.S. EPR design certification will identify any additional site-specific components that need to be added to the equipment list in Table 3.10-1.

This COL information item is addressed by the COL applicant as follows:

> A list of site-specific seismically and dynamically qualified mechanical, electrical, and instrumentation and control equipment is provided in Table 3.10-1. Table 3.10-1 also identifies the type of environment to which the equipment is subjected.

The staff reviewed the site-specific components provided in COL FSAR Table 3.10-1 and finds the list acceptable. Therefore, the staff finds the COL applicant adequately addressed COL Information item 3.10-2.

COL Information Item 3.10-3

The staff reviewed COL Information Item 3.10-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.10.4. This COL information item states:

> If the seismic and dynamic qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S. EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment.

This COL information item is addressed by the COL applicant as follows:

> The seismic and dynamic qualification implementation program, including milestones and completion dates, shall be developed and submitted for U.S. Nuclear Regulatory Commission approval prior to installation of the applicable equipment.

Since the results of seismic and dynamic qualification of equipment were not available at the time of submittal of the COL FSAR, a five-phase qualification program plan was provided for CCNPP Unit 3 equipment in COL FSAR Revision 2.

The COL applicant provided a description of the seismic qualification program for the CCNPP Unit 3 site-specific equipment, which includes the UHS makeup water system intake structure and the fire protection equipment, including the Fire Protection Building and Fire Water Storage Tanks, required to achieve safe shutdown following an earthquake. The COL application outlines a five phase qualification program, stated to be in accordance with RG 1.206, "Combined License Applications for Nuclear Power Plants." Phase I and Phase II of the qualification program involved the Seismic Qualification Methodology and Specification Development with a schedule of "prior to procurement." It was unclear to the staff how much information will be provided prior to issuance of the license. 10 CFR 52.47 requires that the information submitted include performance requirements and design information sufficiently detailed to permit preparation of procurement specifications by the COL applicant. Phases I and II of the qualification program should occur prior to that point. Thus, information from Phase I for all equipment and information from Phase II for risk-significant equipment should be available for staff review prior to issuance of the license. Therefore, in RAI 140, Question 03.10-1, the staff requested that the COL applicant identify when this information will

be available and notify the staff with enough time before scheduled completion allowing the staff opportunity to review the information to make the safety determination for the COL application. Early in the Procurement Phase, the scope of Phase III will involve the Technical Bid Evaluations to compare with the technical specification requirements. Phase IV is for the supplier to perform new seismic analysis and/or testing when required to assure compliance with the technical specification requirements. Phase V (Documentation of Results) shall consist of the preparation of SQDP for each piece of equipment seismically qualified. As a minimum, the SQDP will include information required in the U.S. EPR FSAR, Appendix D, Attachment F. Furthermore, and most importantly for Phase V, the staff requested that the COL applicant notify the staff such that the staff can perform necessary review of test results prior to installation of the equipment.

In a March 19, 2010, response to RAI 140, Question 03.10-1, the COL applicant provided additional information in a table regarding the planned method(s) and milestones of seismic qualification for safety-related, Seismic Category I equipment. The COL applicant also stated that the seismic qualification of mechanical, electrical, and instrumentation and control (I&C) equipment will be performed in accordance with the requirements of Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 344. The equipment vendors will determine the type of qualification methodology to be used (to conform to IEEE Std No. 344. The method of qualification selected will be based on the applicability of the method for the size, type, complexity, and functional requirements of the equipment. The method used to qualify the equipment and the results will be documented in the seismic qualification data packages (SQDPs). This activity will be initiated during the equipment selection and procurement phase.

The COL applicant further indicated that the actual method used to seismically qualify equipment will be included in the ITAAC acceptance criteria for systems that contain components that are listed in the SQDP. The acceptance criteria for this ITAAC is as follows: "Seismic qualification reports (SQDP, EQDP, or analyses) exist and conclude that the Seismic Category I components can withstand seismic design basis loads without a loss of their functions." The requirements for the SQDP are a proposed license condition for COL application Part 10, Appendix A, COL Information Item 3.10-1. The schedule for meeting the ITAAC will be provided to the staff to comply with 10 CFR 52.99(a), "Inspection During Construction."

The staff finds that the COL applicant adequately addressed COL Information Item 3.10-3 because the SQDP is a license condition and is contained in the ITAAC acceptance criteria for systems that contain components that are listed in the SQDP.

3.10.5 Post Combined License Activities

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.10-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the section listed below.

Table 3.10-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.10-1	A COL applicant that references the U.S. EPR design	3.10.4	3.10.4

Item No.	Description	COL FSAR Section	COL SER Section
	certification will create and maintain the SQDP file during the equipment selection and procurement phase.		
3.10-3	If the seismic and dynamic qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S.EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment	3.10.4	3.10.4

3.10.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to seismic and dynamic qualification of mechanical and electrical equipment, and there is no outstanding information expected to be addressed in the COL FSAR related to this section The staff concludes that the information pertaining to COL FSAR Section 3.10 is within the scope of the design certification and adequately incorporates by reference U.S. EPR FSAR Tier 2, Section 3.10, and is therefore acceptable.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the seismic and dynamic qualification of mechanical and electrical equipment incorporated by reference in the COL FSAR have been documented in the staff's SER on design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update Section 3.10 of this report to reflect the final disposition of the U.S. EPR design certification application.

The staff concludes that the information pertaining to COL FSAR Section 3.10 is within the scope of the design certification, adequately incorporates by reference U.S. EPR FSAR Tier 2, Section 3.10, and meets the regulatory requirements of 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 4, GDC 14, GDC 30; 10 CFR Part 50, Appendix B, and 10 CFR Part 50, Appendix S.

3.11 Environmental Qualification of Mechanical and Electrical Equipment

3.11.1 Introduction

This section of the COL FSAR addresses the environmental qualification of CCNPP Unit 3 mechanical and electrical equipment, including instrumentation and control equipment that is essential to safe shutdown and prevention of significant release of radioactive material to the environment.

COL FSAR Sections 3.11.1, 3.11.2, 3.11.4, 3.11.5, and 3.11.6 incorporate the content of the respective design certification FSAR sections entirely by reference with no departures or supplements. COL FSAR Sections 3.11, 3.11.1, and 3.11.3 incorporate the content of the respective design certification FSAR sections by reference with no departures but include supplementary information to address several COL Information Items.

3.11.2 Summary of Application

COL FSAR Section 3.11 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.11 with no departures with supplementary information.

In addition, in COL FSAR Section 3.11, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.11 to address COL Information Item 3.11-1 as follows:

> A COL applicant that references the U.S. EPR design certification will maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.

The COL FSAR stated that the COL applicant will develop and maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.

The COL applicant provided additional information in COL FSAR Section 3.11.1.1.3 to address COL Information Item 3.11-2 as follows:

> A COL applicant that references the U.S. EPR design certification will identify additional site-specific components that need to be added to the environmental qualification list in Table 3.11-1.

The COL application provided in COL FSAR Table 3.11-1 the additional site-specific components that need to be added to the environmental qualification list.

The COL applicant provided additional information in COL FSAR Section 3.11.3 to address COL Information Item 3.11-3 as follows:

> If the equipment qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S. EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment.

The COL applicant stated that it will develop and submit the equipment qualification testing program to the staff, including milestones and completion dates, prior to installation of the applicable equipment.

The COL applicant provided additional information in COL FSAR Section 3.11.2.2.6 to address aspects of the site-specific operational program for maintaining environmental qualification of safety-related mechanical and electrical equipment.

The COL applicant provided additional information in COL FSAR Section 3.11.3 to address maintaining the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.

3.11.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in the staff's safety evaluation related to the U.S. EPR FSAR. The relevant NRC requirements for the additional information provided for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Section 3.11, Subsection II, "Acceptance Criteria," as summarized below. Review interfaces with other NUREG-0800 sections also can be found in NUREG-0800, Section 3.11.

1 GDC 2, "Design Bases for Protection Against Natural Phenomena," as it relates to components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety function.

2 GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs.

3 GDC 23, "Protection System Failure Modes," as it relates to protection systems be designed to fail in a safe state, or in a state demonstrated to be acceptable on some other defined basis, if conditions such as postulated adverse environments (e.g., extreme heat or cold, pressure, steam, water, or radiation) are experienced.

4 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records," for Nuclear Power Plants.

5 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," as it relates to quality assurance requirements.

6 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," as it relates to establishing a program for qualifying electrical equipment important to safety located in a harsh environment.

Acceptance criteria adequate to meet the above requirements include: (Note: Some of the referenced Regulatory Guides endorse IEEE Standards).

1 RG 1.180, "Guidelines for Evaluating Electromagnetic and Radio Frequency Interference in Safety-Related Instrumentation and Control Systems," provides guidance acceptable to the staff for determining EMC for I&C equipment during service.

2 RG 1.211, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants," replaces RG 1.131, "Qualification Tests of Electric Cables and Field Splices for Light-Water-Cooled Nuclear Power Plants," endorses IEEE Std 383-2003, "Standard for Type Test of Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations."

3 RG 1.40, "Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants," endorses IEEE Std 334, “IEEE Standard for Qualifying Continuous Duty Class 1 Motors for Nuclear Power Generating Stations.”

4 RG 1.156, "Environmental Qualification of Connection Assemblies for Nuclear Power Plants," endorses IEEE Std 572, “IEEE Standard for Qualification of Class 1EConnection Assemblies for Nuclear Power Generating Stations.”

5 RG 1.158, “Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants,” endorses IEEE Std 535-1986, “IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations.”

6 RG 1.63, “Electric Penetration Assemblies in Containment Structures for Light Water-Cooled Nuclear Power Plants,” endorses IEEE Std 317, “IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations.”

7 RG 1.73, ”Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants,” endorses IEEE Std 382, “IEEE Trial Use Guide for Type Test of Class 1E Electric Valve Operators for Nuclear Power Generating Stations.”

8 RG 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants,” provides the principal guidance for implementing the requirements and criteria of 10 CFR 50.49 for environmental qualification of electrical equipment that is important to safety and located in a harsh environment.

9 RG 1.97, “Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident,” provides guidance acceptable to the staff for the environmental qualification of the post-accident I&C monitoring equipment.

10 NUREG-0588, Seismic Category I guidance may be used if relevant guidance is not provided in RG 1.89.

11 IEEE Std 323 contains the principles and criteria that are generic to the environmental qualification process (endorsed by RG 1.89).

12 NUREG-0800, Section 3.11 provides additional details for determining acceptability of the application.

3.11.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.11 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of required information relating to this review topic. The staff’s review confirmed that the information contained in the COL application and incorporated by reference addresses the relevant information related to this section. U.S. EPR FSAR Tier 2, Section 3.11 is being reviewed by the staff under Docket No. 52-020.

The staff reviewed the information contained in COL FSAR Section 3.11, as discussed below.

COL Information Items

The staff reviewed the CCNPP Unit 3 design environmental qualification requirements for electrical and mechanical equipment in accordance with NUREG-0800, Section 3.11.

The COL applicant provided additional information in COL FSAR Section 3.11, "Equipment Qualification of Mechanical and Electrical Equipment," to address COL Information Item 3.11-1 as follows:

> A COL applicant that references the U.S. EPR design certification will maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant.

In COL FSAR Section 3.11, the COL applicant stated that it would maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase, and throughout the installed life in the plant.

In RAI 80, Question 03.11-3, the staff requested that the COL applicant clarify how the record shall be maintained in an auditable form so that the documents are readily accessible for audit and record retention in accordance with the requirements of 10 CFR 50.49(j). In an April 13, 2009, response to RAI 80, Question 03.11-3, the COL applicant, stated that in accordance with 10 CFR 50.49, a program for qualifying electric equipment that is important to safety will be established. This program will include developing a list of all electric equipment that is covered by the electric qualifying program. In addition, a record of qualification for each applicable electrical equipment type will be developed and maintained. The information will be kept in an appropriate file format and retained in accordance with Quality Assurance Program Description (QAPD). This information is to remain current and in an auditable form that meets 10 CFR 50.49(j) and QAPD. This file will readily permit verification that the applicable electrical equipment is qualified for its application and meets its specified performance requirements up to the end of its qualified life.

On the basis of its review of the COL applicant's April 13, 2009, response to RAI 80, Question 03.11-3, the staff finds that the COL applicant adequately addressed the issue. Therefore, the staff considers this issue resolved, since this response included a proposed revision to COL FSAR Section 3.11. The staff has confirmed that the COL FSAR Revision 7 was revised as committed in the RAI response. Accordingly, the staff finds that the COL applicant adequately addressed this issue and, therefore, the staff considers RAI 80, Question 03.11-3, resolved.

The COL applicant provided additional information in COL FSAR Section 3.11.1.1.3, "Equipment Review and Screening," to address COL Information Item 3.11-2 as follows:

> A COL applicant that references the U.S. EPR design certification will identify additional site-specific components that need to be added to the environmental qualification list in Table 3.11-1.

In COL FSAR Section 3.11.1.1.3, "Equipment Review and Screening," the COL applicant provided Table 3.11-1, "Site-Specific Environmentally Qualified Electrical/I&C Equipment," which included a site-specific additional list of Environmentally Qualified Electrical and I&C

Equipment for the UHS Makeup Water System and Fire Protection System. The cable types listed in COL FSAR Table 3.11-1 are for Class 1E power, control, instrumentation and communication. The COL applicant also indicated that the Class 1E cables and field splices will be evaluated for the site-specific portion of the UHS makeup water system in accordance with RG 1.131 and RG 1.89. The staff finds this meets the requirements of Class 1E electric cables and field splices in accordance with acceptable IEEE Std 383 endorsed by RG 1.131.

However, RG 1.131 was a draft regulatory guide which is no longer in use for the qualification tests for power cables and field splices. U.S. EPR FSAR Tier 2, Section 3.11.2.3.6 references RG 1.211, "Qualification of Safety-Related Cables and Field splices for Nuclear Power Plants," that endorses the latest IEEE Std 383-2003, "IEEE Standards for Qualifying Class 1E Electric Cables and Fielded Splices for Nuclear Power Plants."

Therefore, in RAI 294, Question 03.11-6, the staff requested that the COL applicant delete any reference to RG 1.131. In a March 25, 2011, response to RAI 294, Question 03.11-6, the COL applicant proposed to modify the regulatory guidance identified in the U.S. EPR FSAR Tier 2, Section 3.11.2.3.6 for the environmental qualification of Class 1E electric cables and field splices. The staff reviewed the COL applicant's response and finds it acceptable as it references correct regulatory guidance document. Accordingly, the staff considers RAI 294, Question 03.11-6 resolved.

The COL applicant provided additional information in COL FSAR Section 3.11.3, "Qualification Test Results," to address COL Information Item 3.11-3 as follows:

> If the equipment qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S. EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment.

In COL FSAR Revision 3, Section 3.11.3, the COL applicant stated that it would develop and submit the equipment qualification testing program, including milestones and completion dates for staff review and approval prior to installation of the applicable equipment. The staff finds this acceptable.

In RAI 302, Question 03.11-7, the staff requested that the COL applicant describe the process for implementation of the U.S. EPR FSAR provisions for environmental qualification of safety-related mechanical equipment in both mild and harsh environments. In a September 22, 2011, the COL applicant stated:

> The CCNPP Unit 3 Equipment Qualification Program includes the operational program for environmental qualification of mechanical and electrical equipment in accordance with SRP Section 3.11 and GDC 4.
>
> The CCNPP Unit 3 EQ program implements the environmental qualification requirements as described in U.S. EPR FSAR Tier 2, Section 3.11. These requirements will be incorporated in the equipment purchase specifications. The environmental qualification requirements for the mechanical items on that list will be specified in accordance with the Program.
>
> Requirements and implementation milestones for the Environmental Qualification Program are described in COL 3 FSAR Table 13.4-1, "Operational Programs Required by NRC Regulations and Program Implementation." As identified in

> COL FSAR Table 13.4-1, the Environmental Qualification Program has two associated license conditions. These conditions are identified as License Conditions 3 and 6 in Part 10, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) and ITAAC Closure" of the CCNPP Unit 3 license application.
>
> License Condition 3, "Operational Program Implementation," establishes a requirement to implement the programs or portions of programs identified in COL FSAR Table 13.4-1 on or before the associated milestones in COL FSAR Table 13.4-1. As described in COL FSAR Table 13.4-1, the Environmental Qualification Program is required to be implemented prior to initial fuel load.
>
> License Condition 6, "Operational Program Readiness," establishes a requirement to submit to the NRC, a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program COL FSAR Table 13.4-1. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the COL FSAR table have been fully implemented.

The staff finds that License Conditions 3 and 6 meet the requirements of RG 1.206, Section C.IV.4.2 and Commission Paper SECY-05-0197, such that an ITAAC is not required for implementation of the environmental qualification program.

The COL applicant stated that the Equipment Qualification Program includes the operational program for environmental qualification of mechanical and electrical equipment; the equipment qualification program for CCNPP Unit 3 implements the environmental qualification requirements as described in U.S. EPR FSAR Tier 2, Section 3.11; these requirements will be incorporated in the equipment purchase specifications; and that program implementation and readiness are license conditions. Therefore, the staff finds the description of the process to implement the U.S. EPR FSAR provisions for environmental qualification of safety-related mechanical and electrical equipment acceptable. The staff will verify implementation of the U.S. EPR FSAR provisions for environmental qualification of safety-related mechanical and electrical equipment by audit of the CCNPP Unit 3 procurement specifications. **RAI 302, Question 03.11-7 is being tracked as an open item** until completion of the staff's EQ audit.

In RAI 302, Question 03.11-8, the staff requested that the COL applicant address the operational aspects of the site specific environmental qualification program for safety-related mechanical and electrical equipment in both mild and harsh environments. In a September 22, 2011, response to RAI 302, Question 03.11-8, the COL applicant stated that COL FSAR Section 3.11.2.2.6, "Maintaining Mechanical Equipment Qualification," will be updated as follows:

> The operational programs for maintaining equipment qualification during the life of the plant will include the following aspects:
>
> (1) Evaluation of environmental qualification results for design life to establish activities to support continued environmental qualification; (2) determination of surveillance and preventive maintenance activities based on environmental qualification results; (3) consideration of environmental qualification maintenance recommendations from equipment vendors; (4) evaluation of operating experience in developing surveillance and preventive maintenance activities for specific equipment; (5) development of plant procedures that specify individual

equipment identification, appropriate references, installation requirements, surveillance and maintenance requirements, post-maintenance testing requirements, condition monitoring requirements, replacement part identification, and applicable design changes and modifications; (6) development of plant procedures for reviewing equipment performance and environmental qualification operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the environmental qualification operational program; and (7) development of plant procedures for the control and maintenance of environmental qualification records.

The staff considers the aspects of the operational program adequate for maintaining equipment qualification during the life of the plant. Therefore, staff finds the aspects of the operational programs for maintaining equipment qualification acceptable. Based on revision of COL FSAR Section 3.11.2.2.6, the staff considers RAI 302, Question 03.11-8 resolved.

In RAI 302, Question 03.11-9, the staff requested that the COL applicant describe the process to maintain the equipment qualification test results and qualification status file; development of procedures and maintenance activities related to the EQ of operational program; and development of the EQMEL which includes the equipment mission times. In a September 22, 2011, response to RAI 302, Question 03.11-9, the COL applicant stated that COL FSAR Section 3.11.3, "Qualification Test Results," will be updated to add the following:

> The documentation necessary to support the continued qualification of the equipment installed in the plant that is within the Environmental Qualification (EQ) Program scope is available in accordance with 10 CFR Part 50 Appendix A, General Design Criterion 1. The licensee is responsible for the maintenance of the equipment qualification file upon receipt from the reactor vendor.
>
> Test results for site-specific electrical and mechanical equipment are maintained with the project records as auditable files. Such records are maintained from the time of initial receipt through the entire period during which the subject equipment remains installed in the plant, is stored for future use, or is held for permit verification. Full responsibility is assumed for the EQ program at time of license issuance. The EQ records are maintained for the life of plant to fulfill the records retention requirements delineated in 10 CFR 50.49, and in compliance with the Quality Assurance Program described in Chapter 17, "Quality Assurance and Reliability Assurance," of this report.
>
> EQ files developed are maintained as applicable for equipment and certain post-accident monitoring devices that are subject to a harsh environment. The contents of the qualification files are discussed in U.S. EPR FSAR Tier 2, Section 3D.8. The files are maintained for the operational life of the plant. For equipment not located in a harsh environment, design specifications received from the vendor are retained. Any plant modifications that impact the equipment use the original specifications for modification or procurement. This process is governed by applicable plant design control or configuration control procedures.
>
> Central to the EQ Program is the EQ Master Equipment List (EQMEL). This EQMEL identifies the electrical and mechanical equipment or components that must be environmentally qualified for use in a harsh environment. The EQMEL consists of equipment that is essential to emergency reactor shutdown, containment isolation, reactor core cooling, or containment and reactor heat

removal, or that is otherwise essential in preventing significant release of radioactive material to the environment. This list is developed from the equipment list provided in U.S. EPR FSAR Tier 2, Tables 3.10-1 and 3.11-1. The EQMEL and a summary of equipment qualification results are maintained as part of the equipment qualification file for the operational life of the plant.

Administrative programs are in place to control revision to the EQ files and the EQMEL. When adding or modifying components in the EQ Program, EQ files are generated or revised to support qualification. The EQMEL is revised to reflect these new components. To delete a component from the EQ Program, a deletion justification is prepared that demonstrates why the component can be deleted.

This justification consists of an analysis of the component, an associated circuit review if appropriate, and a safety evaluation. The justification is released and/or referenced on an appropriate change document. For changes to the EQMEL, supporting documentation is completed and approved prior to issuing the changes. This documentation includes safety reviews and new or revised EQ files. Plant modifications and design basis changes are subject to change process reviews, (e.g., Reviews in accordance with 10 CFR 50.59 or 10 CFR Part 52, Appendix D, Section VIII in accordance with appropriate plant procedures).

These reviews address EQ issues associated with the activity. Any changes to the EQMEL that are not the result of a modification or design basis change are subject to a separate review that is accomplished and documented in accordance with plant procedures.

Engineering change documents or maintenance documents generated to document work performed on an EQ component, which may not have an impact on the EQ file, are reviewed against the current revision of the EQ files for potential impact. Changes to EQ documentation may be due to, but not limited to, plant modifications, calculations, corrective maintenance, or other EQ concerns.

Based on the above response, the staff concludes that the COL applicant adequately described the process that will be used to maintain the equipment qualification test results and qualification status file; development of procedures and maintenance activities related to the EQ of operational program; and development of the EQMEL. The staff notes that the COL applicant is responsible for the maintenance of the equipment qualification file upon receipt from the reactor vendor. Based on revision of COL FSAR Section 3.11,3, the staff considers RAI 302, Question 03.11-9 resolved.

Operating experience from nuclear power plants has revealed the potential for adverse flow effects during normal plant operation that can impact safety-related components (such as safety relief valves). As a result, equipment qualification programs need to address these adverse flow effects to provide confidence in the capability of safety-related equipment to be capable of performing their safety functions. In RAI 302, Question 03.11-10, the staff requested that the COL applicant provide details the CCNPP Unit 3 plan to implement the U.S. EPR FSAR provisions for equipment qualification to address the effects of flow induced vibration. In a September 22, 2011, response to RAI 302, Question 03.11-10, the COL applicant stated:

The design and qualification of mechanical equipment is described within the scope of the certified design and incorporated by reference in the CCNPP Unit 3 FSAR. U.S. EPR FSAR Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment,” describes requirements for the environmental qualification (EQ) elements of the equipment qualification program. The environmental qualification program includes dynamic and seismic qualification. Dynamic qualification is addressed in U.S. EPR FSAR Section 3.9, “Mechanical Systems and Components,” and U.S. EPR FSAR Section 3.10, “Seismic and Dynamic Qualification of Mechanical and Electrical Equipment,” for Seismic Category I equipment.

Adverse piping vibration may occur due to disturbances or instabilities of the flow in the piping, depending upon the as-built piping configuration including supports, and the operating (e.g., pumps, valves and SRVs) and non-operating (e.g., pressure reducing devices and flow restrictors) components in the system. U.S. EPR FSAR Tier 2, Sections 3.9.2, “Dynamic Testing and Analysis of Systems, Components, and Equipment,” and 14.2, “Initial Plant Test Program,” and COL 3 FSAR Section 14.2, “Initial Test Program,” include requirements for pre-operational and initial start-up testing for piping vibrations. This testing provides monitoring and verification of the ability of components and systems to withstand the temperatures, pressures, vibrations, and thermal expansions associated with normal plant operation and maintenance, as well as the transient conditions arising from anticipated operational events, such as valve and pump actuations. During this testing, piping vibration is corrected if it does not meet the acceptance criteria.

U.S. EPR FSAR Tier 2, Section 3.9.2.1 specifically addresses this performance testing as being provided: “.... to identify unacceptable movement, noise, vibration, and damage caused by rapid valve opening and closing, safety valve discharge, pump operation, and other operational transients. During this phase, the piping and piping restraints are observed for vibration and expansion response and the automatic safety devices, control devices, and other major equipment are observed for indications of overstress, excessive vibration, overheating, and noise. Each system test includes critical valve operation during anticipated transients."

U.S. EPR FSAR Tier 2, Section 3D provides an example Equipment Qualification Data Package checklist that includes consideration of non-seismic vibration loads.

UniStar Nuclear Energy will perform vibration testing as described in U.S. EPR FSAR Tier 2, Sections 3.9.2.1 and 14.2, and COL FSAR Section 14.2.

The staff finds the description of the CCNPP Unit 3 plan to implement the U.S. EPR FSAR provisions for equipment qualification to adequately address the effects of flow induced vibration acceptable. Therefore, the staff considers RAI 302, Question 03.11-10 resolved.

3.11.5 Post Combined License Activities

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.11-1 of this report include

the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the SER section listed below.

Table 3.11-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.11-1	A COL applicant that references the U.S. EPR design certification will maintain the equipment qualification test results and qualification status file during the equipment selection, procurement phase and throughout the installed life in the plant	3.11	3.11.4
3.11-3	If the equipment qualification testing is incomplete at the time of the COL application, a COL applicant that references the U.S.EPR design certification will submit an implementation program, including milestones and completion dates, for NRC review and approval prior to installation of the applicable equipment	3.11.3	3.11.4
LC-3	Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall implement the programs identified in FSAR Table 13.4-1 on or before the associated milestones in FSAR Table 13.4-1.	13.11	13.11.4
LC-6	Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC shall submit to the appropriate Director of the NRC, a schedule, no later than 12 months after issuance ofthe COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program FSAR Table 13.4-1. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until either the operational programs in the FSAR table have been fully implemented or the plant has been placed in commercial service, whichever comes first.	13.11	13.11.4

3.11.6 Conclusions

The staff reviewed COL FSAR Section 3.11 and the supplemental information addressed in the COL application for CCNPP Unit 3 and checked the referenced U.S. EPR FSAR to ensure that the COL information and supplemental information required to be provided by the COL applicant have been properly addressed in their COL application relative to the EQ of mechanical and electrical equipment. The staff finds that COL FSAR Section 3.11 and its supplemental information provided in COL FSAR Section 3.11 is incorporated by referencing the U.S. EPR FSAR with no departure and is adequate to support the CCNPP Unit 3 application.

The staff is reviewing the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to environmental qualification of mechanical and electrical equipment incorporated by reference in the COL FSAR will be documented in the staff safety-evaluation report on the design certification application for the U.S. EPR. The SER on the U.S. EPR is not yet complete. The staff will update this report to reflect the final disposition of the design certification application.

As a result of the confirmatory items and open items discussed above, the staff is unable to finalize its conclusions on the information provided in COL FSAR Section 3.11 in accordance with the regulatory requirements of 10 CFR Part 50, Appendix A GDC 1, GDC 2, GDC 4, and GDC 23; 10 CFR Part 50, Appendix B; and 10 CFR 50.49,

3.12 ASME Code Class 1, 2, and 3 Piping Systems, Piping Components, and Their Associated SupportsIntroduction

This section describes the design of the piping system and piping support for Seismic Category I, Category II, and non-safety systems. It also discusses the adequacy of the structural integrity, as well as the functional capability of the safety-related piping system, piping components, and their associated supports. The design of piping systems should ensure that they perform their safety-related functions under all postulated combinations of normal operating conditions, system operating transients, postulated pipe breaks, and seismic events. This includes pressure-retaining piping components and their supports, buried piping, instrumentation lines, and the interaction of Non-seismic Category I piping and associated supports with Seismic Category I piping and associated supports. This section covers the design transients and resulting loads and load combinations with appropriate specified design and service limits for Seismic Category I piping and piping support, including those designated as ASME Code Class 1, 2, 3, and those not covered by the ASME Code.

3.12.2 Summary of Application

COL FSAR Section 3.12 incorporates by reference U.S. EPR FSAR Tier 2, Section 3.12, "ASME Code Class 1, 2, and 3 Piping Systems, Piping Components, and Their Associated Supports."

In addition, in COL FSAR Section 3.12, the COL applicant provided the following:

COL Information Items

The COL applicant provided additional information in COL FSAR Section 3.12.4.2, "Dynamic Piping Model," to address COL Information Item 3.12-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will perform a review of the impact of contributing mass of supports on the piping analysis following the final support design to confirm that the mass of the support is no more than ten percent of the mass of the adjacent pipe span. If the impact review determines the existing piping analysis does not bound the additional mass of the pipe support, the COL applicant will perform reanalysis of the piping to include the additional mass.

In response to this COL information item, the COL applicant proposed a license condition and stated that they will "perform a review of the impact of contributing mass of supports on the piping analysis following the final support design to confirm that the mass of the support is no more than ten percent of the mass of the adjacent pipe span."

The COL applicant provided additional information in COL FSAR Section 3.12.4.3, "Piping Benchmark Program," to address COL Information Item 3.12-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> As indicated in Section 5.3 of topical report ANP-10264NP-A, pipe and support stress analysis will be performed by the COL applicant that references the U.S. EPR design certification. If the COL applicant that references the U.S. EPR design certification chooses to use a piping analysis program other than those listed in Section 5.1 of the topical report, the COL applicant will implement a benchmark program using models specifically selected for the U.S. EPR."

In response to this COL information item, the COL applicant proposed a license condition and stated that they will use piping analysis programs given in topical report ANP-10264NP-A, Section 5.1.

The COL applicant provided additional information in COL FSAR Section 3.12.5.9, "Thermal Oscillations in Piping Connected to the Reactor Coolant System," to address COL Information Item 3.12-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will monitor the RHR/SIS/EBS injection piping from the RCS to the first isolation valve (all four trains), and RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4) during the first cycle of the first U.S. EPR initial plant operation to verify that operating conditions have been considered in the design unless data from a similar plant's operation demonstrated that thermal oscillation is not a concern for piping connected to the RCS.

In response to this COL information item, the COL applicant stated, "The RHR/SIS/EBS injection piping shall be monitored from the RCS to the first isolation valve (all four trains), and the RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4) during the first cycle to verify that the operating conditions have been considered in the design unless data from a similar plant's operation demonstrated that thermal oscillation is not a concern for piping connected to the RCS." Additionally, the COL applicant also proposed a license condition for this item.

The COL applicant provided additional information in COL FSAR Section 3.12.5.10.1, "Pressurizer Surge Line Stratification (NRC Bulletin 88-11)," to address COL Information Item 3.12-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will monitor pressurizer surge line temperatures during the first fuel cycle of initial plant operation to verify that the design transients for the surge line are representative of actual plant operations.

In response to this COL information item, the COL applicant stated, "The pressurizer surge line temperatures will be monitored during the first fuel cycle of initial plant operation to verify that

the design transients for the surge line are representative of actual plant operations." Additionally, the COL applicant also proposed a license condition for this item.

The COL applicant provided additional information in COL FSAR Section 3.12.5.10.3, "Spray Line Stratification," to address COL Information Item 3.12-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will monitor the normal spray line temperatures during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the normal spray are representative of actual plan[t] operations unless data from a similar plant's operation determines that monitoring is not warranted.

In response to this COL information item, the COL applicant stated, "The normal spray line temperatures will be monitored during the first cycle of plant operation to verify that the design transients for the normal spray are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted." Additionally, the COL applicant also proposed a license condition for this item.

The COL applicant provided additional information in COL FSAR Section 3.12.5.10.4, "Feedwater Line Stratification (NRC Bulletin 79-13)," to address COL Information Item 3.12-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will monitor the temperature of the main feedwater lines during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the main feedwater lines are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted.

In response to this COL information item, the COL applicant stated, "The temperature of the main feedwater lines will be monitored during the first cycle of plant operation to verify that the design transients for the main feedwater lines are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted." Additionally, the COL applicant also proposed a license condition for this item.

Supplemental Information

The COL applicant provided the following supplemental information in COL FSAR Section 3.12.5.1, "Seismic Input Envelope versus Site-Specific Spectra."

> The site-specific seismic response is within the parameters of U.S. EPR FSAR Tier 2, Section 3.7.2 as discussed in Section 3.7.2. The In-Structure Response Spectra (ISRS) is generated from the soil cases defined in the U.S. EPR FSAR Section 3.7.1 and is used for pipe stress and support analysis on systems within the scope of the U.S. EPR FSAR certified design for Category I structures. Site-specific ISRS defined in FSAR Section 3.7.2.5 for the UHS MWIS is used for the pipe stress and support analysis of site-specific systems within the structure. These site-specific ISRS are based on foundation input response spectra for site-specific structures discussed in Section 3.7.1.1.1.

3.12.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the SER related to the U.S. EPR FSAR.

In addition, the relevant requirements of NRC regulations for the analysis of ASME Code Class 1, 2, and 3 piping system, components and associated supports, and the associated acceptance criteria, are given in NUREG-0800, Section 3.12, “ASME Code Class 1, 2, and 3 Piping Systems, Piping Components and Their Associated Supports.”

The applicable regulatory requirements for the piping design review are as follows:

1. GDC 1, “Quality Standards and Records,” as it relates to piping systems, pipe supports, and components being designed, fabricated, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.

2. GDC 2, “Design Bases for Protection Against Natural Phenomena,” as it relates to design transients and resulting load combinations for piping and pipe supports necessary to withstand the effects of earthquakes combined with the effects of normal or accident conditions.

3. GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to piping systems and pipe supports important to safety, being designed to accommodate the effects of, and to be compatible with, the environmental conditions of normal as well as postulated events, such as LOCAs and dynamic effects.

4. GDC 14, “Reactor Coolant Pressure Boundary,” as it relates to the RCPB of the primary piping systems being designed, fabricated, constructed, and tested to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

5. GDC 15, “Reactor Coolant System Design,” as it relates to the reactor coolant systems and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design condition of the RCPB are not exceeded during any condition of normal operation, including anticipated operational occurrences.

6. 10 CFR Part 50, Appendix S, “Earthquake Engineering Criteria for Nuclear Power Plants,” as it relates to design transients and resulting load combinations for piping and pipe supports necessary to withstand the effects of earthquakes combined with the effects of normal or accident conditions.

7. 10 CFR 50.55a,“Code and Standards” as it relates to piping systems, pipe supports, and components being designed, fabricated, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.

8. Specific acceptance criteria are described in SRP Section 3.12.

3.12.4 Technical Evaluation

The staff reviewed COL FSAR Section 3.12 and checked the referenced design certification FSAR to ensure that the combination of the information in the U.S. EPR FSAR and the information in the COL FSAR represents the complete scope of information relating to this

review topic. The staff's review confirmed that the information contained in the COL application and incorporated by reference addresses the required information relating to this section. U.S. EPR FSAR Tier 2, Section 3.12 is being reviewed by the staff under Docket No. 52-020. The staff's technical evaluation of the information incorporated by reference related to piping design has been documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff's review of the information contained in the COL FSAR is discussed below:

COL Information Items

The staff reviewed COL Information Item 3.12-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.4.2. The staff finds that the proposed license condition for the piping analytical modeling meets the recommendation of SRP Section 3.7.2.3.B.iii. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-1 acceptable.

The staff reviewed COL Information Item 3.12-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.4.3. The staff finds that the proposed license condition will ensure the COL applicant's computer programs benchmark process is consistent with the guidance in SRP Section 3.12. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-2 acceptable.

The staff reviewed COL Information Item 3.12-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.5.9. COL Information Item 3.12-3 for thermal oscillation monitoring activities will be addressed by the COL applicant during the first cycle of the first U.S. EPR initial plant operation in accordance with the requirements specified by the proposed license condition. The staff finds that the proposed license condition will ensure the operating conditions have been considered in the design to address the recommendations of NRC Bulletin 88-08. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-3 acceptable.

The staff reviewed COL Information Item 3.12-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.5.10.1. COL Information Item 3.12-4 for pressurizer surge line stratification monitoring activities will be addressed by the COL applicant during the first cycle of the initial plant operation in accordance with the requirements specified by proposed license conditions. The staff finds that the proposed license condition will ensure the operating conditions have been considered in the design to address the recommendations of NRC Bulletin 88-11. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-4 acceptable.

The staff reviewed COL Information Item 3.12-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.5.10.3. COL Information Item 3.12-5 for spray line stratification monitoring activities will be addressed by the COL applicant during the first cycle of the first U.S. EPR initial plant operation in accordance with the requirements specified by proposed license conditions. The staff finds that the proposed license condition will ensure the operating conditions have been considered in the design. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-5 acceptable.

The staff reviewed COL Information Item 3.12-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under COL FSAR Section 3.12.5.10.4. COL Information Item 3.12-6 for stratification monitoring activities will be addressed by the COL applicant during the first cycle of the initial

plant operation in accordance with the requirements specified by the proposed license condition. The staff finds that the proposed license condition will ensure the operating conditions have been considered in the design to address the recommendations of NRC Bulletin 79-13. Therefore, the staff considers the COL applicant's response to COL Information Item 3.12-6 acceptable.

The staff acknowledged that the design certification applicant has not completed the piping design and ITAAC (DAC) is used to address the piping design. The COL applicant's piping DAC ITAAC closure is evaluated and documented in Section 14.3.3 of this report.

Supplemental Information

The supplemental information for COL FSAR Section 3.12.4.2 is considered an editorial change by replacing a COL applicant to the owner's name. Therefore, the staff finds this acceptable. In addition, the supplemental information for COL FSAR Section 3.12.4.3 is considered an editorial change to clarify piping analysis programs to be used by the COL applicant. Therefore, the staff finds this acceptable.

The supplemental information for COL FSAR Section 3.12.5.1 identified that the site-specific seismic response has been addressed in COL FSAR Section 3.7.2. The staff evaluated and documented its finding in Section 3.7.2 of this report.

The staff considers the supplemental information for COL FSAR Section 3.12.5.9 and 3.12.5.10 an editorial change to clarify the monitoring activities to be used by the COL applicant. Therefore, the staff finds this acceptable.

3.12.5 Post Combined License Activities

U.S. EPR FSAR Tier 2, Table 1.8-2, contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.12-1 of this report include the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed below.

Table 3.12-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.12-1	A COL applicant that references the U.S. EPR design certification will perform a review of the impact of contributing mass of supports on the piping analysis following the final support design to confirm that the mass of the support is no more than ten percent of the mass of the adjacent pipe span.	3.12.4.2	3.12.4

Item No.	Description	COL FSAR Section	COL SER Section
3.12-2	As indicated in Section 5.3 of topical report ANP-10264NP-A, pipe and support stress analysis will be performed by the COL applicant that references the U.S. EPR design certification. If the COL applicant that references the U.S. EPR design certification chooses to use a piping analysis program other than those listed in Section 5.1 of the topical report, the COL applicant will implement a benchmark program using models specifically selected for the U.S. EPR.	3.12.4.3	3.12.4
3.12-3	A COL applicant that references the U.S. EPR design certification will monitor the RHR/SIS/EBS injection piping from the RCS to the first isolation valve (all four trains), and RHR/SIS suction piping from the RCS to the first isolation valve (trains 1 and 4) during the first cycle of the first U.S. EPR initial plant operation to verify that operating conditions have been considered in the design unless data from a similar plant's operation demonstrates that thermal oscillation is not a concern for piping connected to the RCS.	3.12.5.9	3.12.4
3.12-4	A COL applicant that references the U.S. EPR design certification will monitor pressurizer surge line temperatures during the first fuel cycle of initial plant operation to verify that the design transients for the surge line are representative of actual plant operations.	3.12.5.10.1	3.12.4
3.12-5	A COL applicant that references the U.S. EPR design certification will monitor the normal spray line temperatures during the first cycle of the first U.S. EPR plant operation to verify that the design transients for the normal spray are representative of actual plan[t] operations unless data from a similar plant's operation determines that monitoring is not warranted.	3.12.5.10.3	3.12.4
3.12-6	A COL applicant that references the U.S. EPR design certification will monitor the temperature of the main feedwater lines during the first cycle of the first U.S. EPR initial plant operation to verify that the design transients for the main feedwater lines are representative of actual plant operations unless data from a similar plant's operation determines that monitoring is not warranted	3.12.5.10.4	3.12.4

3.12.6 Conclusions

The staff reviewed the COL application and checked the referenced U.S. EPR FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating to ASME Code Class 1, 2, and 3 piping systems, piping Components, and their supports, and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to the piping design incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update this section of this report to reflect the final disposition of the U.S. EPR design certification application.

In addition, the staff compared additional information provided to address COL information items within the COL application to the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 3.12, and other applicable NRC regulatory guides and concludes that the COL application is in compliance with NRC regulations.

As a result of the open and confirmatory items of Section 3.7 of this report, the staff is unable to finalize its conclusion regarding the ASME Code Class 1, 2, and 3 piping systems, piping components and their associated supports. to be used at CCNPP Unit 3 in accordance with the requirements of 10 CFR 50.55a, 10 CFR Part 50, Appendix S, 10 CFR Part 50, Appendix A, GDC 1, GDC 2, GDC 4, GDC 14, and GDC 15, and that COL information items involving design specifications and as-designed reports will be adequately addressed by the COL applicant's ITAAC and will be resolved after final acceptance of the U.S. EPR FSAR.

3.13 Threaded Fasteners (ASME Code Class 1, 2, and 3)

3.13.1 Introduction

This section provides criteria used to select materials to fabricate threaded fasteners (e.g., threaded bolts, studs) in ASME Code Class 1, 2, or 3 systems, as well as the criteria to fabricate, design, test, and inspect the threaded fasteners in these systems, both before initial service and during service. This section does not address structural bolting. The staff's review of programs and procedures for structural bolting is discussed in Section 3.8 of this report.

3.13.2 Summary of Application

In COL FSAR Section 3.13, "Threaded Fasteners (ASME Code Class 1, 2, and 3)," the COL applicant incorporated by reference U.S. EPR FSAR Tier 2, Section 3.13. U.S. EPR FSAR Tier 2 includes Section 3.13.1, "Design Considerations," and Section 3.13.2, "Inservice Inspection Requirements." U.S. EPR FSAR Tier 2, Section 3.13.1 is incorporated by reference with no departures or supplements. U.S. EPR FSAR Tier 2, Section 3.13.2 is incorporated by reference with supplementary information and a proposed license condition to resolve. (U.S. EPR FSAR COL Information Item 3.13-1).

U.S. EPR FSAR COL Information Item 3.13-1 states:

> A COL applicant that references the U.S. EPR design certification will submit the inservice inspection plan for ASME Class 1, Class 2, and Class 3 threaded fasteners to the NRC prior to performing the first inspection. The program will identify the applicable edition and addenda of ASME Section XI and ensure compliance with the requirements of 10CFR50.55a (b)(2)(xxvii).

3.13.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is documented in U.S. EPR FSAR Tier 2, Section 3.13 related to the design certification. The regulatory basis of the information incorporated by reference is addressed in the U.S. EPR SER. In addition, the relevant requirements of NRC regulations for threaded fasteners, and the associated acceptance criteria, are given in NUREG-0800, Section 3.13 and are based on meeting the relevant requirements of the following regulations:

1 10 CFR Part 50, Appendix A, GDC 1 and GDC 30, as they relate to the requirement that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

2 GDC 4, as it relates to the compatibility of components with environmental conditions.

3 GDC 14, as it relates to the requirement that the reactor coolant pressure boundary (RCPB) be designed, fabricated, erected, and tested in a manner that provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture.

4 GDC 31, as it relates to the requirement that the RCPB be designed with sufficient margin to ensure that when stressed under operating, maintenance, testing, and postulated accident conditions the boundary behaves in a nonbrittle manner and the probability of rapidly propagating fracture is minimized.

5 10 CFR Part 50, Appendix B, as it relates to controlling the cleaning of material and equipment to prevent damage or deterioration.

6 10 CFR Part 50, Appendix G, as it relates to materials testing and acceptance criteria for fracture toughness of reactor pressure boundary components.

7 10 CFR 50.55a, as it relates to the incorporation by reference of the design criteria of ASME Code, Section III, Class 1, 2, and 3 components. The selection of materials, design, testing, fabrication, installation and inspection of threaded fasteners and mechanical joints are acceptable if they meet the criteria of the ASME Code, Section III, Class 1, 2, and 3 components. However, 10 CFR 50.55a(b)(4) permits use of ASME Code cases that have been adopted by the staff in RG 1.84 in lieu of applicable criteria of ASME Code, Section III, Class 1, 2, and 3 components.

8 10 CFR 50.55a, as it relates to incorporation by reference of ASME Section XI for preservice and inservice inspection of ASME Code Class 1, 2, and 3 components, Section XI preservice and inservice inspection includes threaded fasteners.

Acceptance criteria adequate to meet the above requirements include:

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the regulations identified above are described in SRP Section 3.13.

3.13.4 Technical Evaluation

The staff reviewed conformance of COL FSAR Section 3.13 to the guidance in RG 1.206, Section C.III.1, Chapter 3, C.I.3.13, "Threaded Fasteners – ASME Code Class 1, 2, and 3." The staff concluded that COL FSAR Section 3.13 the COL applicant appropriately incorporated by reference U.S. EPR FSAR Tier 2, Section 3.13.

The U.S. EPR FSAR includes COL Information Item in Section 3.13.2 (U.S. EPR FSAR Tier 2, Table 1.8-2, COL Information Item 3.13-1): This COL Information Item states:

> A COL applicant referencing the U.S. EPR design certification will submit the inservice inspection plan for ASME Class 1, Class 2, and Class 3 threaded fasteners to the NRC prior to performing the first inspection. The program will identify the applicable edition and addenda of ASME Section XI and ensure compliance with the requirements of 10 CFR 50.55a(b)(2)(xxvii).

The COL applicant addressed COL Information Item 3.13-1 with the following information:

> (Constellation Generation Group and UniStar Nuclear Operating Services) shall submit the inservice inspection plan for ASME Class 1, Class 2, and Class 3 threaded fasteners to the U.S. Nuclear Regulatory Commission prior to performing the first inspection.

With respect to the information provided in COL Information Item 3.13-1, the staff reviewed this for consistency with the requirements of 10 CFR 50.55a, "Codes and Standards," as it relates to pre-service and inservice inspections of Class 1, 2, and 3 components. 10 CFR 50.55a incorporates by reference ASME B&PV Code, Section XI. ASME B&PV Code, Section XI defines, for each component ASME Code Class (including fasteners), the specific inservice inspection requirement (e.g., methodology, periodicity, acceptance criteria). The inservice inspection program includes a license condition proposed by the COL applicant to perform a pre-service inspection prior to initial plant start up. Sections 5.2.4, "Inservice Inspection and Testing of the RCPB," and 6.6, "Inservice Inspection of ASME Code Class 2 and 3 Components," of this report provide details of the staff's review of the CCNPP3 inservice inspection program description and its implementation. Based on the above, the staff finds the COL applicant adequately addressed COL Information Item 3.13-1 by stating that the inservice inspection plan for ASME Code Class 1, Class 2, and Class 3 threaded fasteners will be submitted to the staff prior to performing the first inspection. The staff finds this COL information item meets the requirements of 10 CFR 50.55a, and is therefore acceptable. The staff notes that the COL information item did not deviate from the intent of the corresponding provision in the U.S. EPR FSAR. Therefore, the staff finds that this item consistent with the U.S. EPR FSAR**.**

3.13.5 Post Combined License Activities

U.S. EPR FSAR Tier 2, Table 1.8-2 contains COL information items that the COL applicant is required to address. The following COL information items in Table 3.13-1 of this report include

the proposed combined license activities which the staff has evaluated in this report, but which will be completed following issuance of the license as discussed in the sections listed below:

Table 3.13-1 Post Combined License Activities

Item No.	Description	COL FSAR Section	COL SER Section
3.13-1	A COL applicant that references the U.S. EPR design certification will submit the inservice inspection plan for ASME Class 1, Class 2, and Class 3 threaded fasteners to the NRC prior to performing the first inspection. The program will identify the applicable edition and addenda of ASME Section XI and ensure compliance with the requirements of 10 CFR 50.55a(b)(2)(xxvii).	3.13-1	3.13.4

3.13.6 Conclusion

The staff reviewed the COL application and checked the referenced design certification FSAR to ensure that all COL information items, interface items, and supplemental information required to be provided by the COL applicant have been addressed in the COL application. The staff's review confirmed that the COL applicant addressed the required information relating threaded fasteners and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff reviewed the information in the U.S. EPR FSAR on Docket No. 52-020. The results of the staff's technical evaluation of the information related to ASME Class 1, 2, and 3 threaded fasteners incorporated by reference in the COL FSAR have been documented in the staff's SER on the design certification application for the U.S. EPR. The staff's SER on the U.S. EPR is not yet complete. The staff will update this section of this report to reflect the final disposition of the U.S. EPR design certification application.

The staff concludes that the information pertaining to COL FSAR Section 3.13 is within the scope of the design certification and adequately incorporates by reference U.S. EPR FSAR, Tier 2, Section 3.13, and meets the regulatory requirements of 10 CFR Part 50, Appendix A, GDC 1, GDC 4, GDC 14, GDC 30, GDC 31, 10 CFR Part 50, Appendix B and Appendix G, and 10 CFR 50.55a. In addition, the staff finds COL Information Item 3.13-1 has been adequately addressed by the COL applicant.