FINAL SAFETY ANALYSIS REPORT

CHAPTER 6

ENGINEERED SAFETY FEATURES

6.0 ENGINEERED SAFETY FEATURES

This chapter of the U.S. EPR Final Safety Analysis Report (FSAR) is incorporated by reference with supplements as identified in the following sections.

6.1 ENGINEERED SAFETY FEATURES MATERIALS

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

6.1.1 Metallic Materials

No departures or supplements.

6.1.1.1 Materials Selection and Fabrication

The U. S. EPR FSAR includes the following COL Item in Section 6.1.1.1:

> A COL applicant that references the U. S. EPR design certification will review the fabrication and welding procedures and other QA methods of ESF component vendors to verify conformance with RGs 1.44 and 1.31.

This COL Item is addressed as follows:

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC} will select vendors in accordance with requirements in the Quality Assurance Program Description (QAPD) referenced in FSAR Section 17.5.

The QAPD describes Control of Purchased Material, Equipment and Services. The QAPD establishes measures to provide control of special processes. Special processes that control or verify quality, such as those used in welding, heat treating, and nondestructive examination, must be performed by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements. Ensuring the vendor processes conform to Regulatory Guides 1.31 and 1.44 (NRC, 1978 and NRC, 1973) will be accomplished by this license condition:

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC} will include, or require its contractors to include, a review of special processes such as fabrication and welding procedures and other QA methods to verify conformance with Regulatory Guides 1.31 and 1.44 for ESF components as part of the procurement process. The procurement process will be established prior to purchasing ESF components.

This will ensure that conformance with RG 1.31 and 1.44 will be established within the appropriate vendor processes prior to initiation of any fabrication activity that would be subject to NRC construction inspection program.

6.1.1.2 ESF Fluids

No departures or supplements.

6.1.1.3 Component and Systems Cleaning

No departures or supplements.

6.1.1.4 Thermal Insulation

No departures or supplements.

6.1.2 Organic Materials

No departures or supplements.

6.1.2.1 Description of Protective Coatings

No departures or supplements.

6.1.2.2 Safety Evaluation

No departures or supplements.

6.1.2.2.1 Coating Integrity and Other Safety Measures

No departures or supplements.

6.1.2.2.2 Coating Repairs and Limitations on Coating Thickness

The U. S. EPR FSAR includes the following COL Item in Section 6.1.2.2.2:

> A COL applicant that references the U.S. EPR design certification will define the coatings program and its implementation, including maintenance and repair of coatings.

This COL Item is addressed as follows:

The coatings program is described in Section 6.1.2.3.2 and implemented within plant administrative procedures as described in Section 13.5.1.

6.1.2.3 Quality Assurance

No departures or supplements.

6.1.2.3.1 Special Processes

No departures or supplements.

6.1.2.3.2 Service Level I Coatings

The U. S. EPR FSAR includes the following COL Item in Section 6.1.2.3.2:

> A COL applicant that references the U.S. EPR design certification will define a coating application and maintenance program for components that cannot be procured with DBA qualified coatings in accordance with 10 CFR 50, Appendix B, Criterion IX.

This COL Item is addressed as follows:

If components cannot be procured with DBA-qualified coatings applied by the component manufacturer, {Calvert Cliffs 3 Nuclear Project, LLC, and UniStar Nuclear Operating Services, LLC} shall do one of the following:

- Procure the component as uncoated and apply a DBA-qualified coating system in accordance with 10 CFR 50, Appendix B, Criterion IX. The DBA-qualified (i.e., Service Level 1) coating will be applied in accordance with the applicable standards stated in

Regulatory Guide 1.54, Rev. 1 (NRC, 2000), except as modified by U.S. EPR FSAR Section 6.1.2.4.

- Confirm that the DBA-unqualified coating is removed and that the component is recoated with DBA-qualified coatings in accordance with 10 CFR 50, Appendix B, Criterion IX. The DBA-qualified (i.e., Service Level 1) coating will be applied in accordance with the applicable standards stated in Regulatory Guide 1.54, Rev. 1 (NRC, 2000), except as modified by U.S. EPR FSAR Section 6.1.2.4.

- Add the quantity of DBA-unqualified coatings to a list that documents those DBA-unqualified coatings already existing within containment.

The protective coatings program will be implemented prior to the application of coatings on plant surfaces or equipment or the procurement of components and equipment with vendor applied coatings. The protective coatings program is implemented within plant administrative procedures. The administrative procedures are described in Section 13.5.1.

6.1.2.3.3 Service Level II Coatings

No departures or supplements.

6.1.2.3.4 Service Level III Coatings

No departures or supplements.

6.1.2.3.5 Protective Coating and Organic Materials Program

No departures or supplements.

6.1.2.4 Exceptions to Regulatory Guide 1.54, Revision 1

No departures or supplements.

6.1.3 References

{**NRC, 1978.** Control of Ferrite Content in Stainless Steel Weld Metal, Regulatory Guide 1.31, Revision 3, U.S. Nuclear Regulatory Commission, April 1978.

NRC, 2000. Service Level I, II, and III Protective Coatings Applied To Nuclear Power Plants, Regulatory Guide 1.54, Revision 1, U.S. Nuclear Regulatory Commission, July 2000.

NRC, 1973. Control of the Use of Sensitized Stainless Steel, Regulatory Guide 1.44, U.S. Nuclear Regulatory Commission, May 1973.}

6.2 CONTAINMENT SYSTEMS

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

6.2.1 Containment Functional Design

No departures or supplements.

6.2.2 Containment Heat Removal Systems

No departures or supplements.

6.2.3 Secondary Containment Functional Design

No departures or supplements.

6.2.4 Containment Isolation System

No departures or supplements.

6.2.5 Combustible Gas Control in Containment

No departures or supplements.

6.2.6 Containment Leakage Testing

The U.S. EPR FSAR includes the following COL Item in Section 6.2.6:

> A COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the CLRT program described under 10 CFR 50, Appendix J.

This COL Item is addressed as follows:

Table 13.4-1 provides milestones for containment leak rate testing implementation in accordance with 10 CFR 50, Appendix J (CFR, 2008).

6.2.7 Fracture Prevention of Containment Pressure Vessel

No departures or supplements.

6.2.8 References

{**CFR, 2008**. Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors, Title10, Code of Federal Regulations, Part 50, Appendix J, U.S. Nuclear Regulatory Commission, 2008.}

6.3 EMERGENCY CORE COOLING SYSTEM

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

6.3.1 Design Bases

No departures or supplements.

6.3.2 System Design

6.3.2.1 Schematic Piping and Instrumentation Diagrams

No departures or supplements.

6.3.2.2 Equipment and Component Descriptions

6.3.2.2.1 System Overview

No departures or supplements.

6.3.2.2.2 System Components

The U.S. EPR FSAR contains the following COL Item in Section 6.3.2.2.2:

> A COL applicant that references the U.S. EPR design certification will describe the containment cleanliness program which limits debris within containment.

This COL Item is addressed as follows:

The containment cleanliness program is consistent with the guidance provided in NEI 04-07 (NEI, 2004), Regulatory Guide 1.82, Rev. 3 (NRC, 2003), Regulatory Guide 1.206, June 2007 (NRC, 2007a), and NUREG-0800, March 2007 (NRC, 2007b). The principal functions of the program are described below.

Latent debris is controlled by limiting the number of potential debris sources prior to reactor containment closeout before plant operation. This effort includes control of intended debris sources and unintended debris sources. General surveys consisting of visual examination of containment shall be performed every refueling outage. Surveys with detailed calculations of latent debris shall be performed every other outage. Additional surveys shall be conducted after invasive or extended maintenance activities.

The containment cleanliness program is performed in conjunction with containment close-out procedures. The outage and planning supervisor is responsible for implementing the containment cleanliness program.

Visual inspection of containment for loose debris is performed to reduce intended and unintended debris sources. Visual inspection includes all levels of the containment; including the gutters, the trash racks, the weirs, and the retaining baskets located below each heavy floor opening. The inspection shall include the Safety Injection System (SIS) and the Severe Accident Heat Removal System (SAHRS) strainers located above each respective sump. The containment cleanliness program shall be implemented through procedures to limit intended and unintended latent debris inside containment.

Examples of intended debris include equipment tags that are not permanent, stickers or placards (adhered with adhesive), and tape. The use of non-permanent tags and stickers shall be controlled by procedure in order to identify potential loading from these sources. The use of tape shall also be monitored and removed once its use has been met. Tape that remains in-place shall be identified as another debris loading source. Storage of outage materials such as temporary scaffolding and tools inside containment during power operation shall be monitored. Loose insulation on piping and equipment inside containment shall be considered as a transport potential. Debris transport is considered in identifying the amount of debris from these sources that reaches the sump.

Unintended debris sources include dust and other particulates that result from in-containment maintenance activities or deterioration of in-containment materials. These sources shall be inspected and an estimate of loading developed based on the inspection results. Statistical sample mass collection is the method used for quantifying latent debris inventories. This method of statistical sample mass collection will be established following guidance provided in NEI 04-07, Volume 2 (NEI, 2004). Sampling results will be evaluated after work in containment is finished and in conjunction with plant walkdowns. This inspection and characterization includes vertical surfaces as well as horizontal surfaces. Inaccessible and accessible areas are considered. Based on inspections, any failures of qualified coatings or degraded conditions will be evaluated following guidance specified in NRC RIS 2005-20, Revision 1 (NRC, 2008). If degraded conditions call for replacement or removal, abatement procedures will be established to avoid generating latent debris in the containment.

The major debris source will be from those SSCs in the zone of influence.

6.3.2.3 Applicable Codes and Classifications

No departures or supplements.

6.3.2.4 Material Specifications and Compatibility

No departures or supplements.

6.3.2.5 System Reliability

No departures or supplements.

6.3.2.6 Protection Provisions

No departures or supplements.

6.3.2.7 Provisions for Performance Testing and Inspection

No departures or supplements.

6.3.2.8 Manual Actions

No departures or supplements.

6.3.3 Performance Evaluation

No departures or supplements.

6.3.4 Tests and Inspections

No departures or supplements.

6.3.5 Instrumentation Requirements

No departures or supplements.

6.3.6 References

{NEI, 2004. Pressurized Water Reactor Sump Performance Evaluation Methodology, NEI 04-07, Nuclear Energy Institute, December 2004.

NRC, 2003. Water Sources for Long Term Recirculation Cooling Following a Loss-of-Coolant Accident, Regulatory Guide 1.82, Rev. 3, U.S. Nuclear Regulatory Commission, November, 2003.

NRC, 2007a. Combined License Applications for Nuclear Power Plants, Regulatory Guide 1.206, U.S. Nuclear Regulatory Commission, June 2007.

NRC, 2007b. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800, U.S. Nuclear Regulatory Commission, March, 2007.

NRC, 2008. Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety," RIS 2005-20, Revision 1, U.S. Nuclear Regulatory Commission, April, 2008.}

6.4 HABITABILITY SYSTEMS

No departures or supplements.

6.4.1 Design Basis

The U.S. EPR FSAR includes the following COL Item in Section 6.4.1:

> A COL applicant that references the U.S. EPR design certification will evaluate the results of the toxic chemical accidents from Section 2.2.3, address their impact on control room habitability in accordance with RG 1.78, and if necessary, identify the types of sensors and automatic control functions required for control room operator protection.

The COL Item is addressed as follows:

An evaluation of the results of toxic chemical accidents identified in Section 2.2.3 was performed. This evaluation did not identify any credible toxic chemical accident that exceeds the limits established in Regulatory Guide 1.78 (NRC, 2001). Therefore, no toxic gas detectors, or automatic isolation control functions, are required or provided specifically for operator protection from an event involving a release of toxic gas.

6.4.2 System Design

No departures or supplements.

6.4.3 System Operational Procedures

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements {and departures}.

The U.S. EPR FSAR includes the following COL Item in Section 6.4.3:

> A COL applicant that references the U.S. EPR design certification will provide written emergency planning and procedures in the event of a radiological or hazardous chemical release within or near the plant, and will provide training of control room personnel.

This COL Item is addressed as follows:

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC} shall provide written emergency planning and procedures for use in the event of a radiological or hazardous chemical release within or near the plant, and will provide training of control room personnel, prior to receipt of fuel onsite at {CCNPP Unit 3}.

{The procedures and training address the toxic chemical events addressed in Sections 2.2 and 6.4 consistent with the guidance provided in regulatory position C.5 of Regulatory Guide 1.78 (NRC, 2001), including arrangements with Federal, State, and local agencies or other cognizant organizations for the prompt notification of the nuclear power plant when accidents involving hazardous chemicals occur within five miles of the plant. The procedures include the conduct of periodic surveys of stationary and mobile sources of hazardous chemicals affecting the evaluations consistent with the guidance provided in regulatory position 2.5 of Regulatory Guide 1.196 (NRC, 2007a). The procedures include appropriate reviews of the configuration of the control room envelope and habitability systems consistent with the guidance provided in regulatory position 2.2.1 of Regulatory Guide 1.196 (NRC, 2007a). The procedures also include

periodic assessment of control room habitability systems' material condition, configuration controls, safety analyses, and operating and maintenance procedures consistent with the guidance provided in regulatory position 2.2.1 of Regulatory Guide 1.196 (NRC, 2007a).

Procedures for testing and maintenance are consistent with the guidance provided in regulatory position 2.7.1 of Regulatory Guide 1.196 (NRC, 2007a).}

6.4.4 Design Evaluations

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements {and departures}.

The U.S. EPR FSAR includes the following COL Item in Section 6.4.4:

> A COL applicant that references the U.S. EPR design certification will confirm that the radiation exposure of MCR occupants resulting from a DBA at a nearby unit on a multi-unit site is bounded by the radiation exposure from the postulated design basis accidents analyzed for the U.S. EPR; or confirm that the limits of GDC 19 are met.

This COL Item is addressed as follows:

{The CCNPP Unit 3 main control room (MCR) habitability was evaluated for a Loss of Coolant Accident (LOCA) at CCNPP Unit 2. A CCNPP Unit 2 LOCA is more bounding than a LOCA at CCNPP Unit 1 due to the distance between the units. The analysis was based on the guidance provided in Regulatory Guide 1.183 (NRC, 2000) and the NRC-approved RADTRAD model in the Safety Evaluation for the CCNPP Units 1 and 2 implementation of the Alternative Radiological Source Term (NRC, 2007b), with the following modifications:

- Use of site-specific atmospheric dispersion factors for transport of post-LOCA releases from CCNPP Unit 2 to the CCNPP Unit 3 MCR intake for filtered air flow and unfiltered in-leakage, as shown in Table 6.4-1, and

- Use of the CCNPP Unit 3 MCR characteristics as given in U.S. EPR FSAR Table 15.0-18 with one exception - actuation of the MCR emergency filtration system (for filtered intake flow and filtered recirculation) was based on 30-minute operator action, in lieu of automatic actuation as a result of high radiation levels in the intake duct. Although it is expected that the emergency filtration system would get actuated by the intake duct radiation monitors in less than 30 minutes, this was not credited in the analysis.

It was determined that the CCNPP Unit 3 MCR dose from a CCNPP Unit 2 LOCA would be 0.2 rem TEDE, which is significantly lower than the acceptance criterion in 10 CFR 50, Appendix A, GDC 19, as incorporated by reference in 10 CFR 52.79(a)(4)(i) (5 rem TEDE).

With respect to direct shine to MCR personnel from post-LOCA external and contained sources, it was determined that their contribution to the total dose would be minimal. Radiation emanating from the external plume would be attenuated by the 6-ft concrete structure protecting the CCNPP Unit 3 MCR, and radiation emanating from the MCR charcoal filtration system would be shielded by a 50-cm concrete floor.}

6.4.5 Testing and Inspection

No departures or supplements.

6.4.6 Instrumentation Requirements

No departures or supplements.

6.4.7 References

{**NRC, 2000.** Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," Rev. 0, U.S. Nuclear Regulatory Commission, July 2000.

NRC, 2001. Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release, Regulatory Guide 1.78, Revision 1, U.S. Nuclear Regulatory Commission, December 2001.

NRC, 2007a. Control Room Habitability at Light-Water Nuclear Power Reactors, Regulatory Guide 1.196, Revision 1, U.S. Nuclear Regulatory Commission, January 2007.

NRC, 2007b. Letter from D. V. Picket, Senior Project Manager, U.S. Nuclear Regulatory Commission to J. A. Spina, Vice President, Calvert Cliffs Nuclear Power Plant, Inc. titled "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Amendment Re: Implementation of Alternative Radiological Source Term (TAC Nos. MC8845 and MC8846), dated August 29, 2007 (ADAMS Accession No. ML072130521).}

Table 6.4-1 — {Unit 2 LOCA Accident Atmospheric Dispersion Factors (χ/Q) for CCNPP Unit 3 MCR Habitability Analysis}

Time Period	Atmospheric Dispersion Factors (sec/m^3) for the Closest Unit 2 Post-LOCA Release Point[1]
0 to 2 hrs	3.377E-04
2 to 8 hrs	1.973E-04
8 to 24 hrs	1.221E-04
1 to 4 days	5.851E-05
4 to 30 days	2.035E-05

1. Atmospheric dispersion factors conservatively applied to all CCNPP Unit 2 Post-LOCA release points

6.5 FISSION PRODUCT REMOVAL AND CONTROL SYSTEMS

This section of the U.S. EPR FSAR is incorporated by reference.

6.6 INSERVICE INSPECTION OF CLASS 2 AND 3 COMPONENTS

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

The U.S. EPR FSAR includes the following COL Item in Section 6.6:

> A COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the site-specific ASME Section XI preservice and inservice inspection program for Class 2 and Class 3 components, consistent with the requirements of 10 CFR 50.55a(g). The program will identify the applicable edition and addenda of the ASME Code Section XI, and will identify additional relief requests and alternatives to Code requirements.

This COL Item is addressed as follows:

The site-specific preservice inspection and inservice inspection programs for Class 2 and Class 3 components meet the requirements of 10 CFR 50.55a(g), and comply with ASME Boiler and Pressure Vessel Code, Section XI, 2004 Edition (ASME, 2004). This code is consistent with that established in U.S. EPR FSAR Section 6.6. No relief requests or alternatives are required. The implementation milestones for the site-specific ASME Section XI preservice and inservice inspection programs for Class 2 and Class 3 components are identified in Table 13.4-1.

The initial inservice inspection program shall incorporate the latest edition and addenda of the ASME Boiler and Pressure Vessel Code approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load. Inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months before the start of the 120-month inspection interval (or the optional ASME Code cases listed in Regulatory Guide 1.147, that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed in 10 CFR 50.55a(b)).

Should relief requests be required, they will be developed through the regulatory process and submitted to the NRC for approval in accordance with 10 CFR 50.55a(g)(5). The relief requests shall include appropriate justifications and proposed alternative inspection methods.

6.6.1 Components Subject to Examination

{No departures or supplements.}

6.6.2 Accessibility

{This section of the U.S. EPR FSAR is incorporated by reference with the following supplement.

Design considerations other than access provisions described in ASME Section XI paragraph IWA-1500, will be needed for specific buried Essential Service Water (ESW) and UHS Makeup Water System components to render inservice inspections practical. In lieu of a visual examination of buried components, the examination requirement shall be satisfied by performing a test that determines the rate of pressure loss or a test that determines the change in flow rate between the isolation valves at each end of the buried piping-segment, in accordance with ASME Section XI, paragraph IWA5244.

The ability to visually inspect the interior lining of ESWS buried 30" diameter and 10" diameter piping will be designed into the system (e.g., vaults with removable spool pieces, bypass sections.}

6.6.3 Examination Techniques and Procedures

No departures or supplements.

6.6.4 Inspection Intervals

{This section of the U.S. EPR FSAR is incorporated by reference with the following supplement.

Testing will be performed to determine the rate of pressure loss or the change in flow rate between the ends of buried components (i.e., to verify any leak) coincident with alternate test cycles of U.S. EPR Generic Technical Specification Surveillance Requirement (SR) 3.7.8.2 for ESW System and SR 3.7.19.5 for the UHS Makeup Water System. Since most of the piping is buried, for additional assurance of system integrity and availability, testing will be performed at the 4-year frequency, which conservatively bounds the requirements per ASME Section XI, paragraph IWD-2411 and Tables IWD-2411-1 and IWD-2500-1.}

6.6.5 Examination Categories and Requirements

No departures or supplements.

6.6.6 Evaluation of Examination Results

No departures or supplements.

6.6.7 System Pressure Tests

No departures or supplements.

6.6.8 Augmented ISI to Protect Against Postulated Piping Failures

{There is no high-energy site-specific piping associated with the UHS Makeup Water System.}

6.6.9 References

{ASME, 2004. ASME Boiler and Pressure Vessel Code, Section XI, 2004 Edition, American Society of Mechanical Engineers, Inc., 2004.}

6.7 MAIN STEAMLINE ISOLATION VALVE LEAKAGE CONTROL SYSTEM (BWRS)

This section of the U.S. EPR FSAR is incorporated by reference.

6.8 EXTRA BORATING SYSTEM

This section of the U.S. EPR FSAR is incorporated by reference.