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:

{PPL Bell Bend, LLC} shall review the fabrication and welding procedures and other QA methods of potential ESF component vendors to verify conformance with Regulatory Guides 1.31 and 1.44 (NRC, 1978 and NRC, 1973) prior to their selection as ESF component vendors.

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.

6.1.2.3 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:

> If components cannot be procured with DBA-qualified coatings applied by the component manufacturer, a COL applicant that references the U. S. EPR design certification must 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.
> - 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.
> - Add the quantity of DBA-unqualified coatings to a list that documents those DBA-unqualified coatings already existing within containment.

This COL Item is addressed as follows:

If components cannot be procured with DBA-qualified coatings applied by the component manufacturer, {PPL Bell Bend, 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.
- 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.
- Add the quantity of DBA-unqualified coatings to a list that documents those DBA-unqualified coatings already existing within containment.

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, 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), as endorsed and modified by Regulatory Guide 1.39, Rev. 2 (NRC, 1977), 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.

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 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 inspection is performed on an every other refueling frequency basis in conjunction with containment close-out procedures. 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 is included.

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, 1977. Housekeeping Requirements for Water-Cooled Nuclear Power Plants, Regulatory Guide 1.39, Rev. 2, U.S. Nuclear Regulatory Commission, September, 1977.

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, Revision 0, 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.}

6.4 HABITABILITY SYSTEMS

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

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4:

> The habitability systems protect the plant operators from the effects of accidental releases of [[toxic and]] radioactive gases.
>
> [[Detection of and protection from toxic gases and hazardous chemicals.]]

The conceptual design information is addressed as follows:

{For BBNPP, the detection of toxic gases and subsequent isolation of the Control Room Envelope (CRE) is not required and is not a part of the design basis. The results of the BBNPP toxic chemicals evaluation in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). As a result, toxic gas detectors and CRE isolation are not required to mitigate a toxic gas release.}

6.4.1 DESIGN BASIS

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4.1:

> [[The CRE is protected from hazardous chemical releases to permit access and occupancy of the main control room.]]

The conceptual design information is addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). No specific provisions are required to protect the operators from an event involving a release of a toxic gas.}

6.4.2 SYSTEM DESIGN

6.4.2.1 Definition of Control Room Envelope

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4.2.1:

> SCBA units, air supply equipment and protective clothing for protection from [[toxic or noxious gases]].
>
> SCBA units contain a minimum of six hours of air supply capacity [[as specified by RG 1.78.]]

The conceptual design information is addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). As a result, BBNPP does not require the use of SCBAs to mitigate a toxic gas release.}

6.4.2.2 Ventilation System Design

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4.2.2:

The CRACS intakes are located on the roof of Safeguard Buildings 2 and 3, to prevent [[intrusion of toxic gases or]] radiological contamination.

[[Control room operators are protected from chlorine releases and other toxic gases in accordance with RG 1.52, RG 1.78, and ASME AG-1 (Reference 2).]]

The ventilation system can be operated in full recirculation mode without outside air makeup during DBAs [[or events involving toxic gas releases]].

Redundancy for air cooling, filtration [[, and toxic gas protection]] is provided by having two independent trains for critical functions.

The conceptual design information is addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). No specific provisions are required to protect the operators from an event involving a release of a toxic gas.}

6.4.2.3 Leaktightness

No departure or supplements.

6.4.2.4 Interaction with Other Zones and Pressure-Containing Equipment

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4.2.4:

The CRE area is isolated and pressurized in the event of an outside fire, [[external toxic gas release,]] smoke, and excessive concentrations of carbon monoxide or carbon dioxide.

Upon detection of [[toxic gas or]] smoke, audible or visual alarms are actuated in the MCR.

The CRACS does not interact with air conditioning equipment serving adjacent zones, minimizing the possibility of transferring [[toxic or]] radioactive gases into the CRE.

The conceptual design information is addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). No specific provisions are required to protect the operators from an event involving a release of a toxic gas.}

6.4.2.5 Shielding Design

No departures or supplements.

6.4.3 SYSTEM OPERATIONAL PROCEDURES

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:

{PPL Bell Bend, 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 {BBNPP}.

The U.S. EPR FSAR includes the following conceptual design information in Section 6.4.3:

> [[Upon detection of any hazardous chemicals in the environment which have a potential for infiltration within the CRE boundary, the control room operator will take protective measures within a short period of time from the initiation of the toxic gas sensors and alarms. The operators are not subjected to prolonged exposures during this time.]]
>
> Storage provisions for SCBAs and procedures for their use allow operators to begin using the SCBAs within a short period of time after detection of a radiological event [[or a hazardous release]].

The conceptual design information is addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). As a result, no specific provisions are required to mitigate a toxic gas release.}

6.4.4 DESIGN EVALUATIONS

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 main control room dose to SSES Units 1 and 2 from a BBNPP LOCA is less than 1.0 rem TEDE. This dose is well below the regulatory dose acceptance criterion of 5 rem TEDE. The BBNPP Main Control Room (MCR) is better designed and equipped for radiological exposure control. Therefore, a LOCA in SSES Unit 1 or 2, which already meets the acceptance criteria for the applicable control room, will also meet the acceptance criteria for the BBNPP Main Control Room. The BBNPP MCR is equipped with safety-related radiation monitors in the HVAC intake ducts and would isolate in a timely manner. The BBNPP MCR HVAC emergency filtration system design basis accident configuration is described in U.S. EPR FSAR 15.0.3.}

The U.S. EPR FSAR includes the following conceptual design information and COL Item in Section 6.4.4:

> Habitability systems provide the capability to detect and protect personnel within the CRE boundaries from external fires, smoke [[, toxic gases]] and airborne radioactivity.
>
> 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 and address their impact on control room habitability in accordance with RG 1.78.

The conceptual design information and COL Item are addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). As a result, toxic gas detectors and CRE isolation are not required for BBNPP.}

6.4.5 TESTING AND INSPECTION

No departures or supplements.

6.4.6 INSTRUMENTATION REQUIREMENTS

The U.S. EPR FSAR includes the following conceptual design information and COL Item in Section 6.4.6:

[[Toxic chemicals whose release has the potential to affect control room operators are monitored by toxic gas sensors. A list of chemicals and their locations is provided in Section 2.2.]]

A COL applicant that references the U.S. EPR design certification will identify any Seismic Category I Class IE toxic gas sensors necessary for control room operator protection.

The conceptual design information and COL Item are addressed as follows:

{The evaluation of the BBNPP toxic chemicals in Section 2.2.3 did not identify any credible toxic chemical accidents that exceed the limits established in Regulatory Guide 1.78 (NRC, 2001). As a result, BBNPP does not require any Seismic Category I Class IE toxic gas sensors.}

6.4.7 REFERENCES

{**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.}

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) (CFR, 2008), and comply with ASME Boiler and Pressure Vessel Code, Section XI, 2004 Edition (ASME, 2004a). 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) (CFR, 2008) 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 (NRC, 2007), 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

{Preservice and inservice inspection of site-specific Class 3 ESWEMS components are conducted in accordance with the ASME OM Code, 2004 Edition (ASME, 2004b). The site-specific ESWEMS components are identified in Table 6.6-1.}

6.6.2 ACCESSIBILITY

No departures or supplements.

6.6.3 EXAMINATION TECHNIQUES AND PROCEDURES

No departures or supplements.

6.6.4 INSPECTION INTERVALS

{The inspection intervals for site-specific ESWEMS components are defined by the ASME Code examination categories identified in Table 6.6-1.}

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 ESWEMS.}

6.6.9 REFERENCES

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

ASME, 2004b. Code for Operation and Maintenance of Nuclear Power Plants, ASME OM Code, 2004 Edition, American Society of Mechanical Engineers, Inc., 2004.

CFR, 2008. Codes and Standards, Title 10 Code of Federal Regulations, Part 50.55a U.S. Nuclear Regulatory Commission, 2008.

NRC, 2007. Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1, Regulatory Guide 1.147, Revision 15, U.S. Nuclear Regulatory Commission, October 2007.}

Table 6.6-1 {Inservice Inspection Requirements for Class 3 Site-Specific ESWEMS}

ASME Code Examination Category	Examination Area	Parts Examined	Method of Examination	Extent of Examination
D-A	Welded Attachments (components supports directly welded to the outside surface or to the integrally cast or forged attachments to pressure retaining components)	Piping	Visual, VT-1	100% of the length of the attachment weld
D-A	Welded Attachments (components supports directly welded to the outside surface or to the integrally cast or forged attachments to pressure retaining components)	Pumps	Visual, VT-1	100% of the length of the attachment weld
D-A	Welded Attachments (components supports directly welded to the outside surface or to the integrally cast or forged attachments to pressure retaining components)	Valves	Visual, VT-1	100% of the length of the attachment weld
D-B	All pressure retaining components	Pressure Retaining Components	Visual, VT-2 During system leakage tests	Pressure Retaining Boundary

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.