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} 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:

{PPL Bell Bend, 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.

6.1.2.3 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. 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, 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.

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 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, 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.

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:

{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} .

{Operational procedures will be developed which direct the operating staff to verify control room envelope isolation upon receipt of a high radiation signal in the air intakes or a primary containment isolation signal, to ensure the system is automatically switched so that the intake is routed through the emergency filtration system. The procedures will direct operating staff to isolate the control room envelope when toxic gas release is detected or reported and to don appropriate respiratory protection equipment if odor indicates toxic gas has entered the Control Room envelope.

The Bell Bend operating staff will be trained in olfactory methods to detect ammonium hydroxide and natural gas (methane) and in the donning and use of respiratory protection equipment. Operating staff and casualty responders will be trained on toxic gas detection

instrumentation and techniques and will have periodic training on procedures for control room evacuation and use of respiratory protection equipment according to RG 1.78 (NRC, 2001), Regulatory Positions C.4 and C.5.

Bell Bend staff will survey the surrounding area for mobile and stationary toxic chemicals triennially and will perform annual surveys of onsite toxic chemicals according to RG 1.196 (NRC, 2007), Regulatory Position C.2.5.

The Bell Bend configuration management program and operating procedures will ensure the Control Room HVAC system is constructed and operated as designed according to RG 1.196 (NRC, 2007). Regulatory Positions C.2.2 and C.2.7.}

{A control room operator will take protective measures within two minutes, as explained in Section 6.4.2.4.}

6.4.4 Design Evaluations

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 6.4.4:

> 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:

{A LOCA in SSES Unit 1 or 2 meets the acceptance criteria for the applicable control room, and will also meet the acceptance criteria for the BBNPP Main Control Room (MCR) as summarized below. 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 analysis performed to demonstrate the doses to the Bell Bend Nuclear Power Plant operators will be below the regulatory limits for a LOCA in Susquehanna Unit 1 or 2 is as follows:

- Confirm that the Susquehanna Unit 1/2 MCR operator dose is within regulatory limits for a LOCA in Susquehanna Unit 1 or 2.

- Calculate the distance factor reducing the dose for the adjacent unit (e.g., Bell Bend Nuclear Power Plant MCR dose for a LOCA in Susquehanna Unit 1 or 2 as compared to that for the Susquehanna Unit 1/2 MCR): in this case, approximately one order of magnitude.

- Compare the operator protection afforded by the Bell Bend Nuclear Power Plant MCR design to that of the Susquehanna Unit 1/2 MCR design for an accident at the adjacent unit; in this case, the Bell Bend Nuclear Power Plant MCR design affords approximately a factor of two improved protection as compared to the Susquehanna Unit 1/2 MCR design.

Since the Susquehanna Unit 1/2 MCR operator dose is within the regulatory limit and the corresponding Bell Bend Nuclear Power Plant MCR dose will be less both because of distance and because of the design of the Bell Bend Nuclear Power Plant MCR, these three points demonstrate that doses to the Bell Bend Nuclear Power Plant operators will be below the regulatory limits for an accident at Susquehanna Unit 1 or Unit 2.}

6.4.5 Testing and Inspection

No departures or supplements.

6.4.6 Instrumentation Requirements

No departures or supplements.

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.}

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

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 .

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

{Preservice and inservice inspection of site-specific Class 3 ESWEMS components are conducted in accordance with the ASME SectionXI, 2004 Edition (ASME, 2004). 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 Section XI 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, 2004.** ASME Boiler and Pressure Vessel Code, Section XI, 2004 Edition, American Society of Mechanical Engineers, Inc., 2004. }

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.