Watts Bar Nuclear Plant (WBN)
Meeting on the Proposed License Amendment Request to Implement **FULL SPECTRUM**™ Loss of Coolant Accident (**FSLOCA**™) Evaluation Methodology and Eliminate TPBAR Post-LOCA Failure Assumptions

July 1, 2019

Agenda

- Opening Remarks
- Overview of the License Amendment Request (LAR)
- Technical Specification Changes
- Regulatory Precedents
- Break (end of Open Portion of the Meeting)
- LAR Technical Evaluation Content (Closed)
- Technical Evaluation
- Technical Evaluation Results
- Closing Remarks

Opening Remarks

- LAR is applicable to WBN Units 1 and 2
- Incorporates **FSLOCA**™ Methodology for 10 CFR 50.46 compliance
- Implements new tritium-producing burnable absorber rods (TPBAR) stress analysis methodology to assess TPBAR rupture following large-break LOCA

Overview of the LAR

- **Reason for Change**
  - Implement **FSLOCA** methodology to resolve licensing issues with PAD4TCD (note: WBN Unit 2 currently has a license condition that permits use of PAD4TCD until the WBN Unit 2 steam generators are replaced)
  - Use lower peak cladding temperatures (PCT) from **FSLOCA** methodology predictions as part of new TPBAR stress analysis methodology to demonstrate that TPBAR integrity is maintained during a large break loss-of-coolant-accident (LBLOCA) event
  - Allows TVA to change the post-LOCA criticality assumption of TPBAR rupture and its consequent effect of lithium loss (positive reactivity)
  - Allows TVA to simplify the core design, increase tritium production capability, and improve fuel economics

Technical Specification Changes

Proposed WBN Technical Specification (TS) changes:

- TS 4.2.1, "Fuel Assemblies" (Unit 1 only) - Deletes Zircalloy clad description based on applicability of **FSLOCA** methodology
- TS 5.9.5, “Core Operating Limits Report” (WBN Units 1 and 2) - Replaces WCAP-12945-P-A (Best Estimate LOCA Methodology) and WCAP-11054-P-A (NOTRUMP SBLOCA Methodology) with WCAP-16996-P-A (**FSLOCA** Methodology)
- Proposed Revision to WBN 2 Operating License Condition 2.C(4) regarding implementation of this LAR (similar to PAD4TCD)
- Various TS Bases changes also being provided in the LAR

Proposed Change

for WBN Unit 1

TS 4.2.1

4.0 DESIGN FEATURES

4.1 Site

4.1.1 Site and Exclusion Area Boundaries

The site and exclusion area boundaries shall be as shown in Figure 4.1-1.

4.1.2 Low Population Zone (LPZ)

The LPZ shall be as shown in Figure 4.1-2 (within the 3-mile circle).

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of ~~Zircaloy,~~ ZIRLO®, or Optimized ZIRLO™ clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. For Unit 1, Watts Bar is authorized to place a maximum of 1792 Tritium Producing Burnable Absorber Rods into the reactor in an operating cycle.

4.2.2 Control Rod Assemblies

The reactor core shall contain 57 control rod assemblies. The control material shall be either silver-indium-cadmium or boron carbide with silver indium cadmium tips as approved by the NRC.

add the Amendment number when the Optimized ZIRLO LAR is approved

(continued)

Proposed Change for

WBN Unit 1 TS 5.9.5

5.9 Reporting Requirements (continued)

5.9.5 CORE OPERATING LIMITS REPORT (COLR)

a. Core operating limits shall be established prior to the initial and each reload cycle, or prior to any remaining portion of a cycle, and shall be documented in the COLR for the following:

LCO 3.1.4	Moderator Temperature Coefficient
LCO 3.1.6	Shutdown Bank Insertion Limit
LCO 3.1.7	Control Bank Insertion Limits
LCO 3.2.1	Heat Flux Hot Channel Factor
LCO 3.2.2	Nuclear Enthalpy Rise Hot Channel Factor
LCO 3.2.3	Axial Flux Difference
LCO 3.9.1	Boron Concentration

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC. When an initial assumed power level of 102 percent of rated thermal power is specified in a previously approved method, 100.6 percent of rated thermal power may be used only when feedwater flow measurement (used as input for reactor thermal power measurement) is provided by the leading edge flowmeter (LEFM) as described in document number 6 listed below. When feedwater flow measurements from the LEFM are unavailable, the originally approved initial power level of 102 percent of rated thermal power (3411 MWt) shall be used.

The approved analytical methods are specifically those described in the following documents:

1. WCAP-9272-P-A, WESTINGHOUSE RELOAD SAFETY EVALUATION METHODOLOGY," July 1985 (W Proprietary). (Methodology for Specifications 3.1.4 - Moderator Temperature Coefficient, 3.1.6 - Shutdown Bank Insertion Limit, 3.1.7 - Control Bank Insertion Limits, 3.2.1 - Heat Flux Hot Channel Factor, 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor, 3.2.3 - Axial Flux Difference, and 3.9.1 - Boron Concentration.

2a. WCAP-16996-P-A, Revision 1, "Realistic LOCA Evaluation Methodology Applied to the Full Spectrum of Break Sizes (FULL SPECTRUM LOCA Methodology)," November 2016.~~WCAP-12945-P-A, Volume I (Revision 2) and Volumes 2 through 5 (Revision 1), "Code Qualification Document for Best Estimate Loss of Coolant Analysis," March 1998 (W Proprietary). (Methodology for Specification 3.2.1 - Heat Flux Hot Channel Factor, and 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).~~

~~b. WCAP-10054-P-A, "Small Break ECCS Evaluation Model Using NOTRUMP Code," August 1985. Addendum 2, Rev. 1, "Addendum to the Westinghouse Small Break ECCS Evaluation Model using the NOTRUMP Code: Safety Injection into the Broken Loop and COSI Condensation Model," July 1997. (W Proprietary). (Methodology for Specifications 3.2.1 - Heat Flux Hot Channel Factor, and 3.2.2 - Nuclear~~

(continued)

Proposed Change for

WBN Unit 2 TS 5.9.5

5.9 Reporting Requirements

5.9.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

1. WCAP-9272-P-A, WESTINGHOUSE RELOAD SAFETY EVALUATION METHODOLOGY," July 1985 (W Proprietary). (Methodology for Specifications 3.1.4 - Moderator Temperature Coefficient, 3.1.6 - Shutdown Bank Insertion Limit, 3.1.7 - Control Bank Insertion Limits, 3.2.1 - Heat Flux Hot Channel Factor, 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor, 3.2.3 - Axial Flux Difference, and 3.9.1 - Boron Concentration).

2a. WCAP-16996-P-A, Revision 1, "Realistic LOCA Evaluation Methodology Applied to the Full Spectrum of Break Sizes (FULL SPECTRUM LOCA Methodology)," November 2016.~~WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)," January 2005 (W Proprietary).(Methodology for Specification 3.2.1 - Heat Flux Hot Channel Factor, and 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).~~

~~2b. WCAP-10054-P-A, "Small Break ECCS Evaluation Model Using NOTRUMP Code," August 1985. Addendum 2, Rev. 1: "Addendum to the Westinghouse Small Break ECCS Evaluation Model using the NOTRUMP Code: Safety Injection into the Broken Loop and COSI Condensation Model," July 1997. (W Proprietary). (Methodology for Specifications 3.2.1 - Heat Flux Hot Channel Factor, and 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).~~

3. WCAP-10216-P-A, Revision 1A, "RELAXATION OF CONSTANT AXIAL OFFSET CONTROL F(Q) SURVEILLANCE TECHNICAL SPECIFICATION," February 1994 (W Proprietary). (Methodology for Specifications 3.2.1 - Heat Flux Hot Channel Factor (W(Z) Surveillance Requirements For F(Q) Methodology) and 3.2.3 - Axial Flux Difference (Relaxed Axial Offset Control).)

4. WCAP-12610-P-A, "VANTAGE + FUEL ASSEMBLY REFERENCE CORE REPORT," April 1995. (W Proprietary). (Methodology for Specification 3.2.1 - Heat Flux Hot Channel Factor).

Proposed Change for

WBN Unit 2 OL 2.C(4)

C. The license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act, and to the rules regulations, and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified or incorporated below.

(1) Maximum Power Level

TVA is authorized to operate the facility at reactor core power levels not in excess of 3411 megawatts thermal.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A as revised through Amendment No. 26, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) TVA shall implement permanent modifications to prevent overtopping of the embankments of the Fort Loudon Dam due to the Probable Maximum Flood by June 30, 2018.

(4) PAD4TCD may be used to establish core operating limits until the WBN Unit 2 steam generators are replaced with steam generators equivalent to the existing steam generators at WBN Unit 1. FULL SPECTRUM LOCA Methodology shall be implemented when the WBN Unit 2 steam generators are replaced with steam generators equivalent to the existing steam generators at WBN Unit 1.

(5) By December 31, 2019, the licensee shall report to the NRC that the actions to resolve the issues identified in Bulletin 2012-01, "Design Vulnerability in Electrical Power System," have been implemented.

(6) The licensee shall maintain in effect the provisions of the physical security plan, security personnel training and qualification plan, and safeguards contingency plan, and all amendments made pursuant to the authority of 10 CFR 50.90 and 50.54(p).

(7) TVA shall fully implement and maintain in effect all provisions of the Commission approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The TVA approved CSP was discussed in NUREG-0847, Supplement 28, as amended by changes approved by License Amendment No. 7.

(8) TVA shall implement and maintain in effect all provisions of the approved fire protection program as described in the Fire Protection Report for the facility, as described in NUREG-0847, Supplement 29, subject to the following provision:

Regulatory Precedent

- **FSLOCA** is an approved large break and small break LOCA analysis methodology
- Diablo Canyon Nuclear Power Plant has submitted a LAR to use of the **FSLOCA** methodology (ML19003A196) and NRC audit in progress (ML19106A390)
- Portion of the WBN LAR that discusses the LOCA analysis is similar in content to the Diablo Canyon **FSLOCA** methodology LAR
- There are no regulatory precedents for the TPBAR stress analysis

Closing Remarks

- The **FSLOCA** methodology results along with the TPBAR stress analysis methodology support a change to the conservative assumption that TPBAR failure occurs as a result of a large break LOCA
- Removal of the TPBAR rupture assumptions allows for more efficient core designs, reduced fuel costs and increased tritium production at WBN
- TVA is submitting a LAR to remove the current license basis assumptions on TPBAR rupture and requesting approval of the LAR within 1 year of it being submitted.

Questions?


TVA