Watts Bar Nuclear Plant (WBN) Unit 2

Pre-Submittal Meeting for License Amendment Request Measurement Uncertainty Recapture (MUR) Power Uprate

July 18, 2019

Agenda

- Opening Remarks
- Proposed MUR Uprate
- License Amendment Request (LAR) Approach
- Proposed Technical Specification (TS) Changes
- Summary of Engineering Reviews
  - Nuclear Steam Supply System (NSSS)
  - Balance of Plant (BOP)
- Plant Modifications
- Regulatory Precedent
- Schedule Milestones
- Closing Remarks

Opening Remarks

- WBN Unit 2 plant initial license based on original construction permit core rated thermal power (RTP).
- Plant completion design and analysis conservatively incorporated anticipated MUR power uprate requirements and conditions for major plant design, construction and analysis activities.
- TVA has built upon the plant completion MUR activities to complete the comprehensive engineering and analysis required to support an MUR power uprate LAR.
- TVA is planning MUR execution for WBN Unit 2, Cycle 4 operation (anticipated November 2020 startup).

Proposed MUR Uprate

- WBN Unit 2 current core RTP is 3411 MWt.
- Power measurement uncertainty currently applied to unit power calorimetric and analysis is ± 2.0%.
- The MUR uprate is based on improved main feedwater (MFW) flow measurement. A Caldon®[1] CheckPlus leading edge flow meter (LEFM®[1]) system was installed during unit completion. The system is operational, but not currently credited for power calorimetric calculations.
- Power measurement uncertainty calculations can be improved to less than ± 0.6% when MFW flow measurements are made with the LEFM system.
- Similar to Unit 1, TVA plans to apply the LEFM to unit power measurement such that a 1.4% uncertainty reduction can be applied to power production in the form of a MUR RTP uprate.
- WBN Unit 1 was approved for a 1.4% MUR core RTP uprate to 3459 MWt in January 2001 (ML010260074). The proposed WBN Unit 2 MUR will align Unit 2 TS requirements with the current Unit 1 requirements.

1. LEFM and Caldon are registered trademarks of Cameron International Corporation (“Cameron”)

License Amendment Approach

- The LAR has been prepared in accordance with the guidance in Regulatory Issue Summary (RIS) No. 2002-03, “Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications”.
- LAR incorporates information consistent with the most recent MUR uprate LAR submittals for similar plants.
- LAR incorporates Request for Additional Information (RAI) responses submitted in response to WBN Unit 1 MUR LAR.
- LAR applies NRC approved Caldon Engineering Report Nos. ER-80P, Rev. 0 and ER-157P-A, Rev. 8. The nine criteria identified in the associated Safety Evaluations have been addressed in the LAR.
- Power measurement uncertainty established using standard Westinghouse Setpoint Methodology consistent with prior endorsement by NRC Staff and industry standards (Regulatory Guide 1.105, R3, NUREG/CR-3659 (PNL-4973), ANSI/ANS Standard 58.4-1979 and ANSI/ISA-67.04.01-1994).

License Amendment Approach

- Supporting Caldon and Westinghouse uncertainty evaluations will be included as part of the LAR.
- Cameron report will provide the LEFM uncertainty information. Westinghouse report will provide the total thermal uncertainty.
- The total thermal uncertainty will be based on the bounding LEFM uncertainty value used for the Unit 1 MUR uprate.

Proposed Technical Specification Changes

- RTP definition revised from 3411 MWt to 3459 MWt.
- Core Operating Limits Report (COLR) requirements revised to indicate RTP limited to pre-uprate value when MFW measurements from the LEFM are unavailable.
- COLR analytical methods updated to include references to Caldon Engineering Report Nos. ER-80P, Rev. 0 and ER-157P-A, Rev. 8.
- TS Bases updated to reference 100.6% of RTP for main steam safety valve relief capacity and condensate storage tank contained volume design bases.

Proposed Change for WBN Unit 2 Operating License

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 3459~~11~~ megawatts thermal.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A as revised through Amendment No. 28, 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.

(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:

Proposed Change for WBN Unit 2 TS Section 1.1

1.1 Definitions (continued)

QUADRANT POWER TILT RATIO (QPTR)	QPTR shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is greater.
RATED THERMAL POWER (RTP)	RTP shall be a total reactor core heat transfer rate to the reactor coolant of 3459**11** MWt.
REACTOR TRIP SYSTEM (RTS) RESPONSE TIME	The RTS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RTS trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by the NRC.
SHUTDOWN MARGIN (SDM)	SDM shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming: a. All rod cluster control assemblies (RCCAs) are fully inserted except for the single RCCA of highest reactivity worth, which is assumed to be fully withdrawn. With any RCCA not capable of being fully inserted, the reactivity worth of the RCCA must be accounted for in the determination of SDM; and b. In MODES 1 and 2, the fuel and moderator temperatures are changed to the nominal zero power design level.
SLAVE RELAY TEST	A SLAVE RELAY TEST shall consist of energizing each slave relay and verifying the OPERABILITY of each slave relay. The SLAVE RELAY TEST shall include, as a minimum, a continuity check of associated testable actuation devices.

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Proposed Change for WBN Unit 2 TS Section 5.9.5

5.9 Reporting Requirements (continued)

5.9.3 Radioactive Effluent Release Report

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A single submittal may be made for a multiple unit station. The submittal should combine sections common to all units at the station; however, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

The Radioactive Effluent Release Report covering the operation of the unit during the previous year shall be submitted prior to May 1 of each year in accordance with 10 CFR 50.36a. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The material provided shall be consistent with the objectives outlined in the ODCM and Process Control Program and in conformance with 10 CFR 50.36a and 10 CFR 50, Appendix I, Section IV.B.1.

5.9.4 Reserved for Future Use

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 Limits
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% RTP is specified in a previously approved method, 100.6% RTP 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 10 listed below. When feedwater flow measurements from the LEFM are unavailable, the originally approved initial power level of 102% RTP (3411 MWt) shall be used. The approved analytical methods are, specifically those described in the following documents:

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Proposed Change for WBN Unit 2 TS Section 5.9.5

5.9 Reporting Requirements

5.9.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

5. WCAP-15088-P, Rev. 1, "Safety Evaluation Supporting A More Negative EOL Moderator Temperature Coefficient Technical Specification for the Watts Bar Nuclear Plant," July 1999, (W Proprietary), as approved by the NRC staff's Safety Evaluation accompanying the issuance of Amendment No. 20 (Methodology for Specification 3.1.4 - Moderator Temperature Coefficient.).

6. WCAP-11397-P-A, "Revised Thermal Design Procedure," April 1989. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

7. WCAP-15025-P-A, "Modified WRB-2 Correlation, WRB-2M, for Predicting Critical Heat Flux in 17 x 17 Rod Bundles with Modified LPD Mixing Vane Grids," April 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

8. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis," October 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

9a. WCAP-12472-P-A, "BEACON™ CORE MONITORING AND OPERATIONS SUPPORT SYSTEM," August 1994, (W Proprietary). (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9b. WCAP-12472-P-A, Addendum 1-A, "BEACON™ MONITORING AND OPERATIONS SUPPORT SYSTEM," January 2000, (W Proprietary). (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9c. WCAP-12472-P-A, Addendum 2-A, "BEACON™ MONITORING AND OPERATIONS SUPPORT SYSTEM (WCAP-12472-P-A) Addendum 2," April 2002, (W Proprietary) (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9d. WCAP-12472-P-A, Addendum 4, "BEACON™ CORE MONITORING AND OPERATIONS SUPPORT SYSTEM, Addendum 4," September 2012, (W Proprietary) (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

10. Caldon Engineering Report No. ER-80P, "Improving Thermal Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM √™ System", Revision 0, March 1997 and Caldon Ultrasonics Engineering Report No. ER-157P-A, "Supplement to Caldon Topical Report ER-80P: Basis for Power Uprates with an LEFM Check or an LEFM CheckPlus System", Revision 08, May 2008.

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Summary of Engineering Reviews - NSSS

- Nuclear Steam Supply System (NSSS) design thermal and hydraulic (T-H) parameters were revised consistent with the MUR uprate and serve as the basis for the successor NSSS analyses and evaluations. No changes to the NSSS design basis transients were required to accommodate the revised T-H parameters.
- NSSS and Auxiliary system and component evaluations were performed for the revised design conditions. Each system remains capable of performing its design basis functions for the revised service conditions. Each component was confirmed to be bounded by the current thermal, structural and fatigue evaluations which confirm compliance with the component Code of Record.
- The Balance of Plant (BOP) fluid system interfaces were evaluated relative to the revised NSSS service conditions. The current main steam, steam dump, condensate and feedwater, auxiliary feedwater and steam generator blowdown systems NSSS interface requirements were found to support the MUR uprate service conditions.
- Transient and accident analyses and associated evaluations were reviewed and were confirmed to bound the MUR uprate with no reanalysis required. The applicable acceptance criteria continue to be met.

Summary of Engineering Reviews - NSSS

- The functional capability of the reactor control systems and setpoints were confirmed to be acceptable for the MUR service conditions.
- The plant operability/margin to trip analyses of record (AOR) were confirmed to remain applicable for the MUR service conditions.
- Fuel design and performance evaluations were performed to demonstrate that design acceptance criteria continue be satisfied for the uprated condition. No changes to cycle-specific core design limits or fuel performance analyses will be required.
- Other evaluations for reactor vessel internals, ice condenser structures and primary loop and pressurizer surge line leak-before-break (LBB) analyses also demonstrated acceptable results for the uprated conditions.

Summary of Engineering Reviews - BOP

- Revised BOP T-H service conditions for the MUR uprate were generated from update of the plant secondary cycle heat balance model. System and equipment design performance capacities/capabilities were evaluated for revised service conditions.
- Operating margins were quantified for key parameters based on predicted conditions and evaluated relative to established administrative limits, instrument setpoints, and component design ratings.
- Some BOP operating margins reduced for uprated service conditions.
  - Turbine Throttle Flow Margin – Governor Valve Opening
  - Condensate Storage Tank Inventory for Station Blackout
  - Generator Hydrogen Cooling System Pressure
  - 6.9 kV Unit Board Loading
- The results of all BOP system and component evaluations demonstrate the functional requirements continue to be met for the MUR uprate service conditions.

Plant Modifications

- The MFW LEFM system hardware was installed during plant completion. No hardware modifications to plant systems, structures or components are required to support the MUR uprate.
- Instrument loop scaling updates for the MUR service conditions will be implemented for the following functions :
  - Steam Generator MFW Flow, Temperature and Pressure
  - MFW Header Pressure and Flow
  - Pressurizer Pressure
  - Turbine Impulse Pressure
- Select changes to the plant Integrated Computer System (ICS) programs and database points will be implemented to support the MUR power calorimetric using the MFW LEFM system.

Regulatory Precedent

- Prior pressurized water reactor MUR power uprate LAR approvals include:
  - Catawba Nuclear Plant – Approved April 29, 2016 (ML16081A333)
  - Byron/Braidwood Nuclear Plant – Approved February 07, 2014 (ML13281A000)
  - McGuire Nuclear Plant – Approved May 16, 2013 (ML13073A041)
  - Shearon Harris Nuclear Plant, Unit 1 – Approved May 30, 2012 (ML11356A096)
  - WBN Unit 1 MUR power uprate approved January 19, 2001 (ML010260074).
- These prior LARs are being reviewed (including associated RAIs and SEs) for applicability to the WBN Unit 2 LAR.

Schedule Milestones

- July 18, 2019 – LAR Pre-Submittal Meeting with NRC
- August 30, 2019 – LAR Submittal – Request NRC Approval within 12 Months of Submittal
- September 2019 – Telecon or meeting to discuss any NRC questions
- October 2019 – Cycle 4 Core Design Initialization
- July 2020 – Cycle 4 New Fuel Delivery
- August 2020 – NRC Approval of LAR (Requested)
- October 2020 – Cycle 3 Refueling Outage Start
- November 2020 – Cycle 4 Startup (Implementation date of the LAR)

Closing Remarks

- Comprehensive MUR power uprate evaluations have been completed to support a WBN Unit 2 RTP increase of 1.4% (to 3459 MWt).
- The MUR evaluation is based on processes and methodologies which have received prior regulatory approval.
- Consistent with MUR uprate expectations, no major plant modifications are required. Changes are limited to ICS program modifications and instrument loop rescaling.
- The Unit 2 LAR is based on guidance in RIS 2002-003 and the content of other recent pressurized water reactor MUR LARs (and the WBN Unit 1 MUR uprate).
- LAR submittal is planned for August 30, 2019. Completion of LAR regulatory review will be requested for August 2020 to support uprate for Cycle 4 operation (November 2020 startup).


TVA