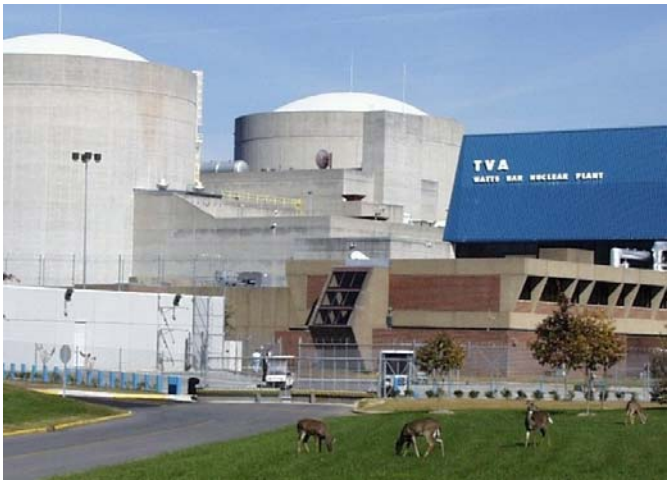
Nuclear

Watts Bar TPBAR Loading Increase LAR Pre-Submittal Meeting



August 14, 2014

Nuclear

Introduction

- Purpose of Meeting
  - Update NRC Management on TVA's Plan to Submit a License Amendment Request (LAR) in January 2015 to Increase Allowable TPBAR Loading for Watts Bar Unit 1

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Agenda

• Introduction	Jim Lemons
• Background	Mark Burzynski
• DOE TPBAR Loading Plans	Carla Borrelli
• Tritium Permeation Experience	Cheryl Thornhill
• Projected Pathway Exposures	Mark Burzynski
• Plant Modifications	Carla Borrelli
• Post-LOCA Shutdown Margin Analysis	Mark Burzynski
• Licensing Plan and Schedule	Mark Burzynski
• Closing Comments	Jim Lemons

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Background

- Background
  - License Amendment 40 Issued on September 23, 2002 Authorized Loading Up to 2304 TPBARs
    - Allowed Loading Subsequently Reduced to Address Post-LOCA Shutdown Margin Issues
  - TVA Letter Dated March 22, 2005 Notified NRC of Interim Cumulative TPBAR Tritium Release Limits
    - While Higher than Projected Permeation Rates were Investigated
  - License Amendment 77 Issued on May 4, 2009 Authorized Loading Up to 704 TPBARs

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DOE TPBAR Loading Plans

- DOE TPBAR Loading Plans for Watts Bar Unit 1:

Cycle	Date	TPBAR Loading	Tech Spec Limit
C12	October 2012	544	704
C13	April 2014	704	704
C14	October 2015	704	704
C15	March 2017	1104	1792*
C16	October 2018	1504	1792*
C17	April 2020	1792	1792*

* Proposed

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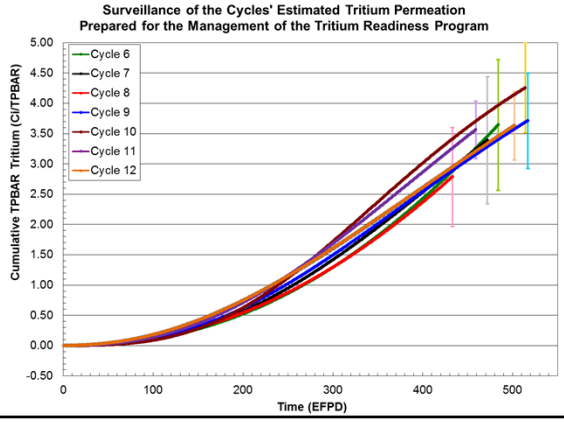
Tritium Permeation Experience (1/2)

- TVA and PNNL Performed Surveillance Of Estimated Tritium Permeation Over Last 7 Cycles of TPBAR Irradiation for the Tritium Readiness Program.
  - Permeation Was Higher than Original Design Goal, But No Design or Production Flaws Have Been Identified.



Uncertainty bars represent 90% confidence interval

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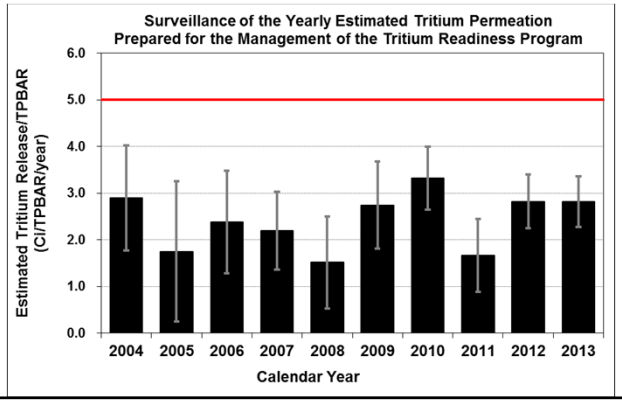
Tritium Permeation Experience (2/2)

- Original Functional Requirement for TPBAR Tritium Permeation in Cycle 6 was an Average of 1 Ci/TPBAR/Year.
- Radionuclide Releases to Environment at WBN-1 will be Managed to Meet NRC Requirements in 10 CFR Part 20 and 10 CFR Part 50 Appendix I.
  - Proposed Management Strategy Assumes TPBAR Tritium Permeation will be 5.0 Ci/TPBAR/year.



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Projected Pathway Exposure (1/2)

- FSAR Chapter 11 Radiological Consequence Analyses Will Be Based on:
  - Release Source Term Based on NRC NUREG-0017 Methodology to Calculate an Average Maximum Hypothetical Release
  - TPBAR Loading of 1792 TPBARs
  - TPBAR Tritium Permeation Rate of 5 Curies/TPBAR/Year (Based on Conservative Upper Bound of Plant Data)
  - Use of TVA QA Computer Codes GELC and QWATA to Calculate Dose to Maximum Exposed Offsite Individual

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Projected Pathway Exposure (2/2)

- Projected Pathway Exposures to Maximum Hypothetical Individual Remain Below NRC Regulatory Limits for All Cases.

Pathways	Preliminary Projected Doses	NRC Limit
Liquid (Realistic)	0.75 mrem Total Body	3 mrem
Liquid (Design)	0.81 mrem Total Body	
Gaseous (Realistic)	1.29 mrem Total Body	10 mrem
	10.86 mrem Critical Organ	15 mrem
Gaseous (Design)	1.29 mrem Total Body	10 mrem
	11.34 mrem Critical Organ	15 mrem

- Applicable NRC Requirements (10 CFR Part 20 and 10 CFR Part 50 Appendix I) and Technical Specifications Will Be Met for All Cases.

Preliminary Results Based on 1700 TPBARs

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Plant Modifications (1/2)

- Addition of 500,000 Gallon Tritiated Water Tank System
  - Increase Flexibility to Manage RCS Feed and Bleed Under Contingency Scenarios and Time Effluent Releases to Environment
  - Allows Changes to Operating Strategy for RCS Feed and Bleed to Keep Tritium Concentrations Low and Simplify Occupational Exposure Controls
  - Implemented under 10 CFR 50.59

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Plant Modifications (2/2)

- Replace Check Valves Used for Thermal Relief on CCS and ERCW Supply Lines with Relief Valves
  - Eliminates Post-LOCA Manual Operator Actions for Isolation
    - Previously Approved by NRC in License Amendment Issued on March 29, 2004
  - Eliminates 40 GPM Source of Unborated Water Leakage into Containment (Assumed for 16 Hours)
  - Implemented under 10 CFR 50.59

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Post-LOCA Shutdown Margin Analysis (1/5)

- Post-LOCA Reactivity Analysis will Be Consistent with Previously Approved by NRC for License Amendment 77 with the Following Key Changes:
  - Elimination of Dilution of Sump Water from 40 GPM Unborated Water In-Leakage
  - Reduce Required RCS Boron Concentration by Increased IFBA Loading
  - Modification of Simplified Assumptions on TPBAR Lithium Leaching
    - Time Dependent Leaching Rate Used
- Preliminary Results Show Sufficient Shutdown Margin for 1792 TPBARs

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Post-LOCA Shutdown Margin Analysis (2/5)

- Xenon Free Post-LOCA – RSAC Item 3.16B

[redacted]	Pre-LOCA C_b (ppm)	Post-LOCA C_b (ppm)	Design Limit (ppm)	Margin (ppm)
HFP EQXE C_b = 744 ppm				
1792 TPBARs	644	1923.0	2135.3	212.3

- Conclusion: 744 ppm core with 1792 TPBARs can accommodate cycle variations

Preliminary Results

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Post-LOCA Shutdown Margin Analysis (3/5)

- Hot Leg Switchover – RSAC Item 3.16A

[redacted]	Pre-LOCA C_b (ppm)	Post-LOCA C_b (ppm)	Design Limit (ppm)	Margin (ppm)
HFP EQXE C_b = 744 ppm				
1792 TPBARs	644	1607.0	1736.5	129.5

- Conclusion: 1792 TPBAR core at 744 ppm with time dependent leach rate meets requirements

Preliminary Results

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Post-LOCA Shutdown Margin Analysis (4/5)

- Cold-Leg Recirculation – RSAC Item 3.11B

[redacted]	Pre-LOCA C_b (ppm)	Post-LOCA C_b (ppm)	Design Limit (ppm)	Margin (ppm)
HFP EQXE C_b = 744 ppm				
1792 TPBARs	644	1817.0	2041.2	224.2

- Conclusion: 1792 TPBARs at 744 ppm core meets requirements.

Preliminary Results

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Post-LOCA Shutdown Margin Analysis (5/5)

- Reflood Recriticality – RSAC Item 3.11C

[redacted]	Pre-LOCA C_b (ppm)	Intermediate LBLOCA (K_{eff})	Small LBLOCA (K_{eff})
HFP EQXE C_b = 744 ppm			
1792 TPBARs	644	0.976000	0.993956

- Conclusion: 1792 TPBAR core at 744 ppm with time dependent leach rate meets requirements.

Preliminary Results

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Licensing Activities

- License Amendment Request to Support Tritium Production Requirements
  - Update of Post-LOCA Reactivity Analysis Previously Approved by NRC for License Amendment 77
  - Would Include Discussion of Expected Effluent Releases (Using Realistic Source Term) and Radwaste System Design and Station Dose (Using Design Basis Source Term) for 1792 TPBARs

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Technical Specification Changes

- Technical Specification (TS) Change to New TPBAR Limit
  - Revise TS 4.2.1 to Reflect New Upper Limit of 1792 on TPBAR Loading
  - Delete Outdated TPBAR Information in Surveillance Requirements 4.5.1.4 and 4.5.4.3

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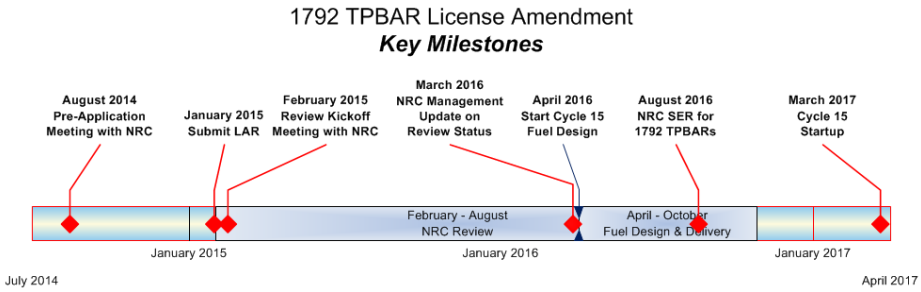
Licensing Activities Schedule



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Closing

- TVA Plans to Submit a License Amendment Request for 1792 TPBARs in January 2015
  - Supporting Analyses will Bound Operating Experience with Tritium Permeation
  - Supporting Analyses will Reflect Plant Modifications Made to Increase Margins
  - All Regulatory Requirements and Plant Technical Specifications will be met with 1792 TPBAR Core Design

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Questions