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Watts Bar TPBAR Loading Increase LAR Pre-Submittal Meeting



January 23, 2013



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Agenda

- | | |
|--------------------------------------|--------------------|
| • Introduction | Terry Cribbe |
| • Background | Mark Burzynski |
| • DOE TPBAR Loading Plans | Curtis Chambellan |
| • Tritium Permeation Experience | Larry Bagaasen |
| • Projected Pathway Exposures | Mark Burzynski |
| • Plant Modifications | Jeff McGuire |
| • Licensing Activities | Mark Burzynski |
| • Post-LOCA Shutdown Margin Analysis | Gregg Swindlehurst |
| • Licensing Activities Schedule | Terry Cribbe |
| • Closing Comments | Terry Cribbe |



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Introduction

- Purpose of Meeting
 - Update NRC Management on TVA's Plan to Submit a License Amendment Request (LAR) in June 2013 to Increase Allowable TPBAR Loading for Watts Bar Unit 1



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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
C11	April 2011	544	704
C12	October 2012	544	704
C13	April 2014	544-704	704
C14	October 2015	1104-1024	1696*
C15	April 2017	1504-1424	1696*
C16	October 2018	1696	1696*

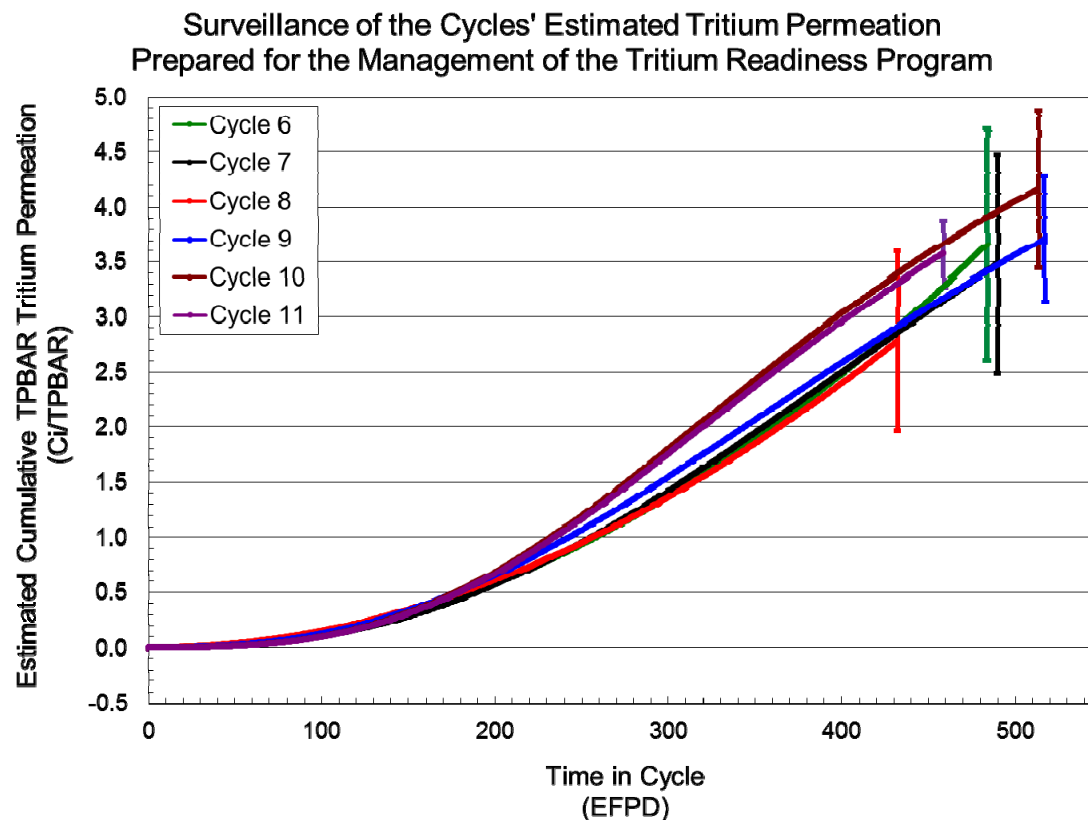
* Proposed



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Tritium Permeation Experience (1/2)

- TVA and PNNL Performed Surveillance Of Estimated Tritium Permeation Over Last 6 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.



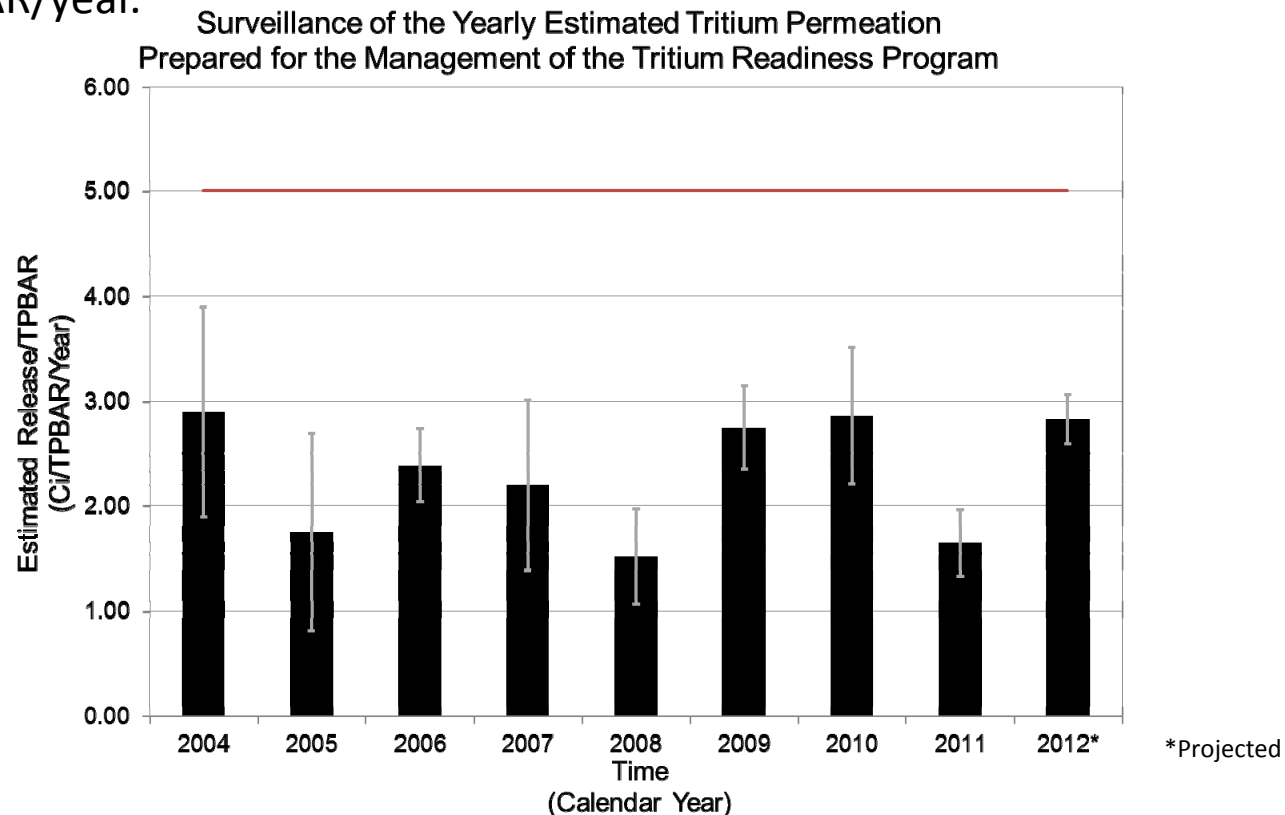
Uncertainty bars
represent 90%
confidence interval



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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 1700 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
Liquid (Realistic)	0.75 mrem Total Body
Liquid (Design)	0.81 mrem Total Body
Gaseous (Realistic)	1.29 mrem Total Body
	10.86 mrem Critical Organ
Gaseous (Design)	1.29 mrem Total Body
	11.34 mrem Critical Organ

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



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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 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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Licensing Activities

- Update Letter Removing Interim Limit on Tritium Releases Attributed to TPBARs (Update to March 22, 2005 Letter)
 - Return to Normal Effluent Controls of 10 CFR Part 20, 10 CFR Part 50 Appendix I, and Technical Specifications
 - Would Include General Discussion of Expected Effluent Releases for 704 TPBARs
- License Amendment Request for 1696 TPBARs
 - 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 1696 TPBARs



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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 at Time of Hot Leg Switchover.
 - Time Dependent Leaching Rate Used
- Preliminary Results Show Sufficient Shutdown Margin for 1696 TPBARs



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Post-LOCA Shutdown Margin Analysis (2/5)

- Xenon Free Post-LOCA – RSAC Item 3.16B

	Pre-LOCA C _b (ppm)	Post-LOCA C _b (ppm)	Limit (ppm)	Margin (ppm)
HFP EQXE C _b = 1200 ppm (less IFBA)				
544 TPBARs	937	1891	2176	285
1696 TPBARs	953	2170	2178	8
HFP EQXE C _b = 900 ppm (more IFBA)				
1696 TPBARs	736	2006	2148	142

- Conclusion: 900 ppm core with 1696 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

	Pre-LOCA C _b (ppm)	Post-LOCA C _b (ppm)	Limit (ppm)	Margin (ppm)
HFP EQXE C _b = 1200 ppm (less IFBA)				
544 TPBARs	937	1891	2009	118
1696 TPBARs	953	2170	2012	-158
HFP EQXE C _b = 900 ppm (more IFBA)				
1696 TPBARs – 50% Leach (Max)	736	2006	1966	-40
1696 TPBARs – 3% Leach (Time Dependent)	736	1897	1966	69

- Conclusion: 1696 TPBAR core at 900 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

	Pre-LOCA C _b (ppm)	Post-LOCA C _b (ppm)	Limit (ppm)	Margin (ppm)
HFP EQXE C _b = 1200 ppm (less IFBA)				
544 TPBARs	937	1891	2115	224
1696 TPBARs	953	2170	2119	-52
HFP EQXE C _b = 900 ppm (more IFBA)				
1696 TPBAR	735	2006	2064	58

- Conclusion: 1696 TPBARs, 900 ppm core meets requirements.

Preliminary Results



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Post-LOCA Shutdown Margin Analysis (5/5)

- Reflood Recriticality – RSAC Item 3.11C

	Pre-LOCA C_b (ppm)	Large LBLOCA (K_{eff})	Intermediate LBLOCA (K_{eff})	Small LBLOCA (K_{eff})
HFP EQXE C_b = 1200 ppm (less IFBA)				
544 TPBARs	937	0.939349	0.968402	0.982261
1696 TPBARs	953	0.964008	0.990343	1.007126
HFP EQXE C_b = 900 ppm (more IFBA)				
1696 TPBARs – 50% Leach (Max)	736	0.955894	0.985144	1.005015
1696 TPBARs – 3% Leach (Time Dependent)	736	0.948534	0.977298	0.996649

- Conclusion: 1696 TPBAR core at 900 ppm with time dependent leach rate meets requirements.

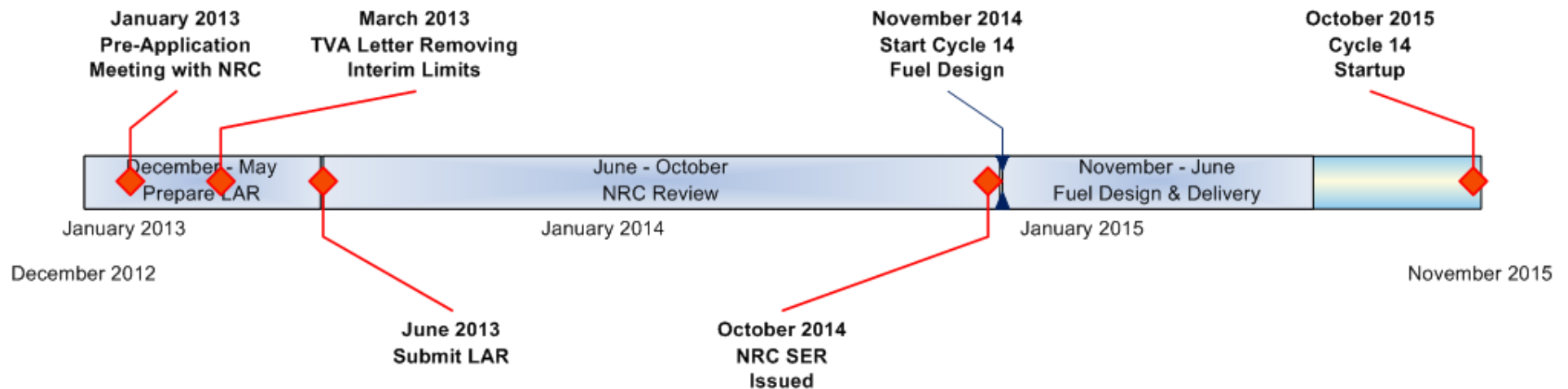
Preliminary Results



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Licensing Activities Schedule

1696 TPBAR License Amendment *Key Milestones*





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Closing

- TVA Will Submit a License Amendment Request for 1696 TPBARs in June 2013
 - 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 1696 TPBAR Core Design



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Questions



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Backup Slides



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TPBAR Leaching Test

- Leaching Results from Dynamic Leaching Test on an Irradiated TPBAR Section

Dynamic Flow Through Tests on Irradiated
ATR Composite Sections (Water with 2650
wppm B, pH = 4.6)

