Tritium Radioactive Source Terms as Currently Used Within the Commercial Light Water Reactor Tritium Production Program (Abbreviated Version)

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Tritium Radioactive Source Terms

Four classifications of Tritium radioactive source terms are currently used within the Commercial Light Water Reactor Tritium Production Program:

1. Radioactive Waste System Design Basis Source Terms – NRC Regulatory based - These values set the Station's shielding requirements, system processing capabilities *and* compliance with occupational radiation exposure limits, they are the **bounding** values.
2. Realistic Source Terms – NRC Regulatory based - These are developed following regulatory approved methodologies. In this context, they are used to demonstrate that the **average** Station radioactive source production will not project annual off-site exposures in excess of the NRC ALARA Guidelines (10 CFR 50 Appendix I).
3. Radiological Consequences of Accidents and Control Room Habitability Systems – NRC Regulatory based - A unique set of System Radioactive Source Terms and release assumptions are used to demonstrate compliance with:

   - 10 CFR Part 20, "Standards for Protection Against Radiation"
   - 10 CFR Part 50, Appendix A *Criterion 19—Control room*
   - 10 CFR Part 100, "Reactor Site Criteria"

   Each defined accident scenario has a reference that defines appropriate source terms, assumptions, calculation methodology, and acceptance criteria. It should be noted that the tritium available for release from a Tritium Production Core (TPC) and the potential radiological consequences (Total Effective Dose Equivalent (TEDE)) are outside the scope of the standard accident scenarios. It was therefore necessary to modify the accident source terms, assumptions, calculation methodology, and acceptance criteria to include TPC tritium.
4. Projected Actual Source Terms – TVA/DOE cycle based – These are developed using appropriate (values are adjusted as necessary to reflect current knowledge and system performance) mean performance (most likely) and highest observed tritium source terms (Tritium Producing Burnable Absorber Rods (TPBARs) and non-TPBAR). These calculations are required to confirm[1] [2] (*The number of TPBARs to be irradiated in any given operating cycle will be evaluated in the*

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[1] WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - TRITIUM PRODUCTION PROGRAM - UNIT 1 CYCLE 6 OPERATING EXPERIENCE, Letter to NRC March 22, 2005

[2] WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - REVISED TECHNICAL SPECIFICATIONS CHANGE WBN-TS-08-04 – REVISION TO THE MAXIMUM NUMBER OF TPBARS THAT CAN BE IRRADIATED IN THE REACTOR CORE PER CYCLE (TAC NO. MD9396))

reload safety evaluation and documented in the COLR.) that the annual tritium estimated to be released by the proposed number of TPBARs to be inserted in the following cycle complies with the current tritium constraints, establishes each cycles Tritium Production Performance Metrics, and to apprise the Staff Station of the forth coming cycles potential radiological consequences (delta from previous cycles).

Tritium Producing Burnable Absorber Rods (TPBARs) Tritium Source Terms

Two quantities of TPBARs are considered; 1,900 TPBARs is used as the most likely total loading required to meet tritium production requirements (Realistic Basis) and 2,500 TPBARs represents the maximum upper bounding total loading (Design Basis).

The estimated TPBAR tritium release rate is established as the averaged tritium release over a cycle's final 365 Effective Full Power Days. An estimated average of 5 Ci tritium permeation per TPBAR is used in the realistic model. The TPBAR 5 Ci average value is based on the best estimated value for Model Mk 9.2 TPBARs including estimated measurement uncertainties rounded upward to the nearest whole value, to provide operational margin.

The average value of 10 Ci tritium permeation per TPBAR is used in the Design Basis model. The TPBAR 10 Ci average value is based on establishing a total tritium (all sources) bounding value that demonstrates appropriate performance with respect to (1) radwaste system design capability to process radioactive wastes at Radwaste System Design Basis fuel defect level and fission product leakage level, (2) confirmation of compliance with radioactive gaseous and liquid effluent release standards and effluent monitoring requirements under routine operations and anticipated operational occurrences, and (3) shielding requirements and compliance with occupational radiation exposure limits, and provides for an appropriate operational margin.

The projected actual release model is calculated each cycle using the current best estimated final 365 Effective Full Power Days permeation value (TPBAR permeation average plus estimated measurement uncertainties). The current best estimated value for Model Mk 9.2 TPBARs permeation, including the 95% confidence level upper bound is ≈ 4.3 tritium Ci/final 365 Effective Full Power Days.