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Mr. Curtis Chambellan
Tritium Readiness Subprogram
Office of Stockpile Technology (NA-123.1)
Department of Energy/NNSA
PO Box 5400
Albuquerque, NM 87185-5400

Dear Mr. Chambellan:

TPBAR Production Estimates With Increasing Numbers of TPBARs

The Tritium Production Planning Group (TPPG) has been assessing transition to equilibrium tritium production cores. The Pacific Northwest National Laboratory (PNNL) has reviewed the TPPG discussions as well as prior tritium production estimates by Westinghouse. PNNL has concluded that as the number of Tritium Producing Burnable Absorber Rods (TPBARs) increase in a reactor core, past some number of TPBARs, the average quantity of tritium produced per TPBAR will decline. The main reason is because with increasing numbers, less optimal (for tritium production) core loading patterns must be used. Scoping analysis performed to date appears to indicate that the average production per TPBAR should be expected to start dropping at about 1700 TPBARs in a core, with an average level of about 0.85 grams per TPBAR being expected at 2300 TPBARs per core.

Also please note that all numbers about the "average" TPBAR production is for cycles that go breaker to breaker. Typically this is not the case which further reduces actual production.

TVA and Westinghouse have done scoping work to optimize loadings for a 1700 gram tritium core. They tentatively concluded that 1700 grams of tritium can be achieved with about 1800 TPBARs, assuming breaker to breaker operation. TVA cautioned that this was a scoping result, and that results had not been reviewed against the core safety checklists. This indicates that average production per TPBAR will likely be less than 1 gram at 1800 TPBARs.

PNNL also notes that in the first 6 tritium production cores (WBN1 Cycles 6-11), an average of 1 gram per TPBAR was only achieved in cycle 10. The overall average for the 6 cycles is about 0.95 grams per TPBAR.

The overall conclusion is clear. DOE should expect that the tritium production per TPBAR will be less than 1 gram per rod for 1700 gram tritium cores and greater. Initial calculations indicate that ~1700 TPBARs is the point where the production per TPBAR might start dropping dramatically, with a potential low of ~0.85 grams per TPBAR at about 2300 TPBARs. This number will be further reduced if cycles are shut down early and/or there are mid-cycle trips. The TPPG still has an activity to calculate the maximum number of TPBARs in a core.

Note that all results and the work done to date are all considered to be unverified scoping results. Actual production estimates will depend on cycle specific core parameters and will be verified for cycle specific reload designs.

If you have any questions, please contact Ed Love at (509) 372-4134, Bruce Reid at (509) 372-4135, or myself.

Sincerely,

Cheryl K. Thornhill

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PNNL Tritium Technology Program

CKT/KAB/csm