LETTER TO THE EDITOR

COMMENTS ON "NEUTRON STREAMING THROUGH GAPS IN FUSION REACTOR SHIELDING"

In Ref. 1, Halley and Miller indicated that the dose behind a straight gap with width as small as 1 cm in the STARFIRE outboard shield is approximately ten orders of magnitude greater than that for a continuous shield. This peaking factor is extremely high, particularly since it is clear from Fig. 2 of Ref. 1 that the slot does not see direct line-of-sight source neutrons from the plasma and the 118-cm-thick shield cannot give more than ten orders of magnitude attenuation.

To verify this we performed two one-dimensional plane geometry calculations using the STARFIRE (Ref. 2) material composition and dimensions for the outboard blanket and shield. In one calculation, the full 118-cm-thick shield is used while in the other no shield is used. For one source neutron per square centimetre per second in the plasma, the dose rate at the back of the shield was found to be 3.6×10^{-12} rem/h in the first calculation, and the dose rate at the back of the blanket in the second calculation is 8.5×10^{-7} rem/h. This implies that the shield results in a factor of 2.4×10^5 dose attenuation, and the peaking factor cannot exceed this value. In addition the authors gave a very hard neutron spectrum behind the slot (Fig. 6, Ref. 1). Our results indicate that the neutron spectrum at the back of the blanket is considerably softened due to slowing down in the blanket. Only 3% of the neutrons are in the 14-MeV energy group.

It should be noted that recent work by Yang and Gohar[3] showed that peaking factors of ~ 15 result in the inboard leg of the toroidal field coil due to 3-cm-wide straight slots in the inboard shield of the Tokamak Fusion Core Experiment. These slots see direct line-of-sight source neutrons from the plasma. The peaking factor drops to ~ 4 if a 24-deg single bend slot is used. The results of Ref. 1 are in sharp contrast with these results. One can only speculate at the source of the discrepancy, but quite possibly it could be the well-known problem of undersampling in Monte Carlo for deep-penetration problems, which can give rise to large overestimates of the attenuation through a shield.[4]

The authors also gave the neutron source spectrum used in the plasma zone (Table I, Ref. 1). This spectrum is considerably soft while no slowing down of the 14-MeV deuterium-tritium neutrons occurs in the low density magnetic fusion plasma.

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REFERENCES

1. A. M. HALLEY and W. H. MILLER, "Neutron Streaming Through Gaps in Fusion Reactor Shielding," *Fusion Technol.*, **10**, 424 (1986).

2. "STARFIRE: A Commercial Tokamak Fusion Power Plant Study," ANL/FPP-80-1, Argonne National Laboratory (1980).

3. S. YANG and Y. GOHAR, "Hot Spots in the Inboard Section of the TFCX Toroidal Field Coils," *Fusion Technol.*, **8**, *1*, Part 2B, 1682 (1985).

4. M. M. H. RAGHEB, "Monte Carlo Particle Transport with First Event Source Estimation," *Atomkernenergie-Kerntechnik*, **37**, 271 (1981).