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Tantalum Gamma Shield

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ABSTRACT

The reference gamma shield material for the Reference ZrH Reactor is tungsten. Since this material is brittle, tantalum-10W has been suggested as an alternate. This study found that in the reference system, the two materials are essentially identical from a nuclear and weight standpoint.

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Introduction

The reference gamma shield material for the 600 kw Ref. ZrH Reactor side shield is tungsten. According to the shield materials development personnel, high tungsten alloys tend to be brittle. They have suggested the consideration of more ductile tantalum alloys. The purpose of this study was to make a nuclear comparison of the two materials in the reference system.

Discussion

The two alloys compared were W-2Mo ($\rho = 18.73$ gm/cc) and Ta-10W ($\rho = 16.9$ gm/cc). Two ANISN transport calculations, S8P3 neutron and S8P5 photon, were performed. In the comparative photon calculations only the prompt fission gammas were considered; however, the conclusions should be applicable to the other photon sources. The gamma shield thickness for all the cases was 0.50".

Results

Across the shield the neutron dose was attenuated a factor of 0.738 for Ta and 0.704 for W. The gamma dose was attenuated a factor of 0.459 for Ta and 0.429 for W. Since the Ta alloy density is about 10% less, the dose rates came out about 10% higher for the same thickness. Increasing the Ta thickness about 10% to reduce the dose will result in about the same shield weights.

In the Ta shield there were about 3% more neutron absorptions. However, the neutron binding energy for Ta (6.03 Mev) is less than for W (6.83 Mev). Consequently, secondary gamma production in the Ta shield is about 5% less than in W. From a heating consideration, there were about 5% fewer photon absorptions in the Ta shield.

Conclusion

With the appropriate density corrections, ~ 10%, the tantalum and tungsten side gamma shield are essentially identical and may be considered interchangeable from a nuclear and weight standpoint.