Characterization of the Epithermal Neutron Beam of the Modified TRIGA Reactor at the Washington State University Nuclear Radiation Center

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Introduction

- Theory of Boron Neutron Capture Therapy (BNCT)
- Design of the Thermal Column
- Characterizing the Beam
- The Future of BNCT
WSU NCT Facility

- 2003: core used HEU/LEU Fuel
- 2008: The core was converted to use only LEU fuel due to a government mandate prohibiting HEU
- There was concern that this change would alter the neutronic performance of the beam
Beam Requalification

- The development of interest in human clinical trials, as well as the core reconfiguration have made it necessary to complete an experimental revalidation of the neutronic performance of the beamline.

- This presentation summarizes the results of the requalification effort.
Theory of Boron Neutron Capture Therapy

Liposome complex

- Hydrophilic head
- Aqueous solution
- Hydrophobic tail

Boron-10

Neutron Filtering and Moderating Assembly (Thermal Column)
Bismuth collimator

collimator design

1) id top - 12
2) id bottom - 36
3) thickness - 12
4) (inner collar to face)
5) spade - .346' (107 pm)
6) height - 13
7) 16 segments
8) 102.2 cu in / segment
9) 36.04#/ segment
10) 8560#/ total

Construction of collimator
Beam Characterization

Metal activation foils
Original Neutron Spectrum

HEU flux: $1.66 \times 10^9$ n/cm$^2$-s
LEU flux: $1.49 \times 10^9$ n/cm$^2$-s

Measured Integral Parameters:
- $\Phi_e = 1.66 \times 10^9$ n/cm$^2$-s
- $k_n = 2.53 \times 10^{-11}$ cGy-cm$^2$
Beam Intensity Measurements

Cadmium-covered fission chambers

Fission chambers inside bismuth shield in beam aperture
Flux Profile Measurements

Flux Wires placed in Leucite Phantom

Head-on view  Side view
June 2014 Cylindrical Phantom Axial Flux Profiles

Flux (n/cm²-s) vs. Depth (cm)

- Epithermal
- Thermal
Conclusion

• HEU to LEU conversion has not significantly changed the beam performance

• WSU will soon initiate canine trials

• Human trials might be performed at WSU in several years with the addition of the new Elson S. Floyd College of Medicine in Spokane, WA
Questions?

Additional questions can be emailed to: kaitlyn.restis@wsu.edu