GENERAL CAVITY THEORIES FOR PHOTON AND NEUTRON DOSIMETRY

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The aim of a general cavity theory is to predict the energy deposition from a source of ionizing radiation in a cavity of arbitrary size and composition. This thesis proposes two new general cavity theories. The first is intended for cavities in photon fields. The second is for spherical cavities in fast neutron fields. Both models can be written in the familiar form of the Burlin cavity theory.

The proposed photon model takes into account the effect of secondary electron scattering at the cavity boundaries. The model can be used to calculate the average cavity dose, the dose distribution inside the cavity, as well as the relative contributions of the wall and the cavity to the cavity response. A comparison is made between the proposed model, the well known Burlin model, and experimental data.

The second model discussed is a calculation of the response of a sphere of arbitrary size in a fast neutron field. The dose deposited in the cavity is calculated taking into account the energy dependence of the stopping power, the secondary starting energy distribution, and the cavity volume. An analytical solution is derived. From this a simple three parameter power function is fitted which accurately predicts cavity doses to within 0.1% of the values predicted by the analytical model.

Results of the calculation are given in a table for TE/TE, TE/air, and C/CO2 wall-gas combinations for neutron energies between 0.76 Mev and 14 Mev and cavity sizes between 0.01 cm('3) and 10 cm('3). These results are compared with a more detailed calculation. There is good agreement between the two methods under 5 MeV in all cases and up to 14 MeV in the hydrogenous cases. That is, the model works well when elastic scattering interactions dominate the cavity response.