IRPA9
1996 International Congress on Radiation Protection
April 14-19,1996
Vienna, Austria

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PAPER TITLE Mass Optimization Studies of Gamma Shield Materials for Space Nuclear Reactors

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MAJOR SCIENTIFIC TOPIC NUMBER 4 (see page 7)

ABSTRACT (See instructions overleaf)

An optimization study of the total gamma shield mass requirements for a space nuclear power system is presented. The minimization of the mass of the gamma shield for a space nuclear power system is of interest because it represents a large fraction of the overall spacecraft mass, typically between 20% and 40%. Optimization of the shield mass can thus result in significant mass savings which translate into reductions in launch costs.

The gamma radiation source and reference dimensions were based on the Russian TOPAZ-II nuclear electric power-generating reactor. The potential shield materials analyzed were aluminum, steel, lead, tungsten, depleted uranium, lithium hydride, and concrete. The required shield masses were normalized to the lowest value, providing a "mass index" that was used as a basis of comparison for the different shield materials. A gamma source of 10^{16} γ/sec originating from a thin disk-source model of the reactor, provided a uniform beam of monoenergetic gamma rays incident on the cone shield. A value of 50 mSv/hr (5 mrem/hr) was chosen as the desired dose equivalent at the reference dose point. The computations were performed with QAD-CGGP, a three-dimensional, point-kernel gamma shielding code. Depleted uranium had a mass index of 1.0 and provided the required shielding with the lowest mass requirement. Mass indices between 1.2 and 1.7 were characteristic of tungsten and lead, making them potential substitutes for depleted uranium in the case of smaller reactor power levels.