UNPUBLISHED PRELIMINARY DATA

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ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE

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A research report with the title "Dosimetric Evaluation of the Alpha Flux in Solar Particle Beams" has been issued and distributed in February. It reviews the available scanty information on the LET/E relationship for alpha particles in tissue in the Bragg peak region and proposes a compromise between the discrepant data in the literature. On the basis of this compromise, mean and instantaneous QF and RBE of alpha particles for the energy region from 0.01 to 1,000 Mev are established and critically compared to the corresponding data for protons. The findings are used for computing rad and rem dose distributions in a tissue slab and a spherical tissue phantom behind 1.75 g/cm^2 (minimum of Apollo vehicle) for the proton and alpha flux of a typical flare spectrum.

As indicated in the preceding Progress Report No. 8, considerable interest exists for dose appraisals in systems of very low shielding such as a space suit which would be the sole protection for the astronaut outside the vehicle. In this case, the shielding equivalent is as low as 0.1 g/cm^2. The flare spectrum proposed by Weir and Brown (see preceding Progress Report No. 8) for such low penetrating power has been used for computing the tissue depth dose distribution behind a shield thickness distribution similar to the Mercury space suit. The results show that the surface tissue dose behind such low shielding is predominantly due to the alpha component of the flare beam with the bulk of this alpha dose administered at high LET values. These findings are reported in a research report with the title "Radiation Exposure in Solar Particle Beams Behind Very Low Shielding" going to press at this time.

Work in progress extends the low shielding analysis to the heavy component of flare beams, i.e., to C, N, O and heavier nuclei. Preliminary results based on the highest reported flare produced flux for heavy nuclei (November 13, 1960 flare) indicate that even for the extremely low shielding of 0.1 g/cm^2 the C component produces a surface dose of only a few per cent of the alpha dose and drops more steeply than the alpha dose with depth.

Work on establishing the integral exposure from galactic radiation on missions of various durations and for orbits of various inclinations is being continued. It appears quite difficult to arrive at reliable estimates for the dose contribution from secondaries in the local hardware. Contrary to solar particle beams or trapped radiations where the bulk of the particle flux, with rare exceptions, is limited to energies up to 300 or 400 Mev, i.e., to energies below the threshold for meson production, galactic radiation centers on very high energies well above the meson production limit. The build-up of secondaries, in this case, involves multiple generations of long range secondaries with many alternative decay schemes defying quantitative treatment with Monte Carlo codes. These difficulties are not due to limitations of computer facilities, but are of a principal nature due to error accumulation in multiple decay schemes as interaction cross sections, angular distributions, and mean free paths are not accurately enough known. The dose

contribution from secondaries accounts for a substantial part of total exposure especially on the rem level in view of the important role of neutrons in the nucleonic cascades. Therefore, establishing merely the absorbed doses from primaries would not seem a very meaningful assessment of exposure for galactic radiation.