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THE SINGLE-SPHERE NEUTRON MONITORING INSTRUMENT*

Dale E. Hankins

Los Alamos Scientific Laboratory

University of California

Los Alamos, New Mexico

MASTER

SUMMARY

The Bonner sphere-technique of measuring neutron spectra consists of a LiI crystal which is placed in the center of 2-in., 3-in., 5-in., 8-in., and 12-in. spheres. Calculations indicated that a sphere of 10 in. would give a response approximating the RBE dose curve. Experiments confirmed that the single-sphere instrument has a response sufficiently close to the RBE curve to be useful as a REM meter.¹

Recent calibrations of the single-sphere instrument with thermal and 2.5 MeV neutrons are briefly summarized. Using a computer, calculations were made of the response of the instrument in the intermediate region by using the recently developed adjoint transport calculations.² No significant changes in the published response of the instrument resulted from these new calculations or calibrations; however, the calculations gave

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a more detailed response curve for the intermediate-energy region. Experiments resulted in a calibration factor for PuBe neutron sources which gives a greater accuracy in the readings obtained from neutrons in the low-energy region. Experience has shown that the single-sphere instrument is sensitive to a relatively low dose-rate of reactor gamma-rays having energies greater than 5 MeV. The limitations of this instrument for accelerator neutrons will be discussed, with special emphasis given to the neutron-energy response of the units.

Neutron-monitoring problems caused Los Alamos Scientific Laboratory to adopt the single-sphere instrument, and operating personnel and health-physics monitoring personnel have accepted the instrument well. The 10-in. spheres have been used to detect neutrons from fast bursts by replacing the scintillation crystals with small foils of lithium. The foils may be counted with an analyzer for either gamma-rays or beta-particles. The sensitivity of this method varies with the counting technique used.

LASL has had three years of operating experience with several models of the sphere instrument, including a portable model. During this period, a continuous study has been made of the maintenance requirements and damages that have occurred

to the instrument. A study was made of radiation damage to the LiI crystals used in the single-sphere instrument, and crystal changes resulting from aging.³ Both radiation and aging can affect the operation of the instrument.

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