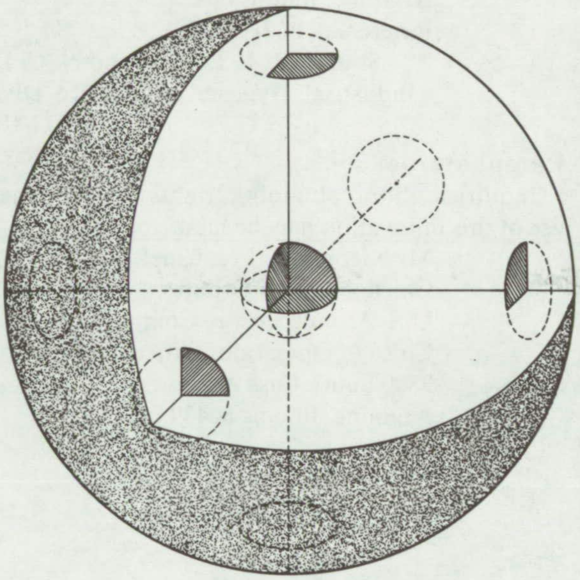
December 1967 Brief 67-10597

AEC-NASA TECH BRIEF

Neutron Detector Simultaneously Measures Fluence and Dose Equivalent



SENSOR GEOMETRY FOR SPHERICAL FOIL NEUTRON DETECTOR

NEUTRON DETECTOR FULLY ASSEMBLED AND READY FOR USE

The problem:

To devise a simple and systematic method for estimating both neutron fluence and dose from a single exposure to fast neutrons that is usable in both constant and rapidly varying fields. No method exists which gives a sufficiently simple and rapid estimation of these parameters.

The solution:

A simple, yet versatile, neutron detector which simultaneously measures dose equivalent and fluence, and thus has application as both an area monitoring instrument and a criticality dosimeter. The fluence is determined by activation of six foils symmetrically located one inch below the surface of the moderator. The dose equivalent is determined from activation of three symmetrically interlocked foils at the center of the moderator. The sensitivity, using indium foils, is 76 cpm per mrem/hr and 25 cpm per n/cm^2-sec at the end of one half-life exposure at uniform radiation level.

How it's done:

The neutron moderator consists of a 12-in.-diameter, aluminum-encased paraffin sphere containing nine neutron sensors (thermal activation foils).

The dosimetric array is a symmetrical group of three sensors at the moderator center. A slotted cylinder holds the foils such that one foil is in each of the three rectangular coordinate planes of the sphere.

(continued overleaf)

The flat-response array consists of six sensors, equidistant from the center and lying on the coordinate axis. The foils, located one inch below the surface of the moderator and five inches from the center, are secured by holders and plugs such that they are externally accessible.

The response of the detector was determined experimentally in the energy range from 20 keV to 2.3 MeV through use of a proton accelerator and the $Li^7(p,n)Be^7$ reaction. The thermal activation foils were of indium and dysprosium, 2 inches in diameter and 10 mils thick.

Exposures were made for approximately one hour at a distance of 105 cm from the target. The energy-dependent fluences ranged between 300 and 2000 n/cm^2-sec. At each energy point, a determination of the scattered-neutron background was made by interposing a 16-1/2-in.-long tapered shadow cone between the target and source, and exposing it for the same length of time at a comparable neutron fluence. Correction factors for background ranged between 6 and 14 percent of the total (cone removed) activity. For energies of 70 keV and above, exposures were made at 0° to the direction of the proton beam. At lower energies, it was necessary to expose at an angle of 60° to the direction of the proton beam to achieve the desired energy stability.

In determining the neutron fluence, the summed activity of the six outer foils is nondirectional and proportional to the fluence within 10 percent over the investigated energy range. In dose equivalent determination, the summed activity of the three center foils is proportional to the dose equivalent within 75 percent over the same energy range. A response correction technique for monoenergetic neutrons brings the dose equivalent to within about 10 percent.

Notes:

1. This detector may be of interest to industrial, academic, and governmental organizations possessing neutron-producing radiation facilities.
2. Complete details are contained in *A Neutron Monitor for Simultaneous Measurement of Fluence and Dose Equivalent*, by R. F. Dvorak and N. C. Dyer, ANL-7085, August 1965, Argonne National Laboratory, Argonne, Illinois. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. Price $3.00 each (microfiche, $0.65).
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B67-10597

Source: R. F. Dvorak and N. C. Dyer,
Industrial Hygiene and Safety Division
(ARG-10071)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439