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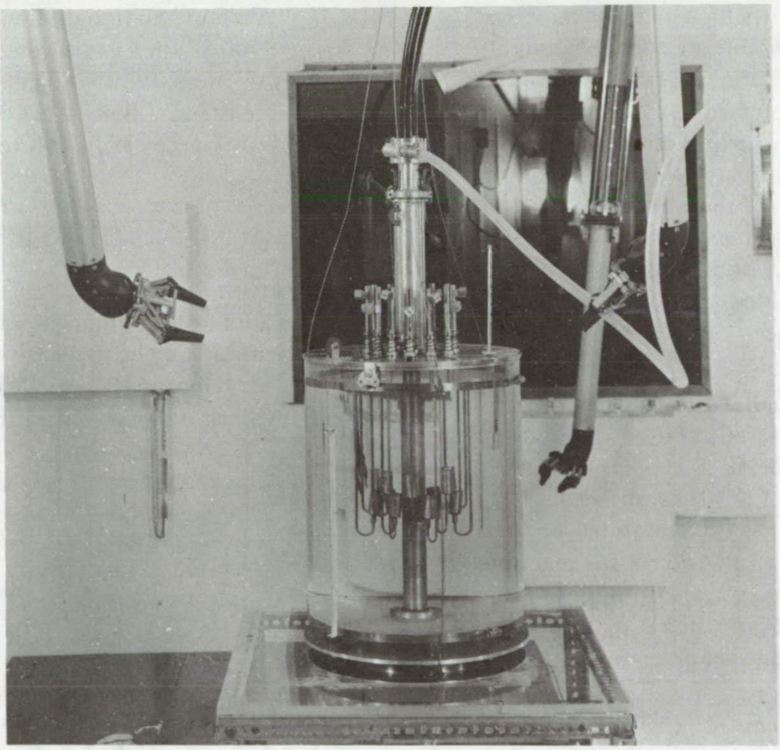
Portable, High Intensity Isotopic Neutron Source Provides Increased Experimental Accuracy



The problem:

To design, develop, and refine experimental techniques and equipment for a small, but high intensity, isotopic neutron source facility. Increased availability and increased intensity of isotopic neutron sources should provide for expanded usage of such facilities. The large nuclear reactors now in use are often not practical for many experiments or potential applications because they are expensive to build and operate, inflexible in use, not portable, and are subject to shutdown. Also, the flux produced is variable in quality and can not be accurately predicted.

The solution:

A small, high intensity isotopic neutron source, which combines twelve curium–americium–beryllium sources for a total output of 7.5 × 10^9 neutrons/second. This high intensity of neutrons, with a flux which slowly decreases at a known rate, provides for increased experimental accuracy.

(continued overleaf)

How it's done:

The isotopic neutron source is housed in a high level shielded cell of a hot laboratory. It consists of a transparent tank of light water moderator that contains a skeletal support frame on which the neutron sources are supported radially around a pneumatic rabbit tube. The supporting framework is designed so that, using master slave manipulators, the array of neutron sources can be varied. This allows for determination of the optimum arrangement for particular irradiation purposes. The individual sources can be remotely removed from their support rods and used singly or in multiple for special experimental setups. The pneumatic rabbit tube carries activated samples through the cell wall to a detector and multichannel analyzer counting system.

Although spontaneously fissioning ^{252}Cf would be a preferred source because of its high neutron emission rate, it is not presently available in adequate quantities. Therefore, a curium–americium–beryllium source was selected from a survey of various types of neutron sources. ^{241}Am–Be sources, having emission rates of 2 to 3×10^6 n/sec, are fabricated without elaborate shielding or equipment and are then irradiated to convert about 20% of the ^{241}Am to ^{242}Cm, which substantially boosts the neutron output. The twelve neutron sources have a combined output, shortly after irradiation, of 7.5×10^9 n/sec.

Notes:

1. Mapping of axial and radial flux distributions as they are affected by different source orientations have been made and indicate a maximum thermal flux in the rabbit tube of 3×10^7 n/cm^2-sec.
2. Experiments involving fission counting, neutron absorption, the study of (n,p) and (N,α) reactions in thin samples, and the installation of a loop-type system for activation studies of controlled streams of liquid are potential applications.
3. Available information on this innovation includes: detailed construction data of the isotopic neutron source facility; construction details for a hot cell capable of handling high level neutron sources; encapsulation of neutron sources; techniques for thermal image intensification; and production of curium by neutron irradiation of ^{241}Am.
4. References: Remote Systems Technology Div., ANS. 13th Proc., p. 138–141, 1965. Remote Systems Technology Div., ANS. 12th Proc., p. 273–278, 1964. ANL-6917, ANL-6933 available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; price $3.00 (microfiche $0.65).
5. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10243

   Source: W. C. Mohr, M. A. Wahlgren, and D. C. Stewart, Chemistry Division (ARG-90250)

Patent status:

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

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