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DETECTION OF PLUTONIUM PENETRATION THROUGH CONTAINERS AT HIGH TEMPERATURES†

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The principal problem facing molten plutonium reactor technology is finding compatible plutonium-alloy-fuel and container combinations. One method* for evaluating such combinations is to subject them to a high temperature and to measure the time required for the plutonium penetration.

Therefore, a system has been built for monitoring plutonium leakage (0.1 μg sensitivity) from capsules at 1100°C by counting the alpha particles with silicon surface barrier detectors. The capsules are heated in high vacuum, and the detectors are kept cool by placing them in cooled head assemblies which have six nickel thermal radiation foils interposed between the detectors and the capsule. A cutaway of the lower half of the system is shown in Fig. 1. Alpha particles from a plutonium leak lose about 1 Mev of their energy in traversing the foils. This provides an energy separation from the Am^{241} calibration alpha sources located next to each detector.

This paper was submitted for publication in the open literature at least 6 months prior to the issuance date of this Microcard. Since the U.S.A.E.C. has no evidence that it has been published, the paper is being distributed in Microcard form as a preprint.

† Work done under the auspices of the Atomic Energy Commission.

* R. L. Andelin, et al., "A New Technique for Testing Molten Plutonium Container Material at High Temperatures", 11th Annual ANS Meeting, June 21-24, 1965.

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The signals from all six detectors are combined in a mixer after passing through separate preamplifiers. The resultant signal is amplified and analyzed by two different subsystems. One is used to measure the plutonium alpha signal by utilizing a single channel analyzer with a threshold at about 1.5 Mev and an upper level at about 4.5 Mev. The other subsystem has its discriminator set at 4.5 Mev and is used to provide an Am²⁴¹ calibration signal and a bias for subtraction of the background due to the calibration source.

Pulse height distributions of the combined signals from six detectors are shown in Fig. 2. The normal distribution is shown with a solid line, and the modification of the distribution, due to plutonium leakage at different times, is shown with dashed lines. The subtraction circuit is set to give zero signal when no leak is present.

Fig. 1

Fig. 2