# REFERENCE 27

**R. C. LLOYD, E. D. CLAYTON, AND W. A. REARDON, "OPERATING EXPERIENCE IN THE HANFORD PLUTONIUM CRITICAL MASS FACILITY," TRANS. AM. NUCL. SOC. 5:76,77 (1962).**

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## 12-2 Operating Experience in the Hanford Plutonium Critical Mass Facility, *R. C. Lloyd, E. D. Clayton, and W. A. Reardon (GE-HAPO)*.

Since June of 1961, the Critical Mass Group at the Hanford Critical Mass Facility has acquired over six months operating experience while performing approximately 60 critical mass determinations. The purpose of these experiments is to determine the criticality properties of plutonium solutions of various concentrations of plutonium and nitrate, and the effects of various reflectors.

The laboratory consists in essence of a heavily shielded cell, a mixing room, and a control room.[1]

The mix tank (72 × 24 × 2½-in.) in the mixing room was the subject of the first experiment. As a check on the previous nuclear safety evaluation for the tank, an approach-to-critical procedure was employed when the 300 g/ℓ plutonium solution was transferred to the tank. The critical mass of the tank was determined to be > 20 kg of plutonium. The tank is reflected with a 0.030-in. Cd layer between the polyethylene reflector and the 0.25-in. stainless steel tank wall.

The approach-to-critical procedure is employed in each critical mass determination, and the rod worth is simultaneously determined for each experiment. The control rod worth, in terms of solution volume, varies from about 60 ml (at high plutonium concentrations) to about 560 ml (at low plutonium concentrations) as shown in Fig. 1. When the control rod is started into the solution (sphere not full), the flux is observed to rise, then fall off as expected. This is because the first portion of the rod is worth more as a volume displacement (improved geometry) than as a neutron absorber. The effect is estimated to be about 5¢ positive reactivity experimentally, and a perturbation calculation provides an estimate of 4.3¢ Δk/k.

While the difficulties encountered to date have been relatively minor mechanically, the presence of plutonium makes any equipment change difficult. The transfer and fast fuel addition pumps were originally gear pumps, but failure to self-prime led to their replacement by rotary displacement pumps. These latter pumps have been successful.

Galling of screw-type valves (stainless steel on stainless steel) have been troublesome, and the valves will be replaced with ball-valves.

Air leaking into the lines has given some trouble with airlocking of the pumps. These leaks are covered adequately with neoprene rubber cement.

Accurate measurement of the liquid level has been troublesome. A liquid level manometer of the servo-following type was installed. It was found that the tubes must be flushed with the new solution at the start of each new experiment, because the reading is very sensitive to the specific gravity of the solution. The manometer has, in addition, suffered from mechanical failures in the selsyn drive mechanism.

Contamination control is an ever-present job of detection and housekeeping. One sizeable spill and several minor ones have occurred to date. In each case prompt detection and clean-up have prevented the spread of the contamination. Clean-up is usually accomplished by quickly covering the affected areas with strippable coating and changing the equipment. Strippable coating is used to fix the contamination until more adequate cleaning can be accomplished. Sodium disulfate has been effective in cleaning exposed stainless steel surfaces.

[1] W. A. Reardon et al., "Hazards Summary Report for the Hanford Plutonium Critical Mass Laboratory," HW-66266 (Aug 1, 1960).

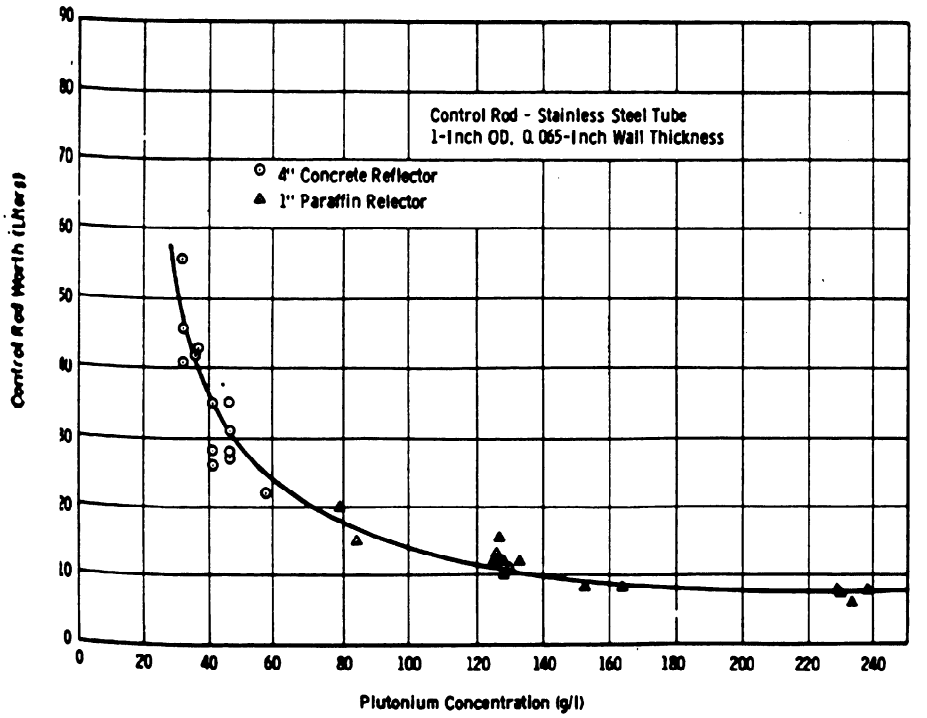


Fig. 1. Control "Rod" Worth vs. Plutonium Concentration in 14-Inch Diameter Stainless Steel Sphere.