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ATOMICS INTERNATIONAL  
A Division of North American Aviation, Inc.

NAA-SR-MEMO 9305

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## APPROVALS

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DEPT & GROUP NO  
721 - 131

DATE 12/11/63

GO NO 7569

TITLE Pre-analyses of the SCA-5 Nine Inch  
Unpoisoned Core

S A NO 2001

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## PROGRAM

## Supporting Technology

SUBACCOUNT TITLE

# Basic Nuclear Analysis

## DISTRIBUTION

## STATEMENT OF PROBLEM

Perform preliminary analysis of the SCA-5.

## ABSTRACT

Initial criticality and control drum worth calculation have been accomplished for the unpoisoned nine inch SCA-5. The results indicate a critical height of  $14.7 \pm 0.5$  inches and a total drum reactivity worth of  $4.2 \pm 0.5\%$   $\frac{\Delta K}{K}$ .

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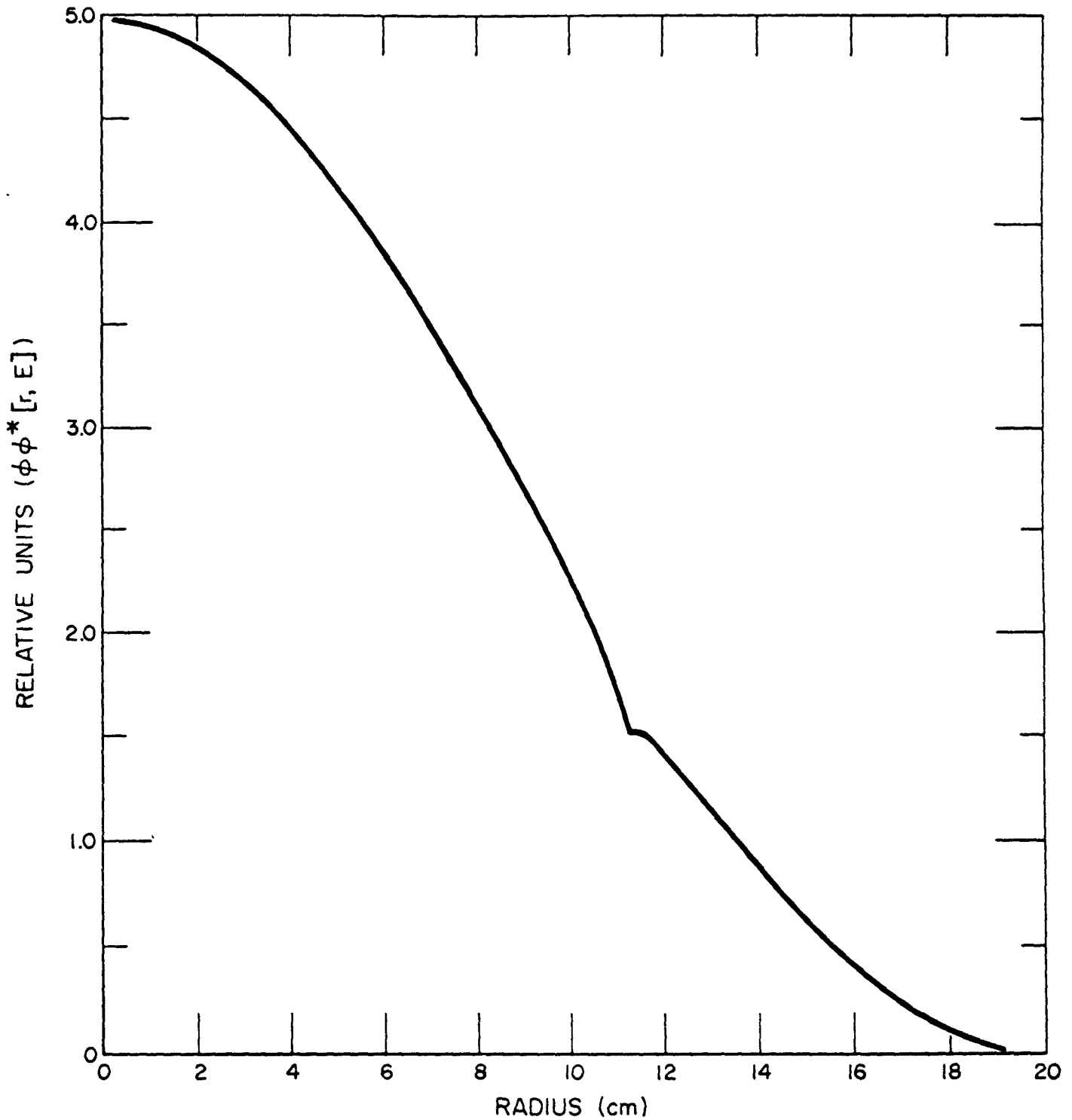
## PRELIMINARY RESULTS

The initial SCA-5 program will be a geometrical mockup of SNAP 8 and will investigate the effects of different compositions of fuel and burnable poisons on core parameters. The core consists of 331 fuel tubes on a 0.462-inch pitch in a hexagonal array (see Figure 1). Each fuel tube is capable of containing 48 pellets of fuel material, moderator, lucite, or aluminum. The initial core loading will consist of unpoisoned fuel pellets of 10 wt %  $\text{UO}_2$ , fully enriched, and 90 wt %  $\text{ZrH}_{1.93}$ . As shown in Figure 2, there are three control drums. Each drum is 21 inches long and 4 inches in diameter. Two-thirds of the control drum is beryllium and for the initial experiments, the remaining third of each drum will be either void or borated stainless steel (2.27 wt % natural boron). The approach to critical will be made by adding fuel pellets axially until the core is brought to a just-critical height.

The results of one- and two-dimensional transport calculations are presented in Figure 3. In the figure, distinction is made not only between one- and two-dimensional calculations, but also between isotropic and linear anisotropic scatter with hydrogen. As can be seen, the results of the best calculation predict a just-critical height of  $14.7 \pm 0.5$  inch or approximately 33 to 35 pellets per fuel tube. The total control available from the three control drums was calculated by mocking up the core in x-y geometry. These results indicate a total control available of  $4.2\% \Delta k/k \pm 0.5\% \Delta k/k$ . In anticipation of measurements of the relative worth of materials as a function of radial position, one-dimensional adjoint calculations also were accomplished. Representative plots of  $\rho^*(r, E)$  are presented in Figures 4 and 5.

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Figure 1

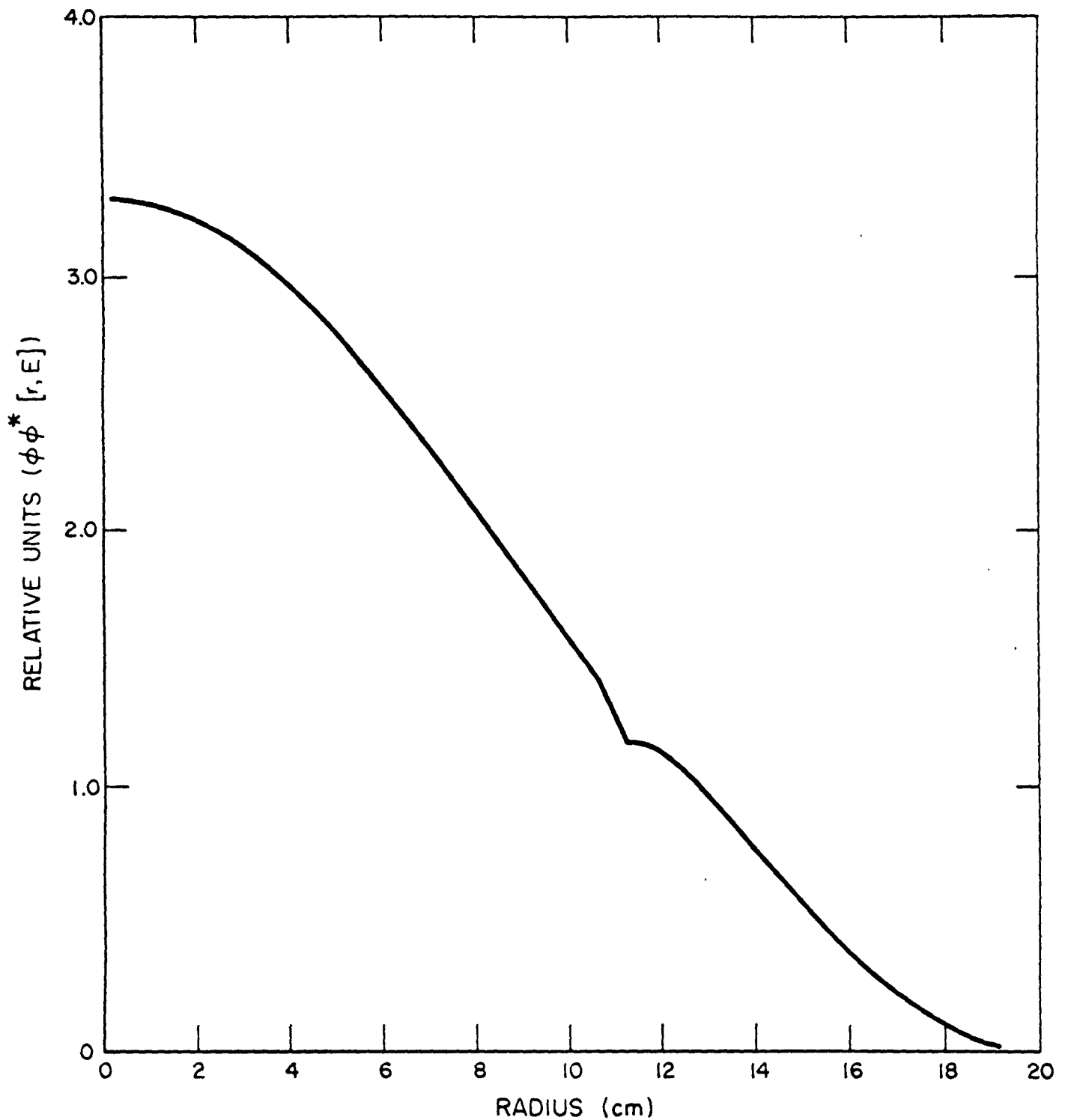
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Figure 2

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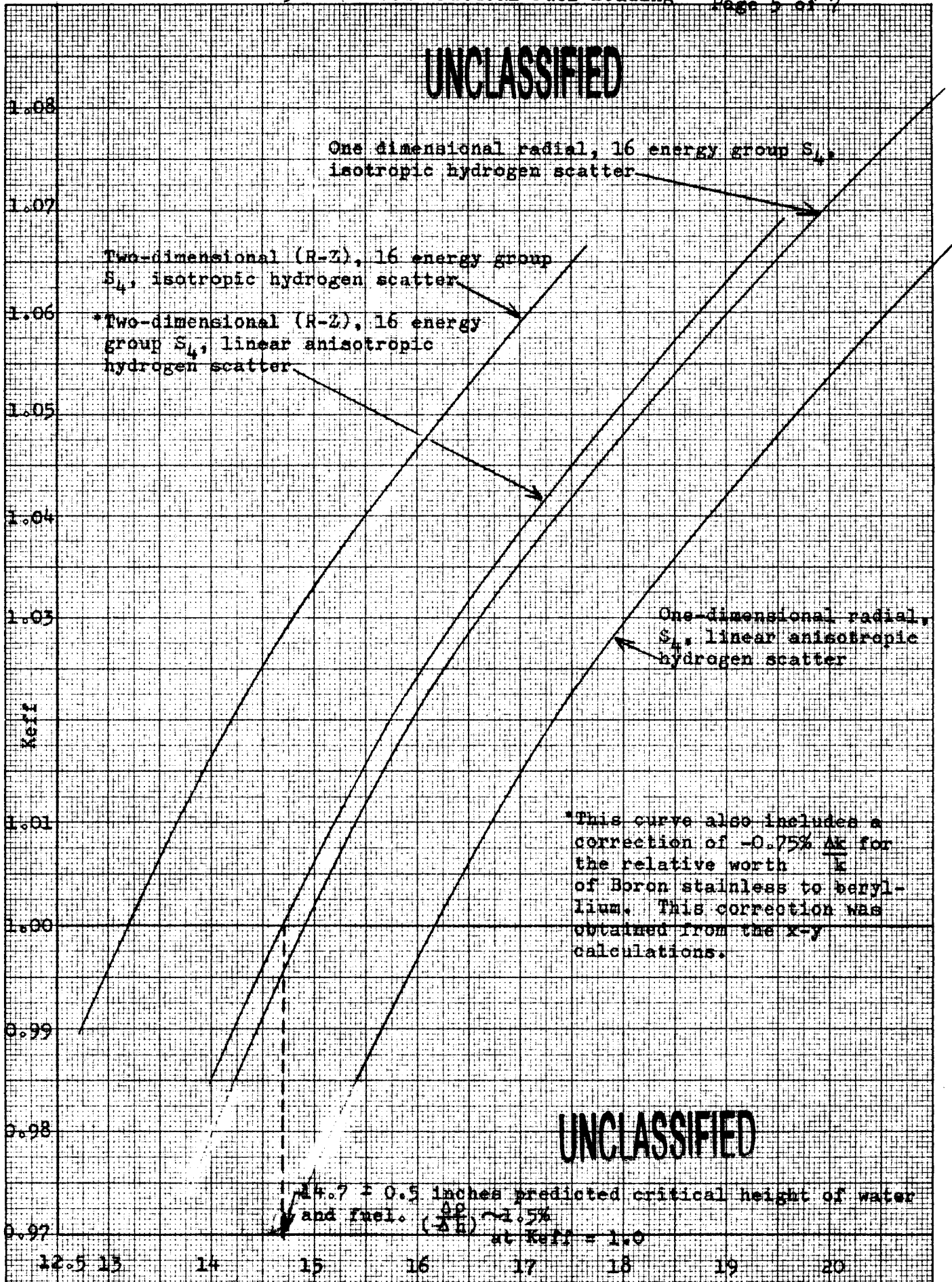
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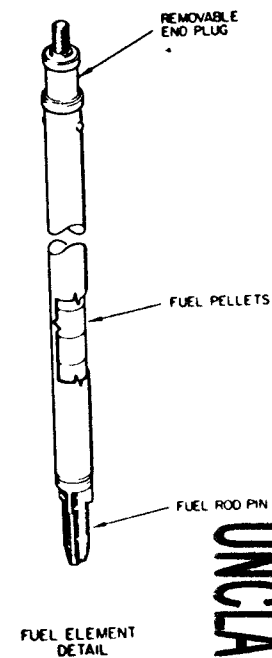
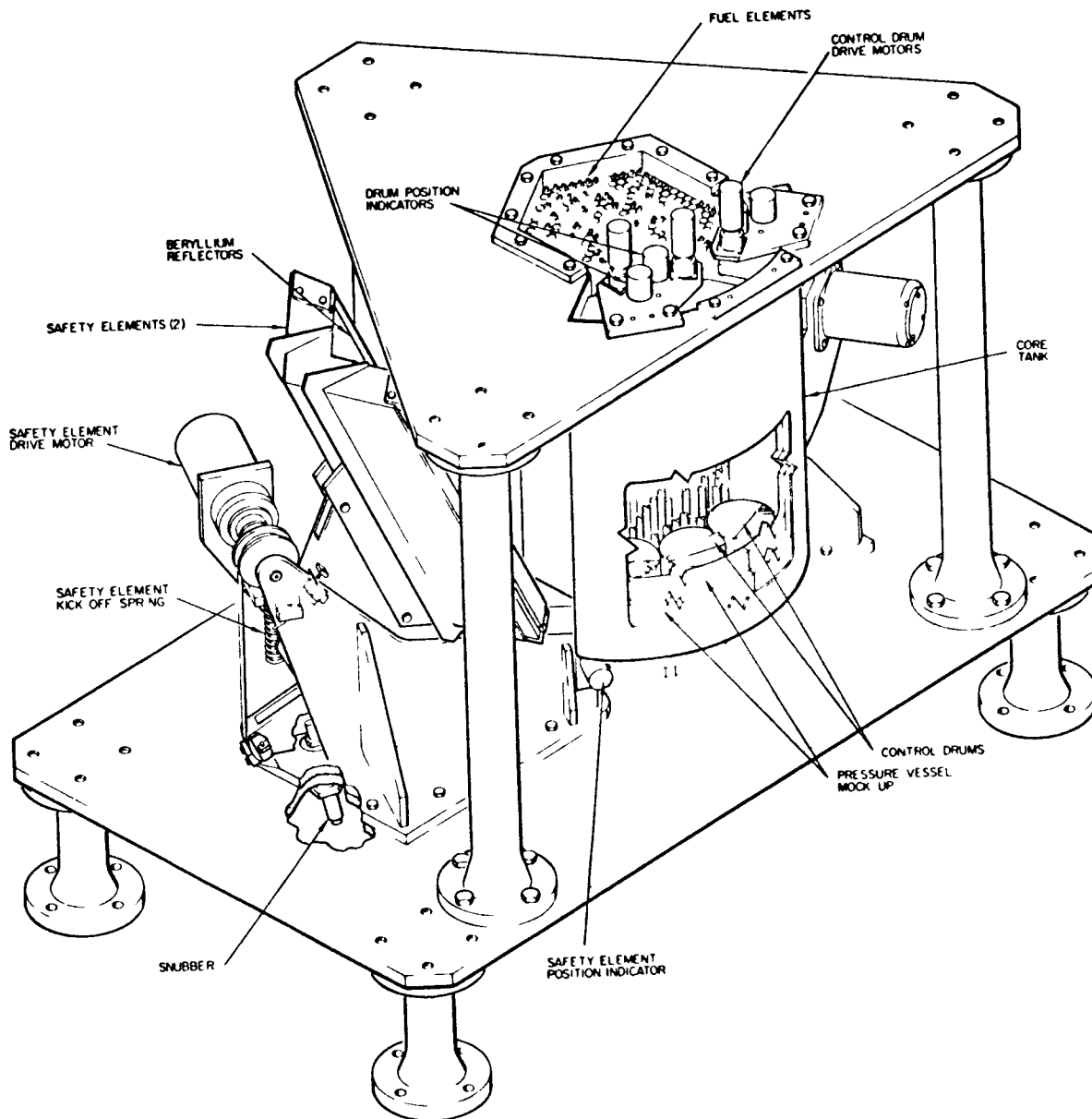
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Figure 4



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Generalized Critical Machine (SCA-5)

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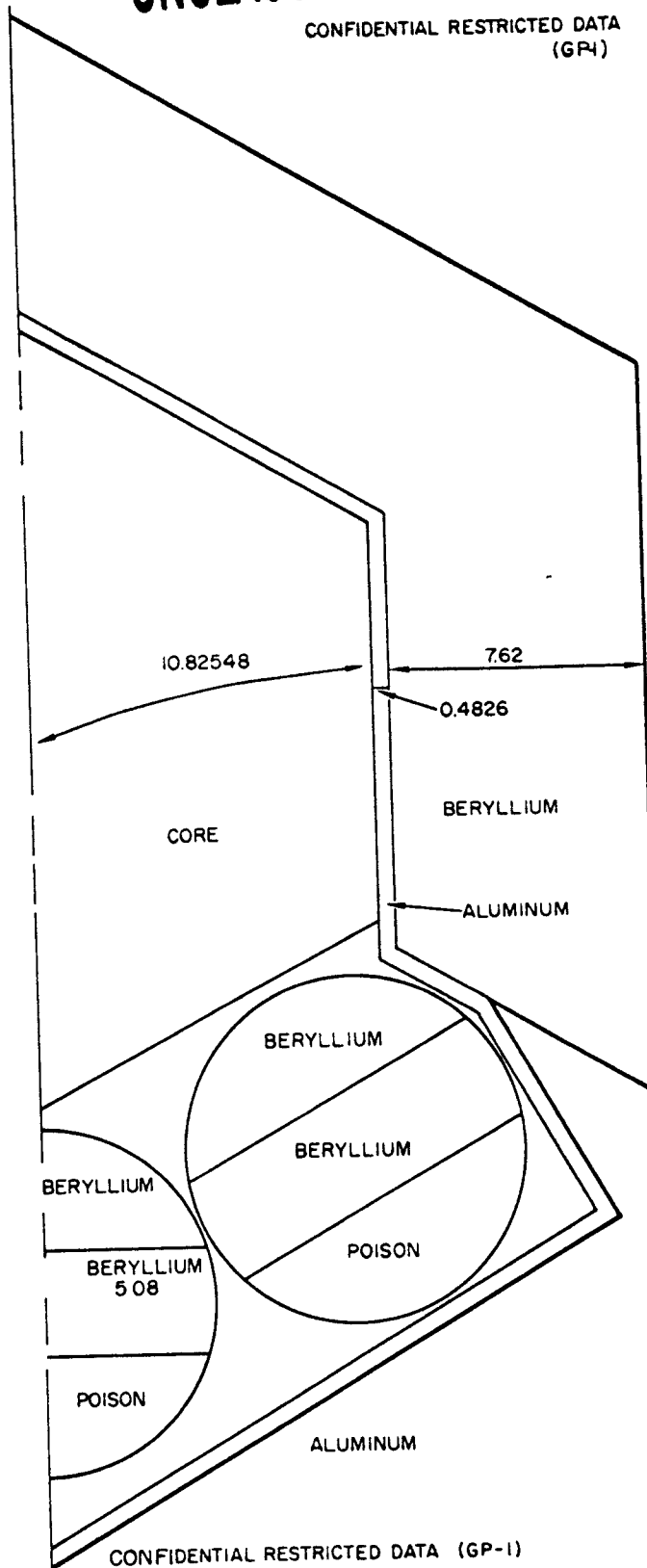
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Figure 5

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