APAE
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APPR-1 LOW POWER TEST PROGRAM
at the
ALCO CRITICAL FACILITY

by

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DISCLAIMER

ALCO CRITICAL FACILITY - APPR-1 TEST PROGRAM

I. Initial Criticality.

A. Approach to Critical.

The first experiment will be to reach criticality with the minimum number of fuel elements. Criticality will be approached step-wise, by adding a small number of elements and measuring the sub-critical multiplication of the core. The neutron source strength will be measured before any fuel is added. Control rod elements with rods attached will be the first fuel put into the core. Additional elements will be added to the assembly, building out a solid array of fuel radially from core center. Calculations predict initial criticality with 22 elements in a 5 x 5 square array, with three of the corners removed.

B. Super Critical Arrays.

With initial criticality, there will be established a critical position of the central control rod only, Rod C, and the 5 rod bank, Rods 1, 2, 3, 4, and C. A calibration will be made of C, and the bank over a short distance about their initial critical position.

Once the minimum number of elements necessary for criticality has been established, additional fuel will be added to reach the 7 x 7 condition. This fuel will be added in increments of 1 element and critical positions of Rod C, and the 5-rod bank will be noted after each addition. Calibrations will be made for C, and the bank over a short distance at several different symmetric loadings. As the elements are added, enough excess K will be built up so that at some point Rod C alone will no longer be sufficient to control the assembly. Critical position measurements for this rod will stop at that point. The reactivity worth of water in the clean core (no rods) will be measured at several arrays.

C. 7 x 7 Array.

Finally, a critical bank position will be found for the full APPR-1 loading, a 7 x 7 array with the 4 corners removed.

II. Low Power Tests.

A. Introduction.

The low power tests will be performed on the 7 x 7 array. They will include control rod calibrations and evaluation, flux measurements, low-temperature temperature coefficient determination, and several other measurements pursuant to the safe operation of APPR-1.

In order to provide some flexibility for reactivity measurements, stainless steel strips containing boron as neutron poison will be available to insert into fuel elements, between individual plates.

B. Control Rod Calibration, and Evaluation.

A series of reactivity measurements will be made to calibrate and find the total worth of the central rod and an eccentric rod, using the shim bank, and the addition of poison to compensate for motion of the subject rod. The 5-rod shim bank will be calibrated from its 7 x 7 critical position, to full out, using distributed poison.

It will be determined whether or not the core will be subcritical if all rods except 1 and A are fully inserted; and with 1, A and B not inserted.

The total reactivity control available in 7 rods will be estimated.

C. Flux Measurements.

1. A detailed 3 dimensional flux map will be made of the core with the 5-rod bank at 7 x 7 critical position, to determine volumetric peak to average power. Flux measurements will also be made in the radial and axial reflectors. Cd ratios will be found at various points.

2. A detailed 3 dimensional flux map will be made of the core with all rods out, and the excess reactivity controlled by the addition of uniform boron poison. Reflector fluxes will be measured for this configuration. Cd ratios will be found at various points.

3. Fine structure measurements will be made to determine the flux distribution; within a fuel element, in fuel elements adjacent to control rods, in and around control rods, and in any areas of suspected flux peaking.

4. Should it appear necessary from the results of 1, detailed flux maps will be made for various rod program configurations. These will be to investigate methods of achieving more uniform power distribution in the core.

D. Temperature Coefficient.

The temperature coefficient of reactivity will be determined from room temperature to about 200°F. Water in the reactor tank will be heated for this measurement. Additional control rod calibrations will be made simultaneously with this experiment to insure accurate reactivity coefficient measurement.

E. Training Program.

A period will be set aside for a reactor familiarization and training program for Army personnel who will be at the Ft. Belvoir site. This program may include observation and actual operation of the reactor, with subcritical, just critical, and supercritical core loadings. This work will be closely supervised by Alco personnel.