

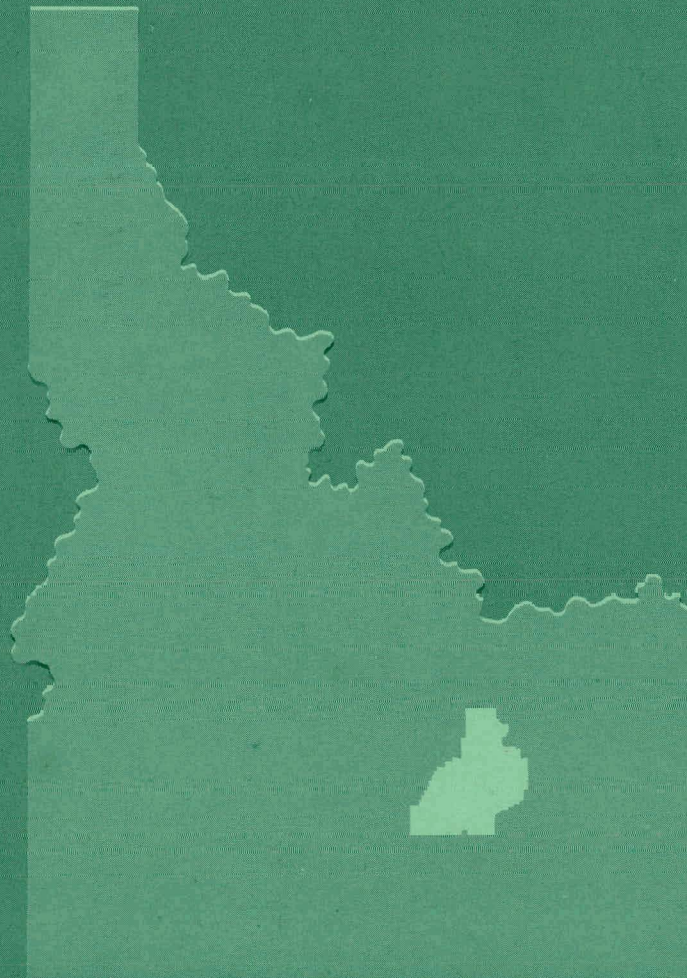
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ETR GAMMA HEAT GENERATION
MEASUREMENTS FOR CYCLES 27, 33, AND 34

L. D. Weber
C. H. Hogg

May 31, 1961



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ATOMIC ENERGY DIVISION

NATIONAL REACTOR TESTING STATION
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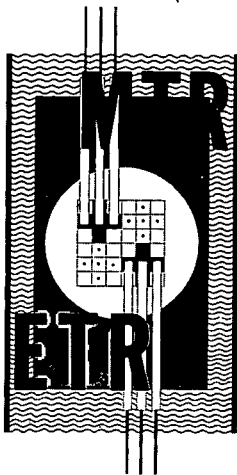
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A B S T R A C T

The gamma heat generations in selected positions of the ETR were measured for Cycles 27, 33, and 34. The measurements for Cycle 27 include data for the clean core and depleted core.

Maximum gamma heat generation maps are presented for each cycle along with vertical traverses for all positions monitored.

The measurements were made using a graphite-CO₂ ionization chamber.

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I. INTRODUCTION

The gamma heat generations in selected positions of the ETR were measured at the beginning (0 MWD) and end (4467 MWD) of Cycle 27, and at the beginning (0 MWD) of Cycles 33 and 34. Graphite-CO₂ ionization chambers were used in making the measurements. All of the measurements were made at low reactor power (~2 Mw) and the values extrapolated to a power of 175 Mw. Data for previous ETR gamma heat generation measurements can be found in Reference 1.

II. EXPERIMENTAL APPARATUS

The principle of ionization chambers is described fully in References 2 and 3. The graphite-CO₂ ionization chamber has a fast response. The neutron contribution to the heating is negligible. These chambers can be checked in the gamma facility against ceric dosimetry. A value of 32.5 ev per ion pair was used to calculate the energy absorption in CO₂ as applied in the Bragg-Gray Cavity Theorem⁽³⁾. Although this chamber may be gamma energy dependent when used in air, it is believed that this causes little error when used in the dense medium of the reactor lattice or reflector. The chamber wall was made thick enough to stop the Al²⁸ betas from the facility liners. Since the ionization currents encountered are high, no difficulty was experienced in their measurement with a microammeter. The CO₂ flow rate through the 10 cc graphite chambers was about 200 cc per minute. Since the chamber is not sealed, corrections for temperature and pressure were made. Fig. 1 shows a pictorial view of the graphite-CO₂ ionization chamber used in the measurements.

III. EXPERIMENTAL PROCEDURE

The chambers were inserted into the desired experimental positions through empty aluminum tubes from the open top of the reactor. The chambers could then be raised or lowered in the tube to make a vertical traverse of the heat generation in each position.

Since the ETR core contains some residual heating, background (0 power) measurements were taken in each position and subtracted from the power measurements before extrapolation. At full power the residual heating is negligible. The measurements were made at a measurable power level of 2 Mw and were extrapolated from this level to 175 Mw.

IV. EXPERIMENTAL DATA

The results have been summarized in Fig. 2 for Cycle 27, and Fig. 3 for Cycles 33 and 34. These values are at the maximum (usually 3" to 4" below the reactor midplane). The Cycle 27 data include both a clean core (0 MWD) and a depleted core (4467 MWD) value. Vertical traverses of each position monitored are shown in Appendix I. The data have been arranged alphabetically by number.

Traverses taken in the F-10-NE facility during Cycle 6 are also shown.

A maximum value of 9.4 w/gm was measured in the K-6-NE position on April 22, 1959, with an aluminum calorimeter unit (described in Reference 1).

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2. C. H. Hogg, Gamma Ray Dosage Measurement, IDO-16205 (1954).
3. R. D. Evans, The Atomic Nucleus, Pages 723-725, McGraw-Hill Book Company (1955).

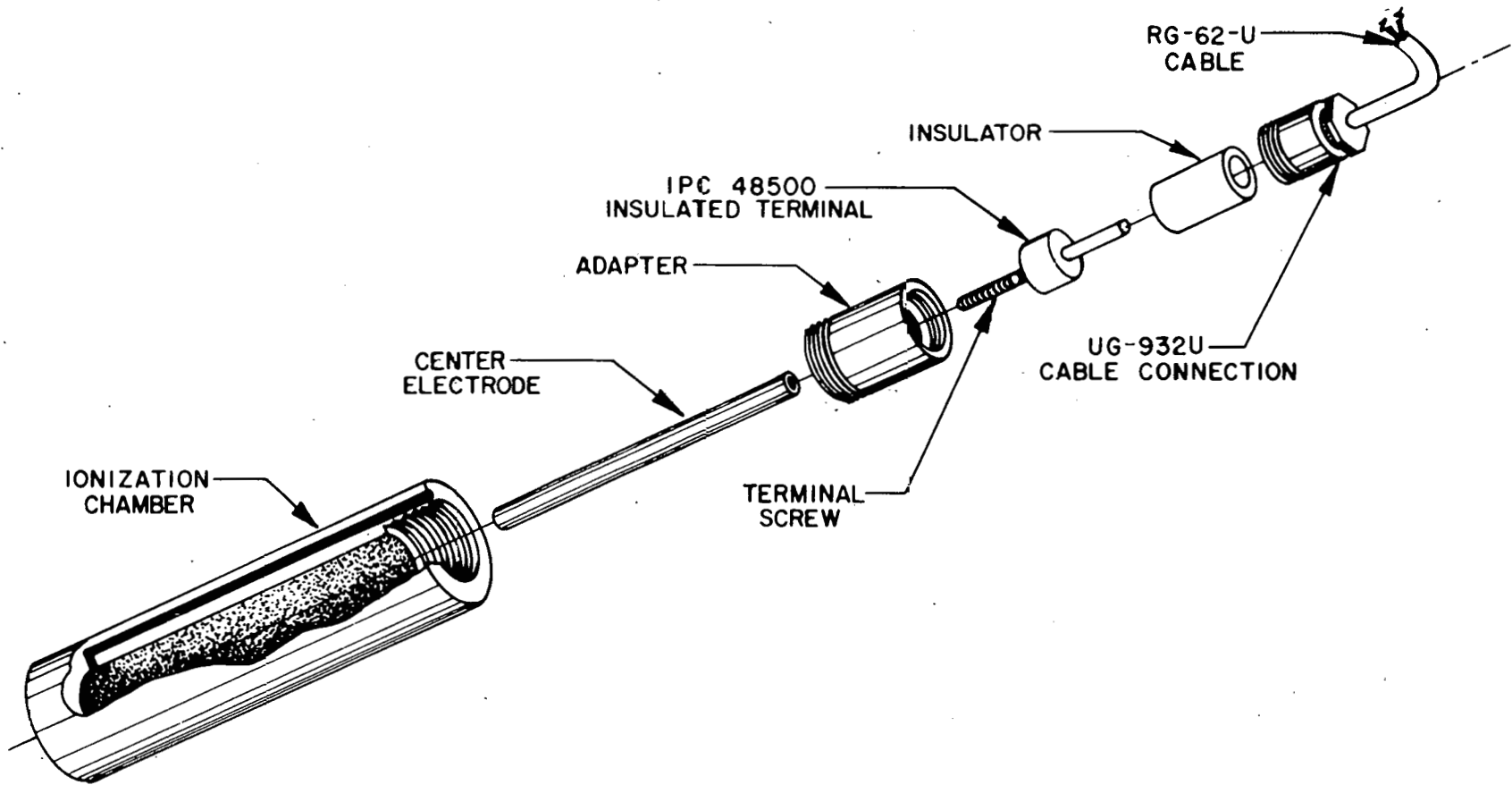


FIG. 1
GRAPHITE - CO₂ WALL
IONIZATION CHAMBER

ETR Cycle 27 Gamma Heat Generation
175 Mw

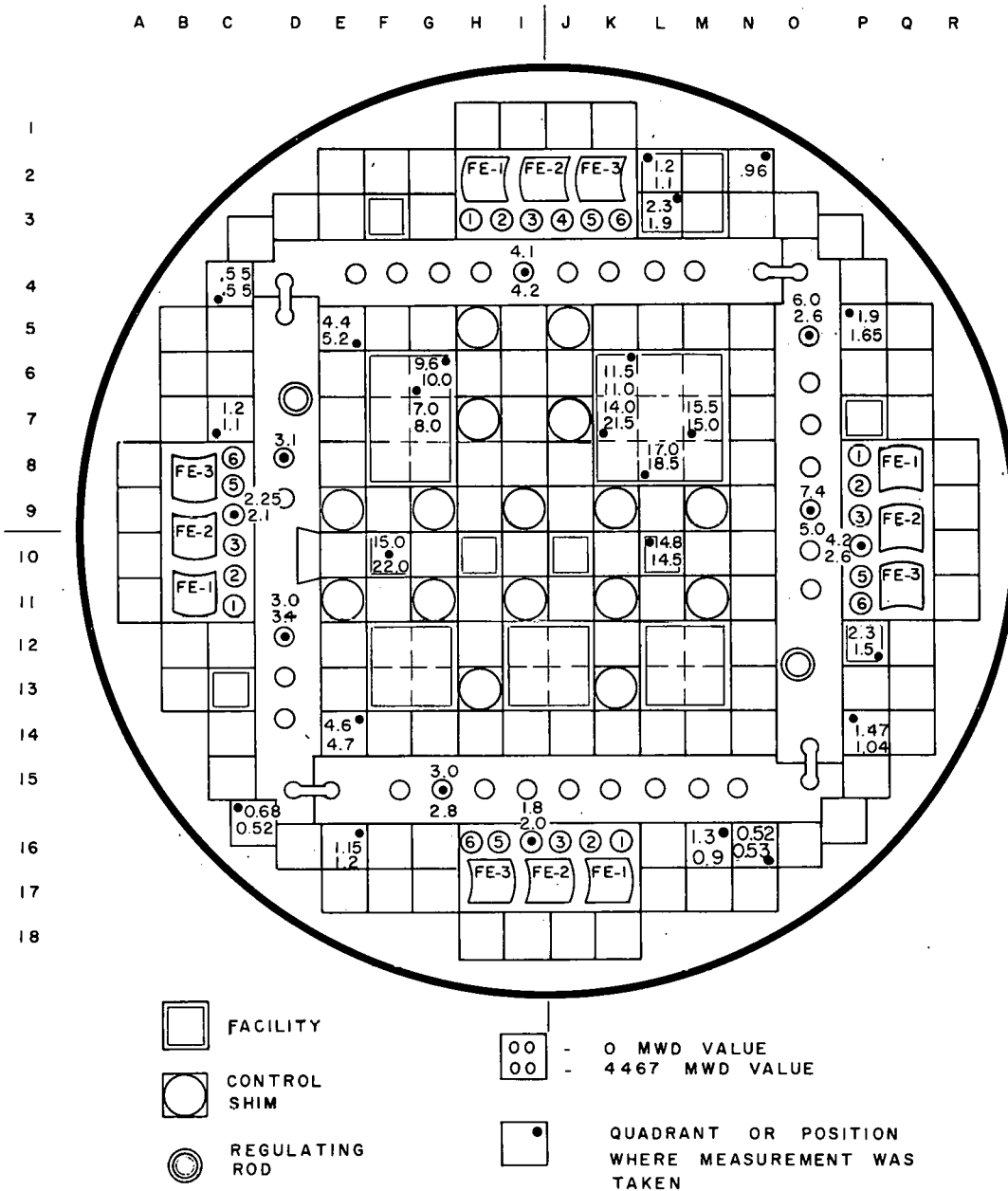


FIG. 2 Gamma heat generation extrapolated to a power of 175 Mw measured in the ETR on cycle 27 for a clean and depleted core. Units are in watts/gram of graphite.

ETR Cycle 33 & 34 Gamma Heat Generation
175 Mw

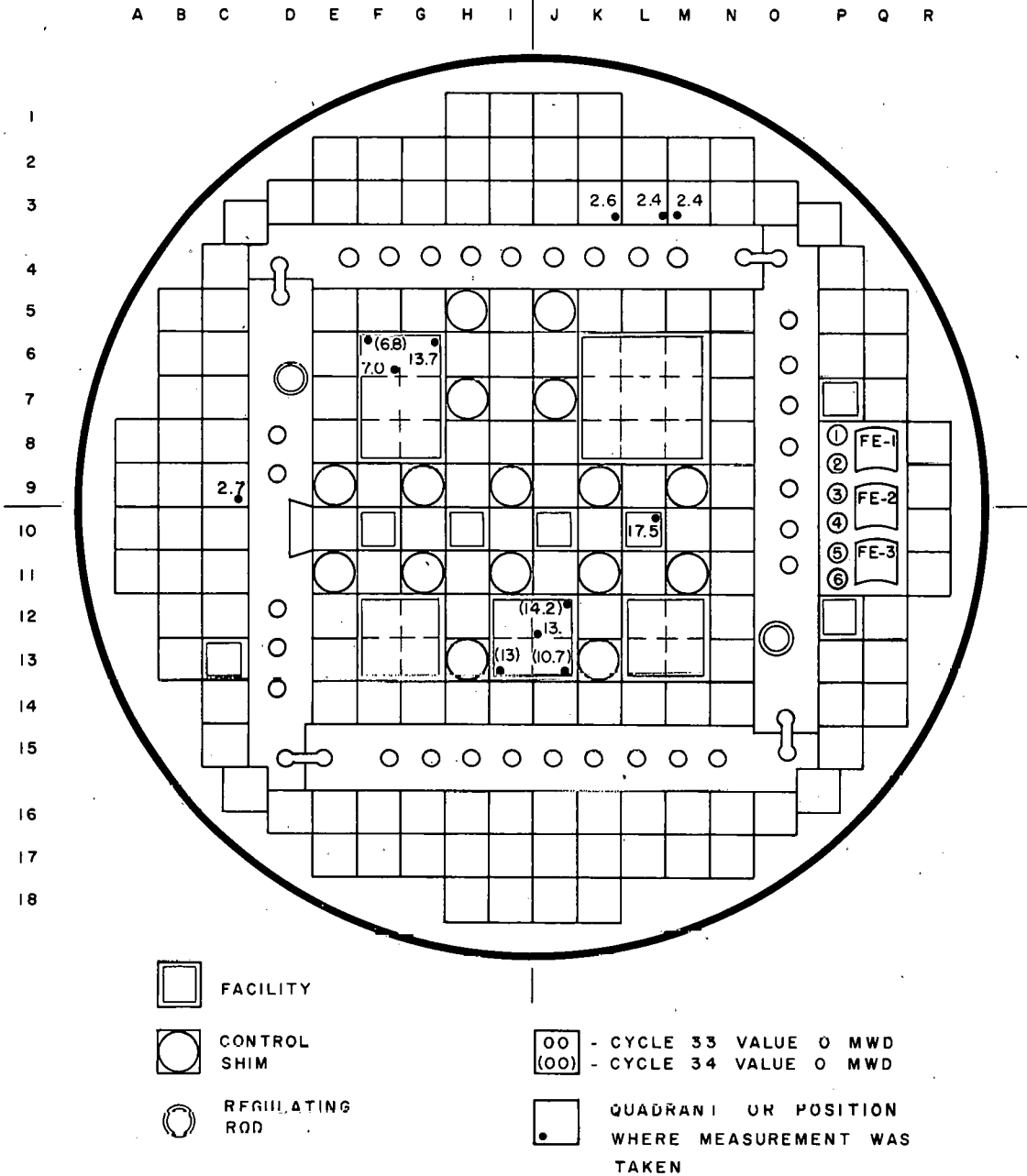
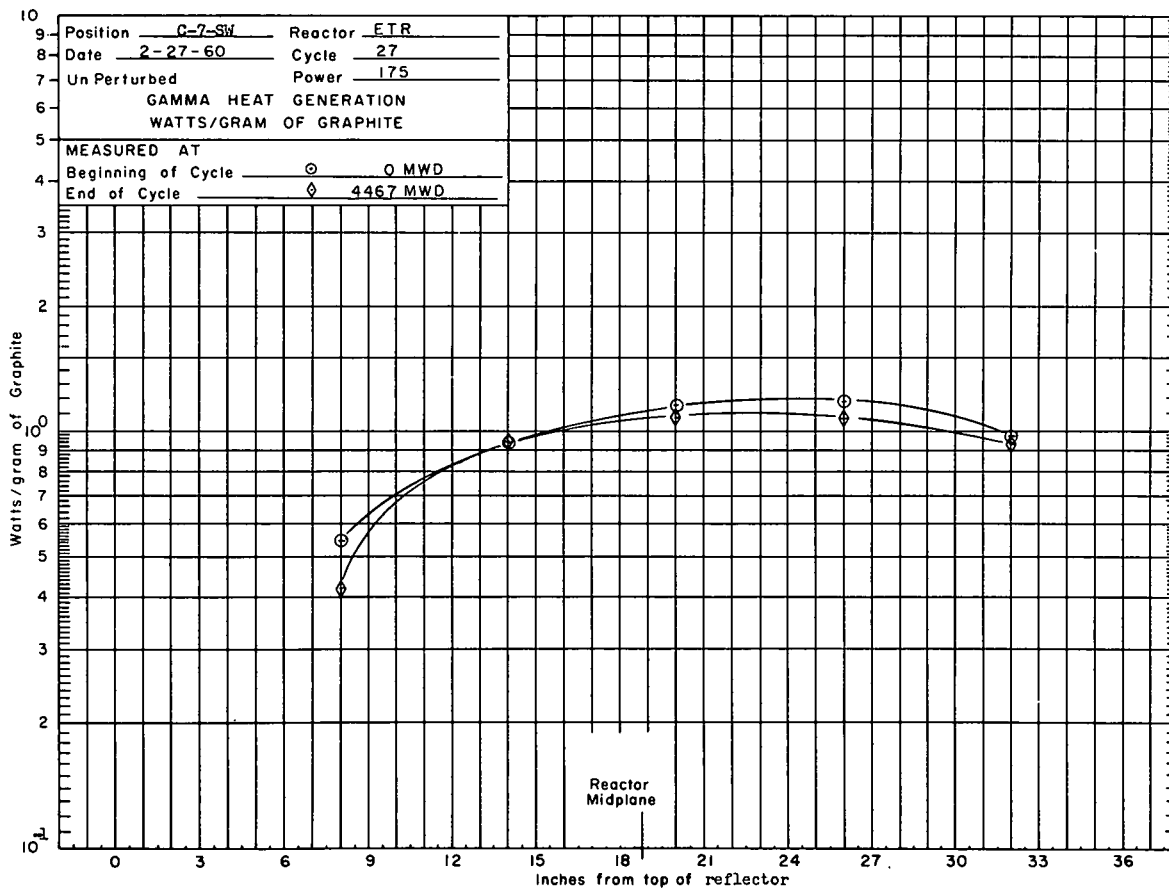
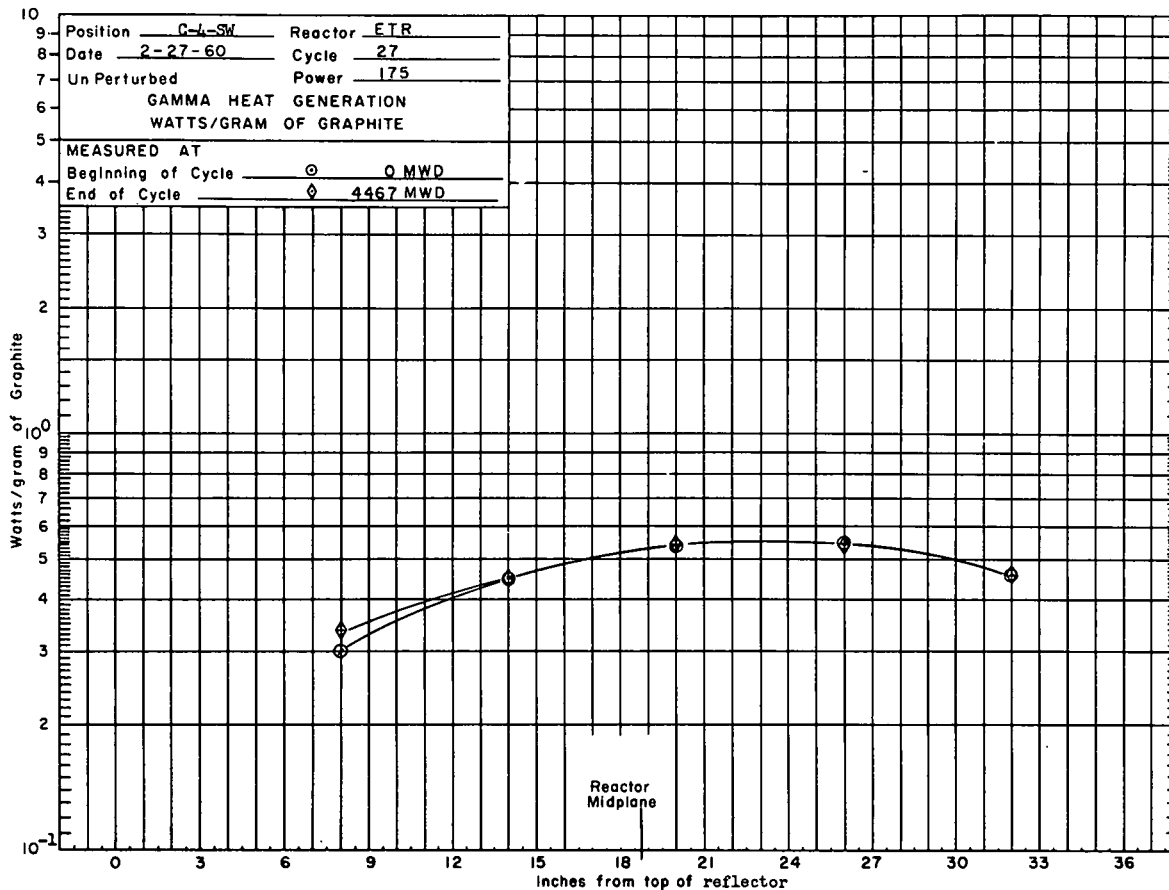
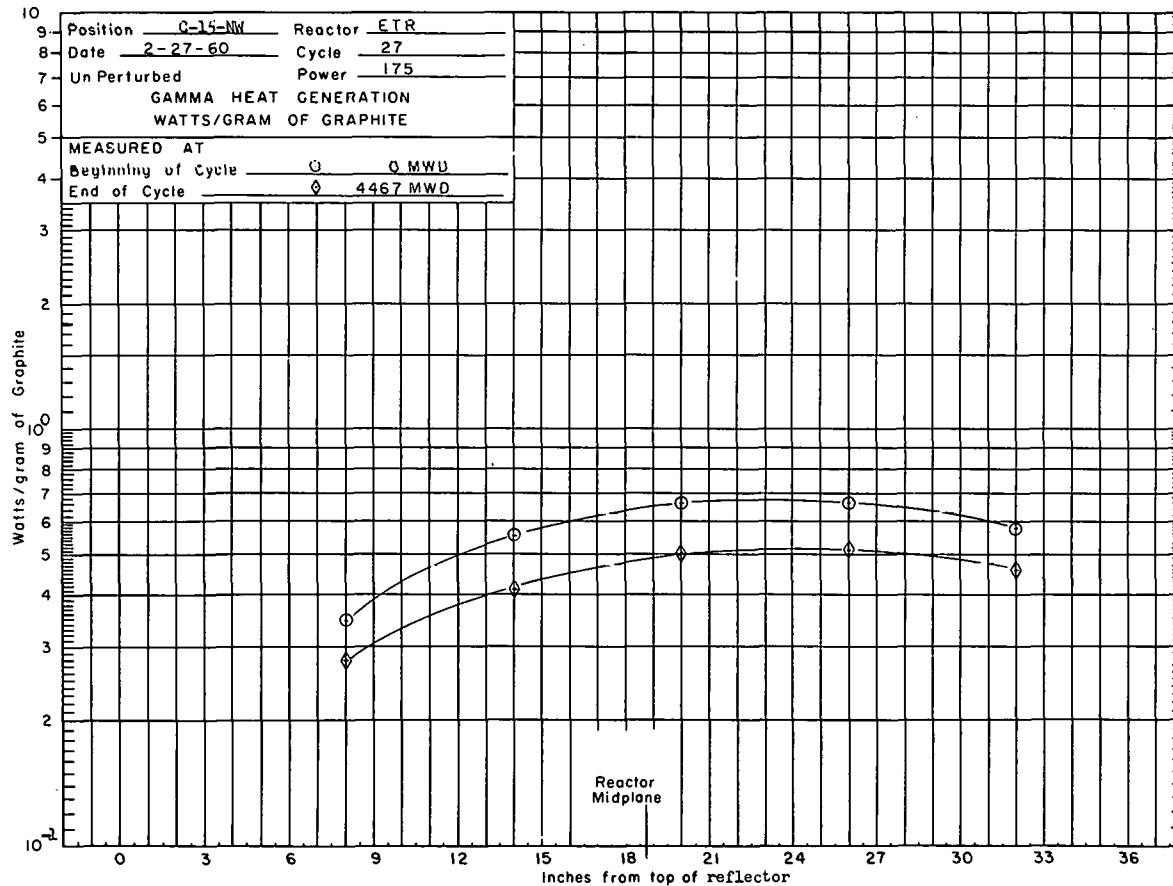
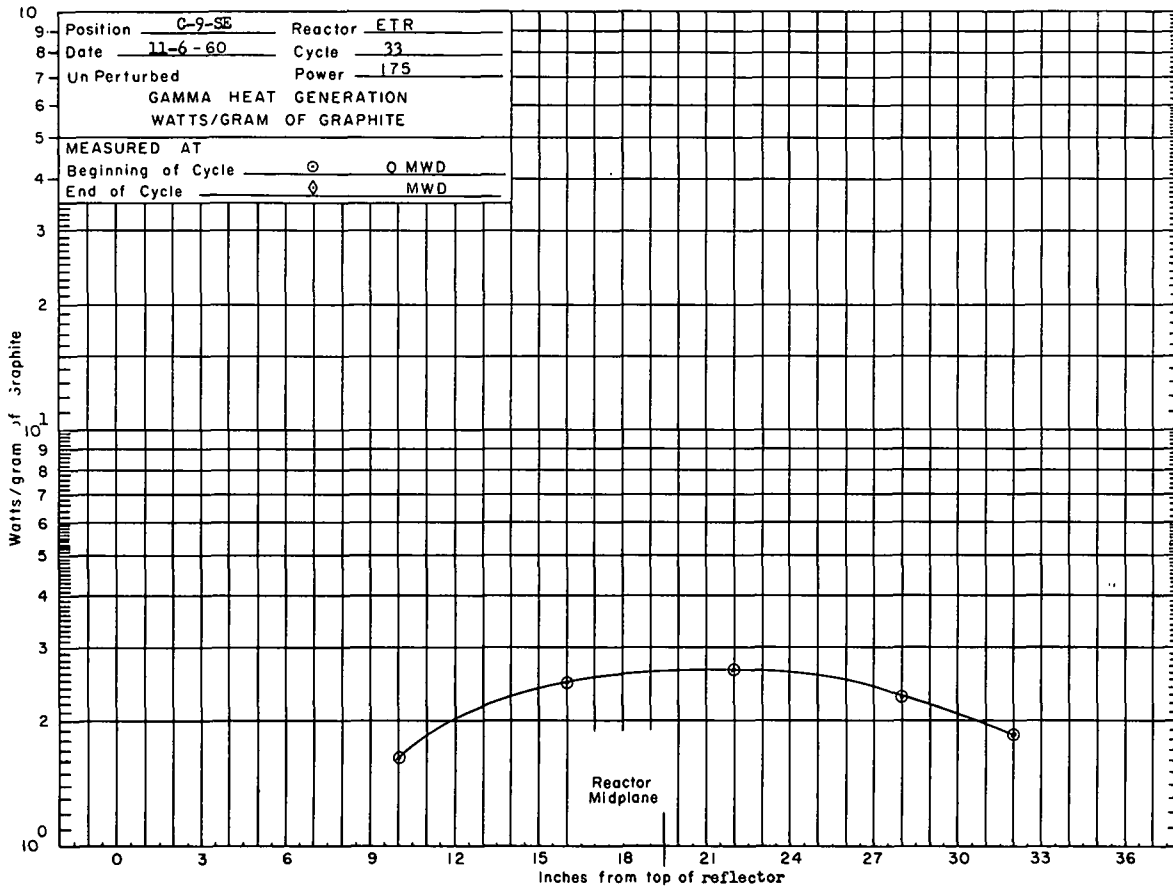
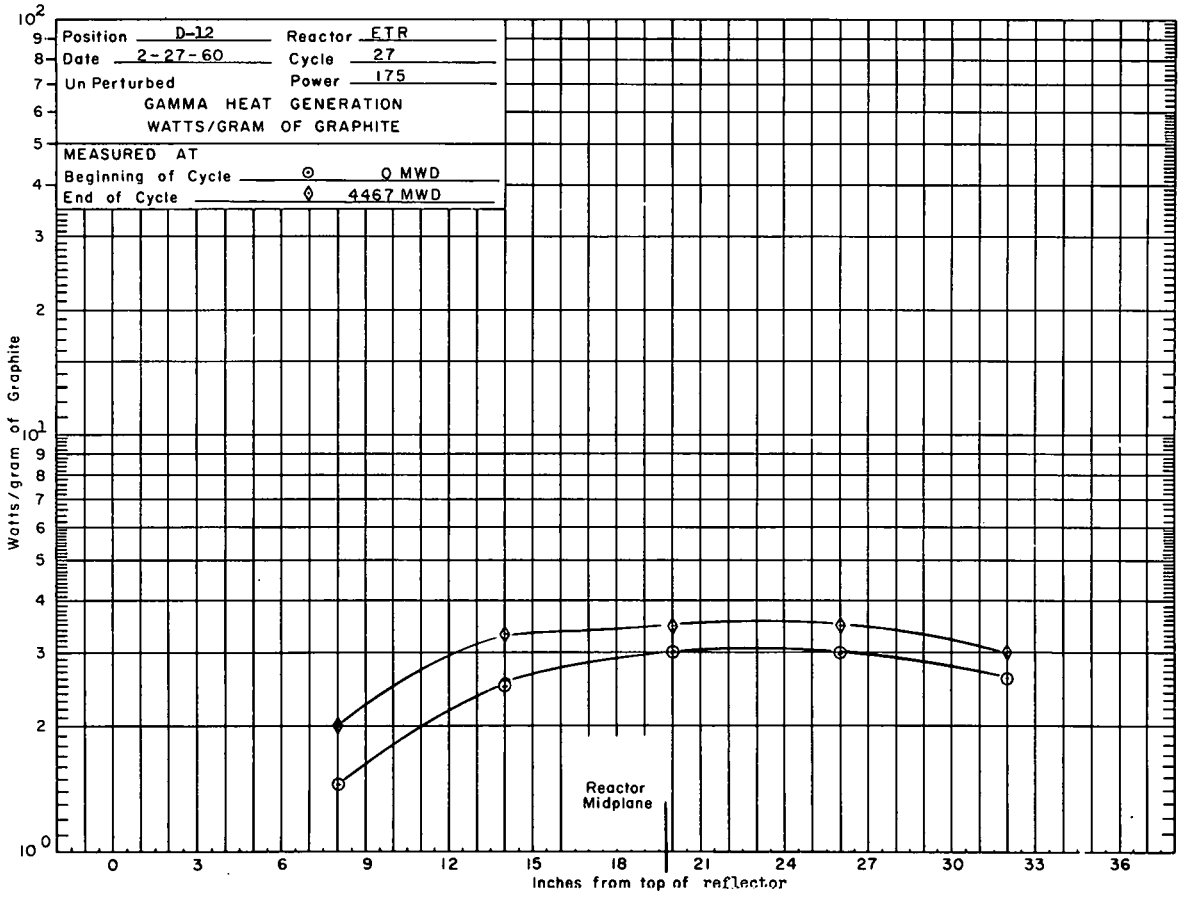
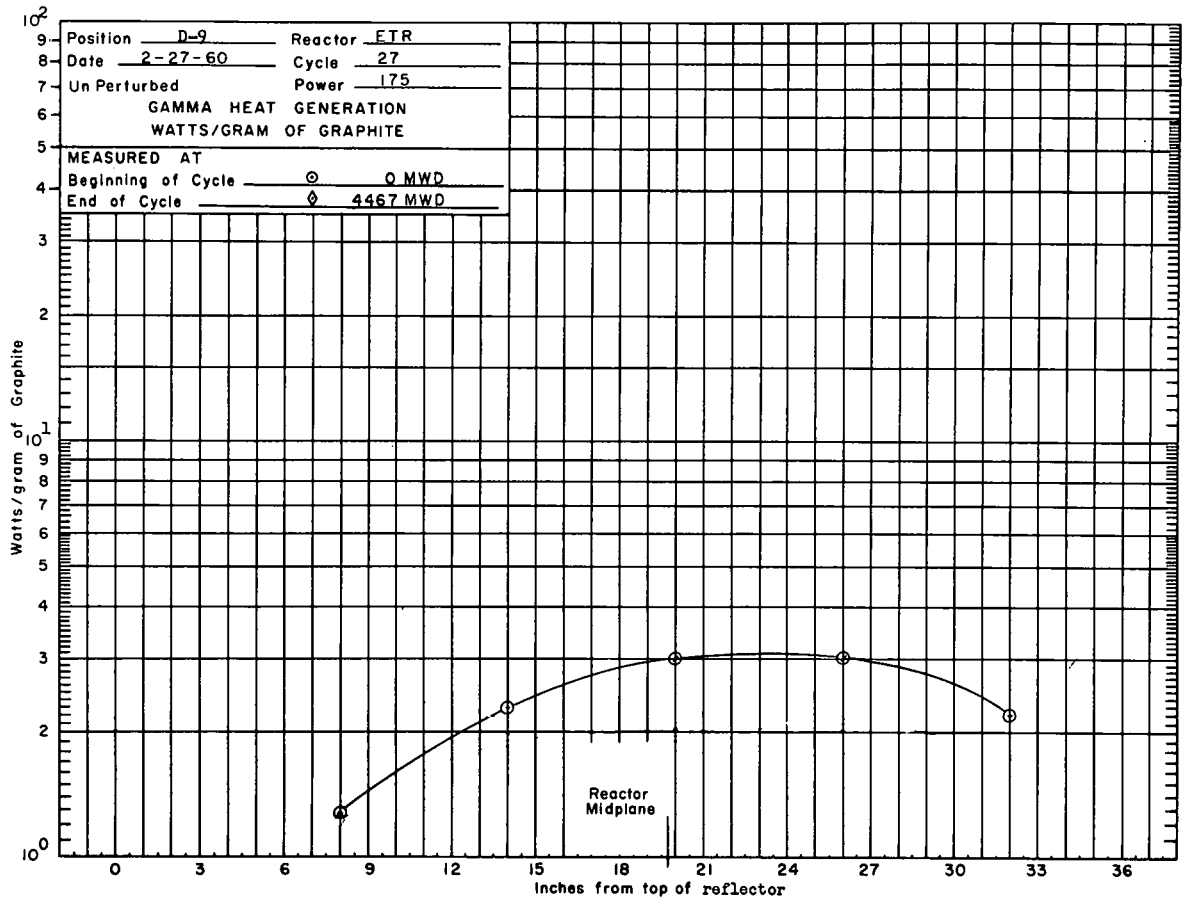
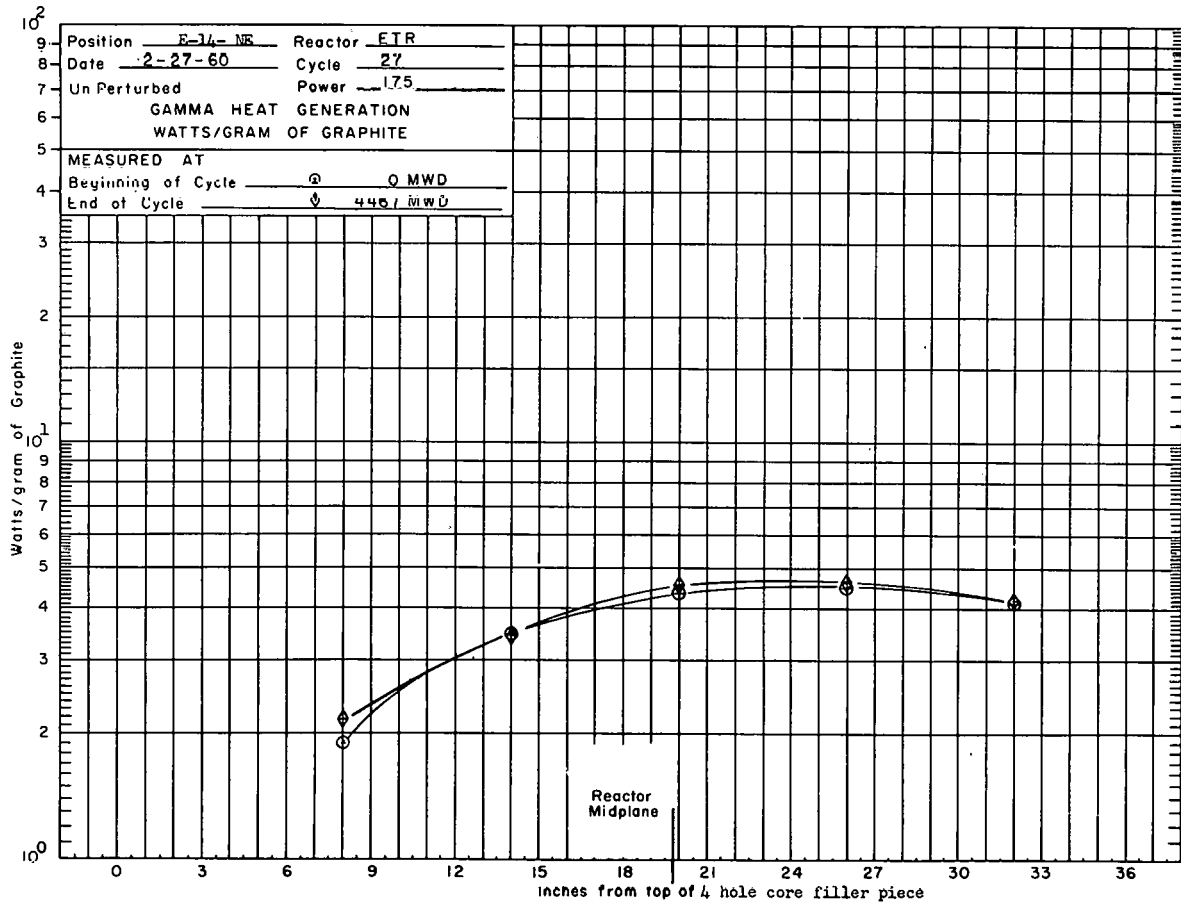
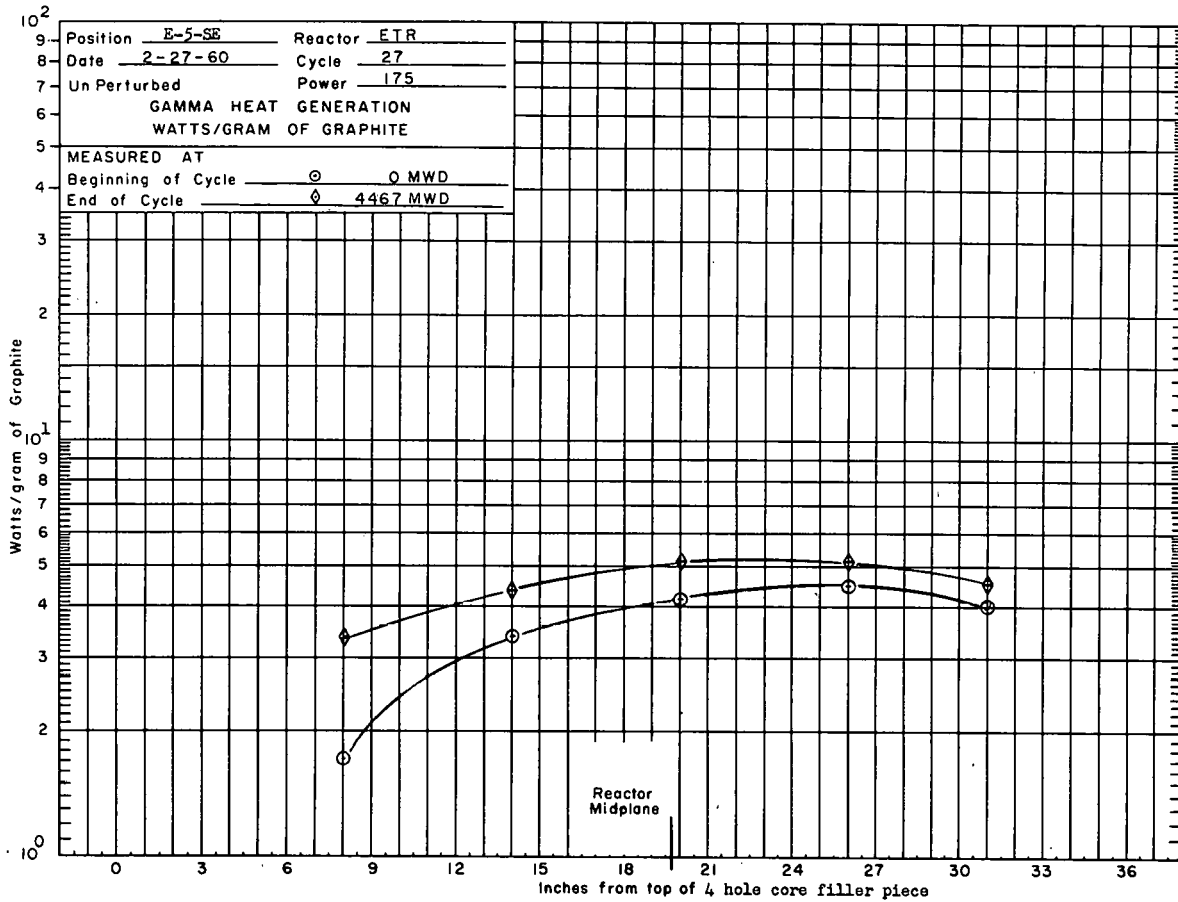


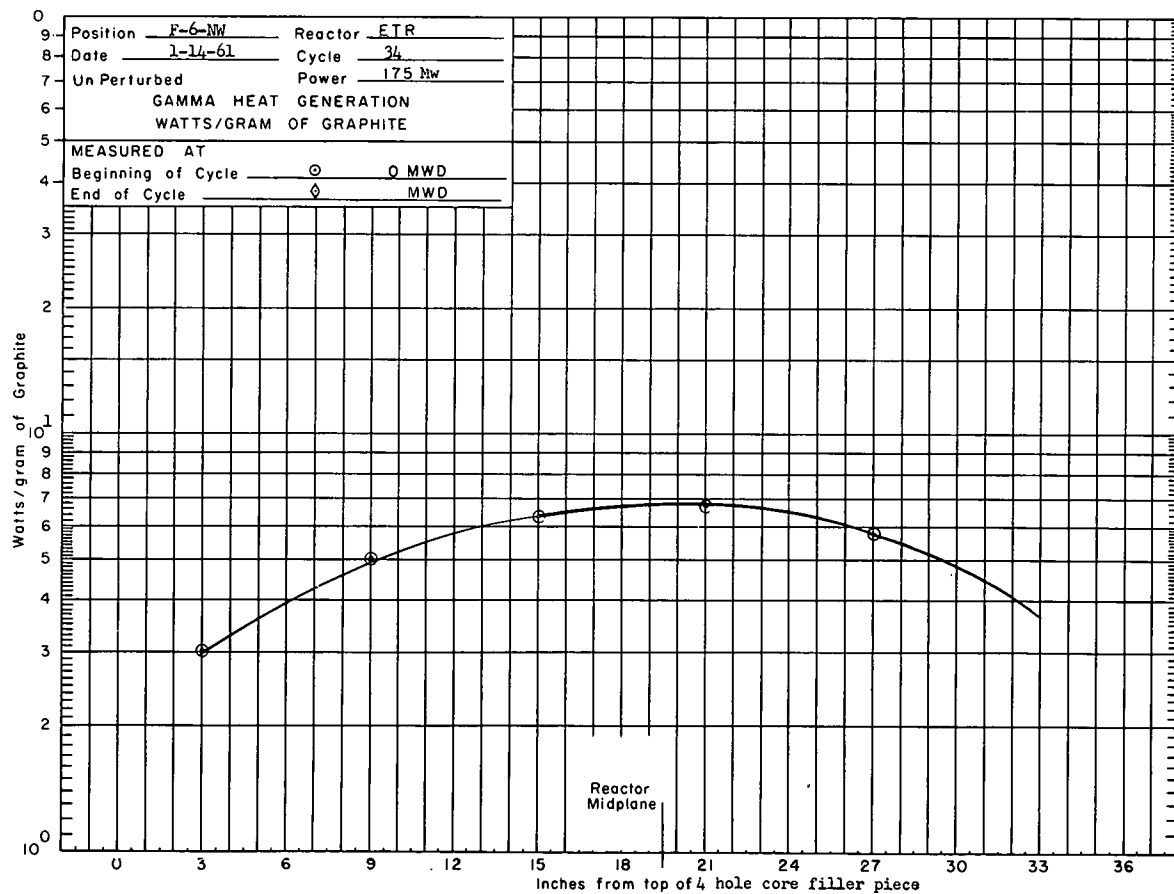
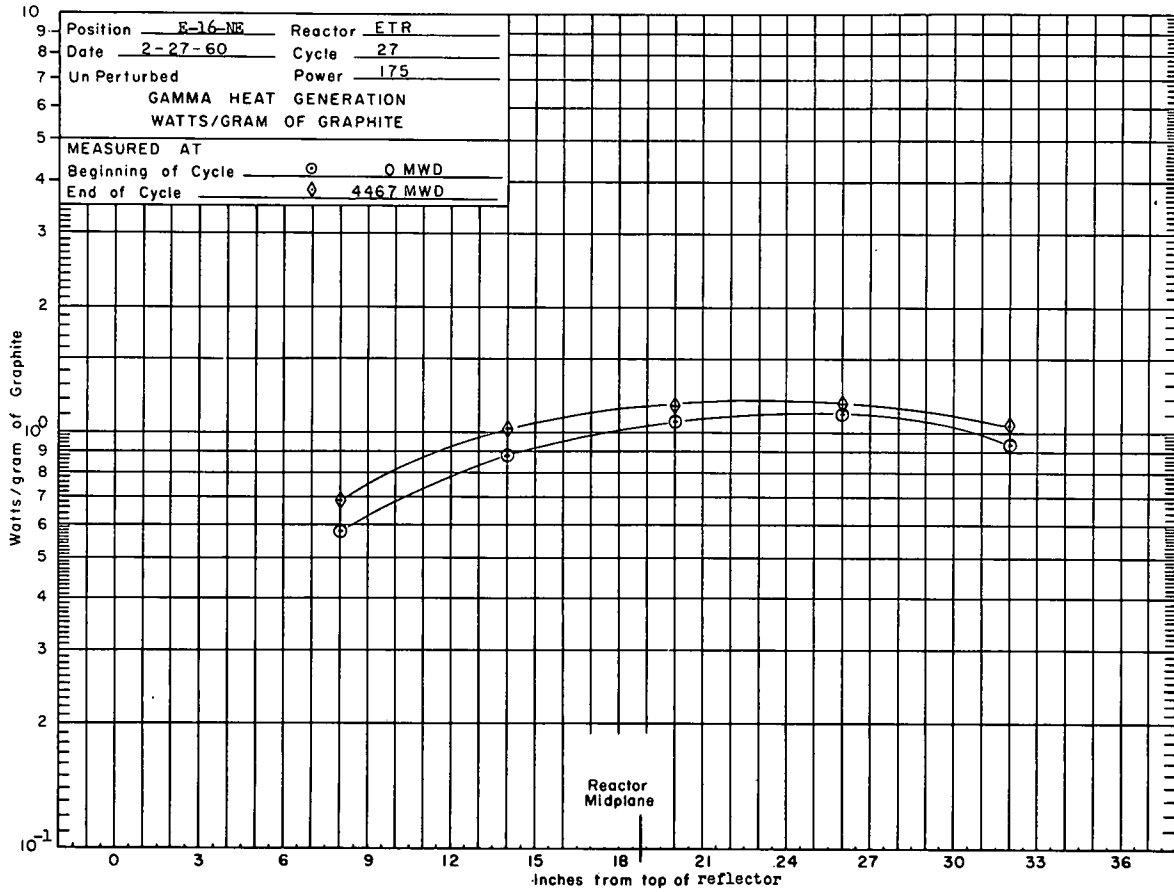
FIG. 3 Gamma heat generation extrapolated to a power of 175 Mw measured in the ETR on cycle 33 and 34. Units are watts/gram of graphite.

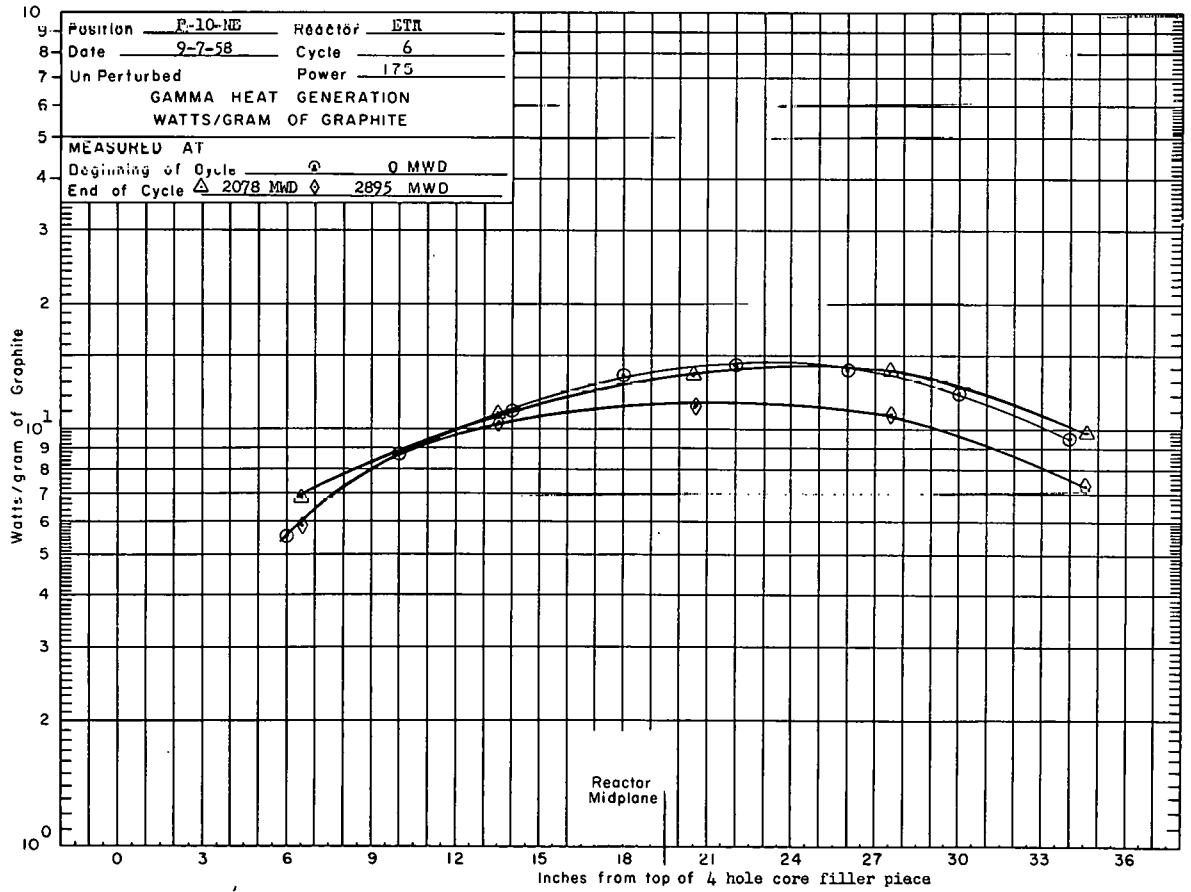
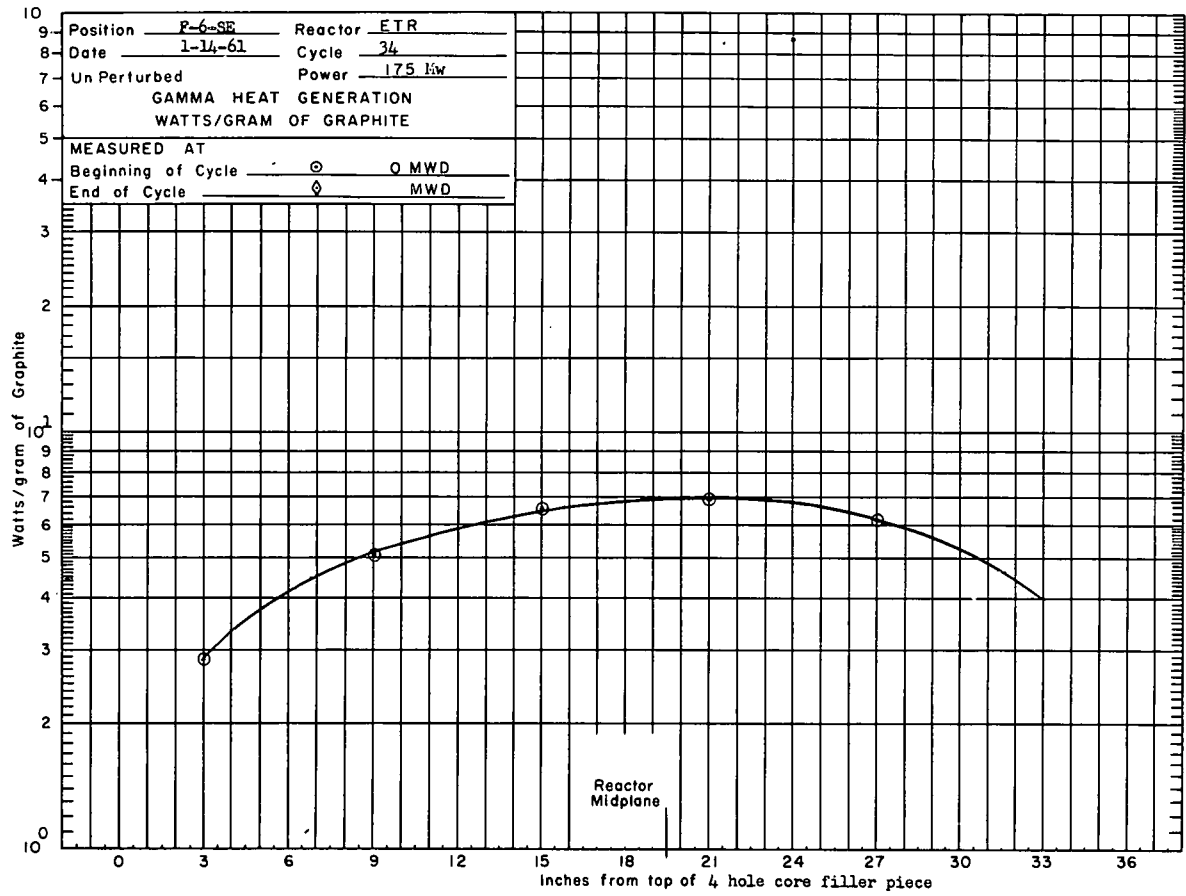


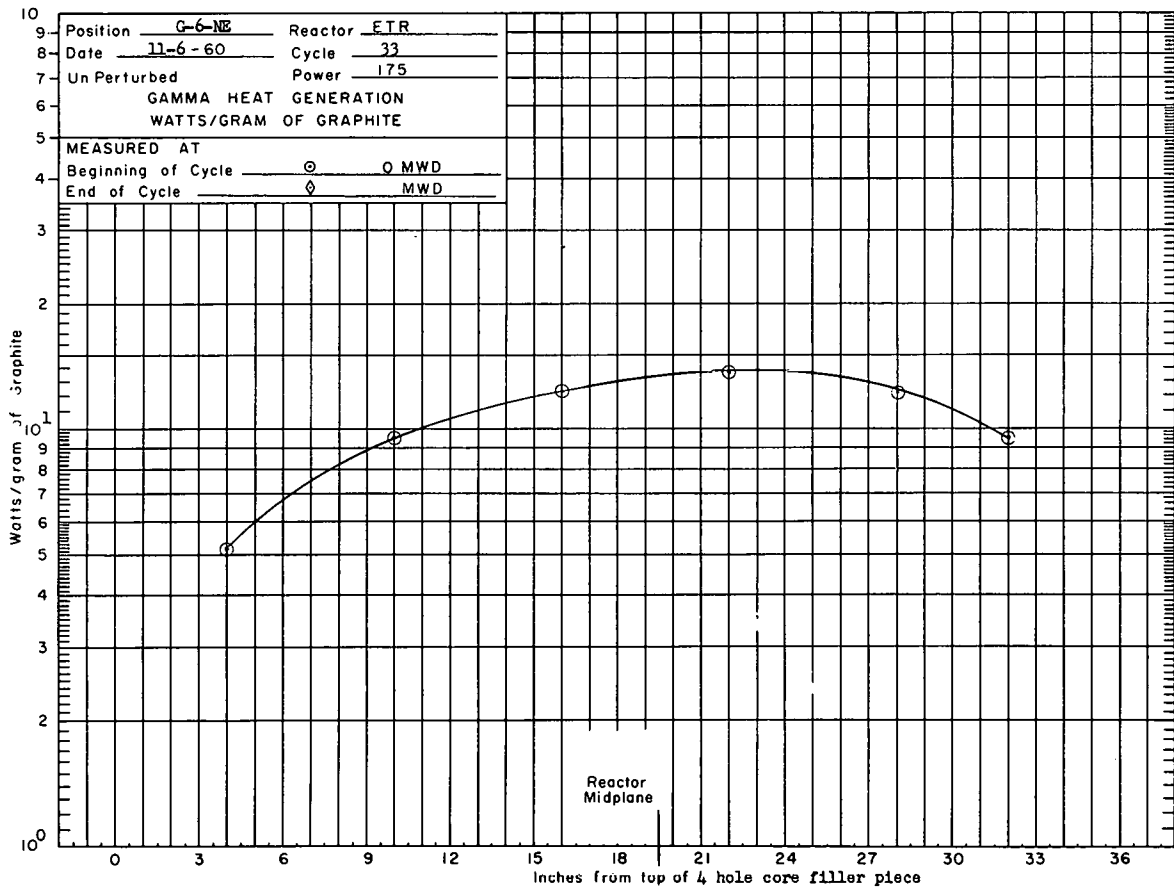
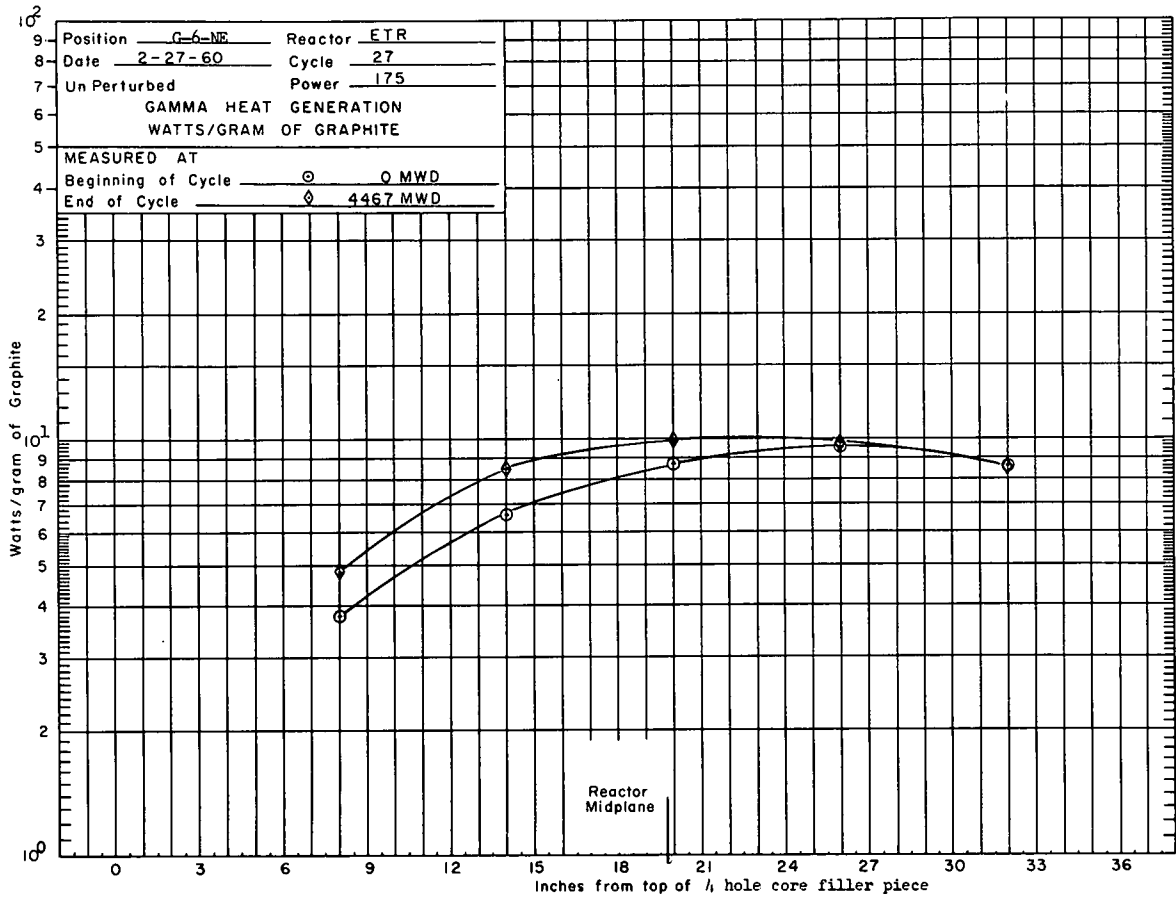


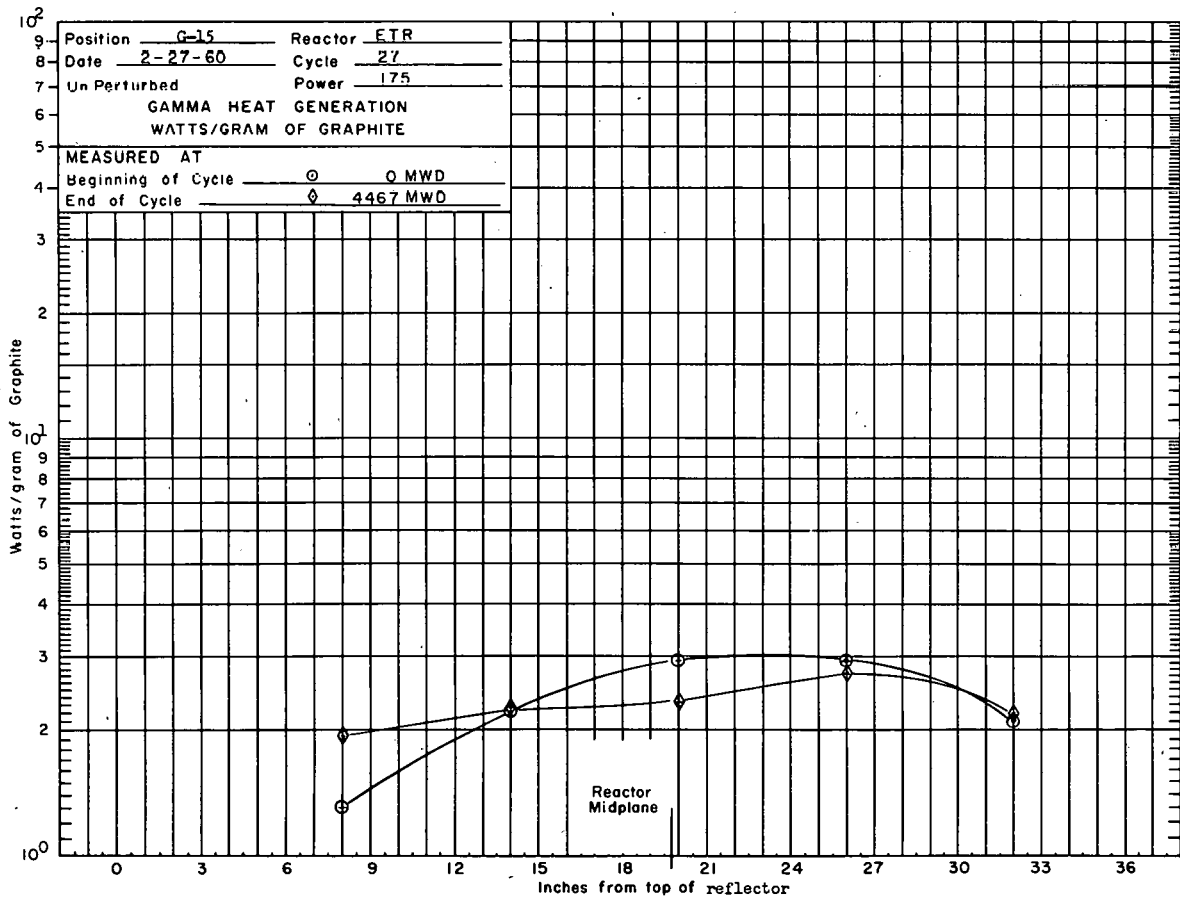
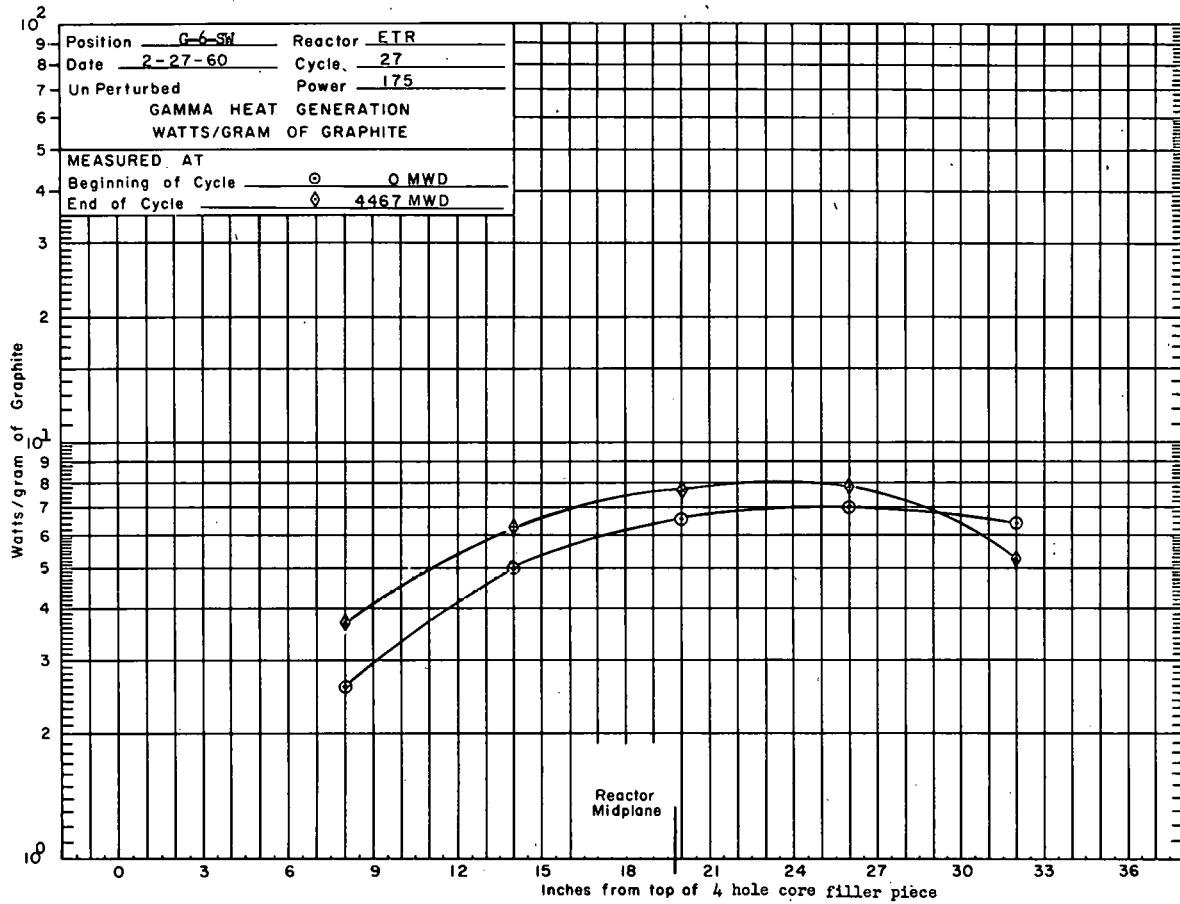


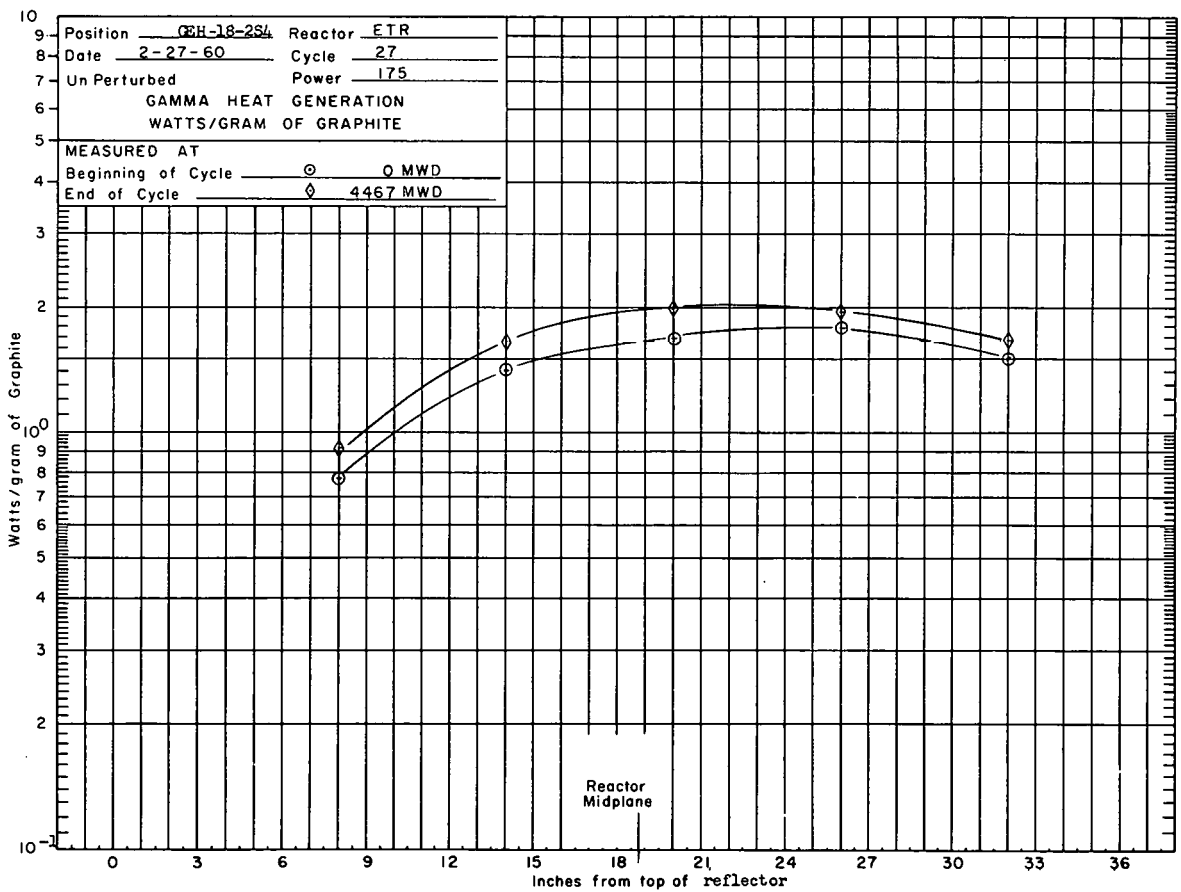
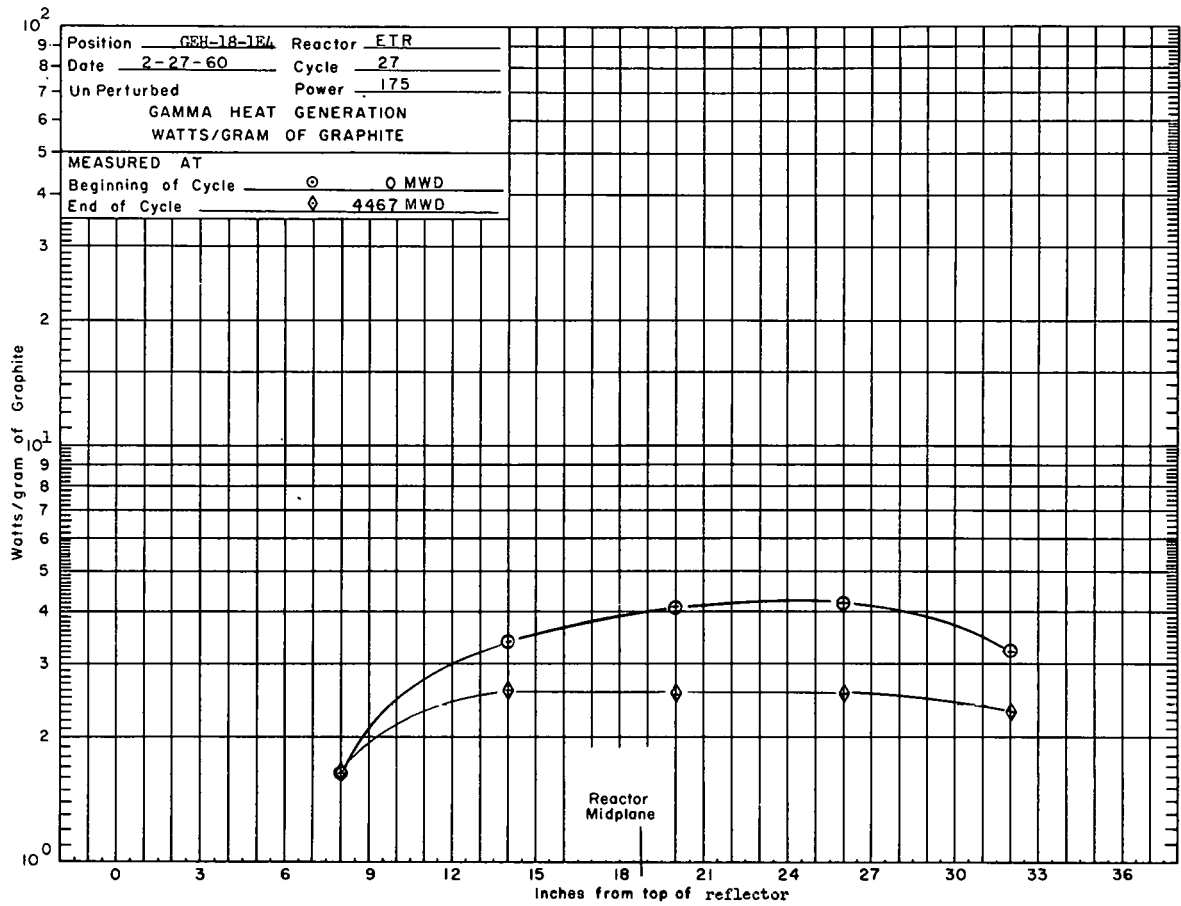


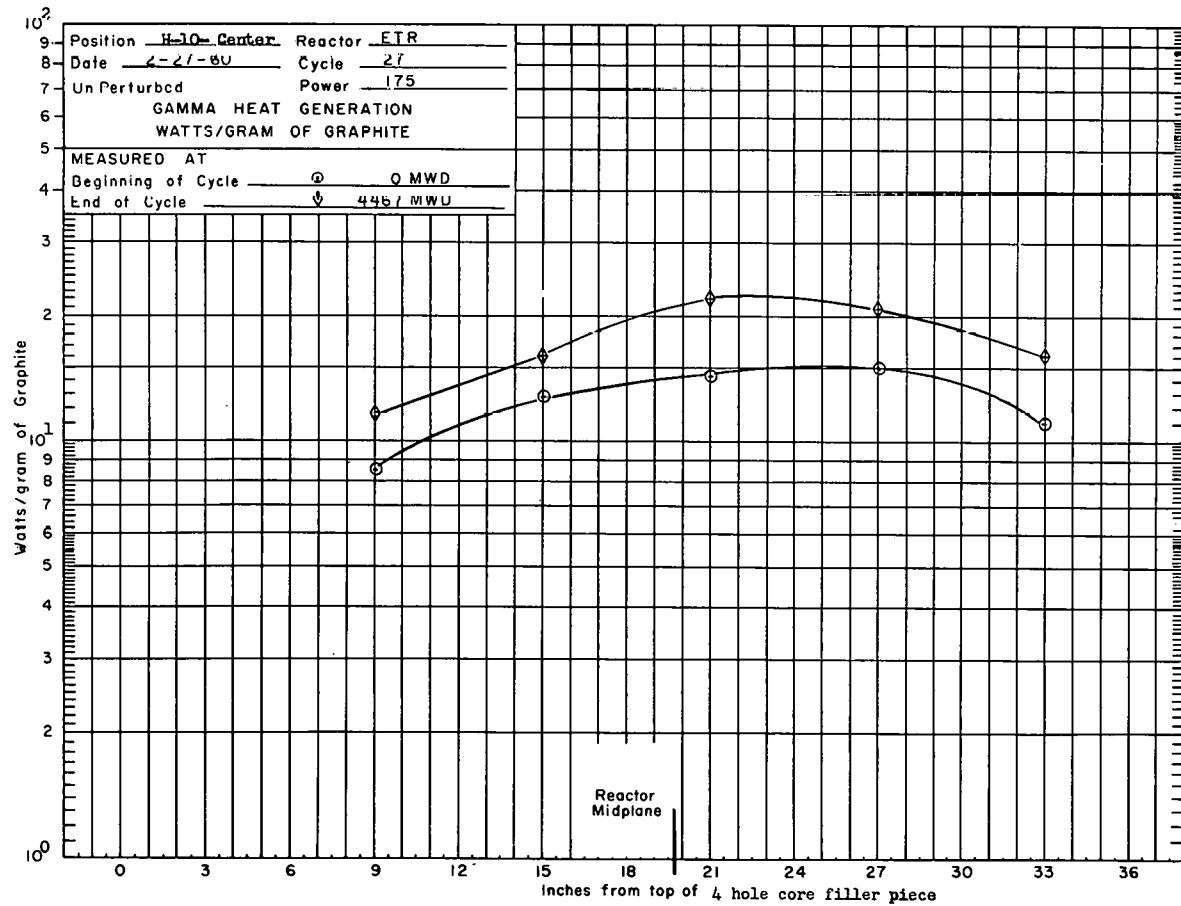
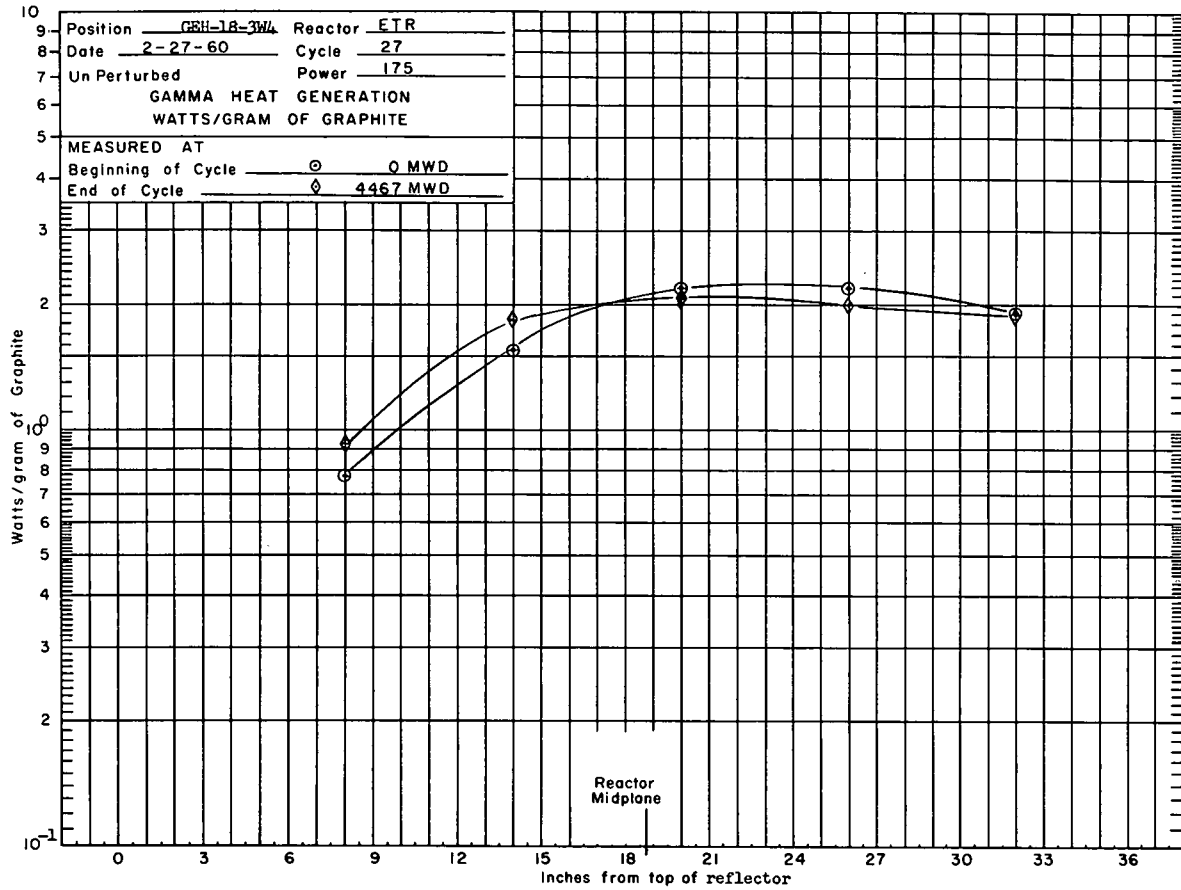


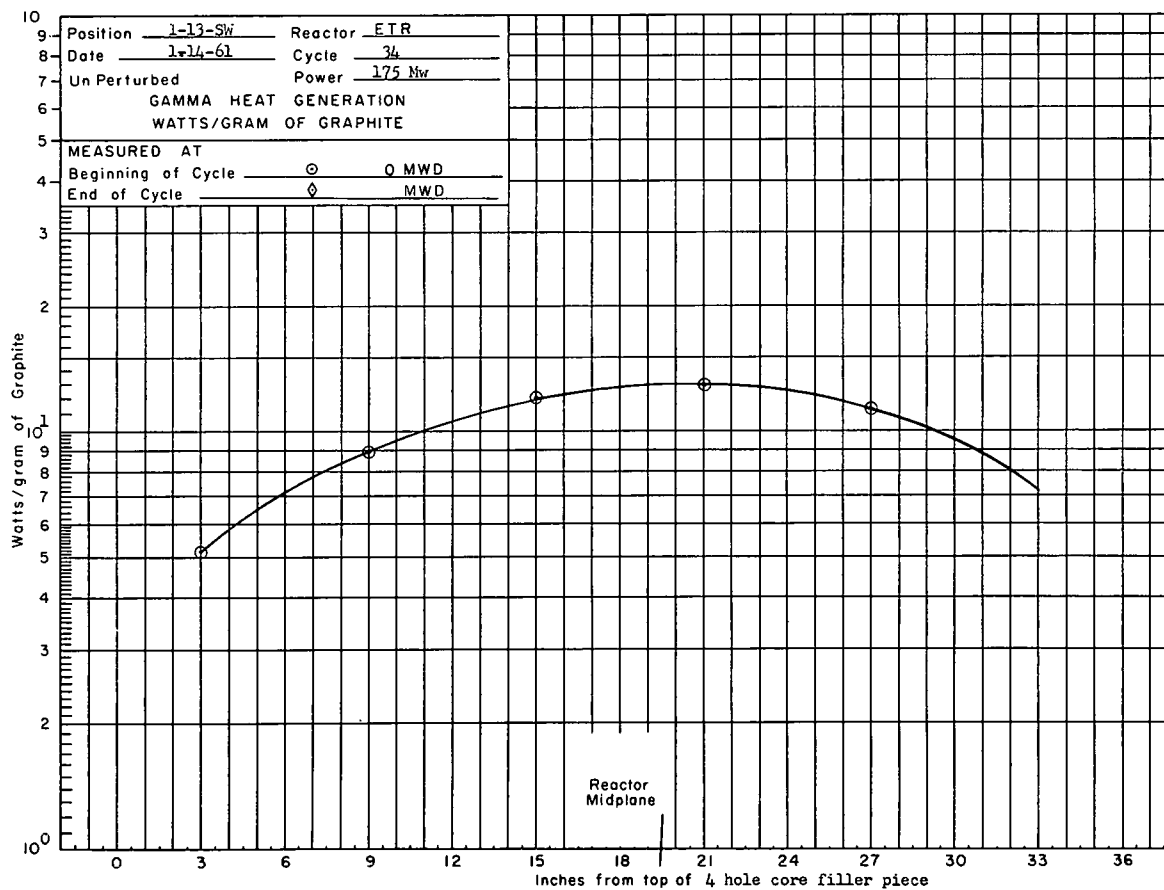
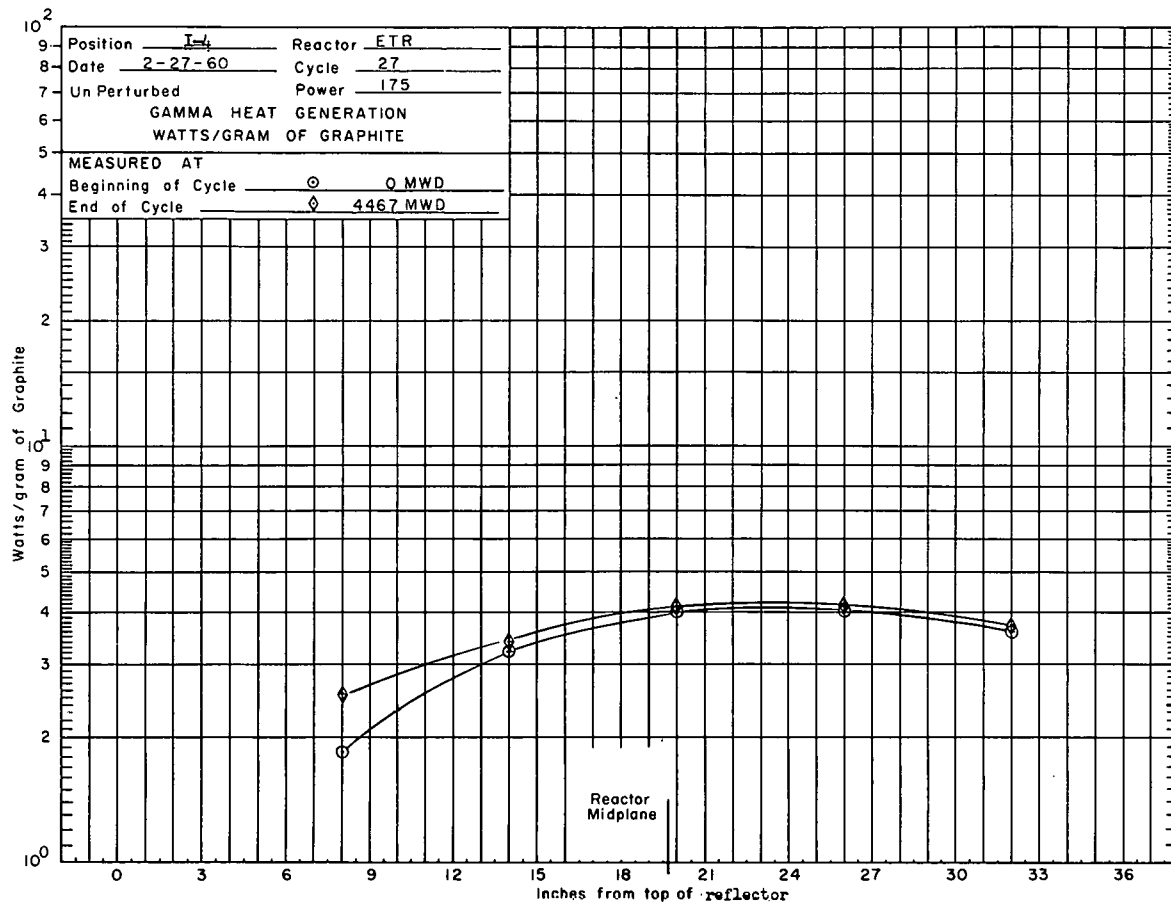


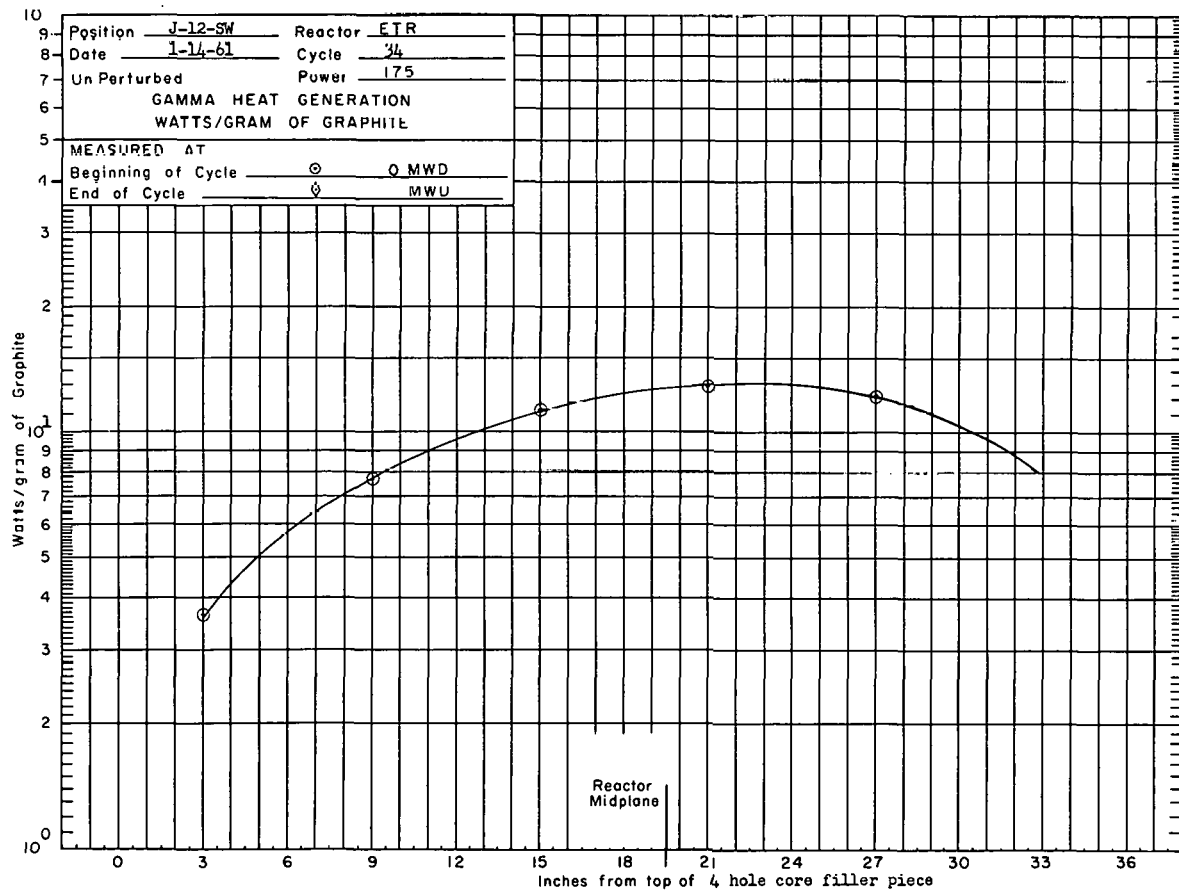
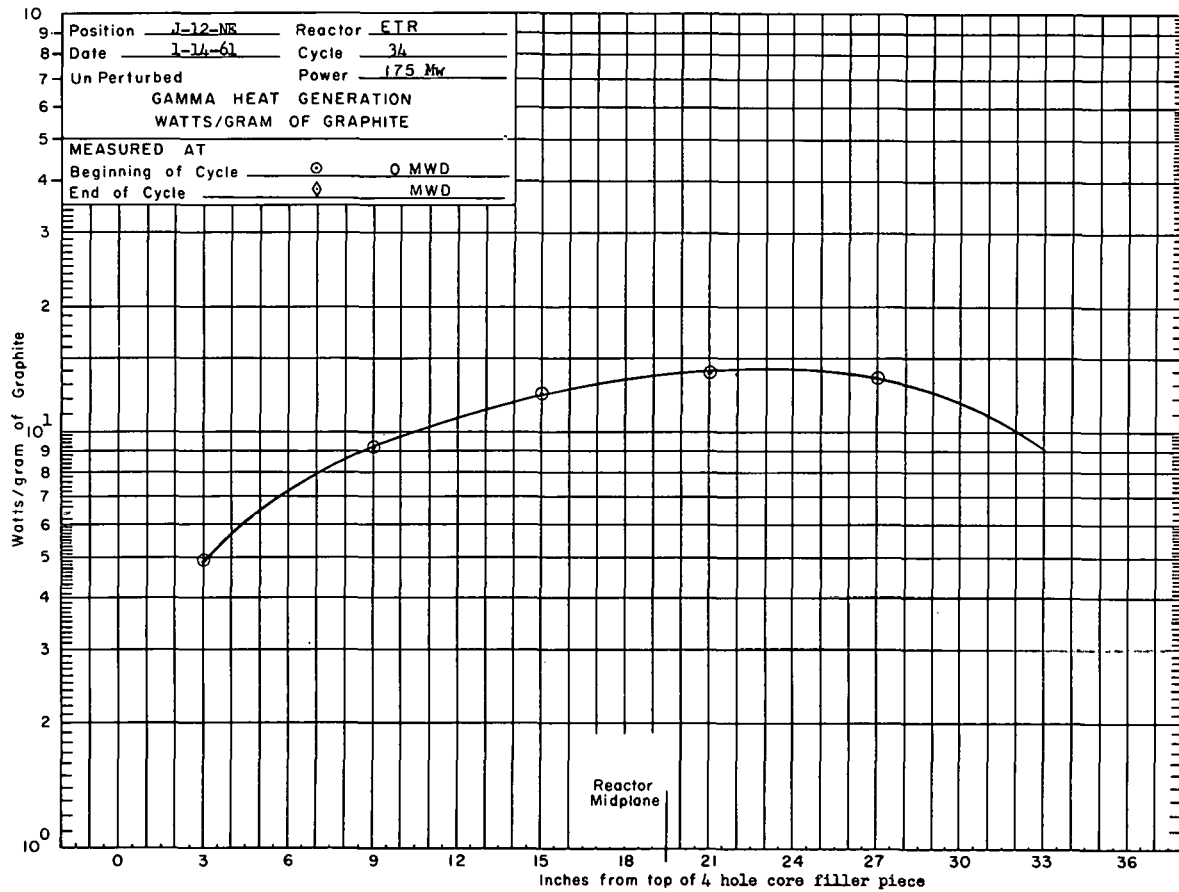


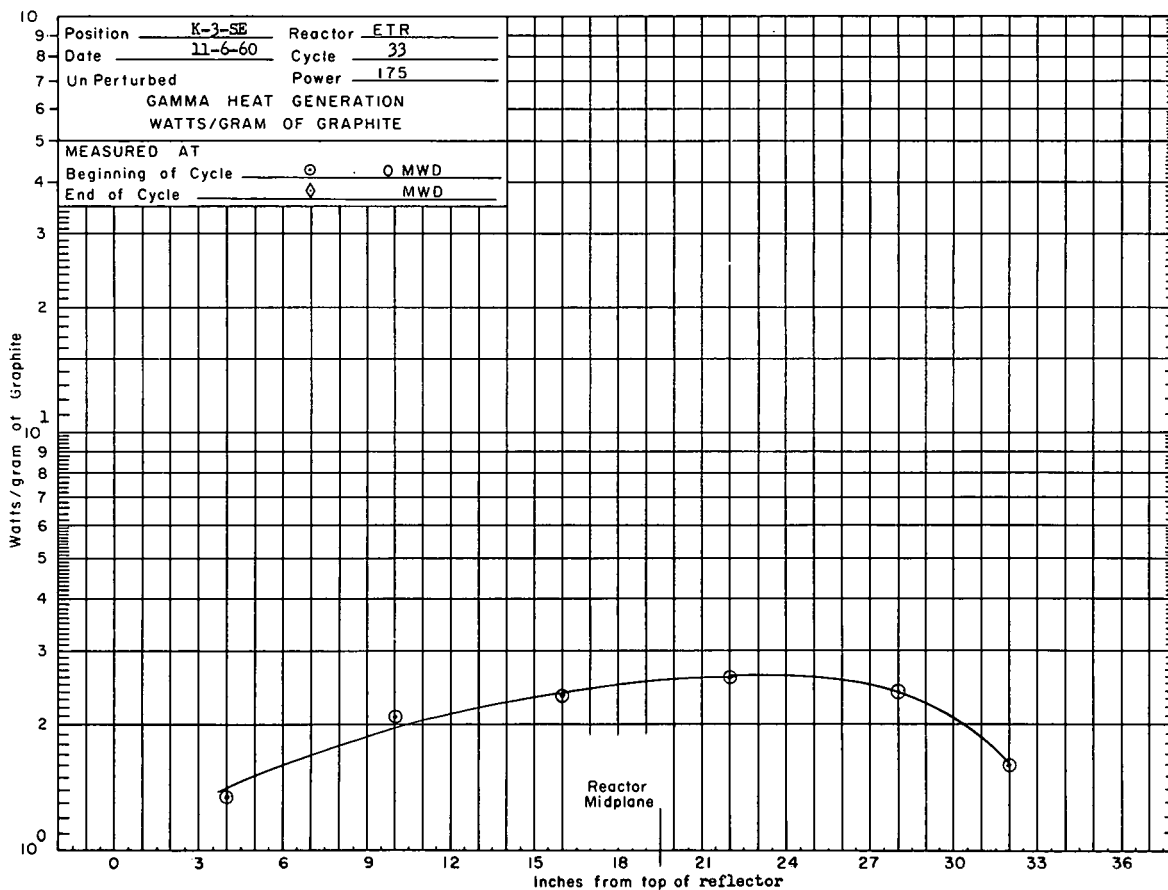
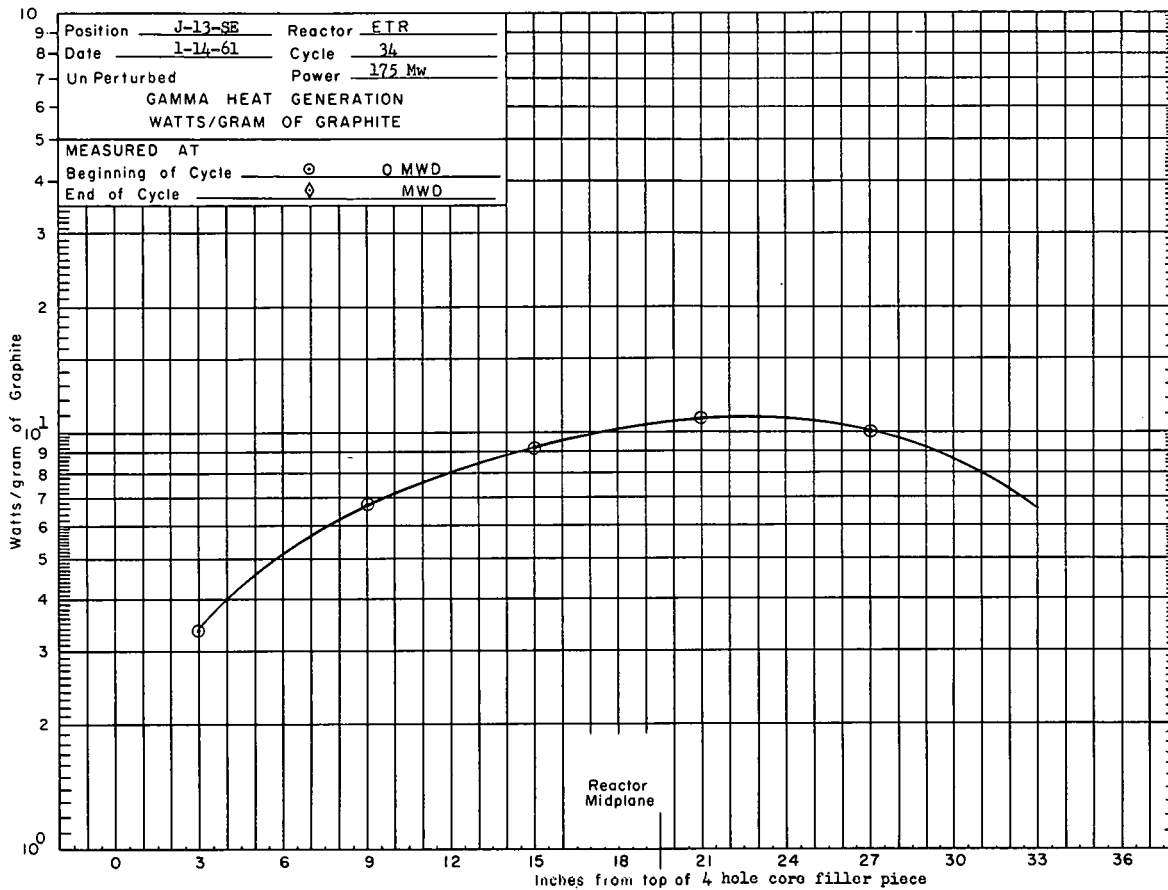


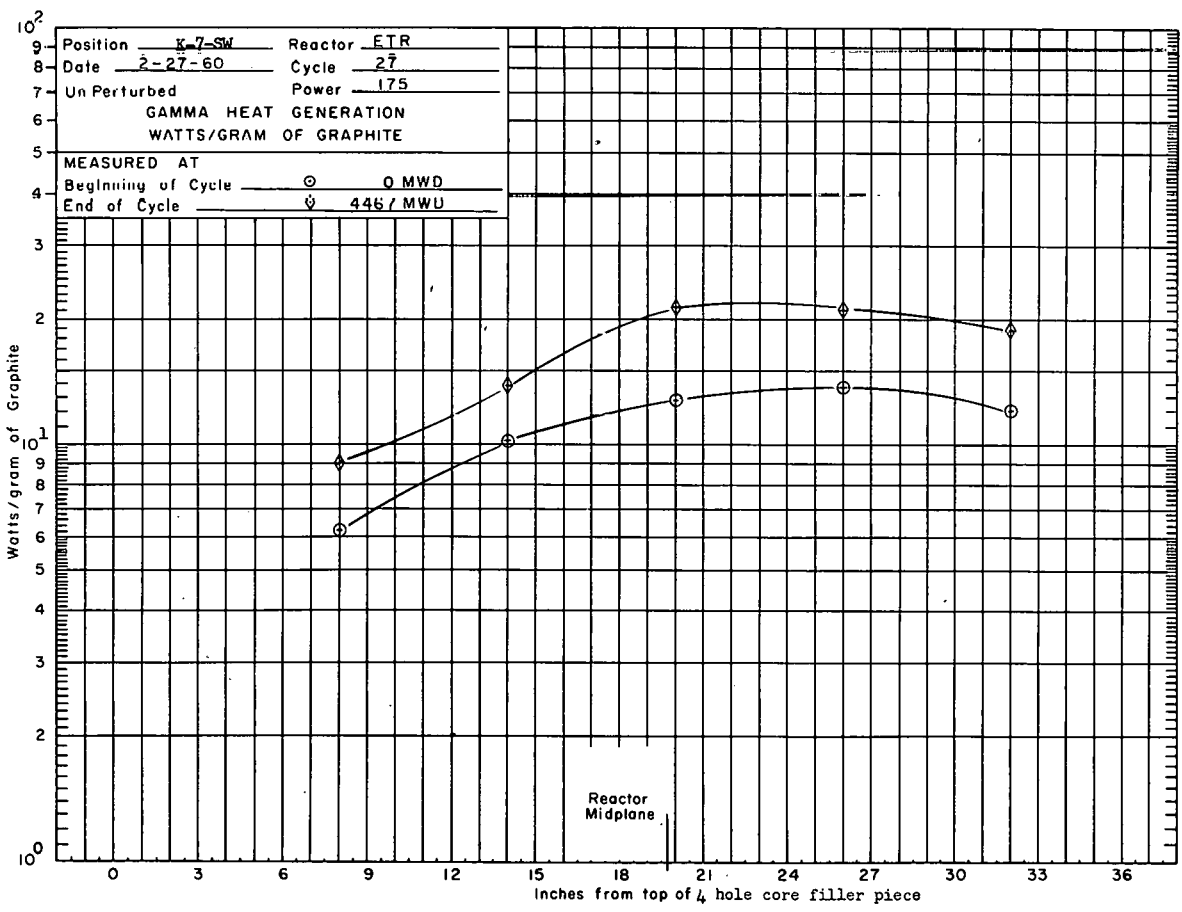
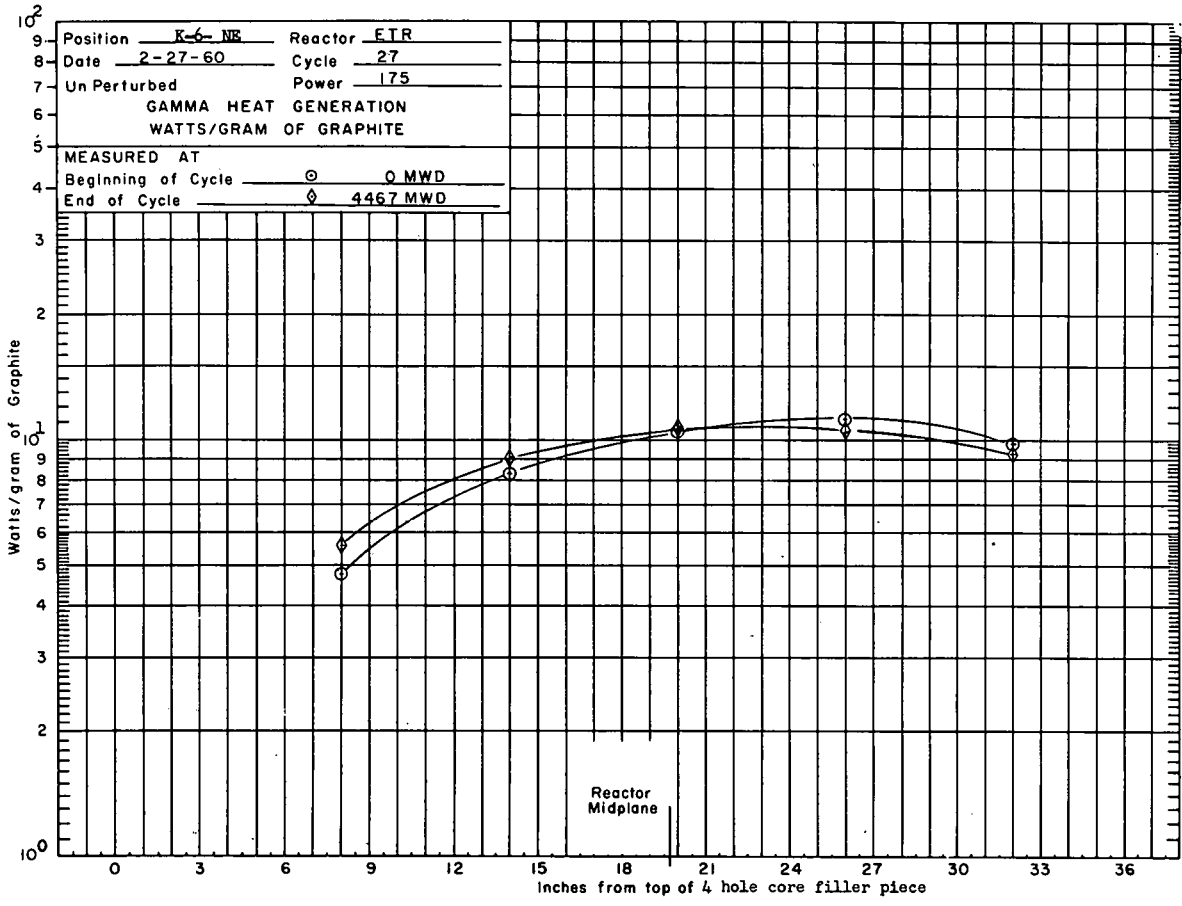


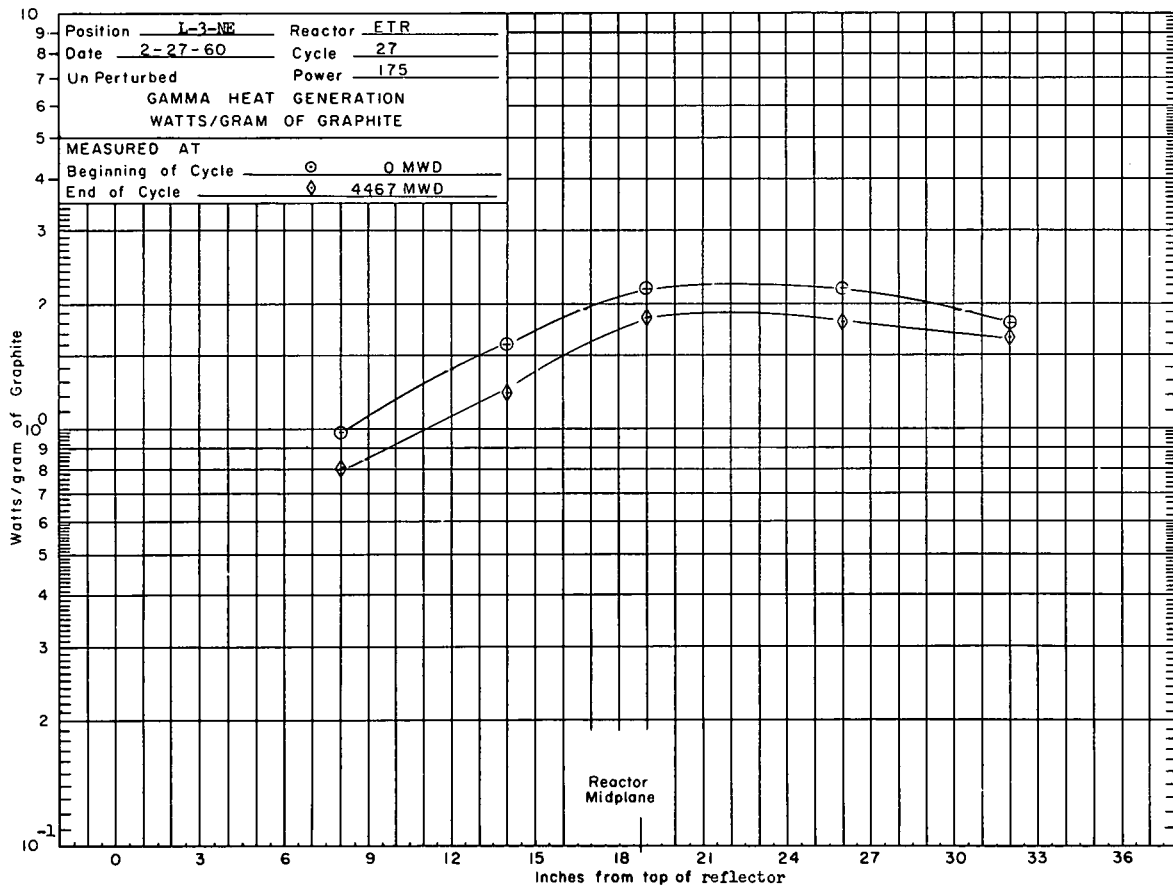
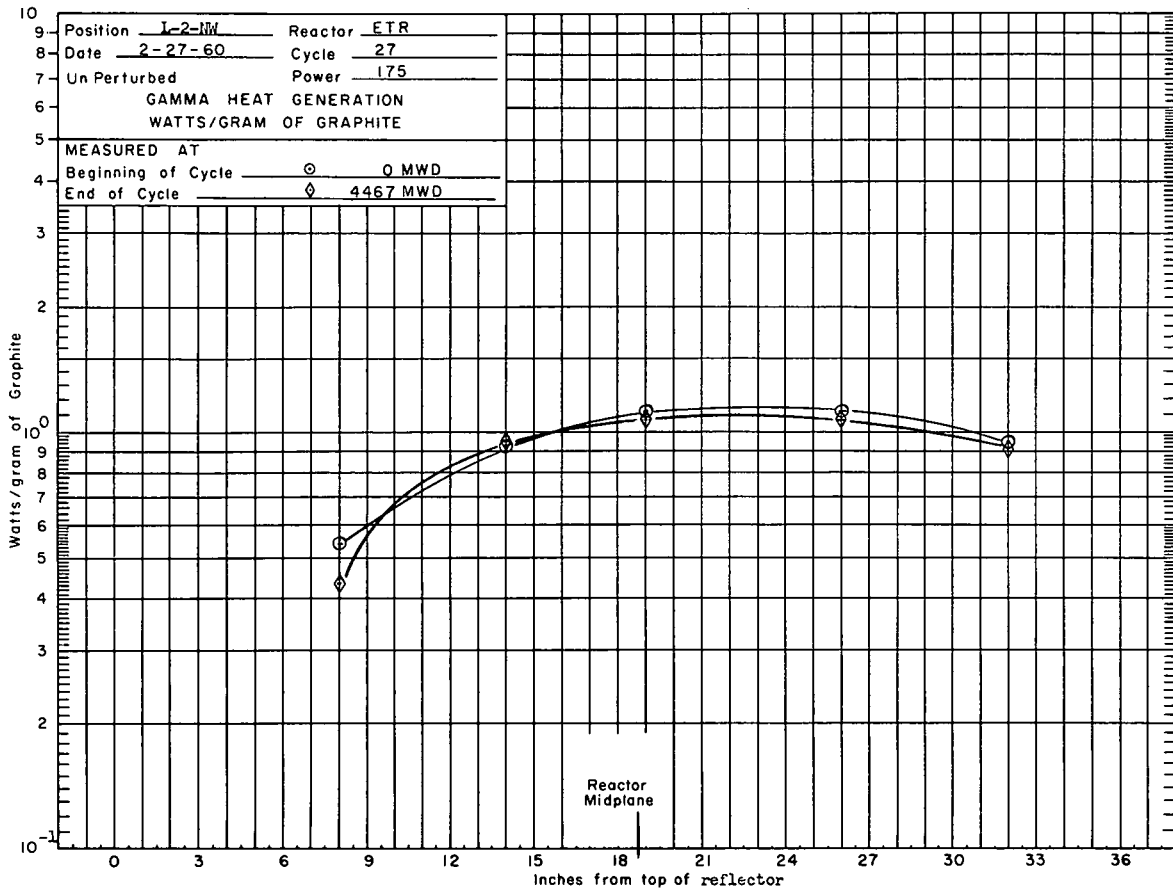


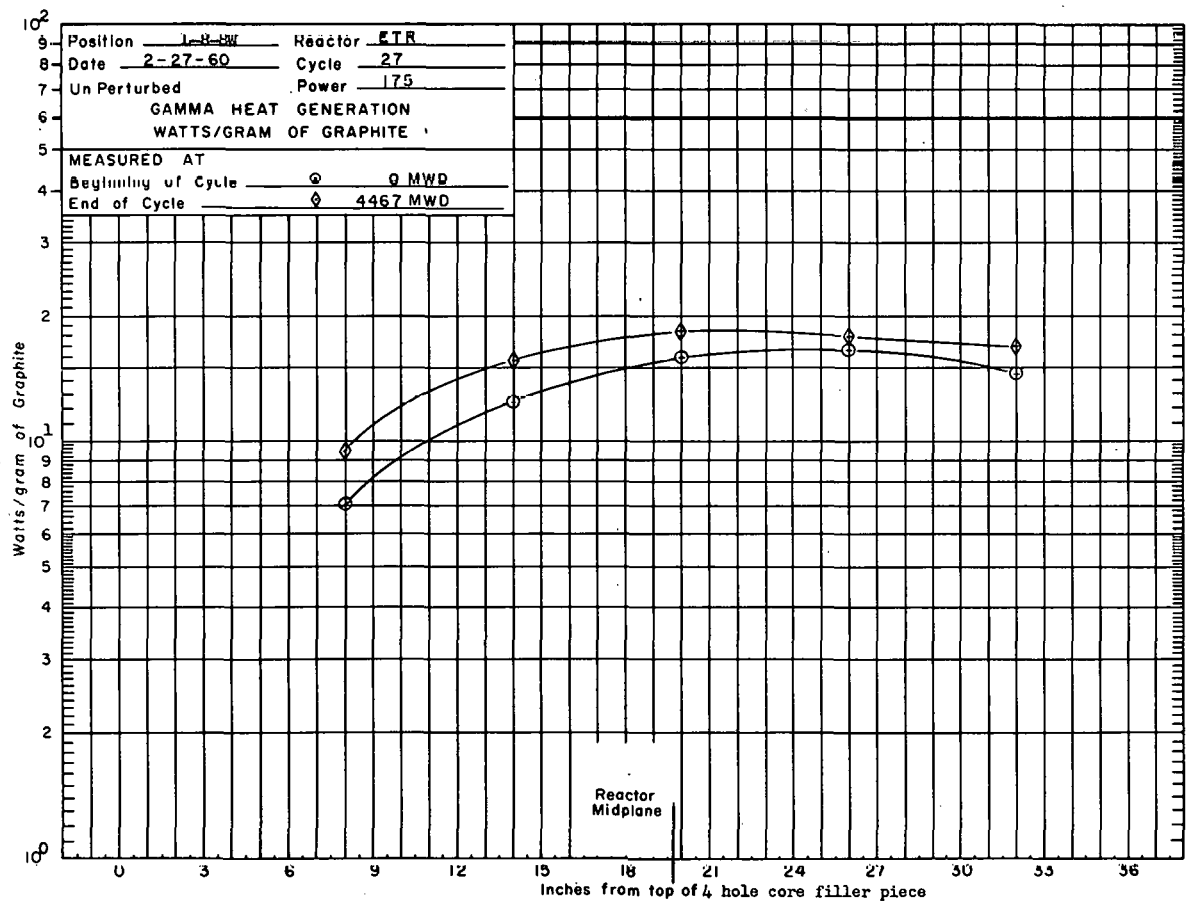
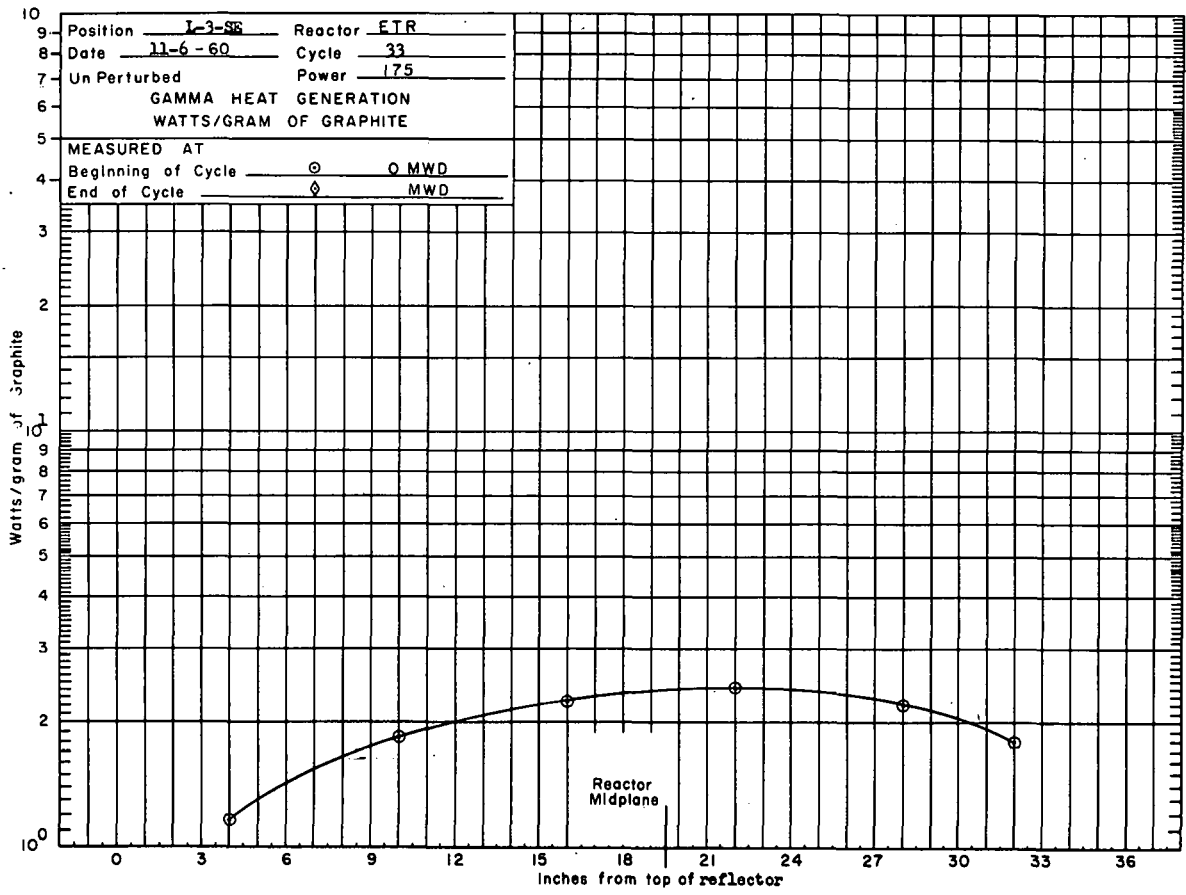


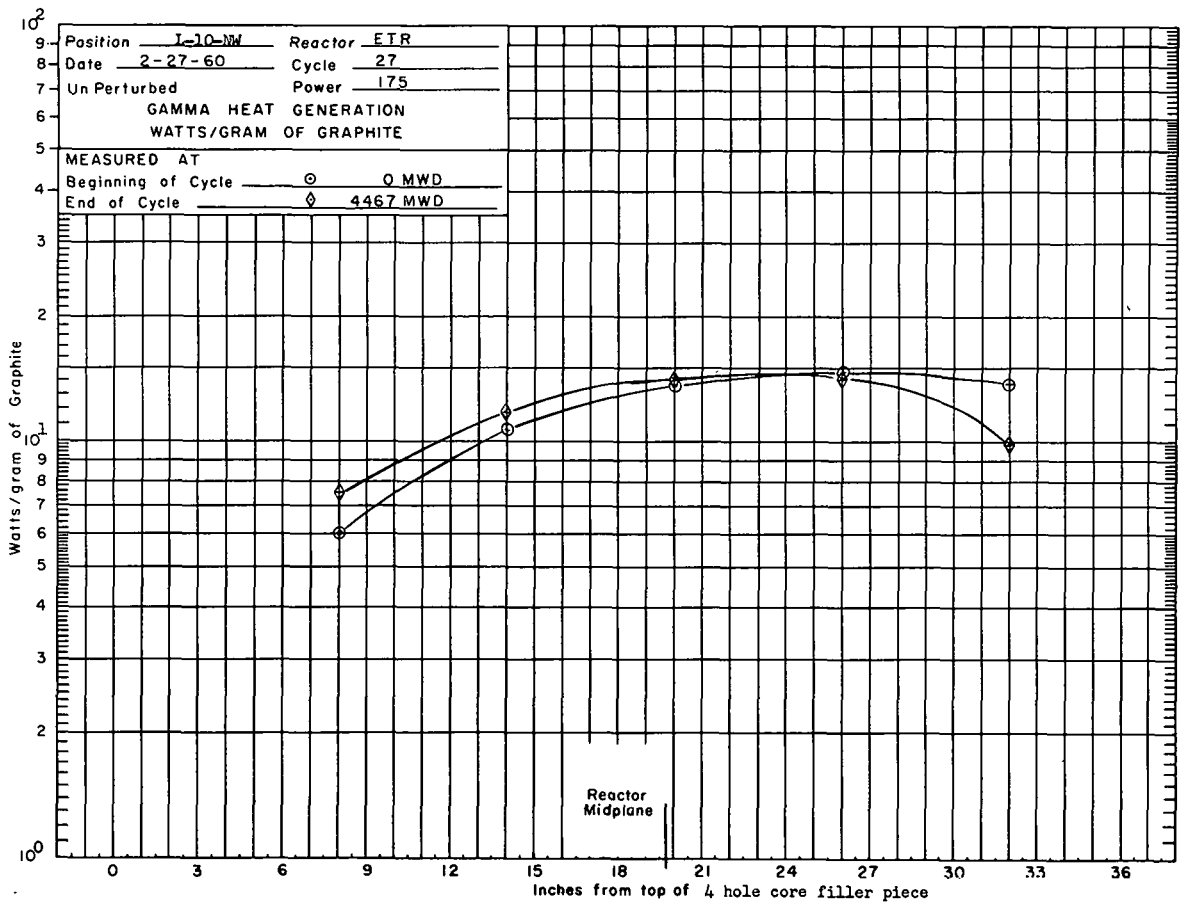
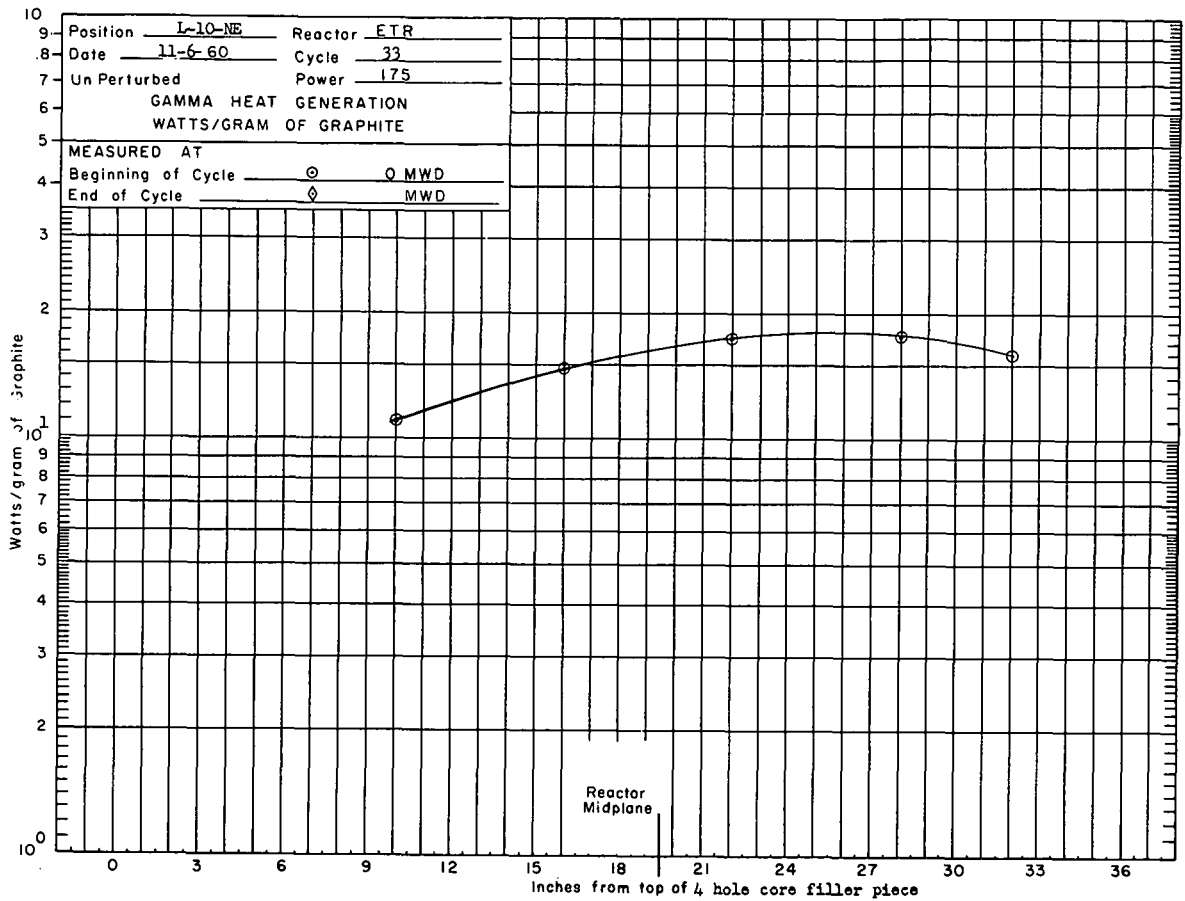


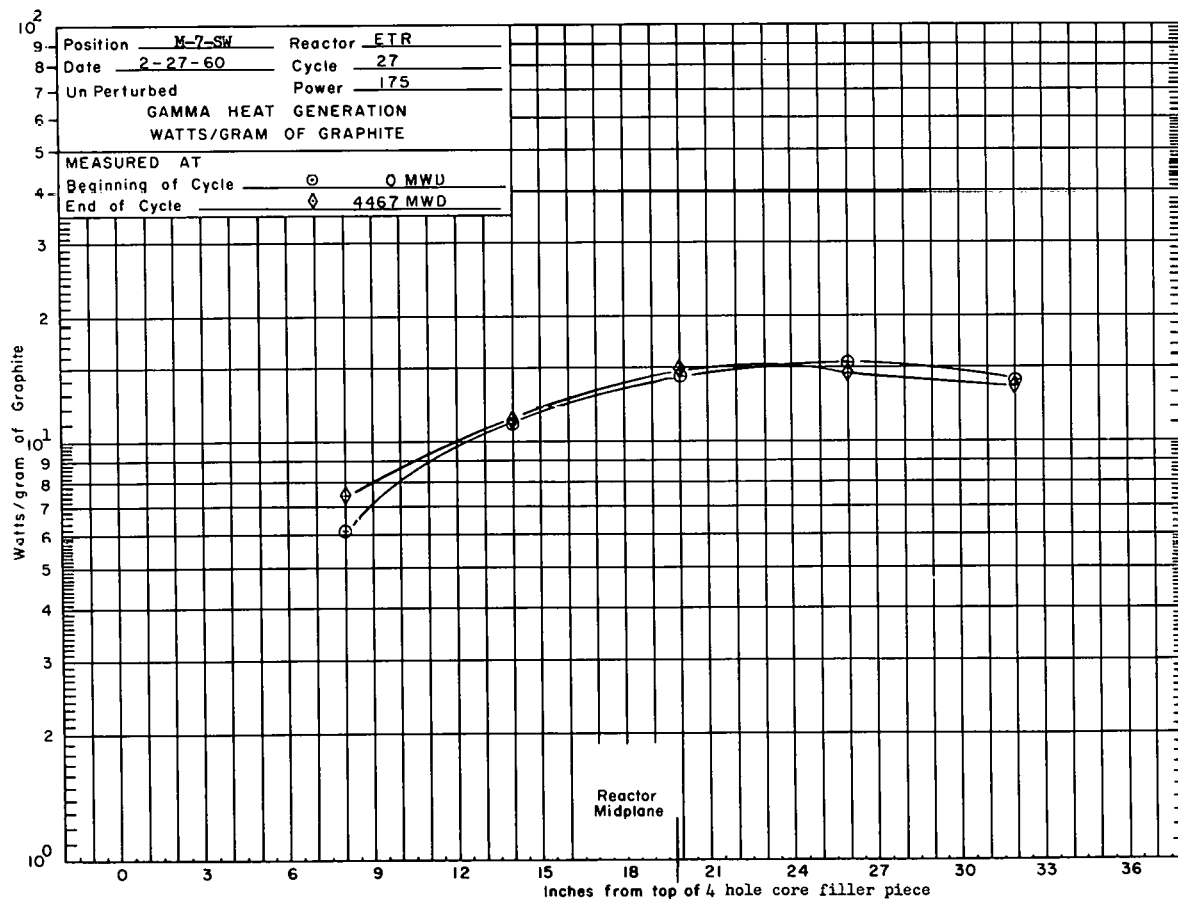
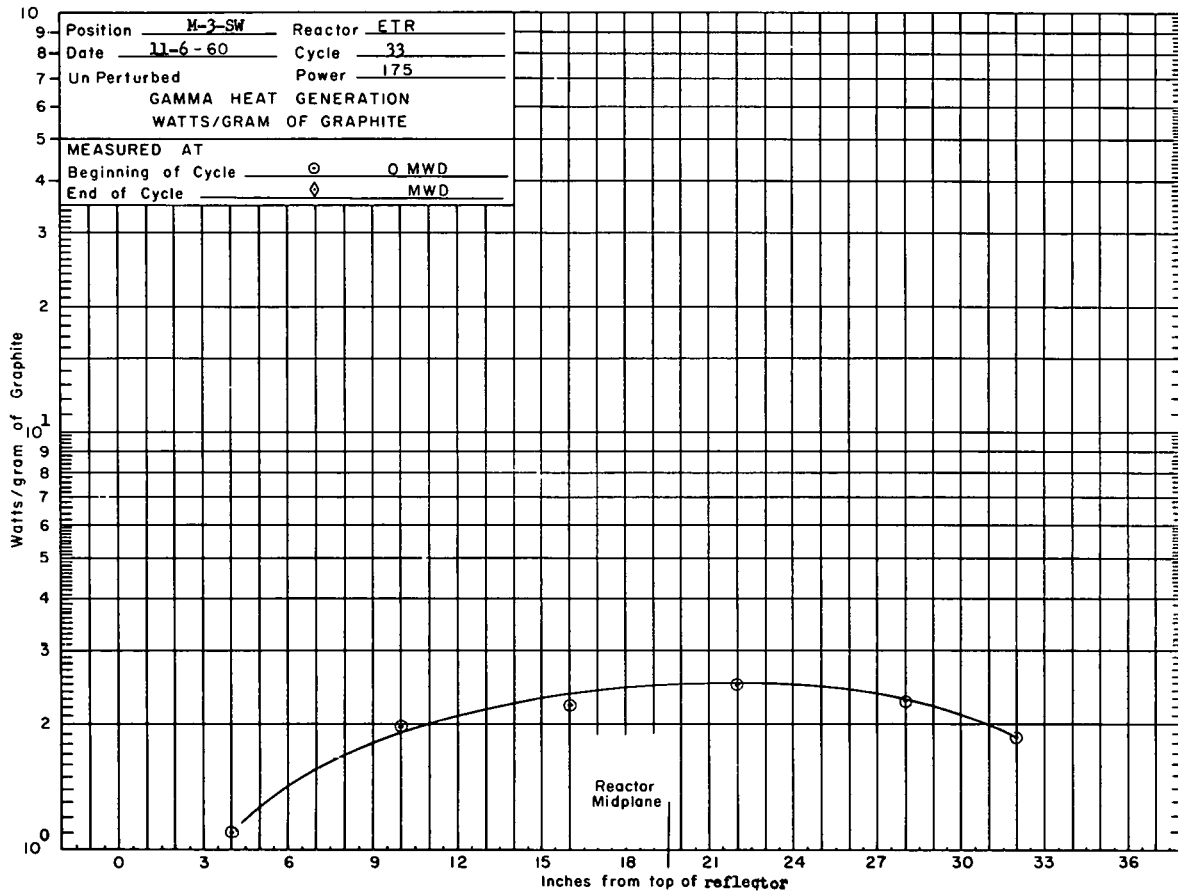


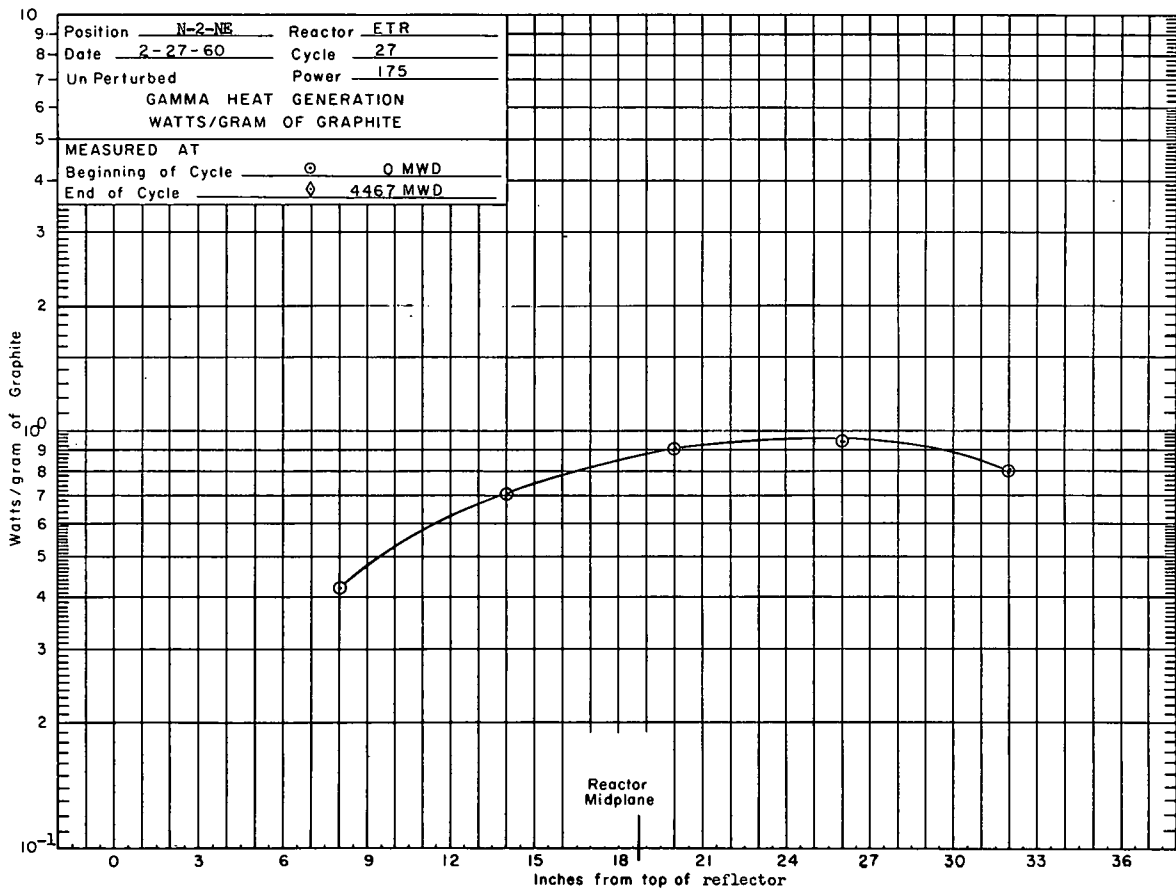
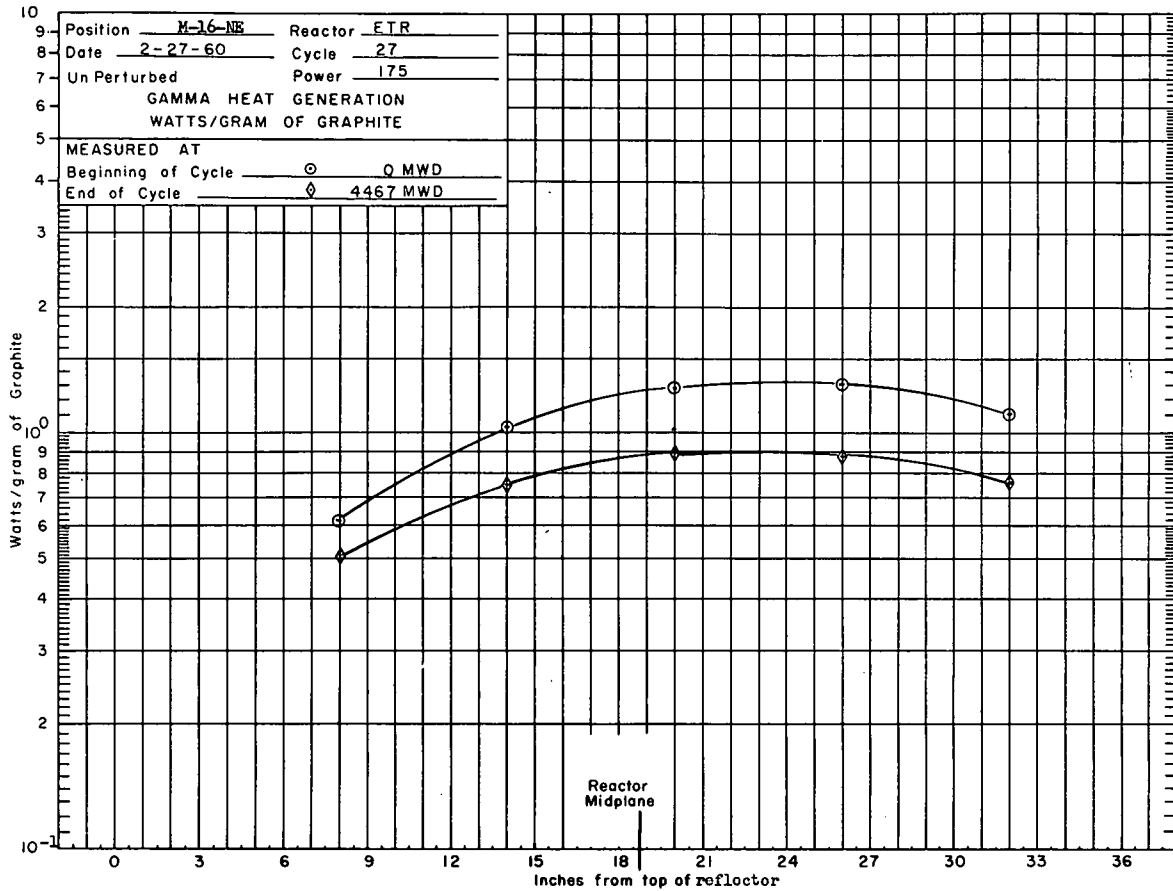


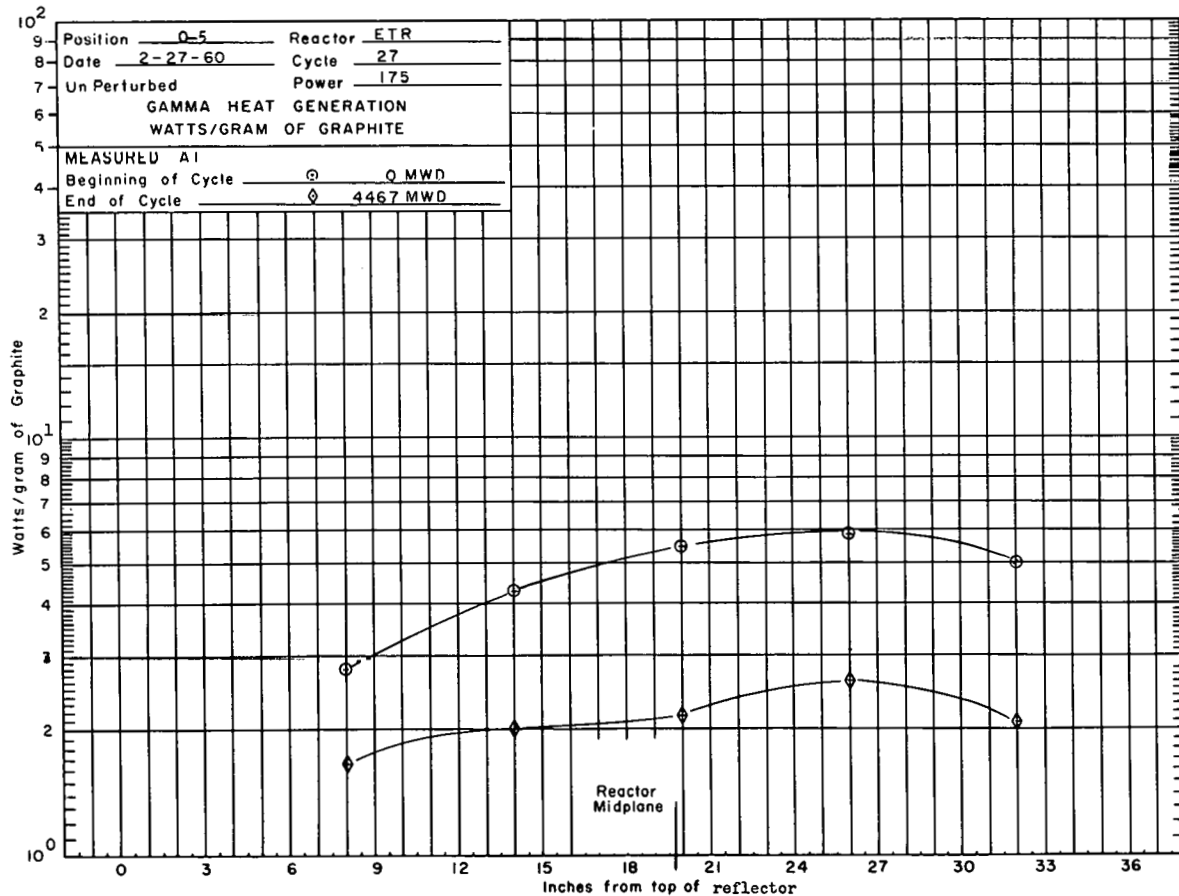
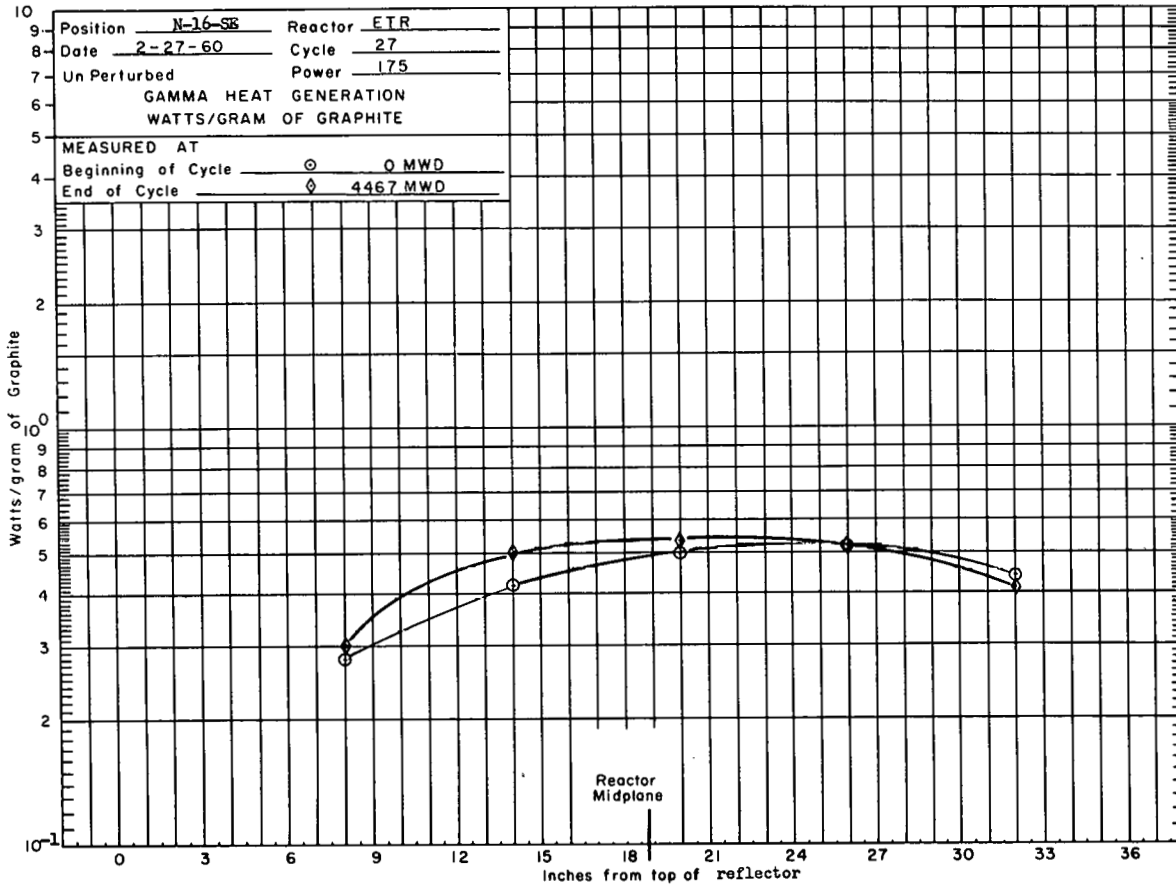


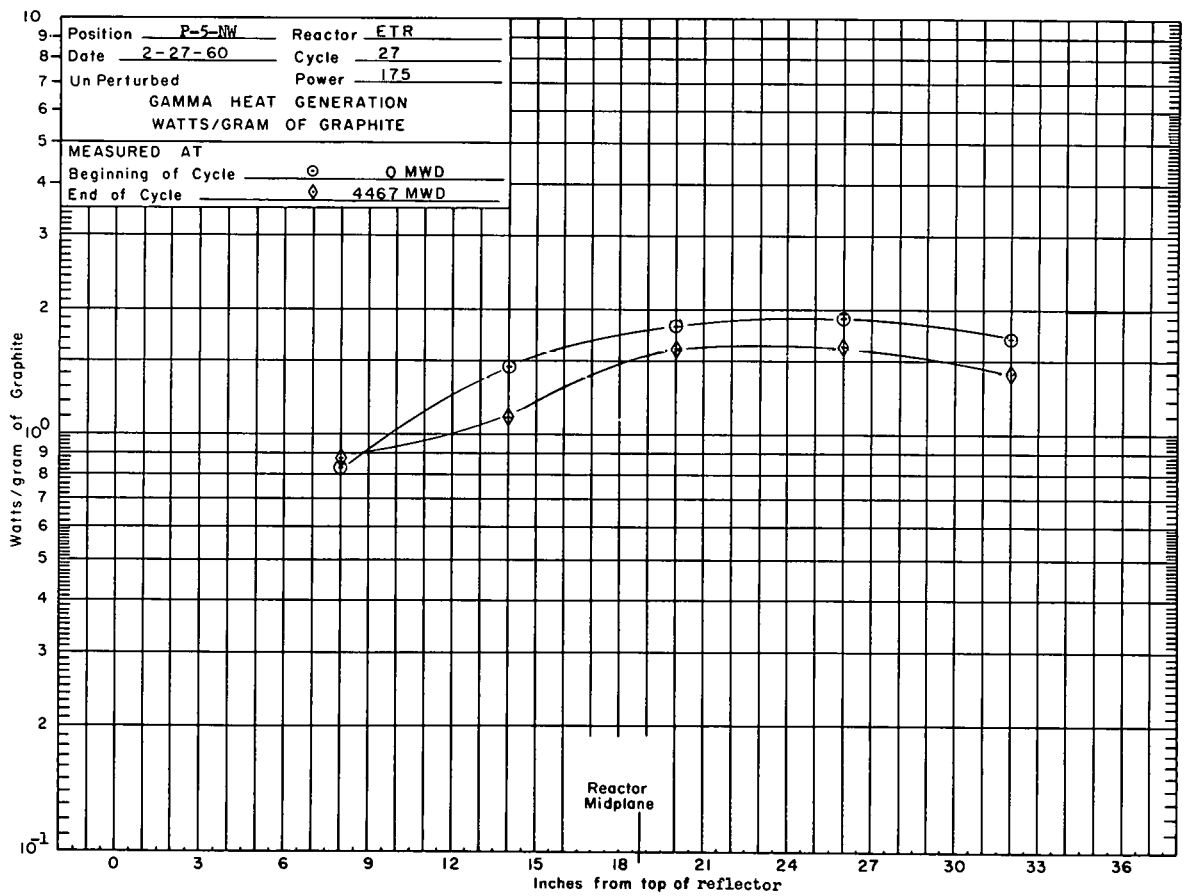
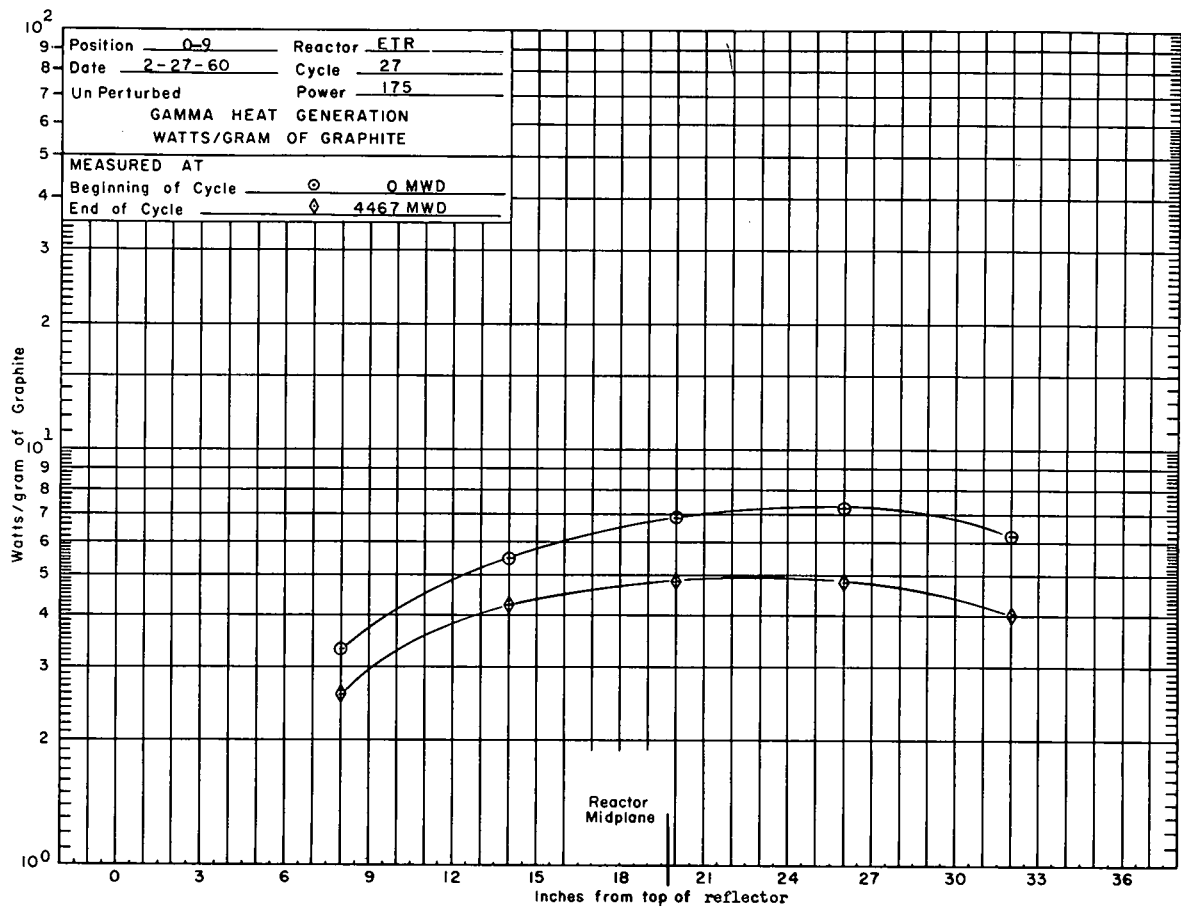


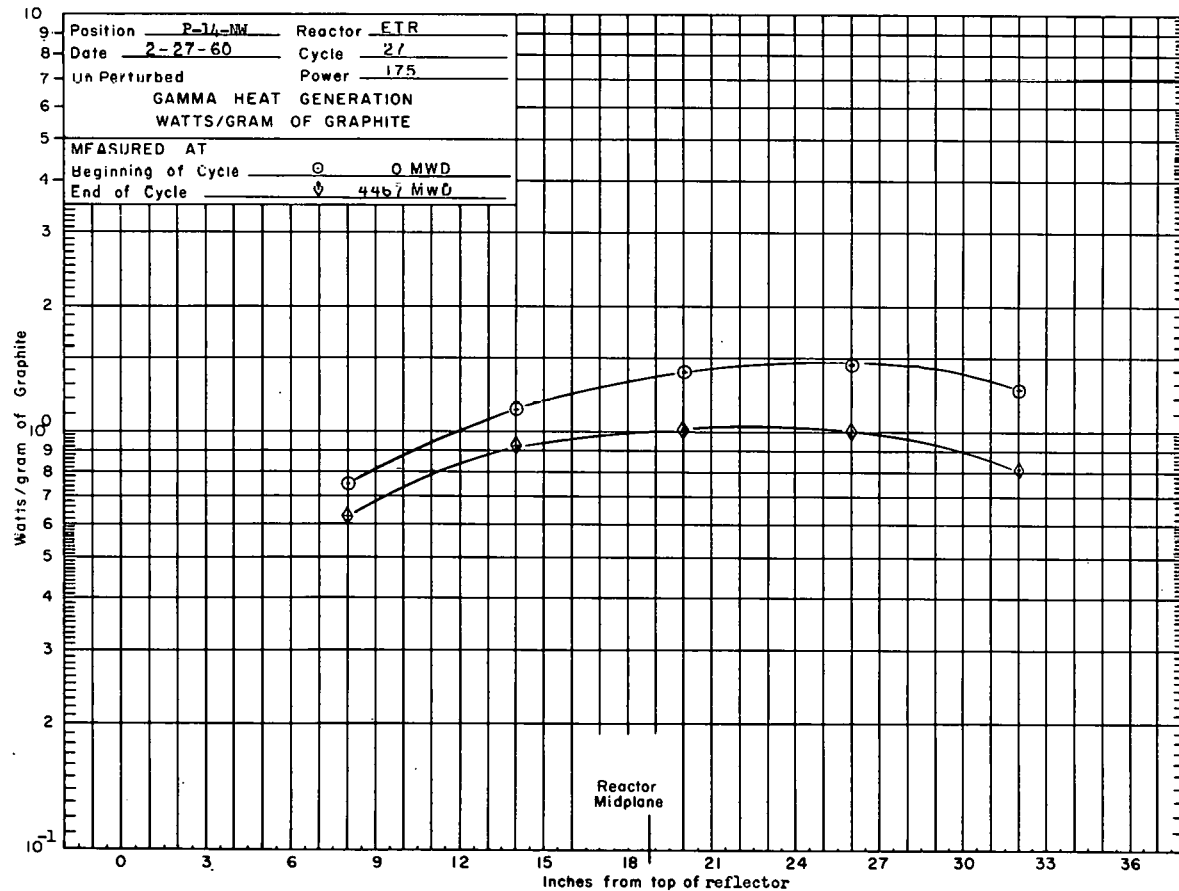
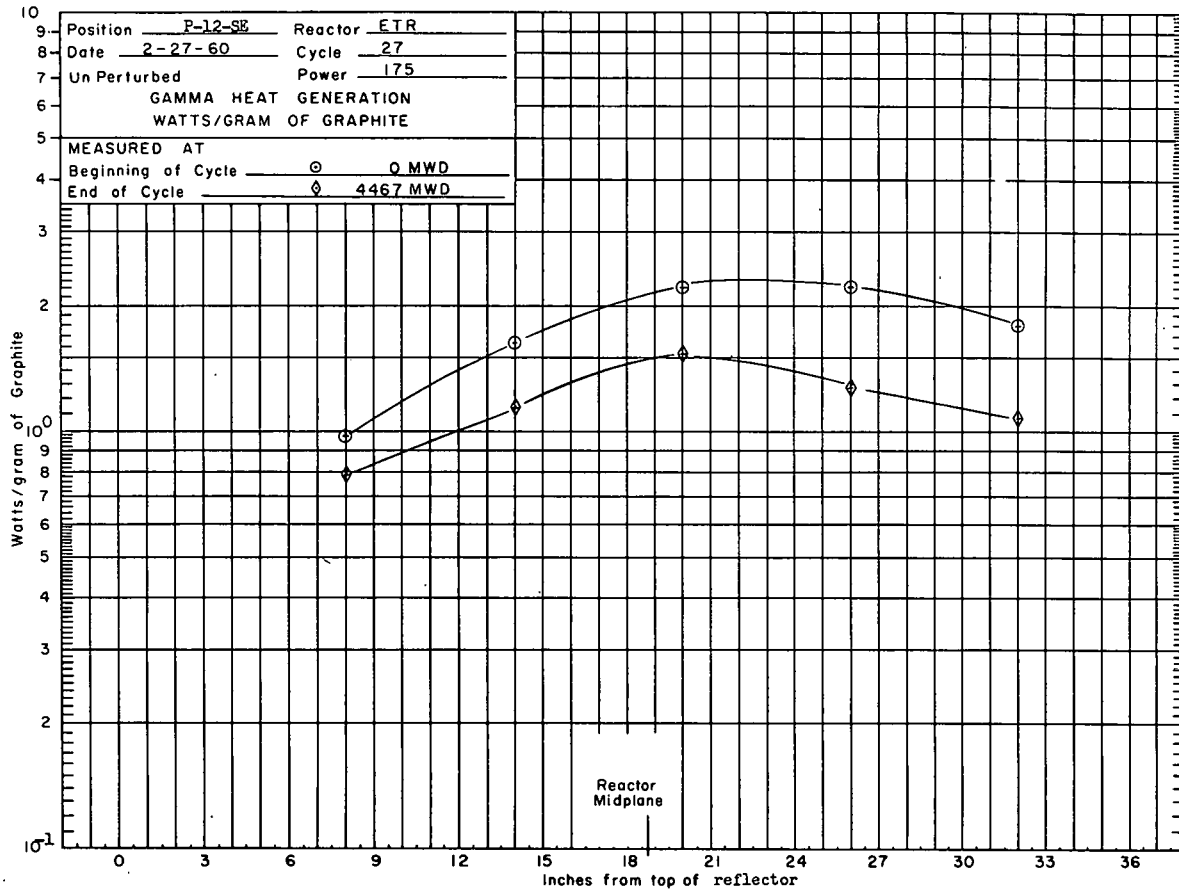




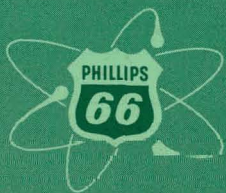








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