

BIOMEDICAL DIVISION

1 October 1975

To: Emilio Iranzo, J.E.N.

From: Phillip N. Dean, L.L.L.

Subject: Status of the J.E.N. Whole-Body Radioactivity Monitor

The data obtained during the period 9 January 1975 to 22 July 1975 has been carefully analyzed. The performance of the equipment has also been studied. The results of these investigations are presented below.

I. Initial examination of the data revealed that the background at 12-24 keV was extremely variable over the time period stated. Indeed, the variability persisted until 23 September 1975. An immediate study was begun in an effort to learn the source of the variability. Beginning on 18 September the counter background was continuously recorded. Figures 1 and 2 are plots of counting rate versus time for three counting regions. It is immediately apparent that except for Saturday and Sunday, when there is no work at the J.E.N., the 12-24 keV count rate increased dramatically at about 0800 and 1400 each day. Possible sources for this increase were reviewed, including escape of gases from the reactor and isotopes sections and from direct radiation from the reactor. The increased count rate could not be definitely associated with any of these sources.

On Tuesday morning, 23 September 1975, it was discovered that the electronic noise level in the chest counter amplifier output was very high, abnormally so. A small change in line power level could cause an artificial increase in background count rate. This could occur as the power drain at the J.E.N. was changed abruptly at about 0800, beginning of work, and 1400, after lunch. The photomultiplier high voltage was then increased to raise the signal level, permitting a reduction in the amplifier gains lowering the effective noise level. The noise remaining appeared to be periodic, suggesting a.c. line interference and possible ground loops. It was then noticed that neither the steel room nor the electronics rack was connected to the a.c. electrical ground. This situation was immediately (by afternoon) corrected and the noise problem has gone away.

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As shown in Figure 3 the background is now very stable and at its lowest level.

- II. At different times within the past eight months a spurious peak was observed in the background spectrum, indicating contamination of the steel room. At this time, it was discovered that the second ventilation unit, installed to increase the air flow rate in the steel room, was operating without filtration. A large volume of unfiltered air was being blown directly into the steel room, carrying with it dust and radioisotopes. This unit was then turned off. It has recently (24 September) been discovered that with this unit turned off no air has been moving through the steel room, a situation that will also lead to unstable background counting rates.

Since the filters had not been examined since February 1975, this was done on 24 September. The filters were discovered to be heavily coated with dust and were replaced.

The outside entry to the second ventilation unit was sealed and this unit turned on. Air flow in the steel room is now normal.

### III. Summary of Counting Data

The background in the 12-24 keV region was extremely variable over the time 9 January 1975 to 22 July 1975. The total range was from a low of 0.17 c/s to a high of 0.45 c/s. On many days repeat background counts varied by a factor of 2 or more (e.g., 17 February, 0.17 to 0.38). A more typical variation was 15 April, 0.25 to 0.38. It appears that during this time the number 1 high voltage supply was intermittently totally or partially failing. It was known to have done so late in this time and was replaced. Also, contamination of the room, probably with  $^{131}\text{I}$ ,  $^{203}\text{Hg}$ ,  $^{51}\text{Cr}$ ,  $^{59}\text{Fe}$ ,  $^{137}\text{Cs}$  and others probably occurred. Some of these isotopes are currently present in the room, due to the ventilation problem.

As a result of all the difficulties just mentioned, all counting results in the region of 12-24 keV are unreliable and to be disregarded.

The background in the regions 50-70 keV and 75-100 keV, although more stable than for the 12-24 keV region, were still highly variable. On any one day repeat counts were much better, with variations of only 10-12 percent in general. This was not always true (e.g., 5 June, 0.28 and 0.46; 21 July, 0.36 and 0.49; 22 July, 0.35 and 0.46). As a result all  $^{241}\text{Am}$  results have been carefully studied.

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The minimum detectable amount of  $^{241}\text{Am}$  for this detection system is about 0.25 nCi. Therefore, all results less than this are disregarded at once. A total of 18 positive results are obtained. Three of these are discarded because repeat backgrounds on those days were much higher and if used would result in no burden. All five results on 22 April were high. Backgrounds of 0.603 and 0.754 c/s are the highest for the year (normal  $\sim 0.42$  and  $0.45$ ). There would appear to have been contamination or power supply malfunction. These data are judged to be unreliable. Four results on 2 June 1975 are high (greater than 0.4 nCi). Only one background was taken but appeared normal. It should be noted that all results on this day were positive at about the same level. Four results on 8 July were very high. However, in checking the data it was discovered that an unrecoverable error was made in the calculations. These data are to be disregarded. One result, serial 130756 appears to be all right ( $0.50 \pm .15$ ). The final result, serial 130711, of  $1.05 \pm 0.23$  is extremely high. This amount of  $^{241}\text{Am}$  would result in a high peak in the spectrum. None was observed. The result is probably due to a low (by 25 percent) 50 keV background.

With all the background problems that existed, including effects on calibration procedures to be discussed shortly, all  $^{241}\text{Am}$  data are believed to be unreliable.

#### IV. Present Detector Performance

The electronics have been carefully checked and all settings optimized. The response of both crystals has been measured.  $^{241}\text{Am}$  spectra for the individual detectors and for the two together are attached. The resolution is the same as was obtained in May 1974.

The three new plastic lung sets have been counted in the phantom. The spectra are attached. The calibration factors obtained are very different from those obtained previously.

#### V. Recommendations

1. The calibration of the counting system should be repeated periodically, using the artificial lungs provided by LLL and the attached instructions.
2. The electronics should be checked at least once per month, paying special attention to gain stability and noise level.
3. Fluorescent lights generate electronic noise and should not be turned on while subjects are being counted with either detector.
4. An additional ground wire should be connected between the large crystal mount and the steel wall.

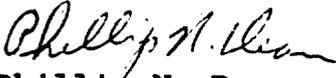
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5. The advisability of the present bleeder string network on the large crystal should be studied.
6. Air flow in the ventilation system should be checked at least monthly.
7. The second ventilation unit should be removed and replaced with a blower fan.
8. All persons counted for plutonium should be counted at the same time for total body gamma activity, using the large NaI(Tl) crystal positioned over the subject.
9. The ventilation filtration must be improved to remove all radioisotopes, particularly  $^{131}\text{I}$ .

#### SUMMARY

A large number of people, from both the Junta de Energia Nuclear and from Palomares, were examined in the J.E.N. counting facility for possible contamination with  $^{239}\text{Pu}$ . These measurements took place over a long period of time, January to July 1975. A careful examination has been made of the data and of the counting equipment. It was discovered that a number of problems occurred during this time, including failure of a high voltage supply, appearance of a high electronic noise level, and contamination of the shielded room. These problems combined to make invalid all estimates of lung burdens of plutonium. Although these problems were not as severe in the detection of  $^{241}\text{Am}$ , changes in the detection calibration for this isotope also invalidates these results.

The electronic problems have been corrected and the detectors are being recalibrated for both plutonium and americium, using calibration standards provided by Lawrence Livermore Laboratory. It is recommended that the J.E.N. personnel involved be examined again very soon and the Palomares people as soon as is advisable.

  
Phillip N. Dean

PND:jmg

FIG. 1

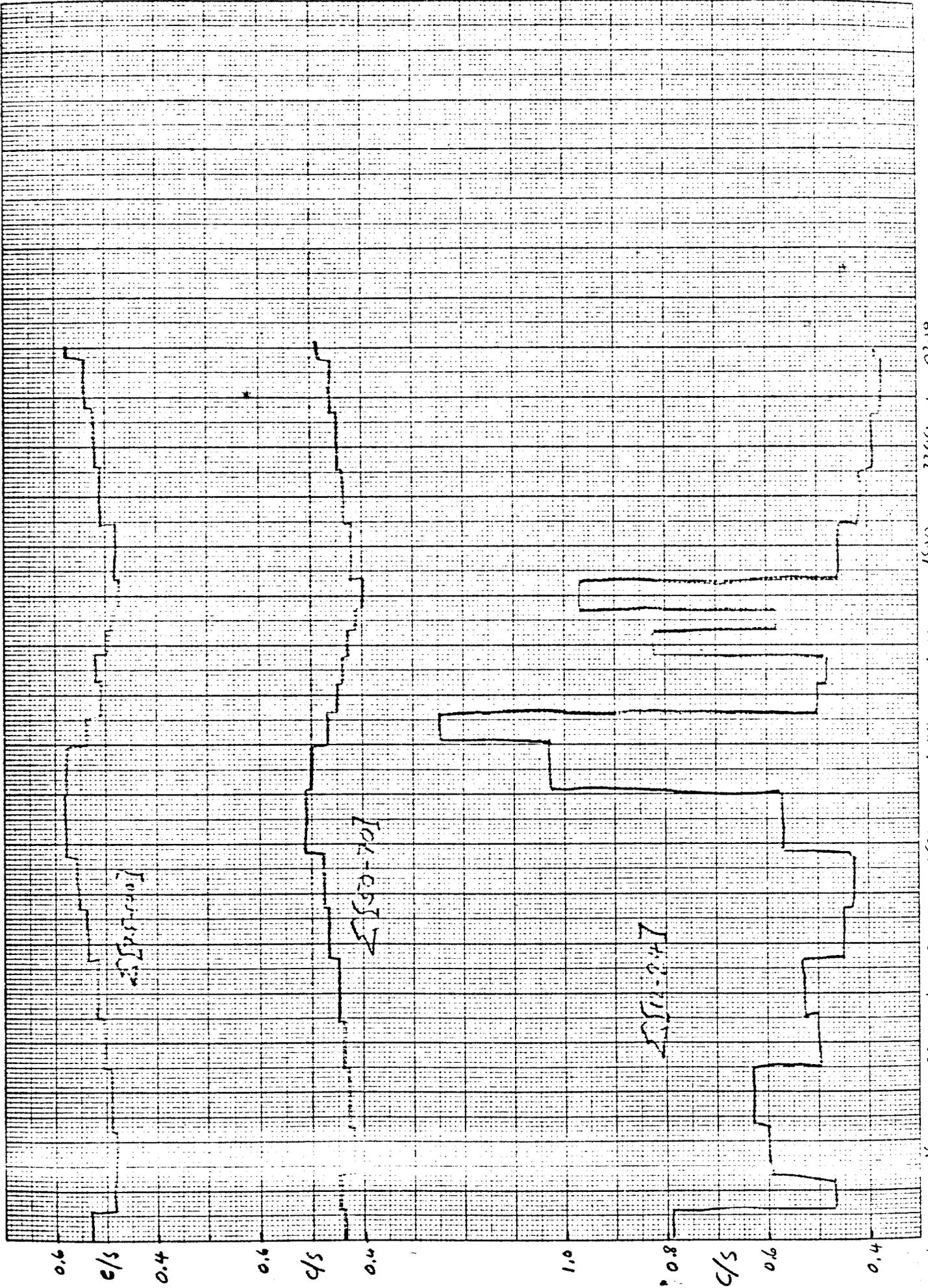


FIG. 2

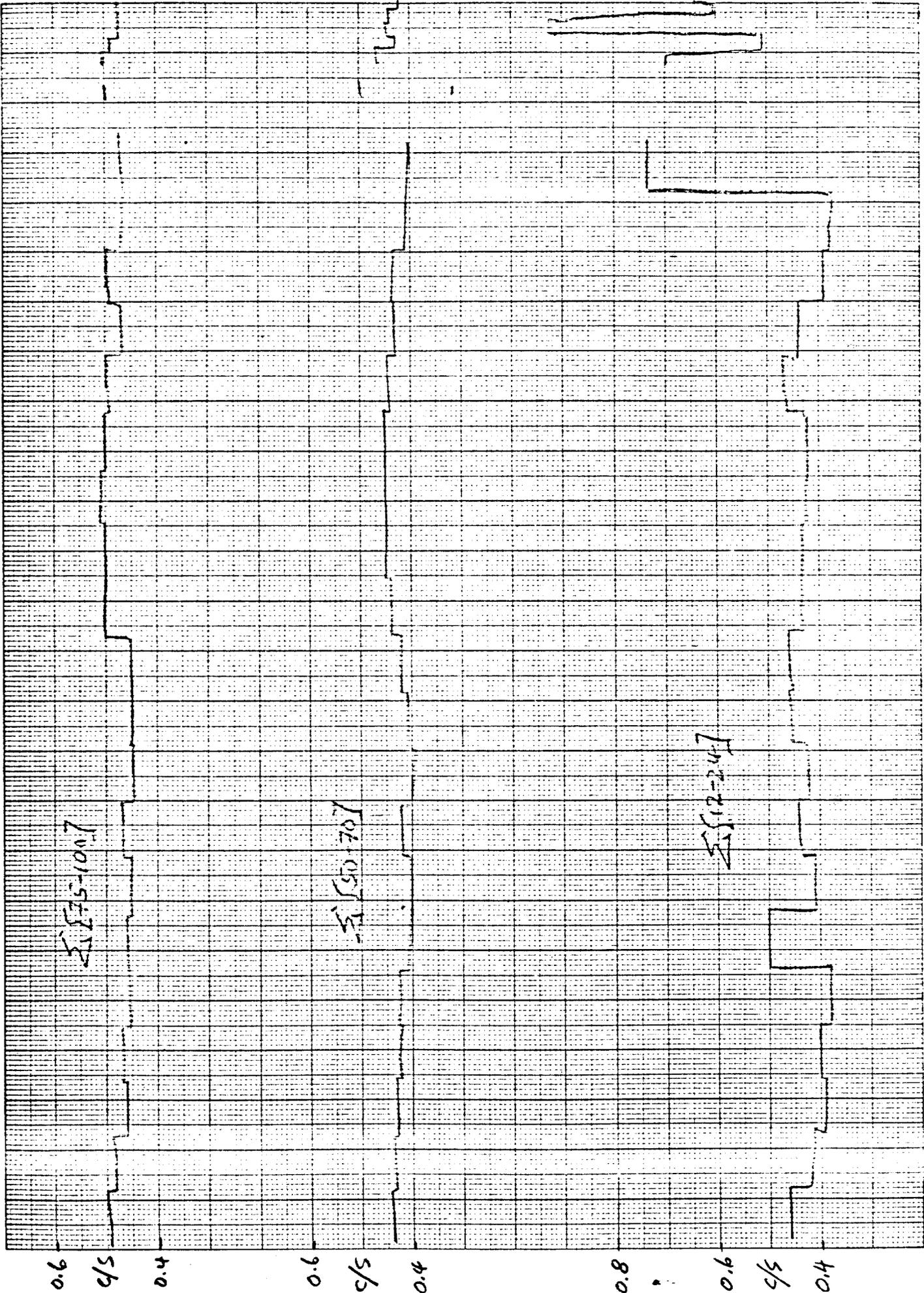
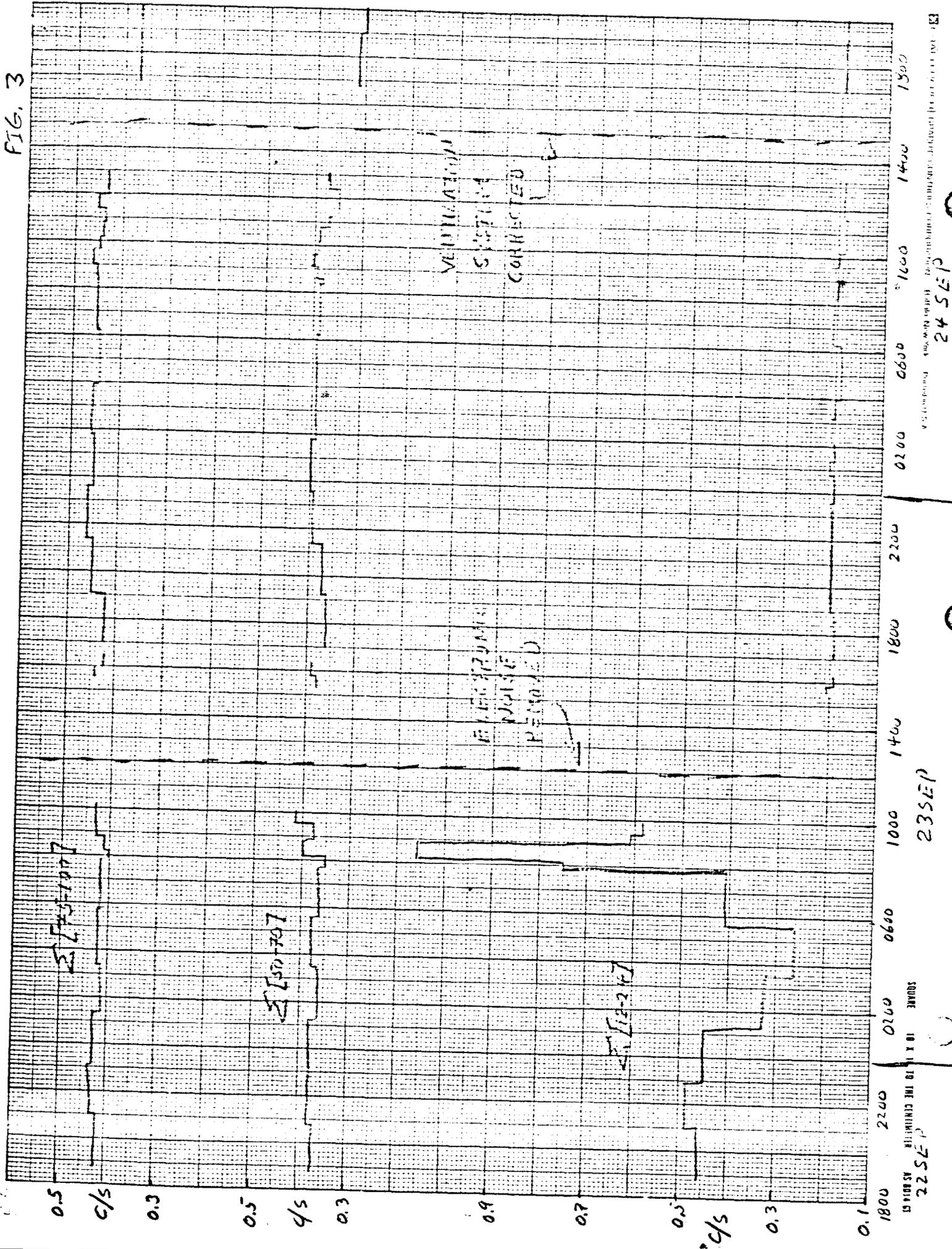
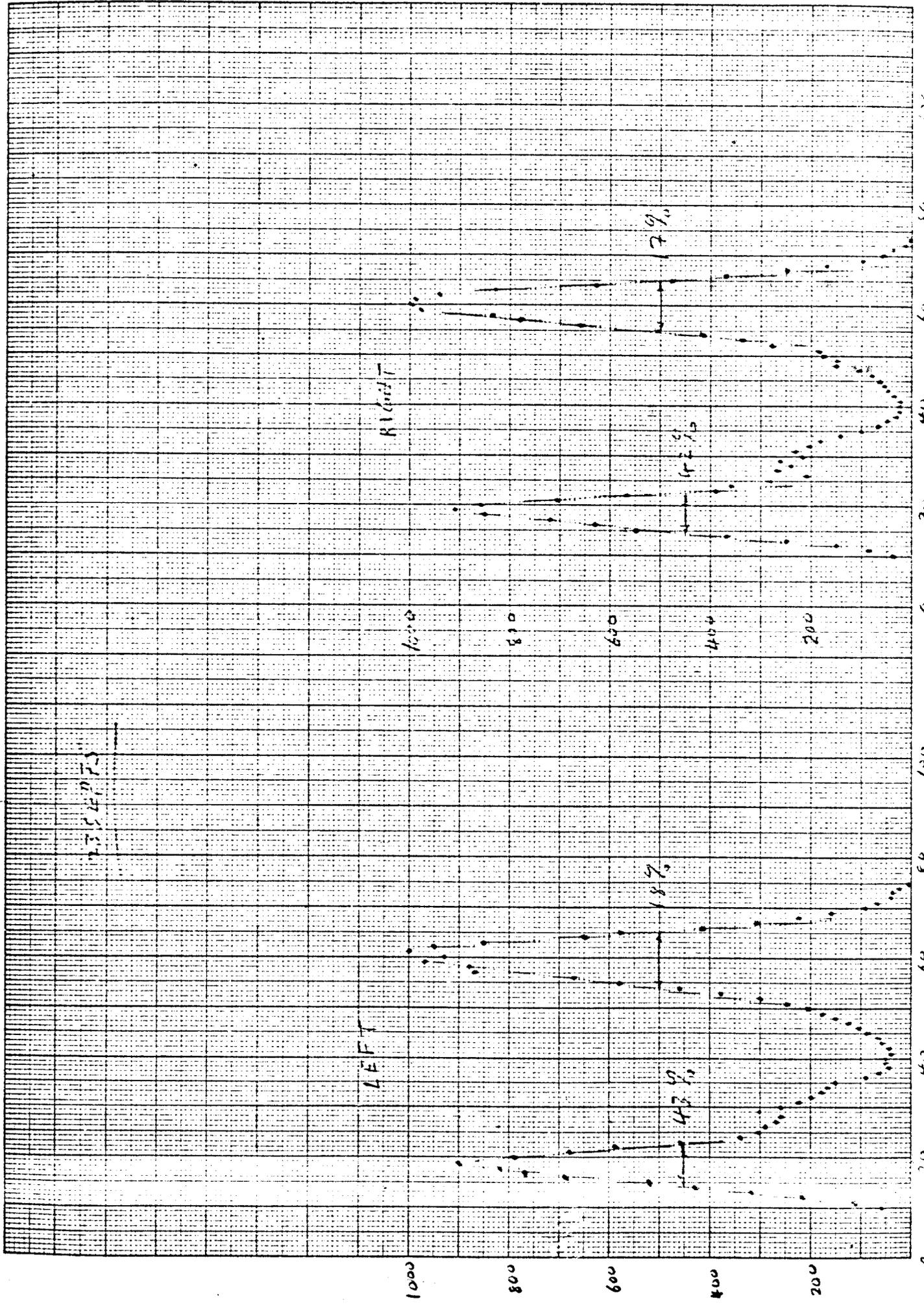


FIG. 3



SQUARE  
 10 X 11 TO THE CENTER  
 AS SHOWN  
 22 SEP 23  
 24 SEP



AS 8014 CT  
TO X. 10 TO THE CENTIMETER  
SQUARE

500

25 SEPT 5

400

2330

12  
10 PHANTOM

300

COUNTS/2000 SEC

200

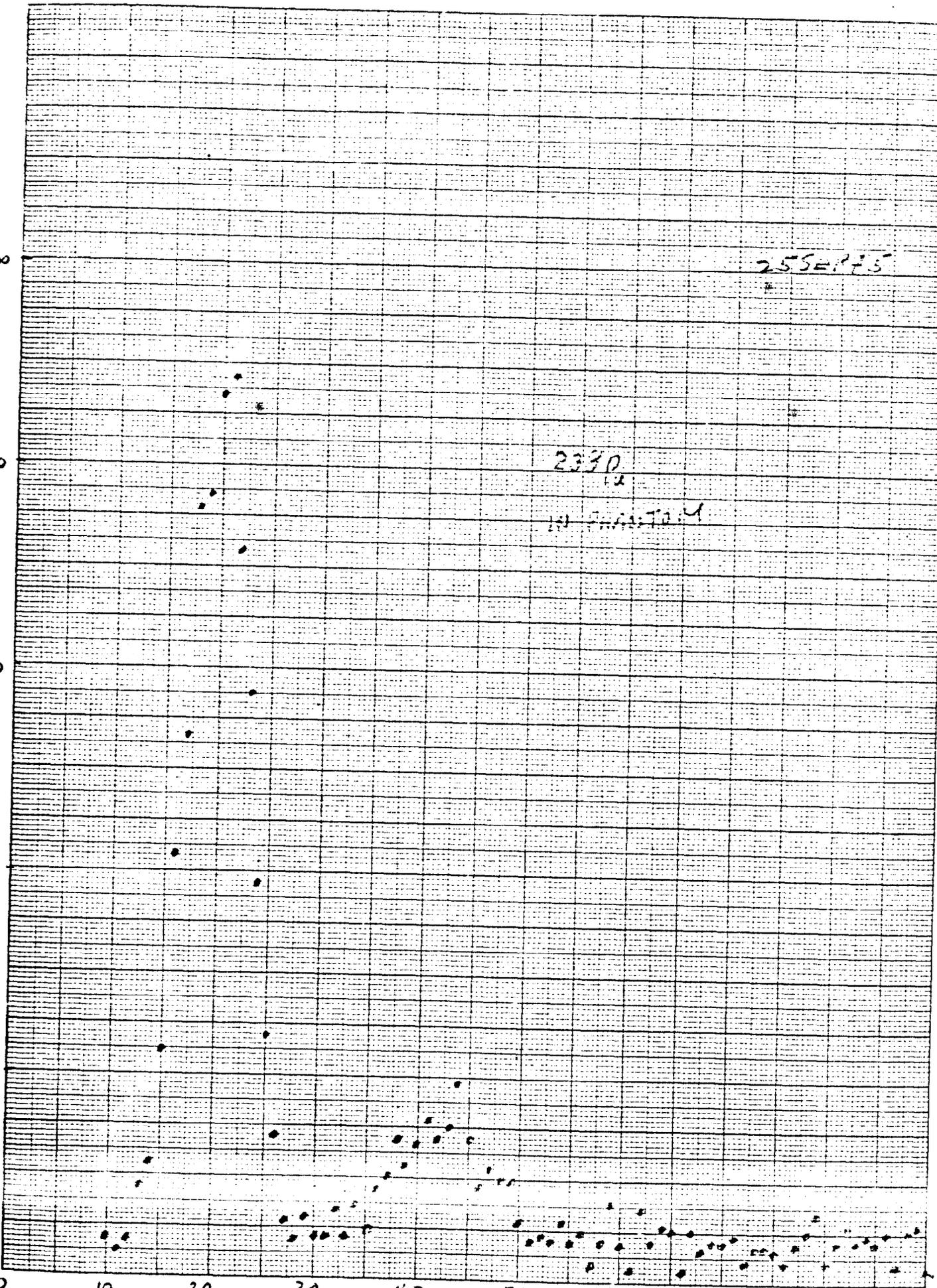
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GRAPHIC CONTROLS CORPORATION Buffalo, New York Printed in U.S.A.

0

0 10 20 30 40 50 60 70 80 90

ENERGY (KEV)

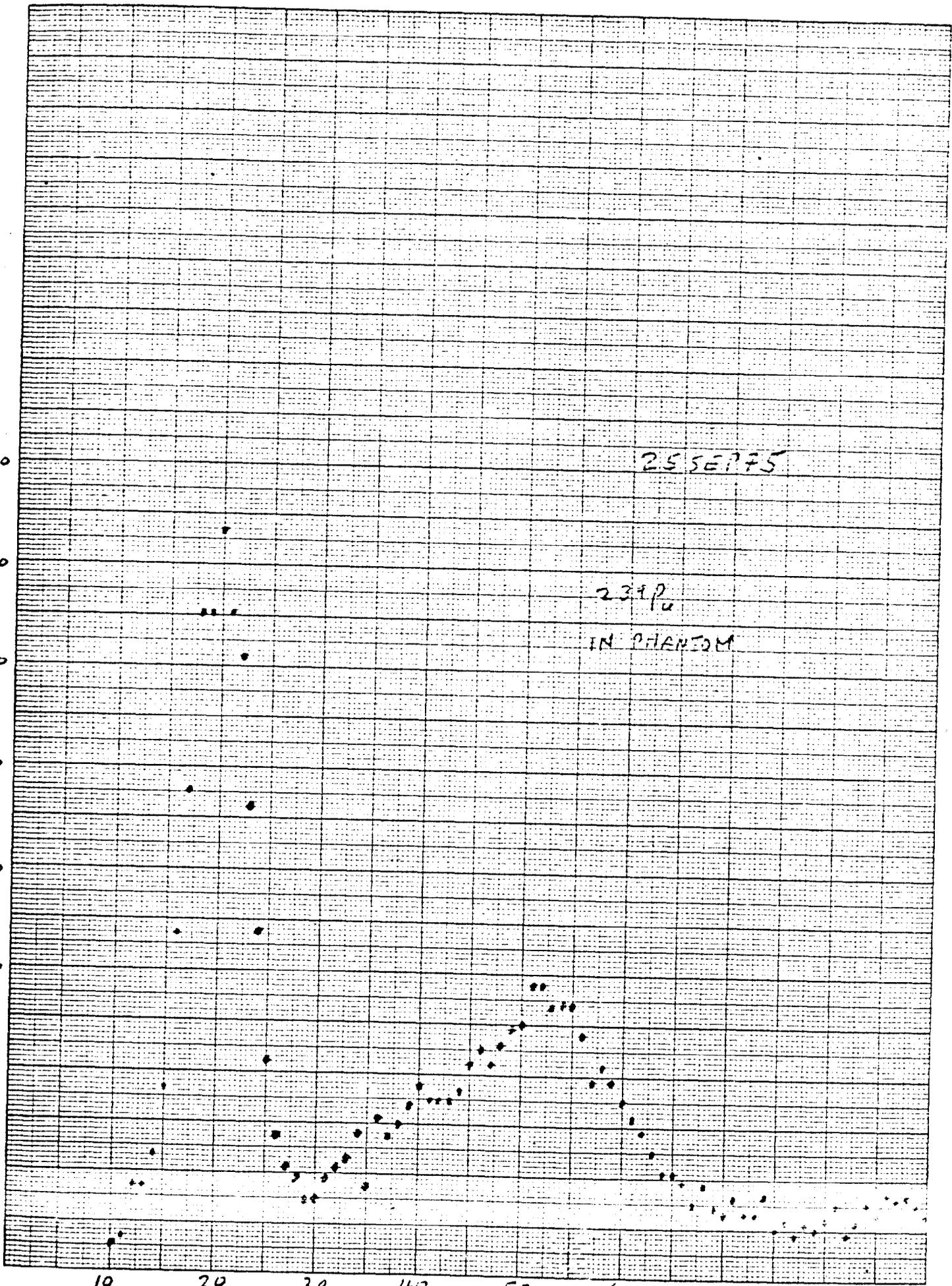


SQUARE 10 X 10 TO THE CENTIMETER AS 0014-67

COUNTS/2000 SEC

Buffen, New York

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ENERGY (KEV)

AS NOTED

10 X 10 TO THE CENTIMETER

SQUARE

4000

255-275

241A  
Pm

IN PHANTOM

3000

2000

COUNTS / 1000 SEC

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0

10

20

30

40

50

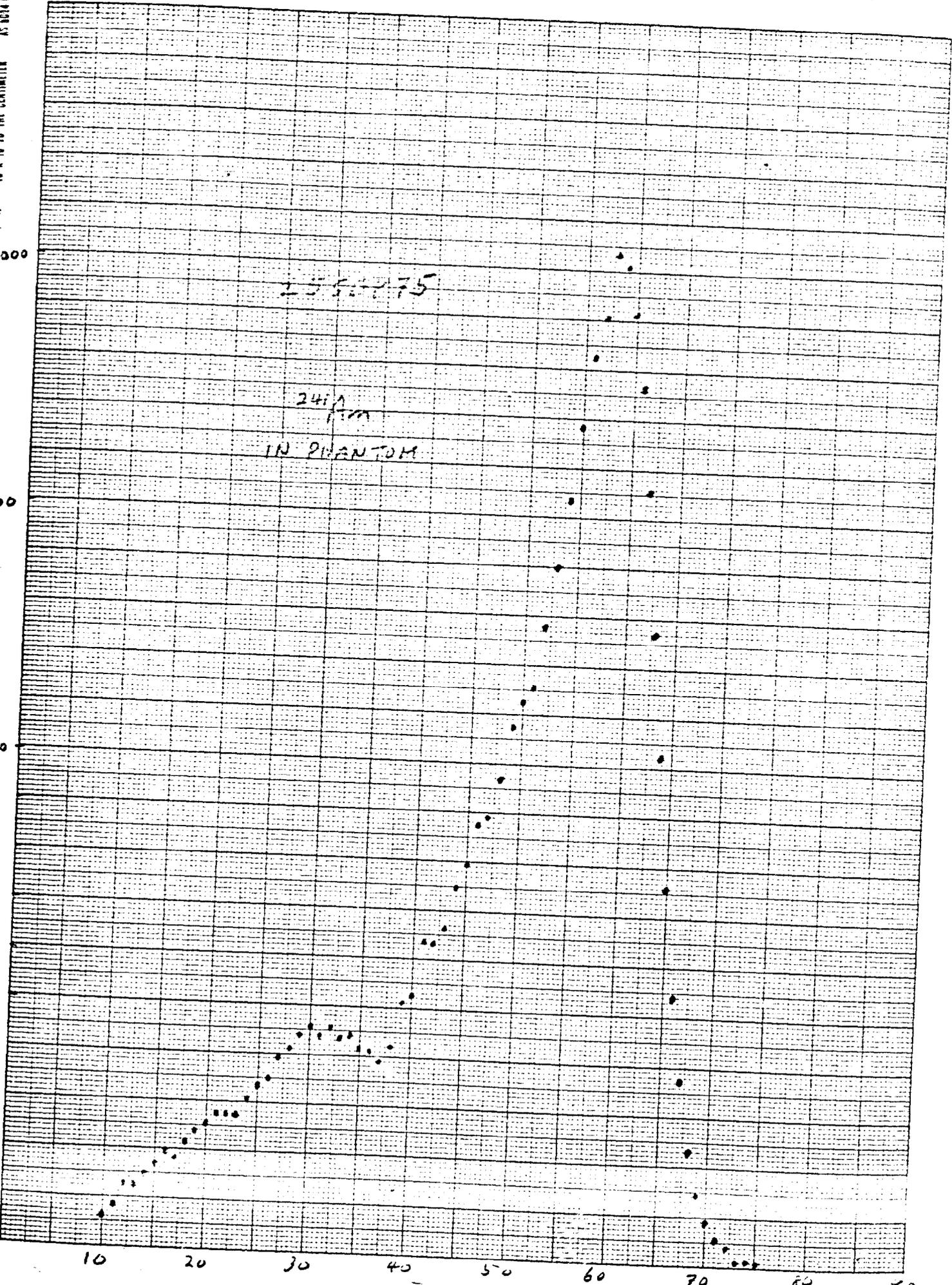
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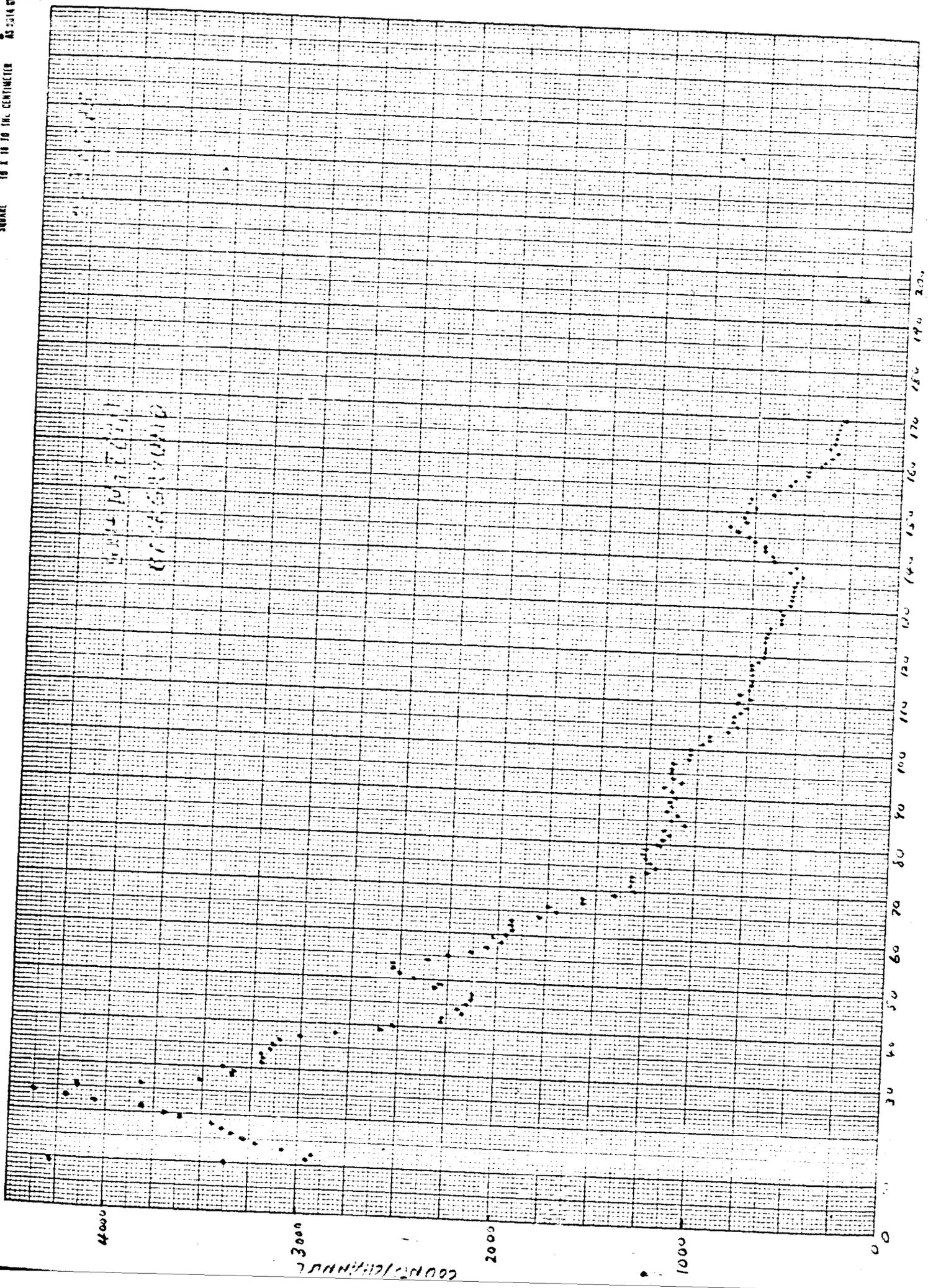
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80

90

ENERGY (KEV)





COOPERATIVE  
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COOPERATIVE