Commonwealth Edison
Quad-Cities Nuclear Power Station
Post Office Box 216
Cordova, Illinois 61242
Telephone 309/654-2241

50-254

Not on mailed

BBS-72-11

December 4, 1972

Mr. Angelo Giambusso
Deputy Director of Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

SUBJECT: Quad-Cities Unit 1 Jet Pump Instrument Line Failure

Dear Mr. Giambusso:

A routine survey of the Unit 1 Recirculation system revealed an abnormal high jet pump flow reading. Subsequent investigation led to the conclusion that all jet pumps are operable and that Jet Pump 7 low pressure tap(s) and/or sensing line is open to the pressure of the reactor annulus.

At approx. 0300 on October 31, 1972 Unit 1 reactor was operating at approx. 75% power and approx. 80% flow when indicated flow of Jet Pump 7 (G) read approx. 6.5 mlb/hr and all others were reading approx. 3.7 mlb/hr. A jet pump operability check was made and Tech Spec. 4.6.G. could be met indicating jet pump operability. The situation was flagged for day shift investigation.

At 0815 extensive investigation confirmed jet pump operability. Points for 1A & 1B recirc pump speeds vs. flow were plotted against known good data for similar reactor conditions. The points agreed completely with the base data. Indicated power-flow point was justified by the control rod pattern and Xenon inventory.

The calibration of the Jet Pump 7 Δ P transducer was checked and found to be as specified. Because Jet Pump 7 is a single tap jet pump, its high pressure tap is common to all pumps, core plate Δ P, and REA Δ P (see fig. 1). This reasoning declared the pressure in the low pressure leg to be lower than normal. It was postulated at this time that a leak or crack might be present in the low pressure leg,

50-254 inquiry

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either in the drywell or in the reactor vessel, or a blocked check valve in the sensing line might exist. The drywell environment was found to have no high temp or radioactivity and no abnormal sump flow existed. A Heisi pressure guage was installed in the low pressure leg sensing lines of Jet Pump 7, Jet Pump 8, and REA Δ P. The Heisi guage readings showed that the Jet Pump 7 low pressure leg sensing line was reading approximately the annulus pressure and not any possible jet pump diffuser pressure.

After consultation with the General Electric Company and careful review of available data, the Station Review Board declared Unit 1 safe to operate provided that no information to the contrary were received. Jet Pump 8 flow was added to the loop A core flow summer in place of Jet Pump 7, whose dP cell was respanned to be on scale in the 0-20 psid range.

On November 1, 1972 the Technical Staff reviewed the plant strip charts for the earliest indication of core flow abnormalities. It was found that on October 16, 1972 at approx. 2330, the total core flow recorder showed a step increase of approx. 2 mlb/hr from 98 mlb/hr to 100 mlb/hr. Core plate Δ P, recirc pump flows, core power, and total steam flow showed absolutely no change at this time (see fig. 2). This response is contrary to normal flow increase response which followed even smaller core flow increases earlier in the day (also fig. 2). On October 19, 1972, the total indicated core flow was reduced by the operator to 98 mlb/hr but the core plate Δ P was lower than the core plate Δ P at 98 mlb/hr core flow on October 16 (see fig. 3).

On November 2, 1972, a test was devised in conjunction with the General Electric Company to provide additional information concerning the condition of Jet Pump 7 low pressure leg sensing line. A six channel variable speed brush recorder was connected to the dP cell outputs of Jet Pumps 6, 7, and 8, and REA dP. Holding total core flow constant, 1A and 1B recirc pump speeds were split to about 8% mismatch first with 1B pump speed higher, and then again with 1A the higher speed pump. Digital volt meter readings were taken of the recorded variables at the various steady state conditions.

Plots of the steady state dP readings show that Jet Pump 7 dP does not follow 1A recirc pump speed as Jet Pump 6 and 8 dP values do; but rather it follows total core flow (as more accurately trended by core plate dP) as does REA dP (see figs. 4 and 6). Additionally, the brush recordings reveal the superimposition of 5 to 6 hz noise upon the fluctuations of REA dP to be the characteristic trace of the Jet Pump 7 low pressure leg sensing line (see fig. 5). The 5 to 6 hz noise showed on all traces but the REA dP, and is the characteristic noise of a forward flowing jet pump diffuser. It is therefore concluded that a continuous piping path exists between Jet Pump 7 diffuser and the #7 dP cell. At least one point of the line, however, is exposed to and at equilibrium with the environment of the reactor annulus.

On November 3, 1972, the Station Review Board reviewed all available information and determined that additional weekly surveillance be done to monitor the sensing line for 5 hz noise. Should the sensing line become detached, the surveillance will permit timely action to be taken if analysis determines it prudent. Such analysis of a double sensing line severance-primary system interaction has been requested of the General Electric Company.

On November 4, 1972, additional data was taken during a load reduction by flow control. This data extended the range of core flow (via core plate dP) for which the Jet Pump 7 sensed dP follows REA dP rather than Jet Pump 6 and 8 dP (see fig. 6).

The first weekly surveillance of Jet Pump 7 sensed dP noise (fig. 7) showed that the condition of the sensing line was no different than that at the time of the initial test. This weekly surveillance will be continued indefinitely. No other actions are contemplated at this time.

Very truly yours,

B. B. Stephenson
Superintendent
Quad-Cities Nuclear Power Station

PGK/lk

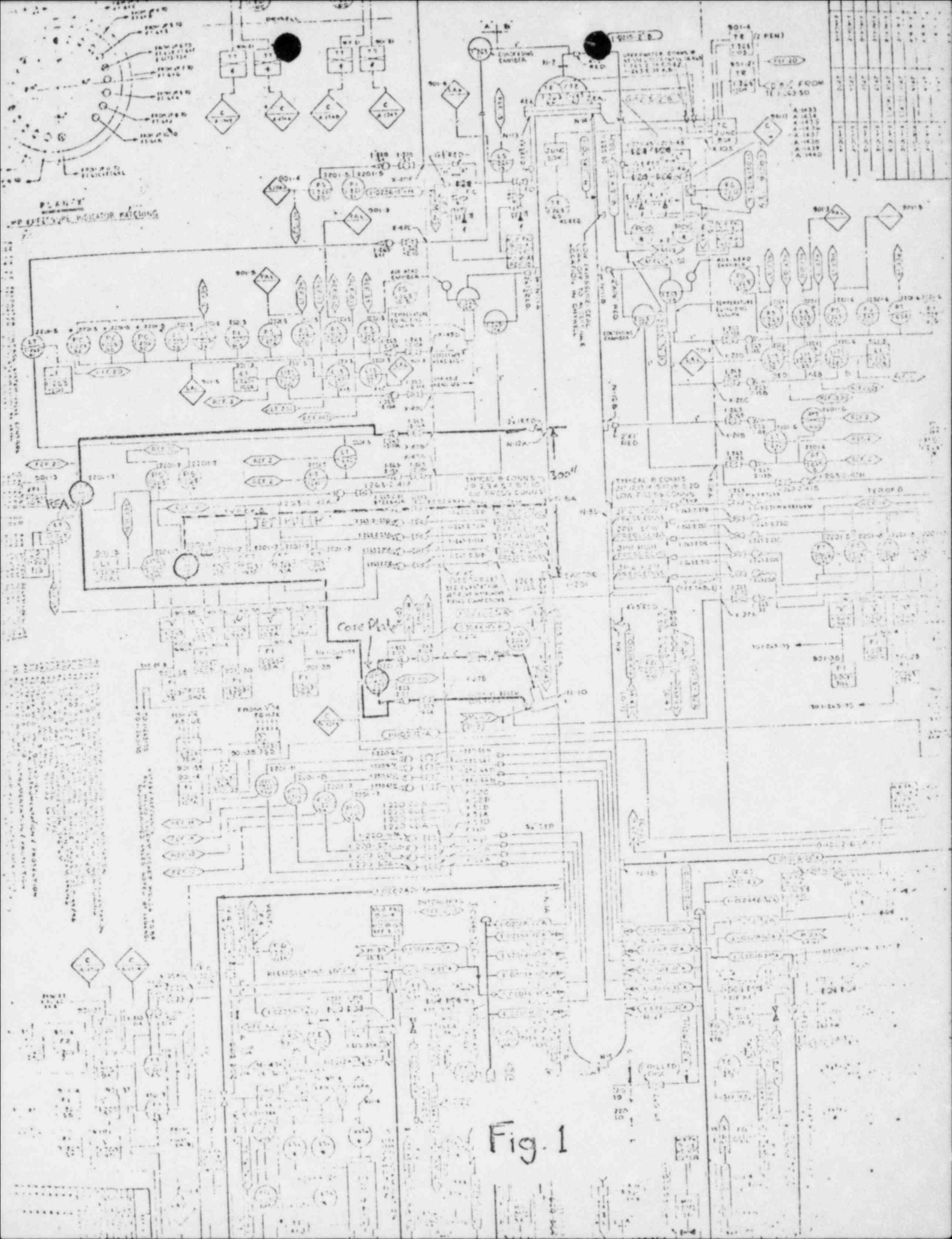
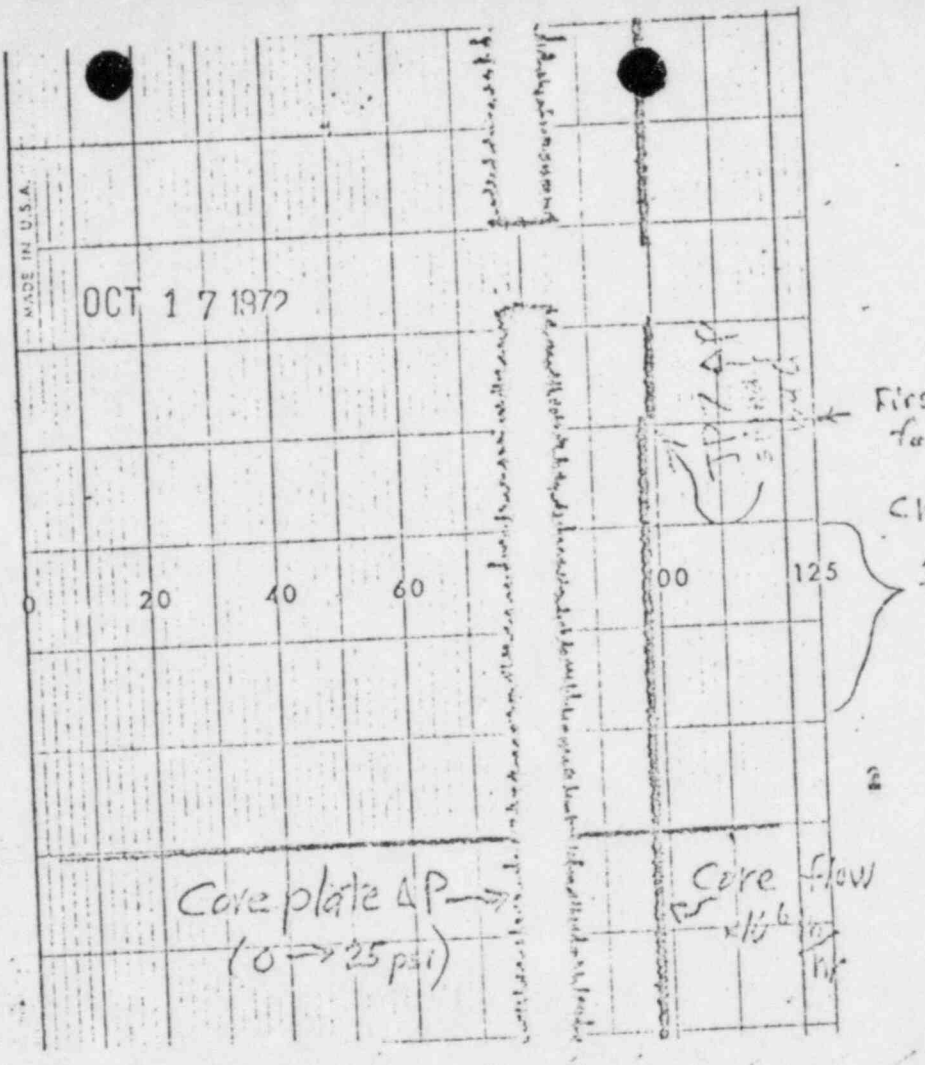
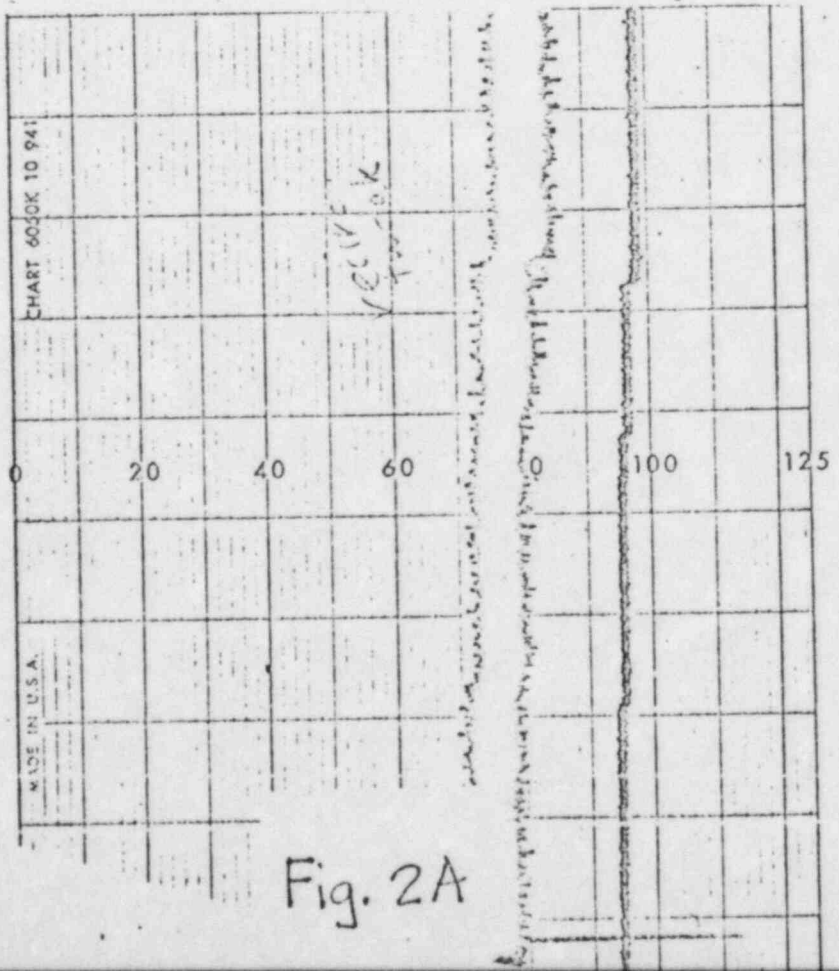


Fig. 1


MADE IN U.S.A.
OCT 1 7 1972
0
20
40
60
00
125
First indication of failure
Chart Speed.
1 in./hr
Core plate ΔP
(0 → 25 psi)
Core flow
10-16-72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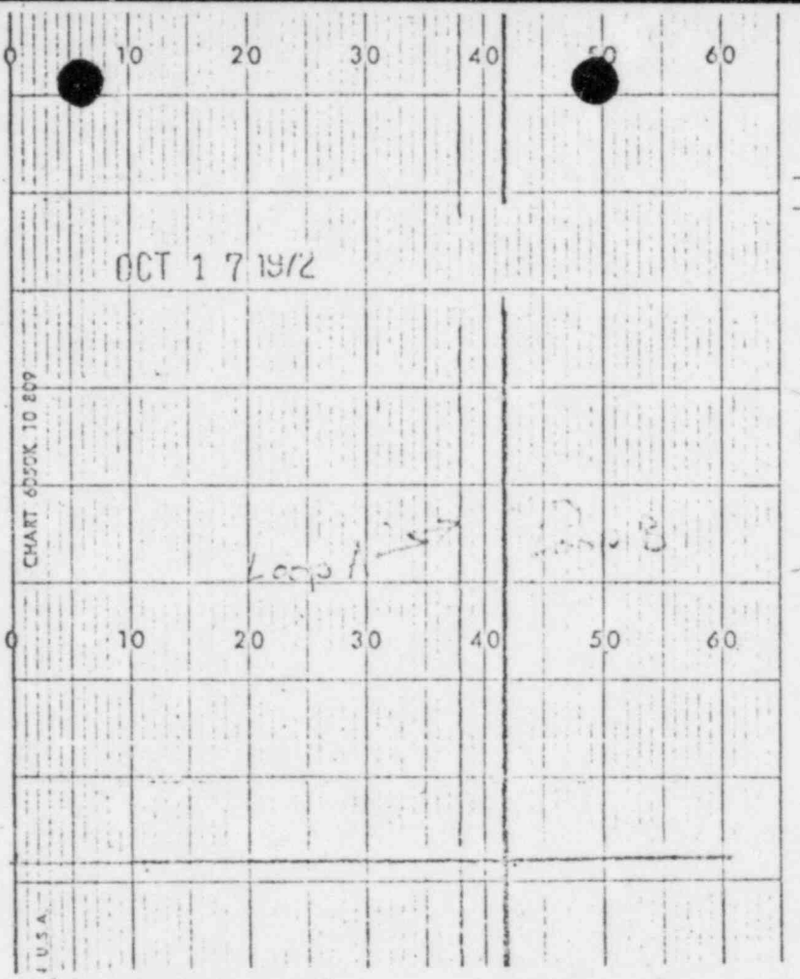
40
60
0
100
125

Fig. 2A

Recirc. Pump. Flows (KGPM)



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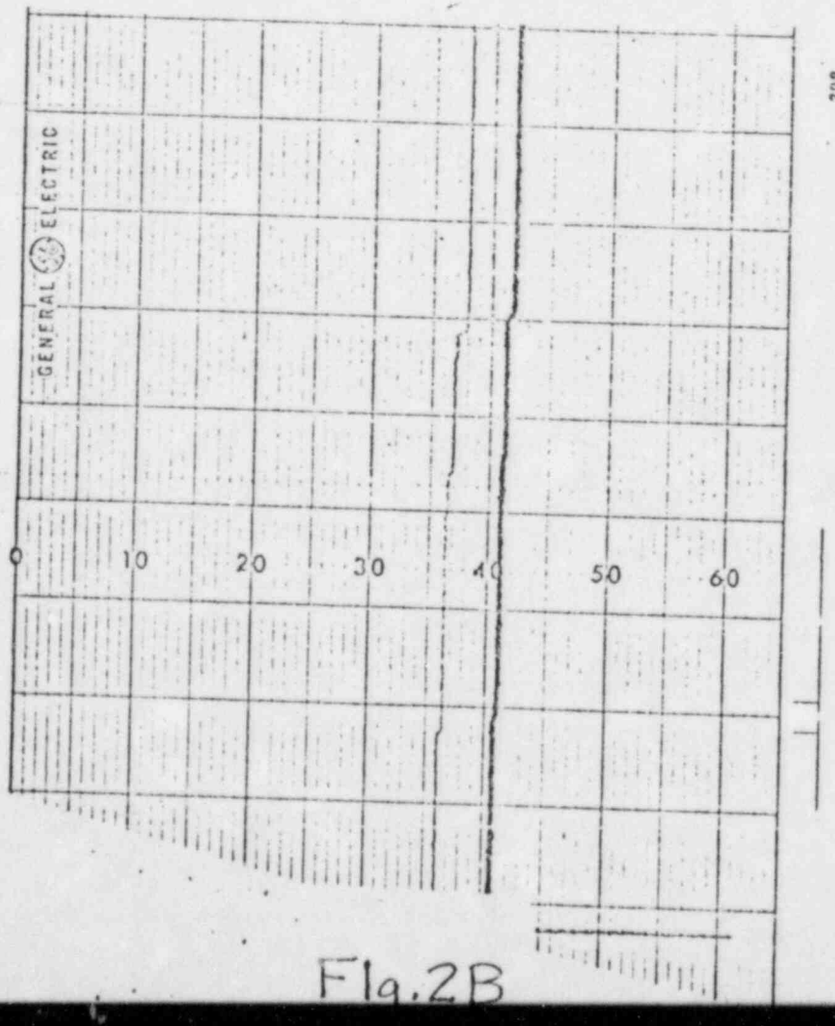
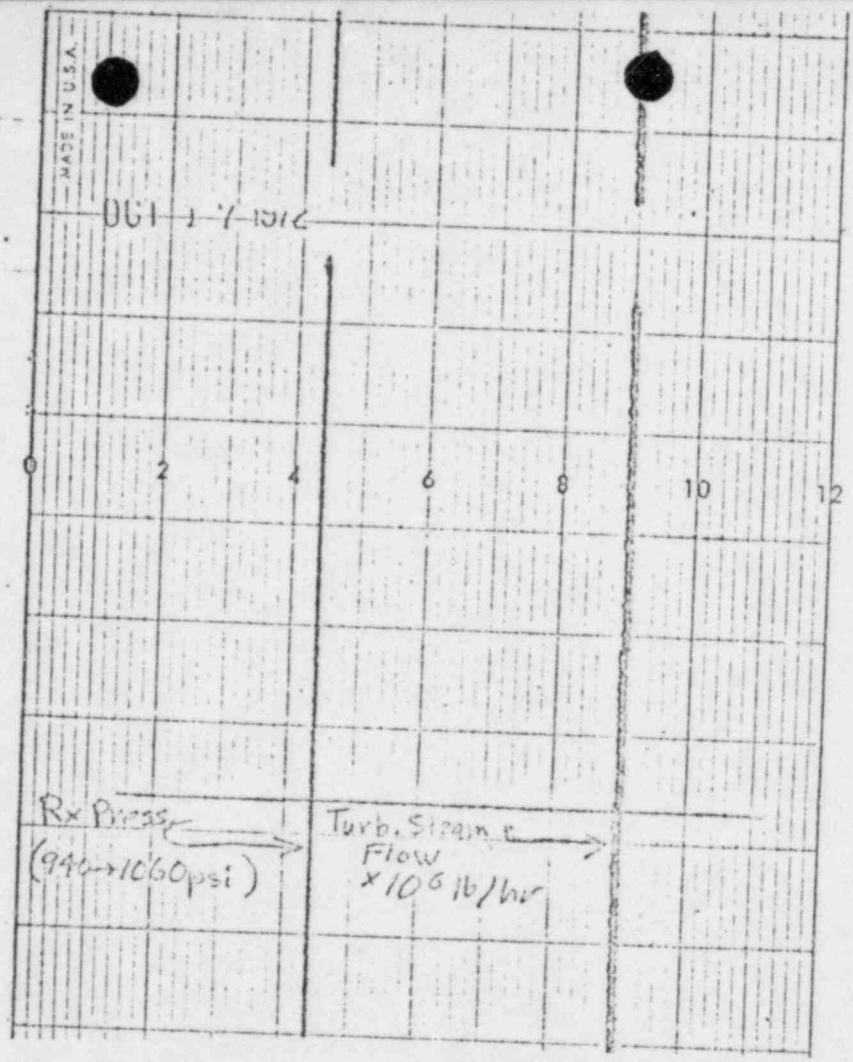


Fig. 2B



1/2
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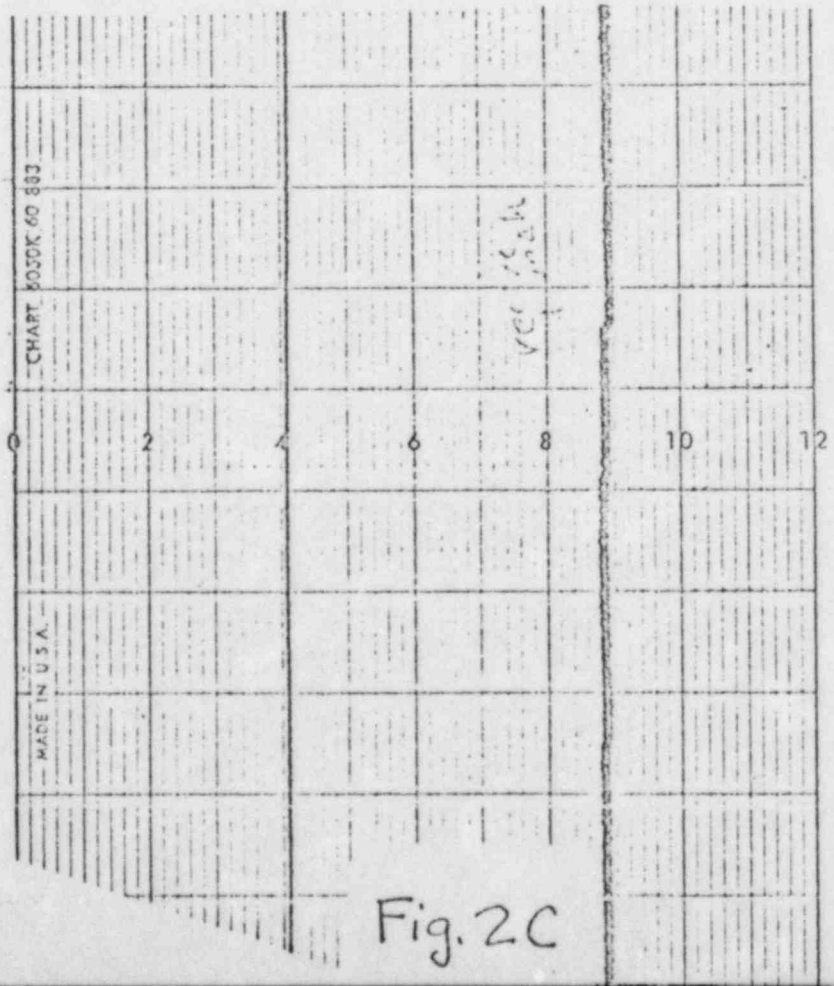
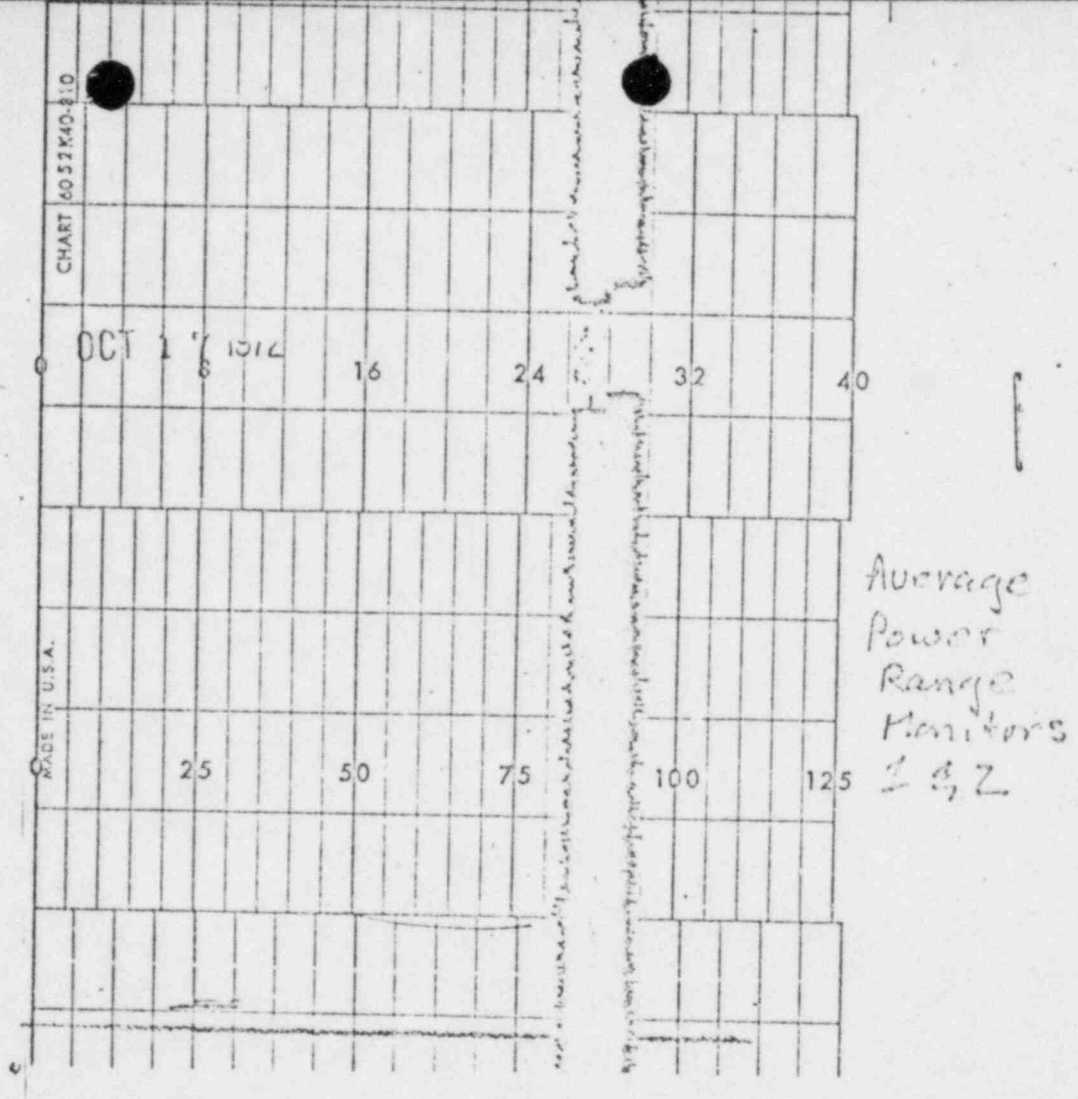
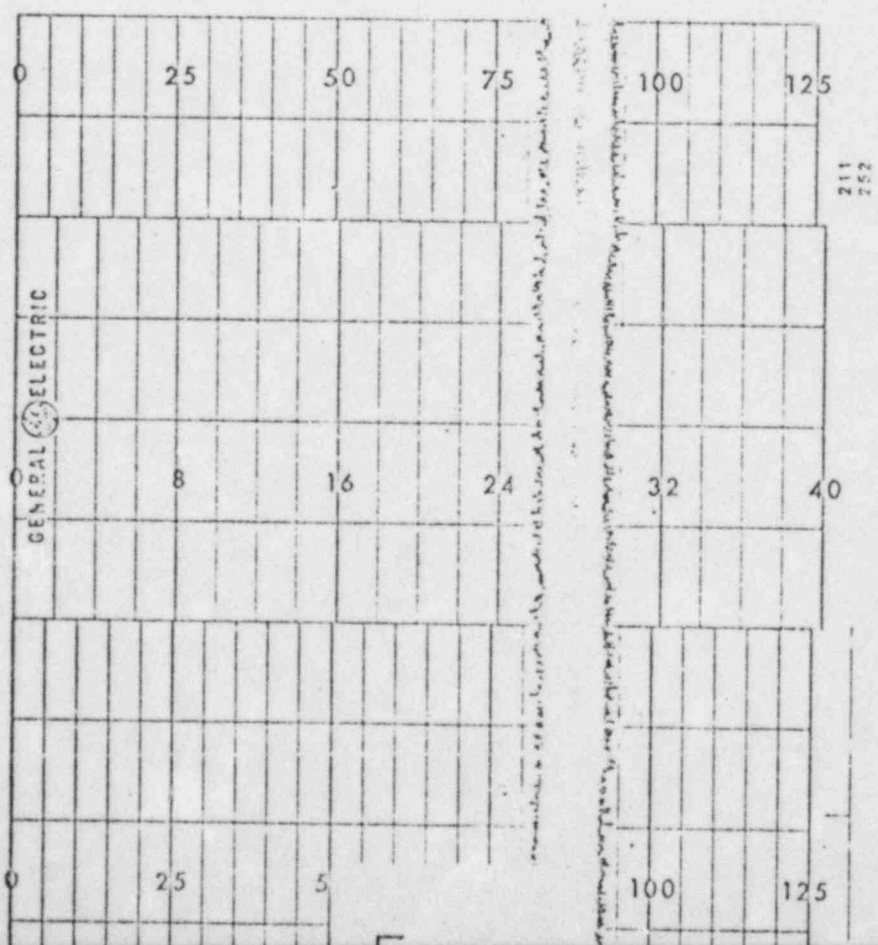
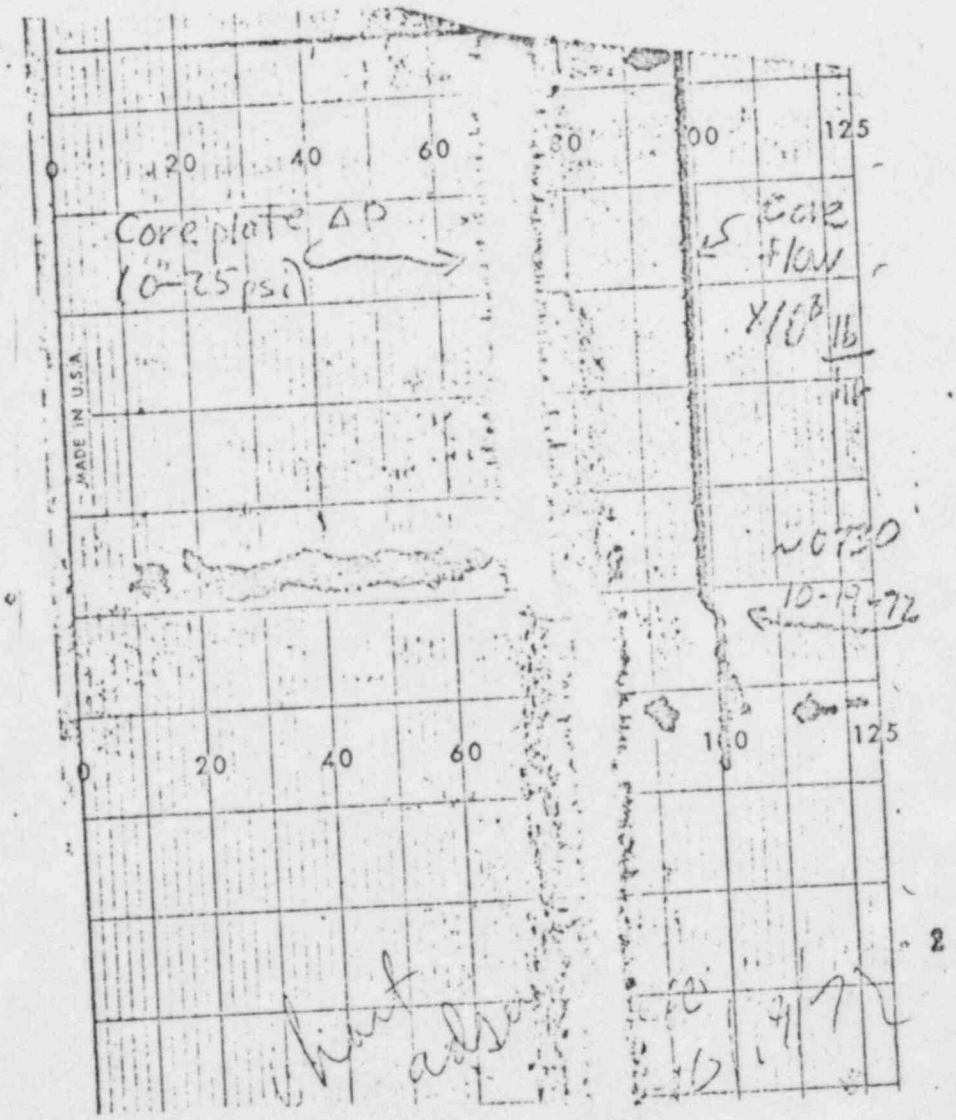


Fig. 2C



Average Power Range Monitors 1 & 2




0
20
40
60
80
100
125
Core plate ΔP
(0-25 psi)
Coil flow
X10³ lb
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10-19-72
0
20
40
60
100
125
2

Fig. 3A

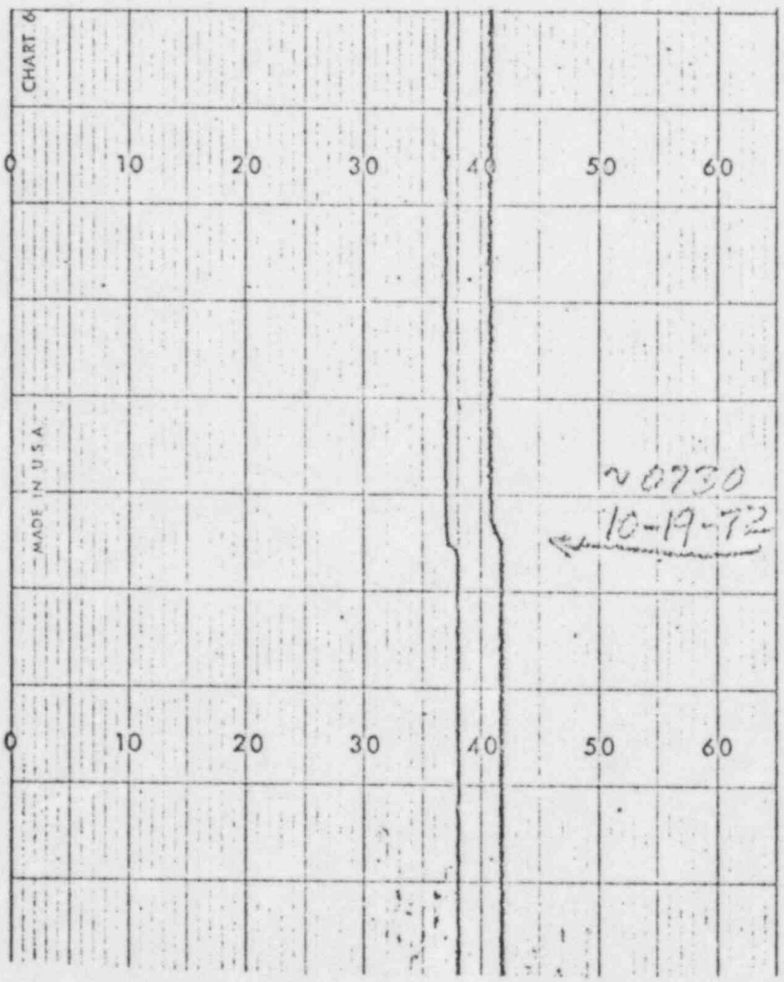
CHART 6
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10
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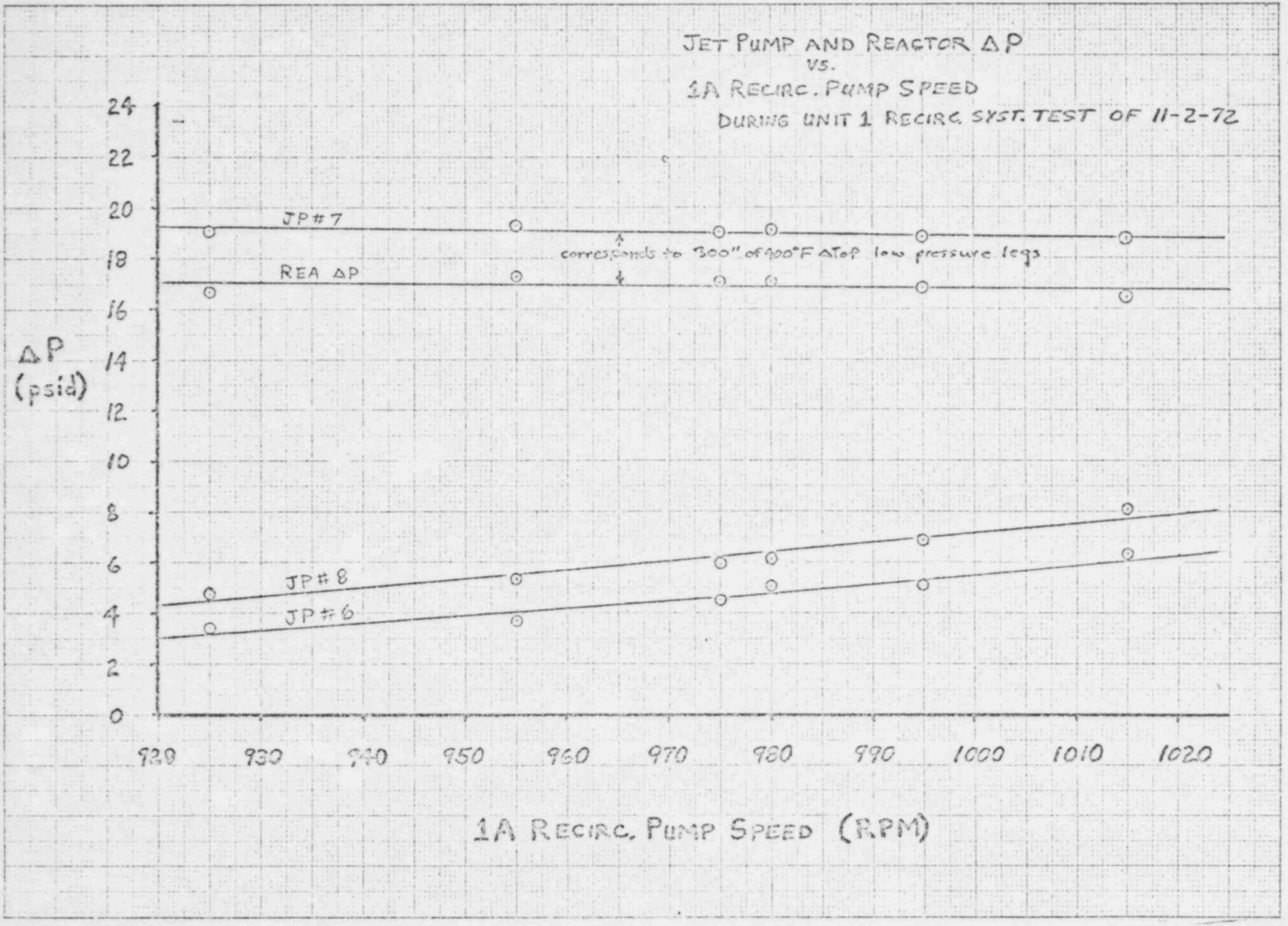
Fig. 3B



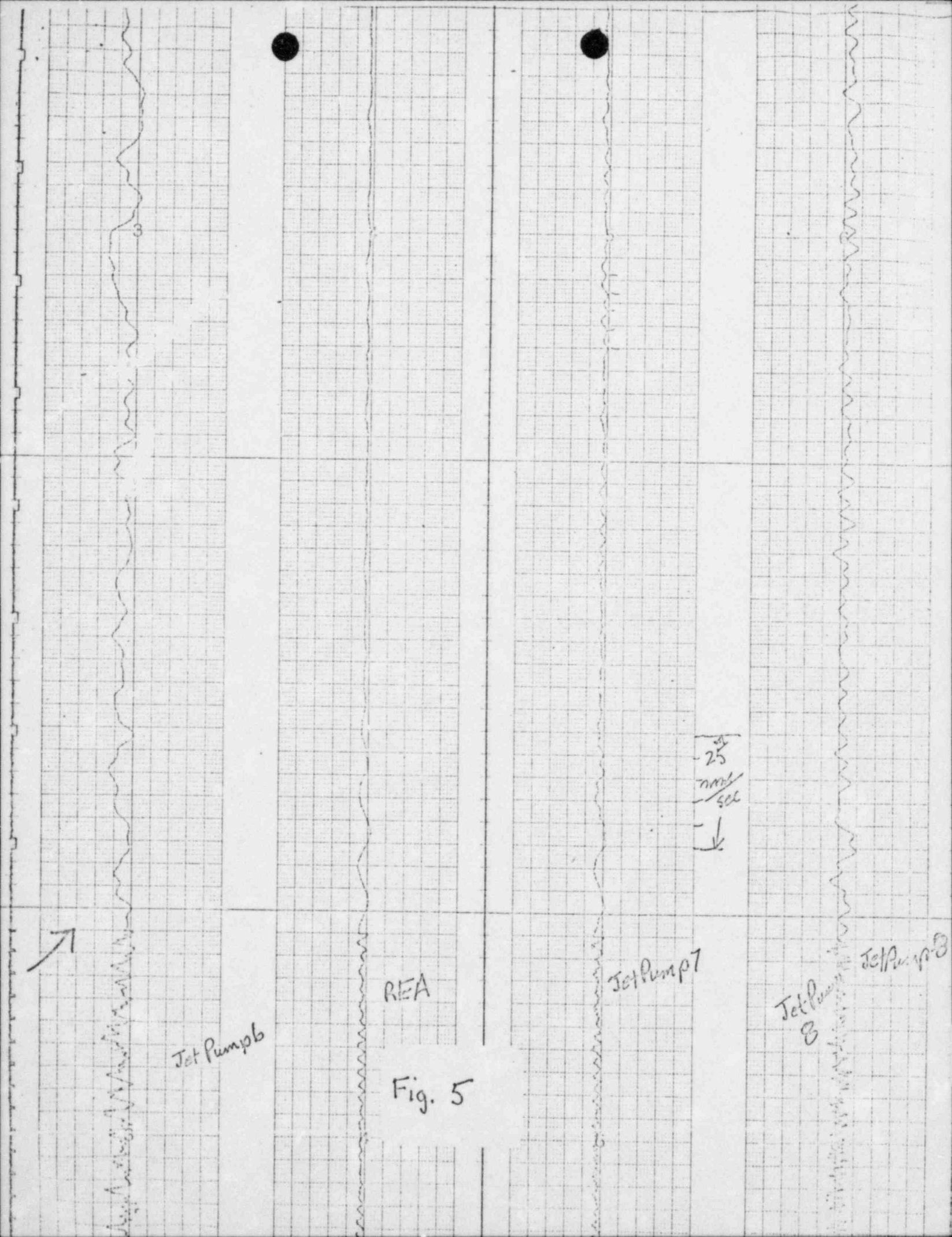


Fig. 5

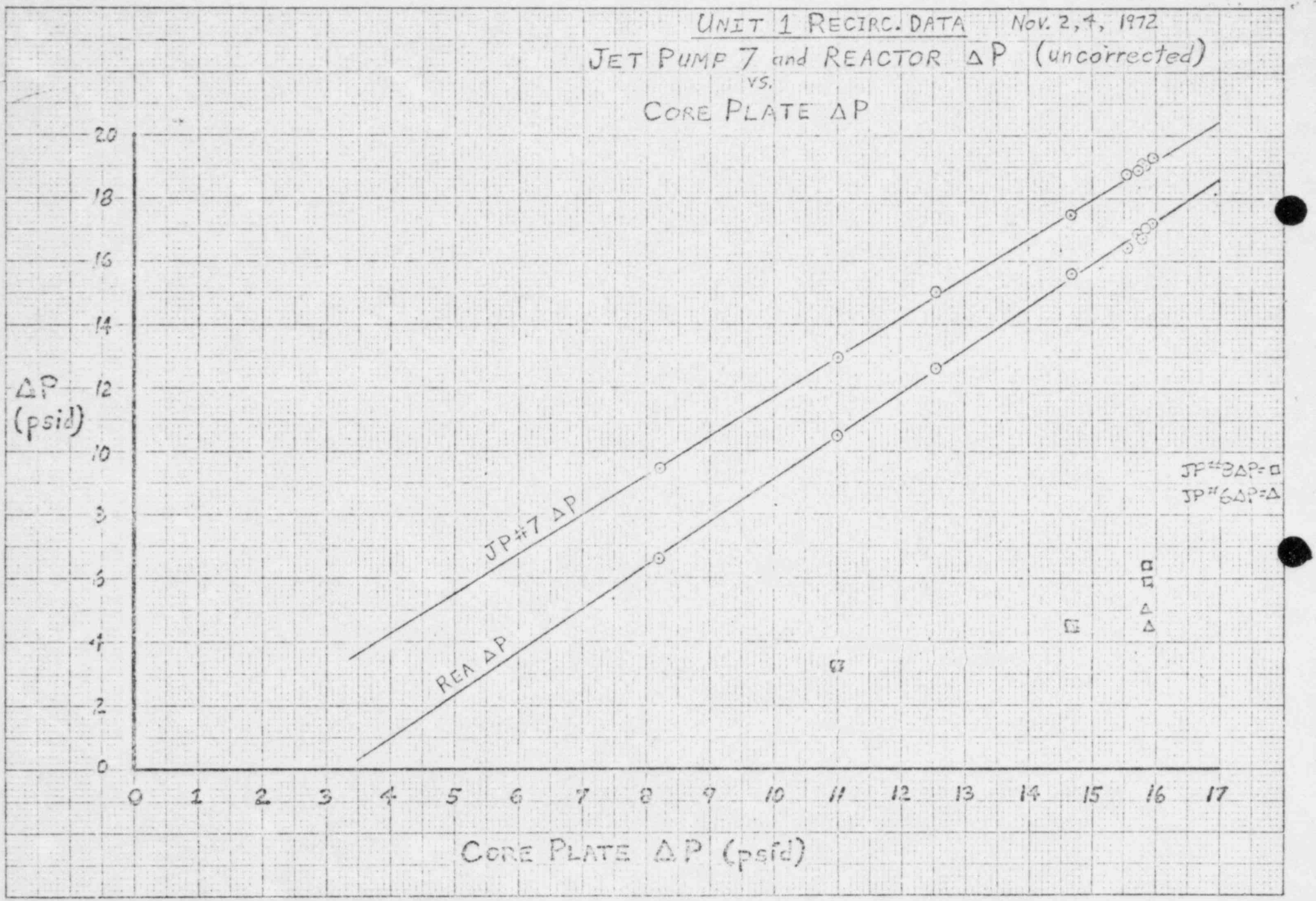
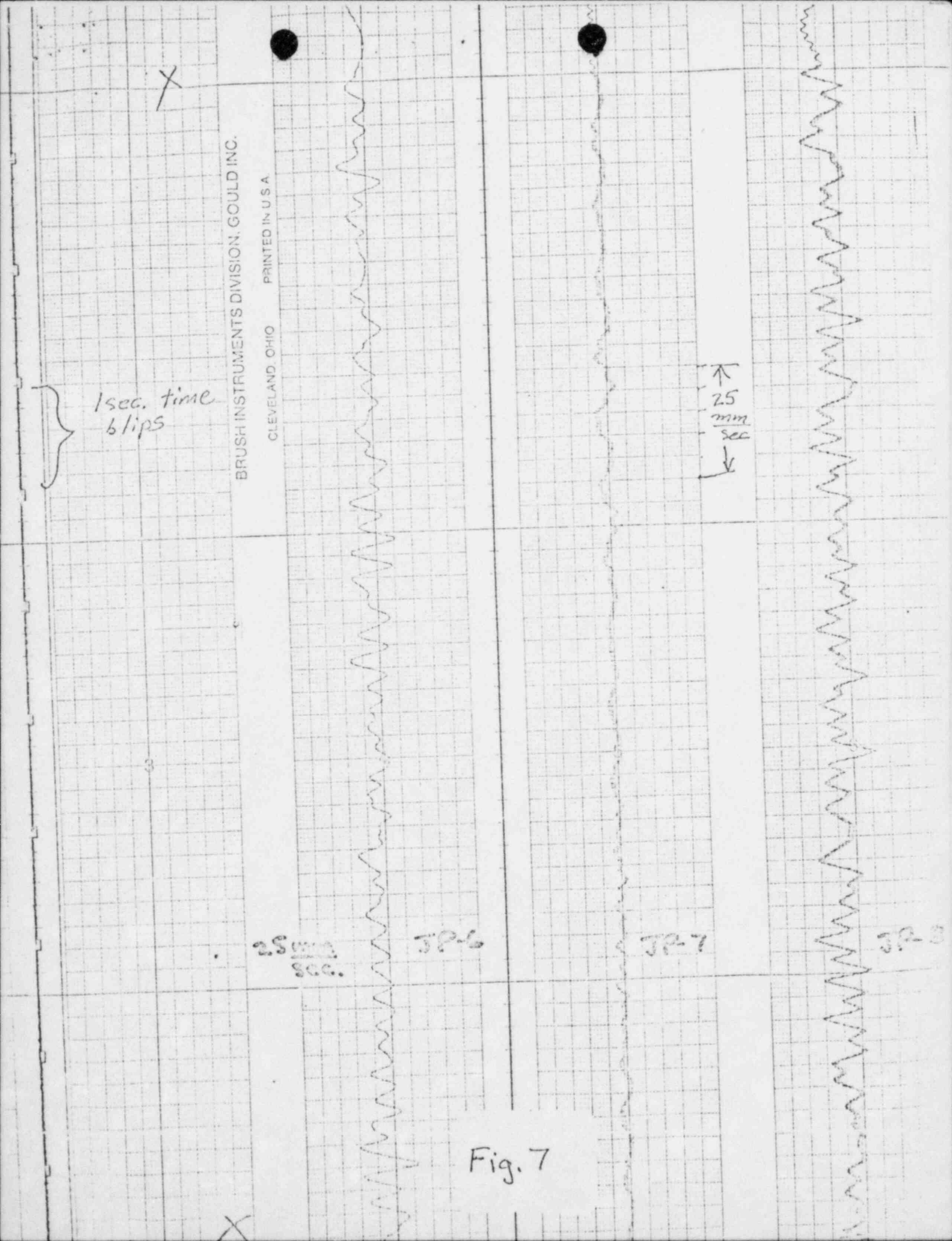


Fig 6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CLEVELAND, OHIO PRINTED IN U.S.A.
1 sec. time blips
25 mm/sec
JP-6
JP-7

Fig. 7