TASK CLOSE OUT DOCUMENT

Task Scope ______________________________

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Committee Leader

POOR ORIGINAL

160 149

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Attached is a summary report on the ORNL-TEC diagnostic monitoring at TMI-2.

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SIG Coordinator

NA:dr
Attachment

160 150

Inspection Measurements Made By [illegible]

In-core Thermocouples

Measurements: Spectral analysis of all in-core thermocouples was performed over a period of time 23:55 (4/5/79) to 15:00 (4/6/79). Bandwidth of spectral analyses were 0.01 Hz – 1.5 Hz. Highest root-mean-square noise was observed on TC 11E. TC readings were obtained simultaneously with spectral analysis [illegible] recording for each TC [illegible] [illegible]

Obs.: (1) Amount of noise on TCs is very small [illegible] as expected [illegible] noise was observed on TCs [illegible] temperature [illegible] temperature.

(2) No appreciable difference was observed between TCs [illegible] TCs [illegible]

(3) TC 8F had a periodic variation of temperature of ~ 0.2°F rms at a frequency of ~ 0.0033 Hz. The oscillation was observed with [illegible]. No other TC exhibited this oscillation. The oscillation was not found on 4/6/79. We do not have any explanation to the observed phenomenon or its disappearance.

160 151

(4) TC 8L noise increased with a factor of 2–3 during approximately [illegible] on 4/6/79. [illegible] was not observed [illegible]

~~4) There is no apparent [illegible] [illegible] [illegible] of thermocouples~~

(5) There is no difference between RCS pressure (Loop A) and a hot TC (11E on 4/5/79). Therefore we conclude there was possibly a large amount of boiling at this location.

<u>Status:</u> A continuous monitor has been installed which records on a strip recorder read-out from TC 8-E and [illegible] was installed at [illegible] on 4/12/79.

<u>[illegible] Recommendation</u>

Because of an open loop [illegible] [illegible] in the computer [illegible], TC [illegible] from the computer [illegible] the program [illegible] [illegible] the [illegible] monitoring [illegible] are [illegible] and the important with the [illegible].

Therefore, we recommend that [illegible] be eliminated from the monitoring system if [illegible] monitoring is initiated.

Measurement: The noise from the A and B loop pressure signals were continuously monitored on strip chart recorders. In addition, spectral analysis was performed over a frequency band of 0-25 Hz (no significant signal was observed at frequencies greater than 25 Hz due to time response of the pressure transmitters estimated to be 1.2 sec).

Peak-to-peak pressure fluctuations were estimated from a) the strip chart recordings and b) amplitude probability distributions from the signals.

The strip chart recordings of the noise were available during the short [illegible] of time ([illegible] minutes) between the [illegible] of the [illegible] pumps and the initiation of [illegible].

Measurements were made during Procedure Z-57 (Pressure Reduction During Deaeration) at approximately every [illegible] step reduction in pressure.

160 153

Observations and Trends: 1. Every time a new lower pressure was reached, the pressure fluctuations in the A and B loops as observed on the strip chart would be significantly reduced.* Upon venting (deaeration), the pressure noise would increase to a level consistent

* This effect was attributed [illegible] ([illegible]) and [illegible] ([illegible]) to the [illegible] of the system with gas coming out of solution.

with that prior to the pressure reduction. Upon completion of degassification, further variations in pressure (above that at which degassification occurred) would have no dramatic effect on pressure noise with the exception of a general trend described earlier.

2. At 1000 psi, the A loop pressure noise was ~50 psi p-p as observed on the strip chart. The B loop was about 5 psi p-p as observed (see Fig 3, 4, and 5 for an expanded time trace and PSD). At the lower pressure extremes (~300 psi) monitored (after degassification), the character between the A and B loop pressure signals were reversed, i.e., the A loop pressure fluctuations were observed at ~10 psi p-p and the B loop fluctuations were near symmetrical and had pressure fluctuations of ~50 psi p-p (the PSDs are presented in Figs 6 and 7). This shifting of character from the A to B loop was repeatable over the limited pressure variations we observed. The spectral characteristics observed are described next.

E of 13

3. The spectra for the A and B loop pressure signals at high pressure are presented in Fig 7. The characteristics are:

i) A 6.7 Hz dominant resonance (with harmonics) in the A loop.

ii) The B loop has a resonance of 6.7 Hz [illegible] (modulated) by the A loop.

iii) The A and B loops are out of phase at the resonant frequencies.

iv) The amplitude of the pressure fluctuations of the spectra [illegible] are ~ [illegible] psi, but, assuming our time constant estimates from the noise spectra and that derived earlier by plant personnel ~ about 1.2 sec. for the Foxboro sensors are correct, the signal at 6.7 Hz has been attenuated by a factor i.e. 20-50. Thereby the fluctuations at these frequencies are of the same order as those observed on the [illegible] chart in APL at low frequencies. This suggests a hydraulic resonance may be responsible for the large pressure fluctuations in the 'hard' system.

4. The spectra for the A and B loop pressure signals at low pressure (300 psi) are presented in Fig. 9. The characteristics are:

   i) The B loop resonance has shifted down from 8.0 Hz to 6.2 Hz and combined (coinciding the A loop). The A loop resonance has shifted from 6.7 Hz down to about 6.4 Hz.

5. The shifting of the resonance frequency in the A and B loops with mean pressure was found to be repeatable which seemingly rules out the effect being attributable to gas content (only a limited number of pressure reductions were obtained). Thusly we do not have an explanation for the behavior.

6. The driving function for resonance effect in the A and B loop pressure signals is the pumps. This was evident during the short interval of time between the loss of the A1 pump and startup of the A2 pump. The pressure noise in the A and B loops was not observable on the strip chart at this time.

7. The shifting of the pressure noise from

loop to 3 loop was observed to occur with rear pressure in a repeatable manner after the initial depressurization. Therefore [illegible] improbable the resonance shift is not governed by the amount of gas in the system.

8. The reduction of the loop 3 loop pressure noise each time a new low pressure was reached followed by the reappearance of the noise with repressurizing leads us to concur with the postulate of Harrison Engineering that the presence of [illegible] coincides with the [illegible] with increasing pressure [illegible] stiffens (dampens) the system to the point the pressure noise is suppressed.

9. The absence of the pressure noise during the minutes or so the pumps was off leads us to the conclusion the noise is a hydraulic phenomenon and not boiling induced.

10. The sensitivity of the pressure noise to small (20-50 psi) pressure variations during depressurization suggests there are not large bubbles [illegible] in the system. If there were large bubbles, we believe the pressure noise would not have been

disappeared significantly and reappeared upon de-amplification

11. Finally, we do not understand the shifting of the dominant pressure noise from the A loop to the B loop with decreasing mean pressure. Therefore, we cannot comment on the significance of it or extract any diagnostic information from it. However, the appearance of the large pressure noise in the B loop at lower mean pressure tends to remove the conceivable concern that "small pressure noise at higher pressure in the B-loop is indicative of trapped gas in that loop".

IN-CORE TEMPERATURE 4/6/79

°F

~1,000 PSI

PUMP A1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							291	294							
C						292			303	297			297		
D					292					454				290	
E				288			305		344		413				
F			296				267	213				324	297		
G		290			317				337		437		302		
H	289				283			378 368	305				290		
K					291						354	332			
L		291	290								331		+		
M			290				295		312	315				292 295	
N				291				307	295						
O					288	289				295		293			
P						284									
R							293			290					

4/7/77

IN-CORE THERMOCOUPLE NOISE

(Mean Square millivolts from 0.0122 - 1.562 Hz)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

A

B 0.612 0.247

C 0.164 13.2 4.7 19.6

D 0.063 25.4 0.69

E 0.165 44. 5.4 155.

F 0.117 0.055 4.4 6.9 0.70

G 0.134 0.421 0.163 30.6 24.9 8.1

H 0.10 0.330 0.670 0.775 23.5 0.05

K 0.152 0.18 6.8

L 0.172 0.06 0.093 6.5

M 0.069 0.151 6.2 0.39 0.13 A2 / 1.54 A1 } maybe pump change from A1 to A2

N 0.129 1.03 3.3

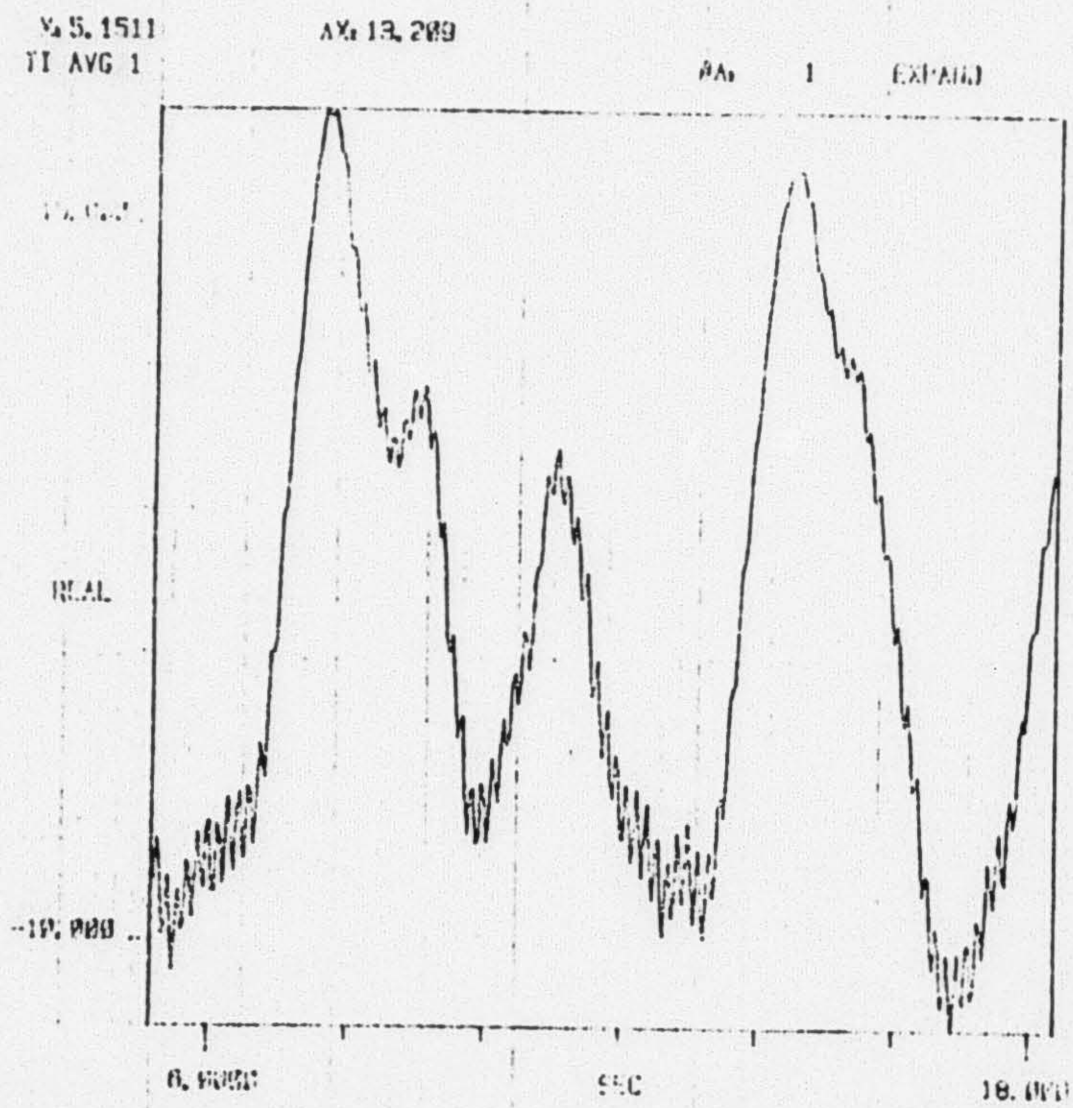
O 0.075 0.067 0.75 0.26

P 0.29

R 0.333 0.14

AMP BKG CH A = 0.049 SN 434 IC 19735

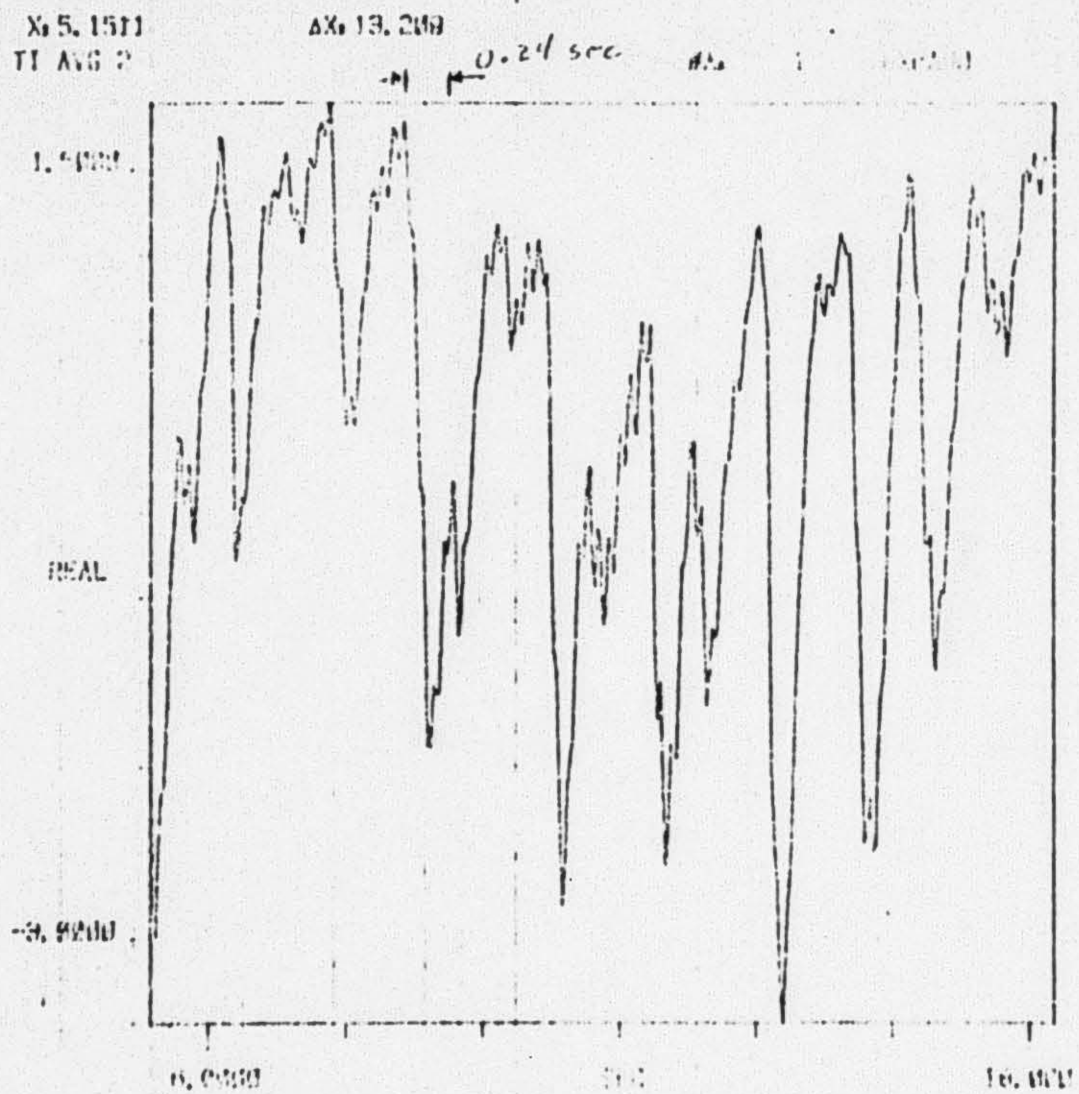
AMP BKG CH B = 0.137 SN 11124 IC 19925



TMI 4/9/79
Press = 950 psi
~ 16:00

Fig 3a. A-LOOP PRESSURE VS TIME

160 161

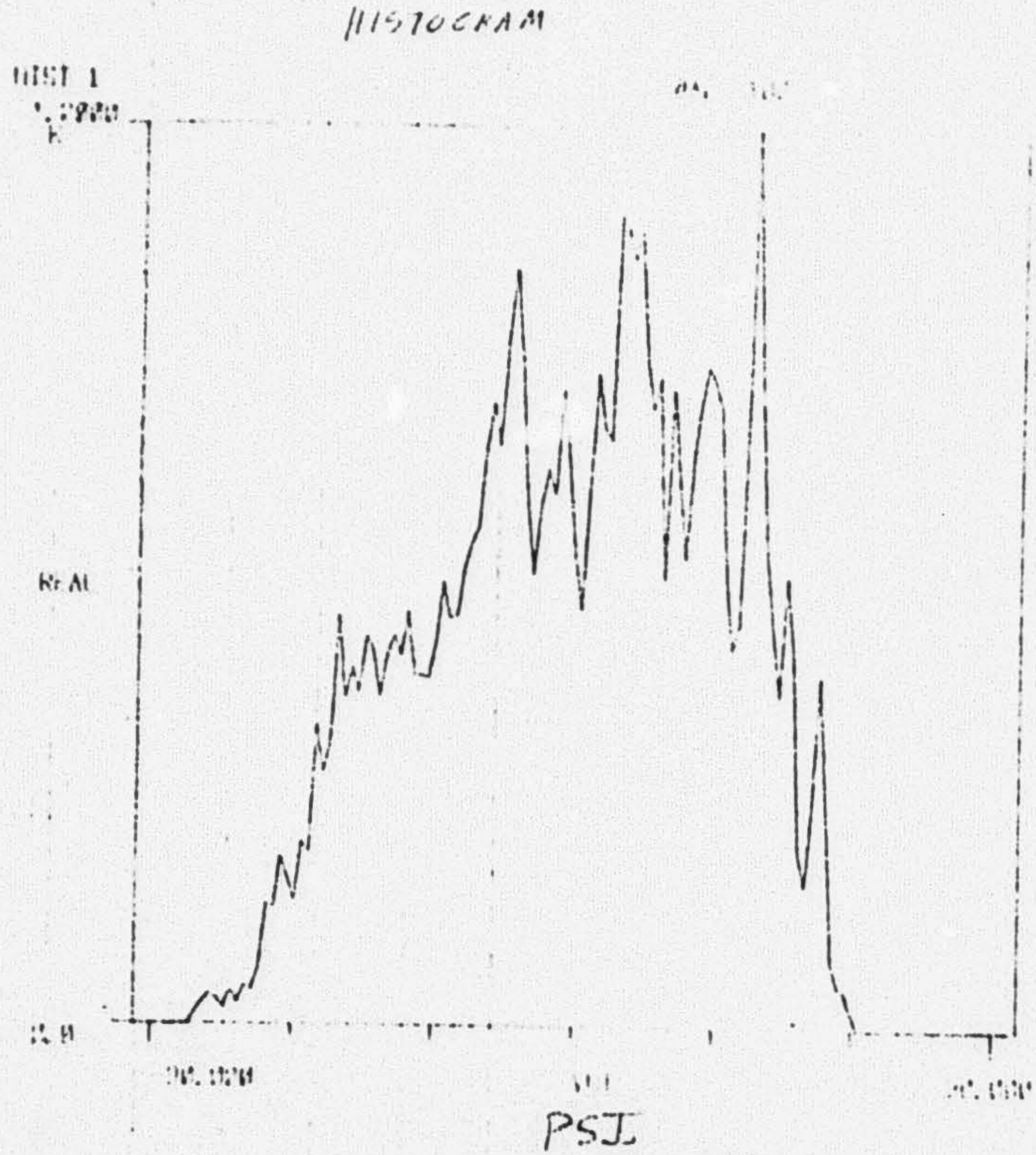


TMI I 4/4/79
Press = 450 psi
B Pres Time Trace

Fig. 3b. B-LOOP PRESSURE VS TIME

160 162

P13 of 15

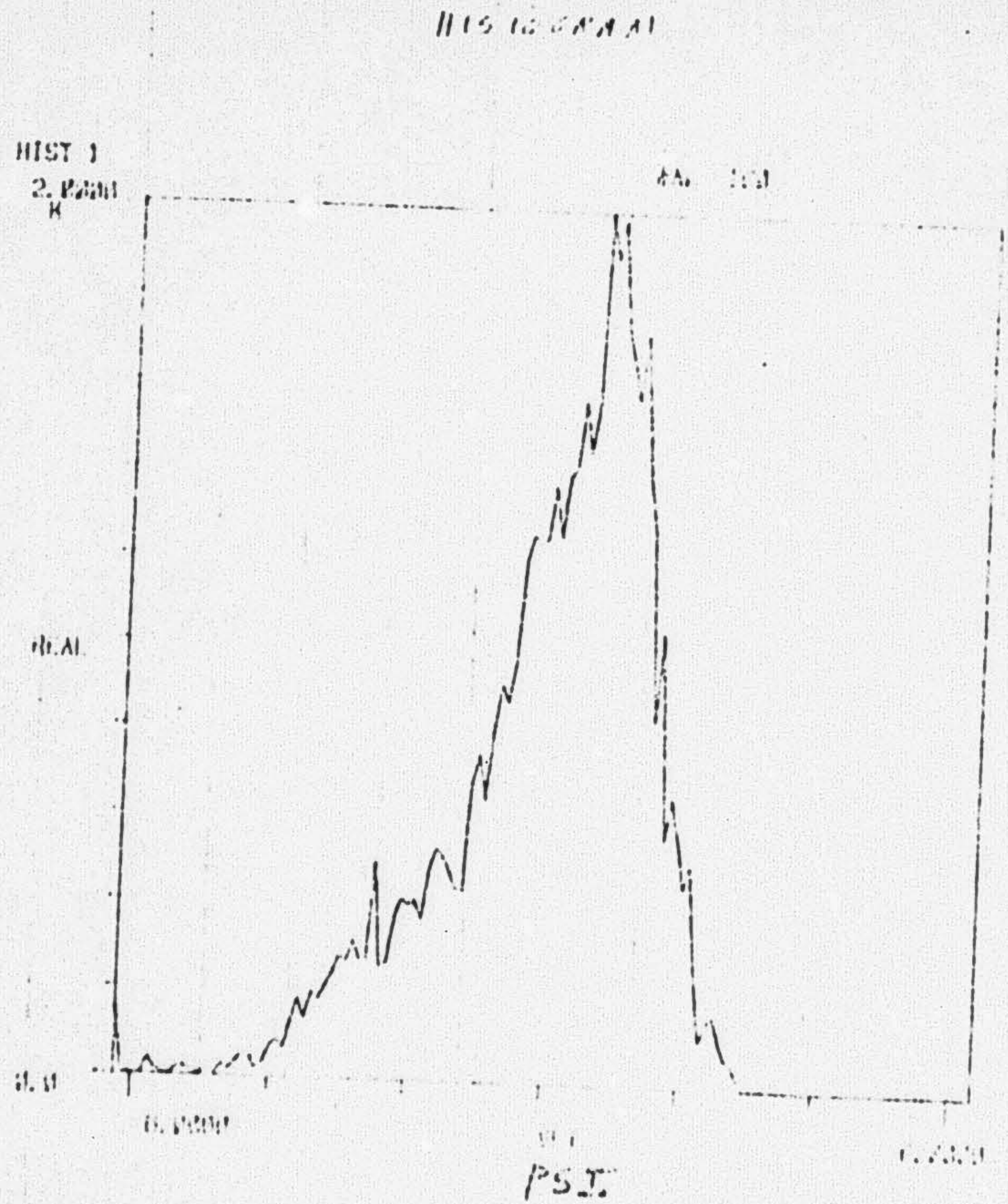


A 0376 LVL = 96
B 0376 LVL = 95

160 163

Fig. 4. A-LOOP PRESSURE AMPLITUDE DISTRIBUTION

R19 of 12



7MJ 4/9/?? 12:?? [illegible] = 1000
Scale in psi
B-[illegible]

A OSTG LVL = 96
B OSTG LVL = 95

160 164

Fig. 5. B-LOOP PRESSURE AMPLITUDE DISTRIBUTION

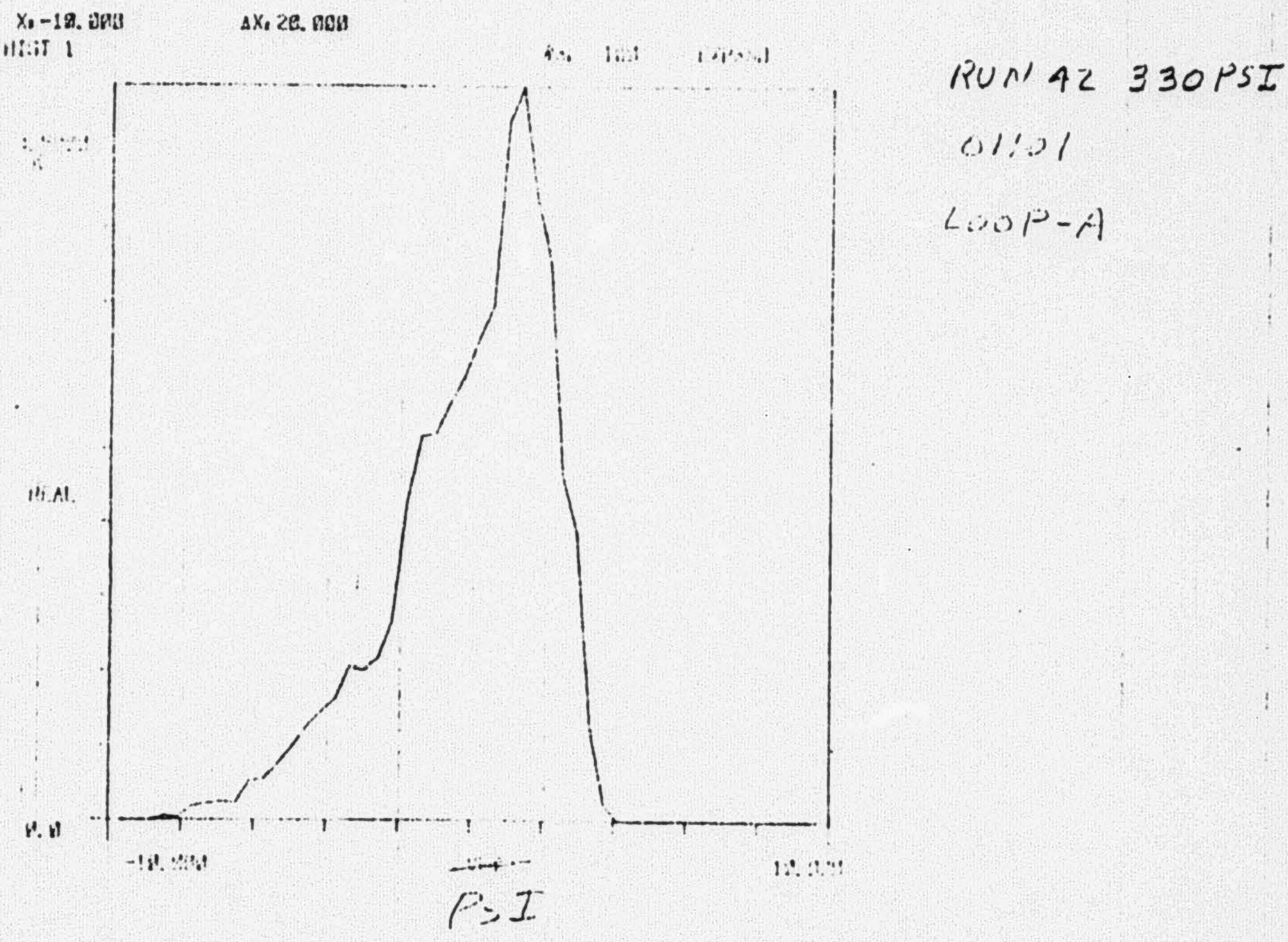


Fig. 6. A-LOOP PRESSURE AMPLITUDE DISTRIBUTION

160 165

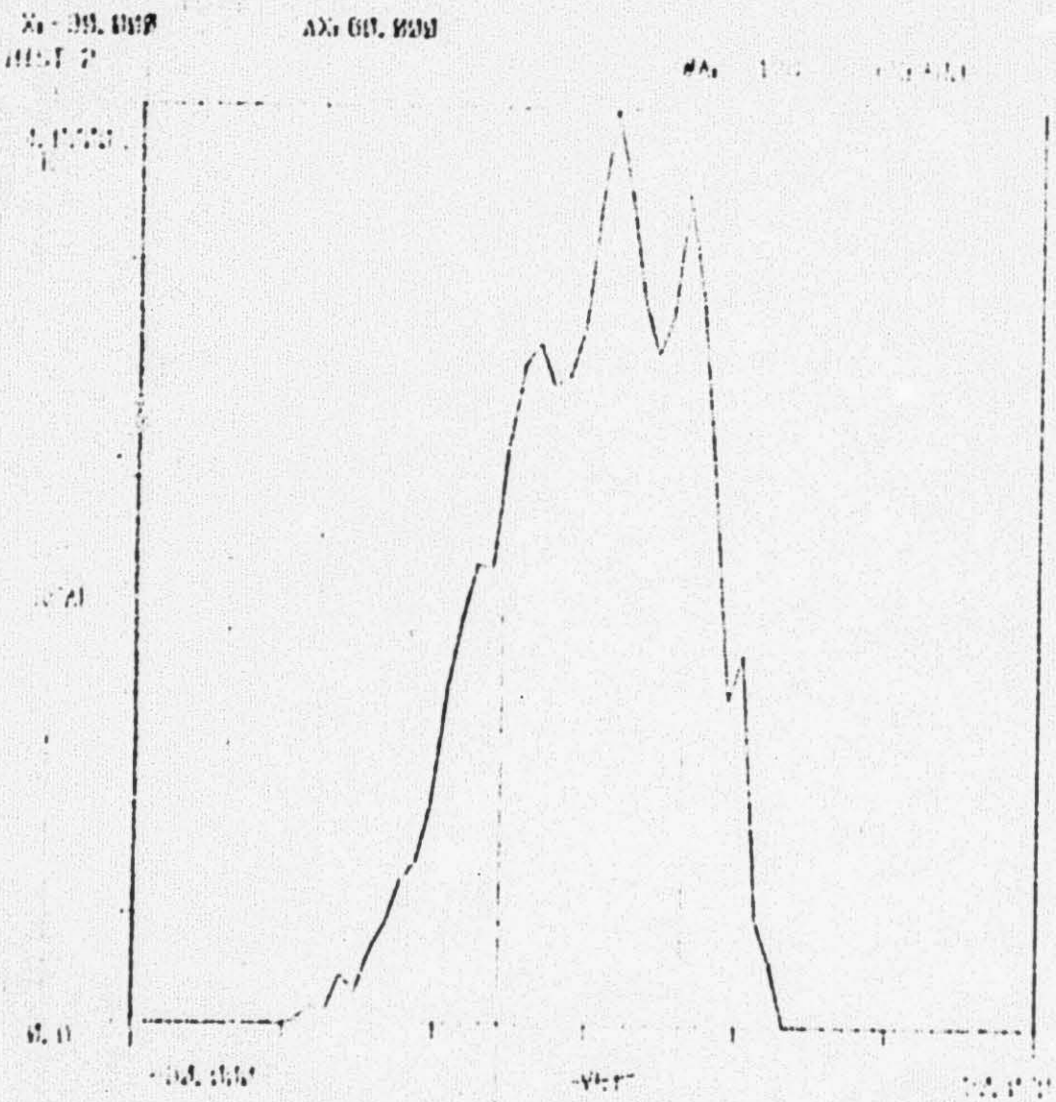


Fig. 7 B-LOOP PRESSURE AMPLITUDE DISTRIBUTION

160 166

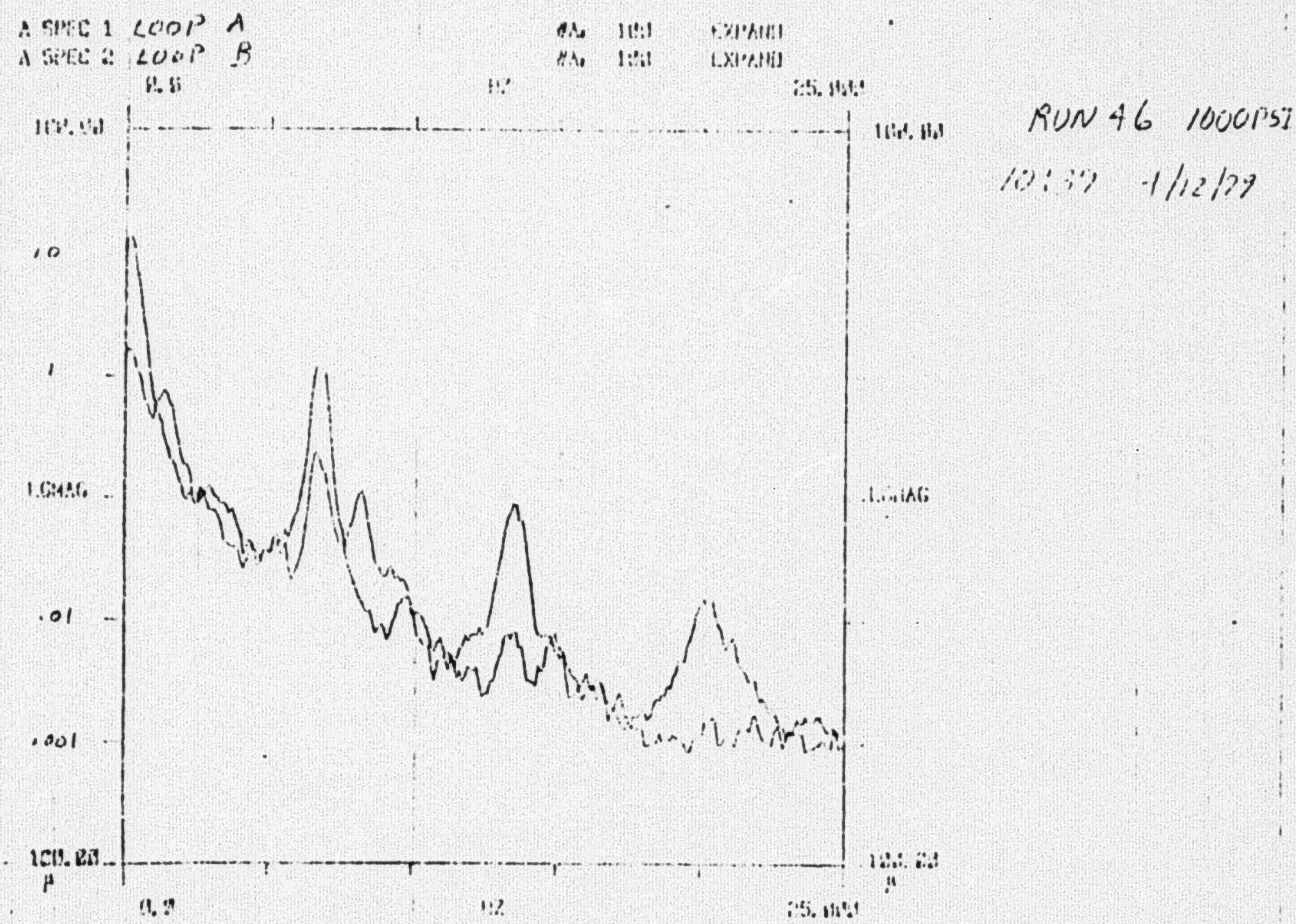
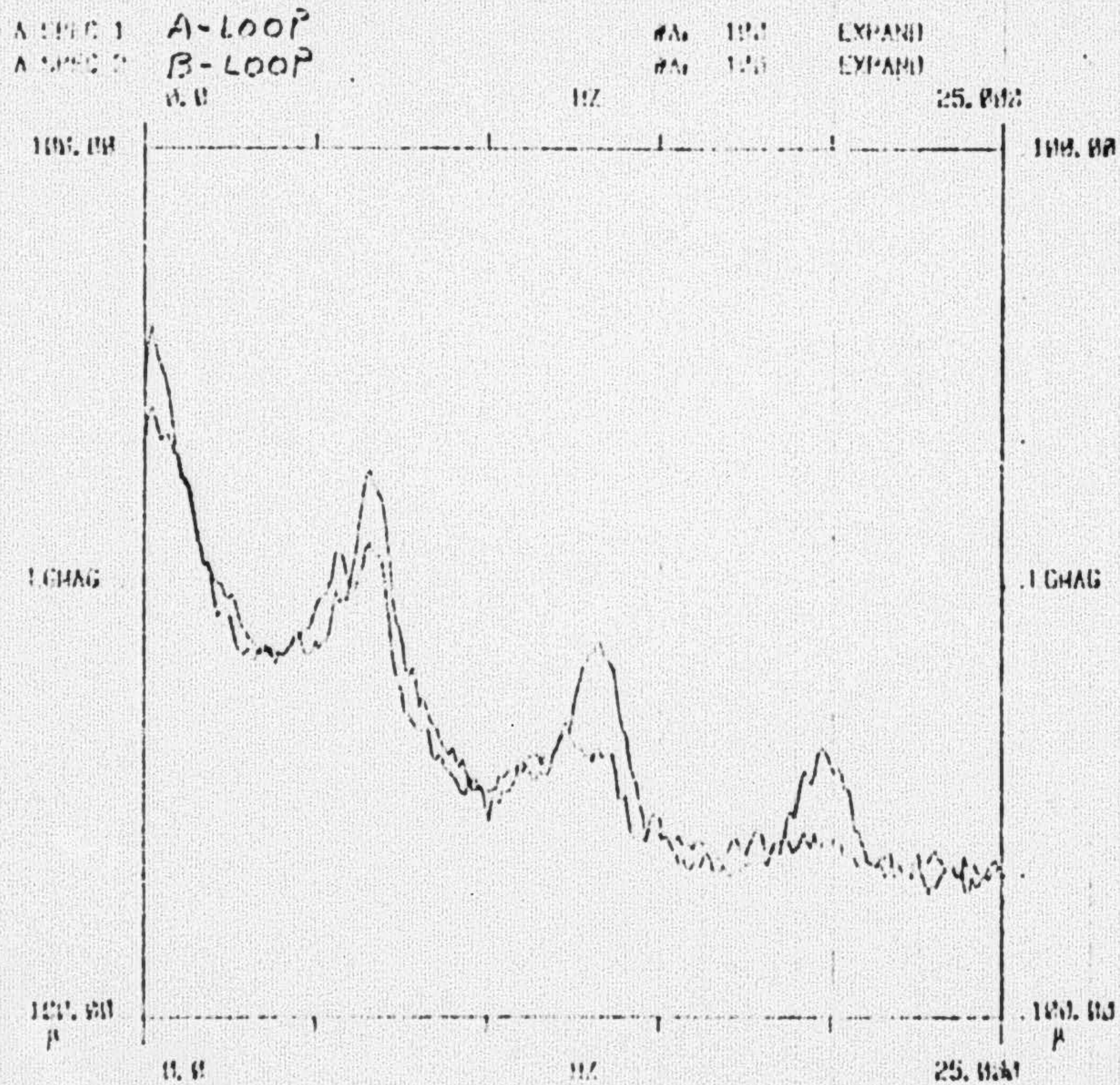


Fig. 8. NOISE SPECTRUM OF A & B PRESSURE AT 1000 PSI

160 167



RUN 44 300 PSI

01:10 7/12/79

Fig. 9 NOISE SPECTRUM OF A & B PRESSURE AT 300 PSI.

160 168