

DAVIS BESSE
SEPT. 24, 1977

DB-1 ABNORMAL OCCURRENCE
(9/24/77)

I. INTRODUCTION

The applicant stated that all damaged insulation had been cleaned up and replaced. Since there was little to gain by a tour of the containment, the staff utilized the entire time reviewing the abnormal occurrence with the applicant, Bechtel, and B&W. An attendance list is attached.

II. SUMMARY

(A) The event was a loss of feedwater compounded by two additional single active component failures. Power level was ~10%. Although the event itself was fairly significant (and many questions will have to be addressed) probably the most intriguing part is the endless "what ifs" which could keep

anyone busy for a long while ...

(B) The systems which malfunctioned were:

1. Safety-grade SFRCs
(Steam Feedwater Rupture Control System)

- This system initiated the loss of feedwater event

2. Safety-grade AFWS
(Auxiliary Feedwater System)

- One train of the AFWS failed to deliver design flow to SG-2.

3. Non-Safety grade RV
(Relief Valve)

- Failed open

(C) Several key areas of concern which will have to be addressed by the applicant include:

1. Common mode failure potential of AFWS, turbine governors.

2. Effects of excessive cooldown rate on primary side

- 3. Stresses on steam generators, especially SG-2 which the applicant believes went dry.
- 4. Dynamic effects of vapor formation in RCS during transient (RCP cavitation, seal effects, etc)

These and other areas of concern are discussed in greater detail in Part III.

III. DISCUSSION

A. Event Scenario

The plant was at ~10% power with main feedwater being regulated through the main feed startup control valves. A momentary, unexplained signal ("half trip" of SFRCs) caused an inadvertent closure of the feedwater startup valve in SG-2. This loss of feedwater to SG-2 initiated a slow heatup of the primary side. About 1 1/2 min. after the

why not both?

spurious "half trip" of SFRCS, a low-level in SG-2 completed the remaining "half trip" of the SFRCS. This initiated secondary side isolation (closure of all main steam and feedwater isolation valves and actuation of both steam-driven ARWS trains). At about this time the pilot-actuated relief valve lifted and stuck open. Within two minutes of the initial spurious signal, the operator manually scrammed the reactor (~ 30 sec after the RV stuck open). A low-pressure scram (1900 psig) would have occurred about 30 sec after the time the operator tripped the reactor... according to the plots.

Reactor pressure continued to decrease due to the stuck open RV. ESFAS actuation, including ECCS, occurred at 1600 psig (~ 1 min after manual scram). Continuing

blowdown of the primary side through the failed-open relief valve eventually resulted in a blowout of the Quench Tank rupture disc inside containment ($\approx 4\frac{1}{2}$ min after manual scram). Peak containment pressure during the event was about 4 psig. Primary side pressure decreased to saturation pressure at about 6 minutes after the scram. The operator manually tripped two of the four RC pumps at 7 minutes. After observing the lack of response of SG-2 level, the operator took manual control of AFW for SG-2 at about 13 minutes after his manual scram. This cleared the malfunction in the AFW train, however, the operator did not fill SG-2, apparently due to a concern that he would perturb the primary side even further. Pressure

Eriatic
pump
perform?

6

in SG-2 decreased to zero at about this time, apparently drying out, but immediately responded when the operator took manual control of AFW to SG-2.

The operator secured EICS (turned off HPI pumps) at 4½ minutes after his manual scram (he observed a restoration and increasing pressurizer level). At about 20 minutes after the manual scram, the operator concluded that the RV was stuck open and closed a remote-manual block valve from the control room, thereby terminating the primary side blowdown.

B. System Failures

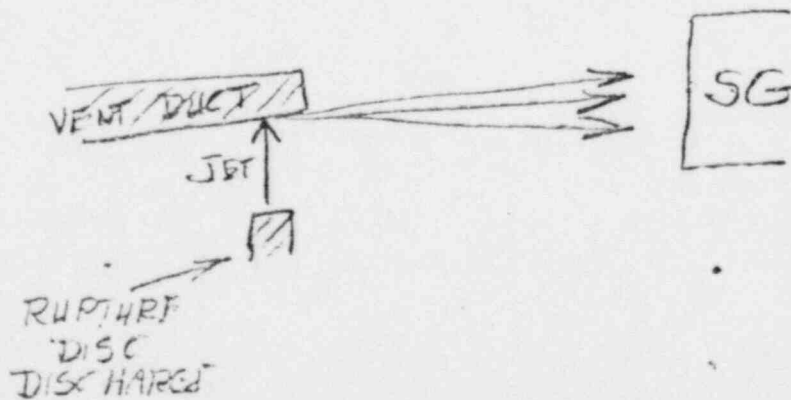
1. AFWS - Turbine governor speed control linkage binding prevented pump from attaining full speed. Problem had occurred previously (Sept 2), but was presumed fixed. Sticking of governor linkage is an obvious CMF concern since both AFWS trains have the same design.

2. RELIEF VALVE - Valve is set to open at 2255 psig and close at 2205 psig. It was subsequently discovered that a "close" relay was missing from a cabinet (reason unknown). This missing relay resulted in erratic "fluttering" (open and close) of the relief valve until it jammed open due to a bent pilot stem.

3. SFRCS - Cause of spurious "half-trip" which initiated event is unknown. Slightly loose connections were subsequently found which possibly could have initiated a false signal.

C. Other Observations

1. Quench Tank - Potential for jet impingement damage from blown rupture disc would not have been obvious. The reason is that the jet was INDIRECT.



2. Core - B/W calculations of maximum ΔP across clad was 300 psi.

3. Containment - 15 pieces of metal insulation were peeled off and dislodged from the SG receiving the jet force. These pieces were 4'x5' and ~ 3 inches thick. A total of about 30 pieces were replaced on the SG.

Some cabling was affected and had to be either dried or replaced.

No apparent ^{external} damage to SG, but a complete evaluation is being made.

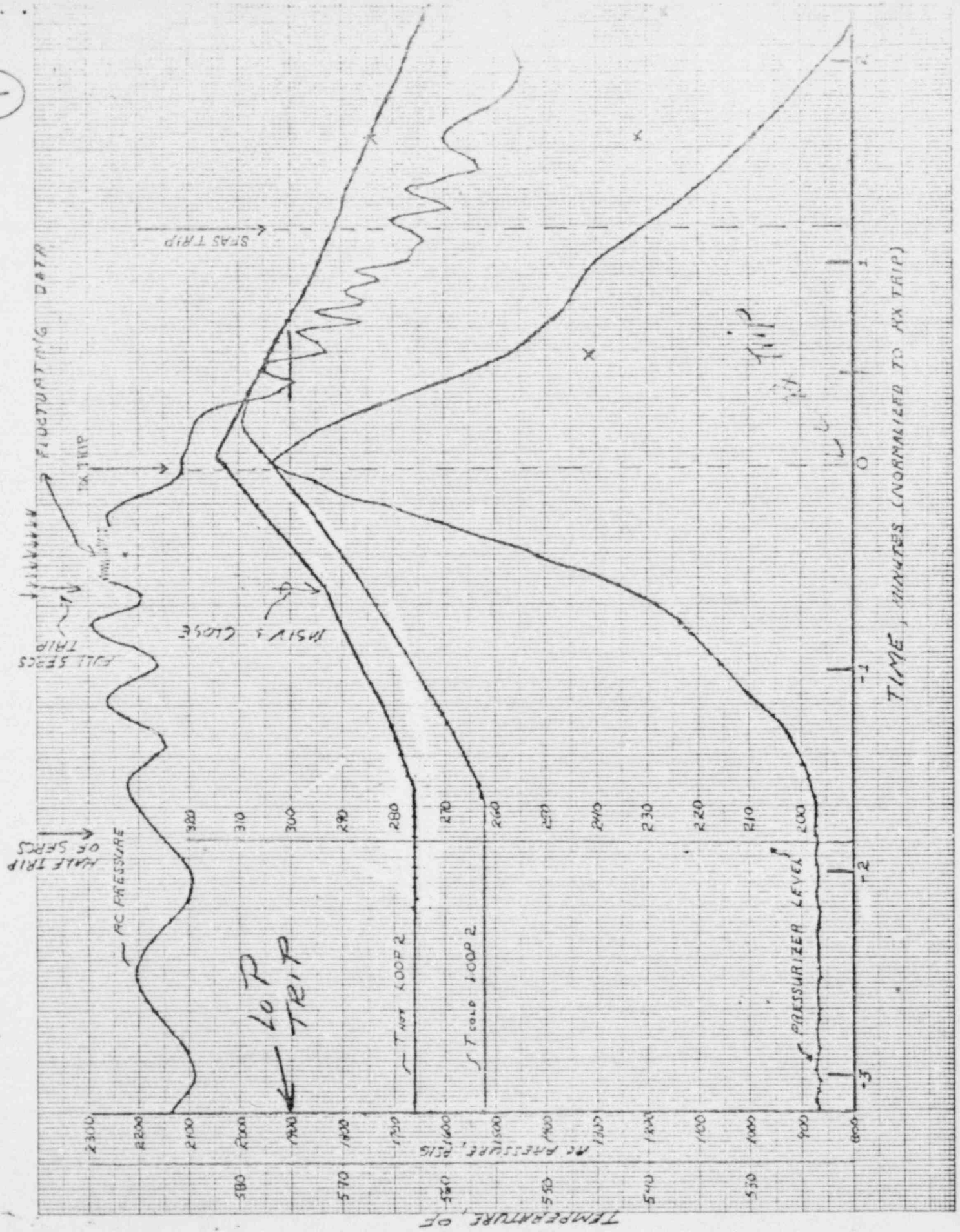
9/30/77

meeting at Davis Besse

<u>NAME</u>	<u>Organization</u>	<u>Title</u>
C. R. DOMECK	TECO	Nuclear Project Engineer, va.
L. Engle	USNRC	Project Manager, DPM
V. T. H. Leung	USNRC	Sys Engineer, DSS
A. S. Szukiewicz	NRC	Reactor Engineer
Jerry Mazetis	NRE	"
J. R. Rajan	NRC	Mechanical Eng
IL HARISTEC	USURC RIII	REACTOR INSPECTOR
W. S. Little	NRC RIII	Nuclear Support Sect. Sup
E. C. NOVAK	TECO	GENC SUPT FOR EXERC & CONST
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Jack Evans	T. ECO.	DB/5th Supt
Larry Stalter	T. ECO.	D.B./ Tech Engr.
Fred Faist	B&W	D.B. Site Op. Mgr.
Fred Miller	TECO,	P. E.
L. E. Poe	TECO	VP, Fac. Dev.
ARTHUR MCBRIDE	B&W	PLT. INTEGRATION
FRANK LEVANDOSKI	BW	LICENSING
C M RICE	TECO (Cons)	
GEORGE MEYER	B & W	FUEL ENGINEERING
JOHN D DEMPSEY	B & W	R.C. PUMP ENG.
J. A. LAUER	B & W	PROD. MGR.
J. D. LENARDSON	TECO	QA MGR.
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NAME	ORGANIZATION	TITLE
J. W. FAY	BECHTEL	ASSISTANT PROJ. ENGR.
R. W. JACKSON	BECHTEL	MECH SUPRV.
DW DOWDS	"	SENIOR ENGR.
R. V. BINS	TECO	INSTR. & CONTROL SYS. ENGR.
B. F. NOVICH	BECHTEL	POWER ENGINEERING
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2

46 1510

KOE 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

TOledo EDISON COMPANY
REACTOR TRIP FROM 10% F.P.
AT 2136 9-24-77

HPI ABNORMAL FLOW

QUENCH TANK RUPTURE
DISK BURST
HPS PUMPS TURNED OFF

HPS PUMPS TRIPPED
LOOP 2 (E-3)
LOOP 1 (I-1)



1100

1000

900

800

700

600

500

400

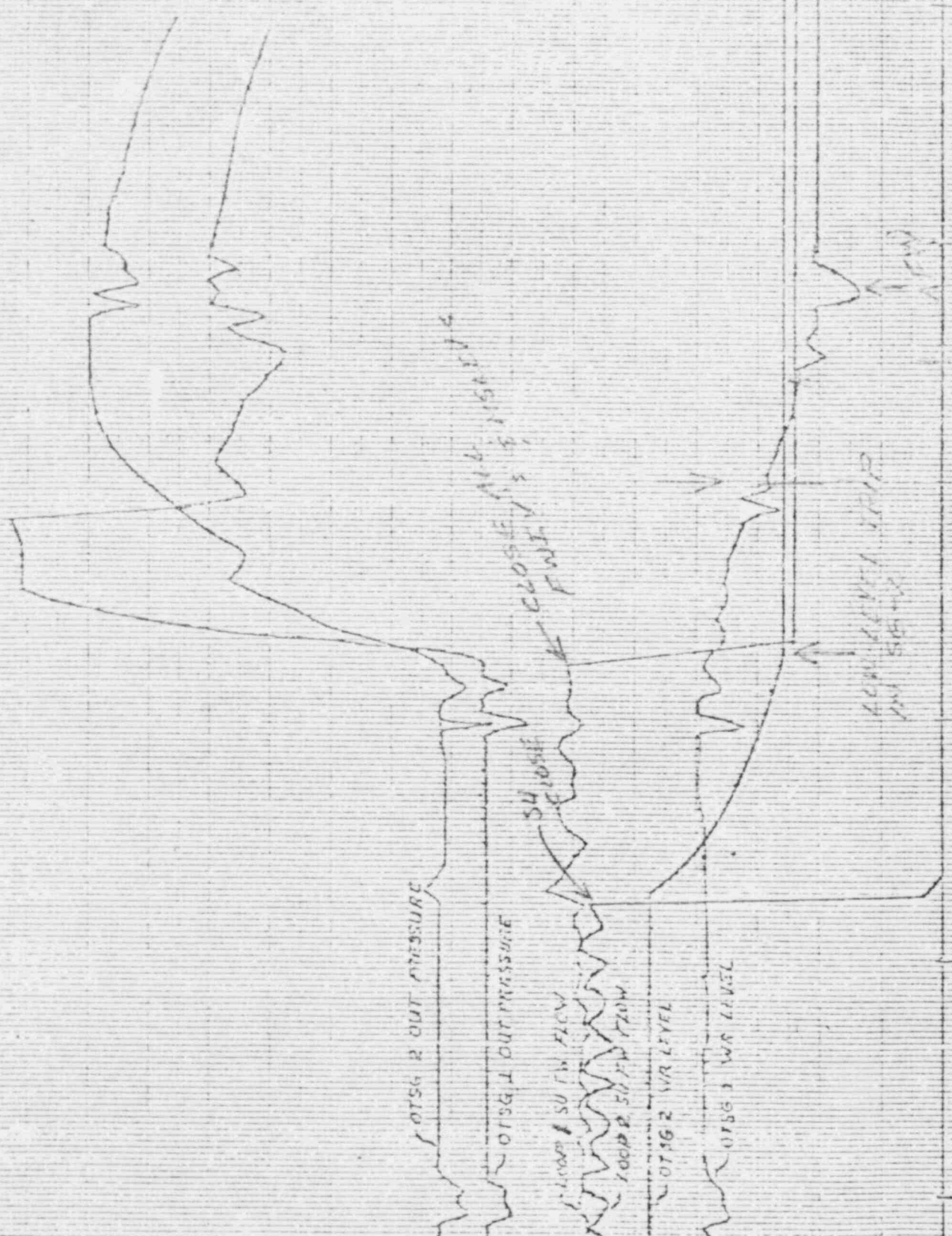
300

200

100

0

STARTER FM FLOW, MDDP X 100
OTSG LEVEL, INCHES



OTSG 2 OUT PRESSURE

OTSG 1 OUT PRESSURE

LOOP SU TW FLOW

LOOP SU FW FLOW

OTSG 2 WR LEVEL

OTSG 3 WR LEVEL

SHUT OFF

CLOSE VALVES & ISOLATE

LOW LEVEL TRIP
OUT 505 MDC
FW

Manual Rx Trip

5

NOV 21 1957

OTSG # 2
(REPORT)

MANUAL RAISE OF RFT STEED

Net
Swic
Operator took manual
control of new
airline valves
OR 12 MIN

PRESSURE PSIG

LEVEL (in) WR

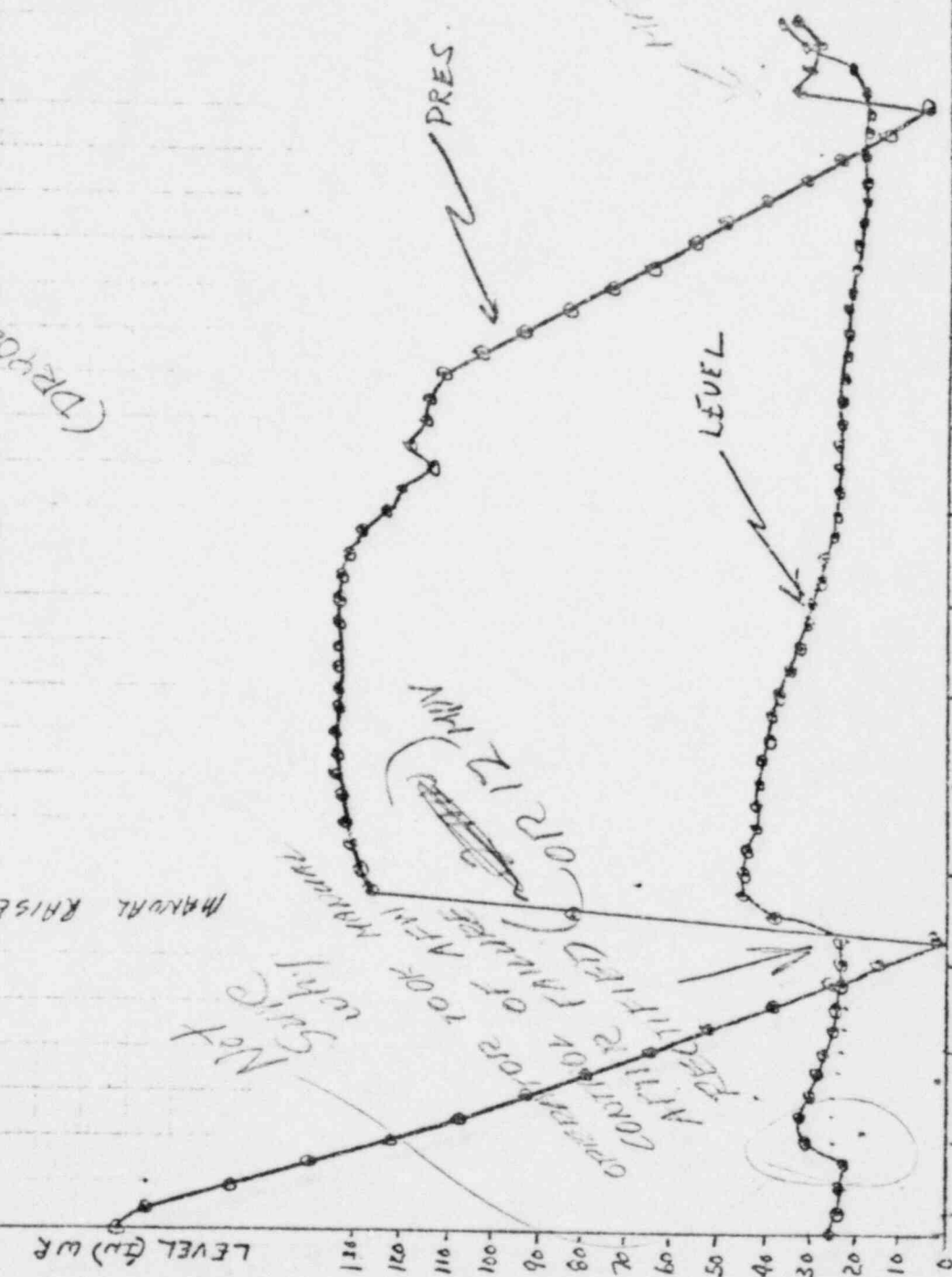
1000
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760
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660
640
620
600

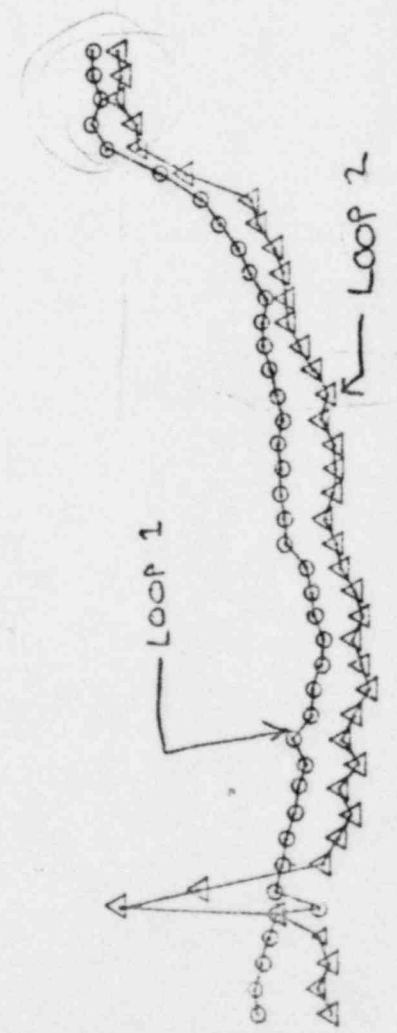
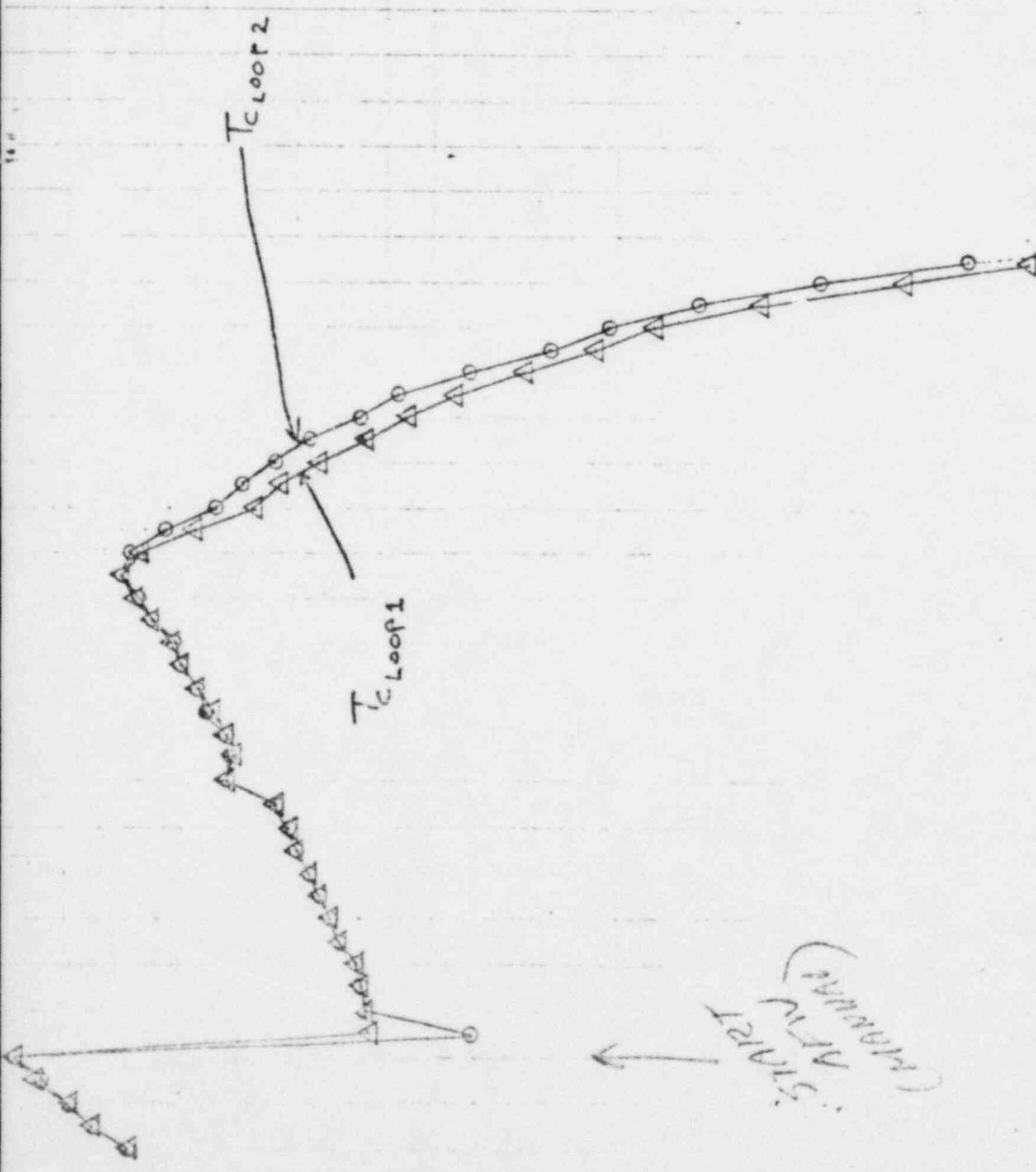
PRES.

LEVEL

TIME (min)

All 40 sec
FOR TIME AFTER RFTSD





57
 55
 53
 51
 49
 47
 45
 43
 41
 39
 37
 35
 33
 31
 29
 27
 25
 23
 21
 19
 17
 15
 13
 11
 9
 7
 5
 3
 1

12 16 20 24 28 32 36 40 44 48 52 56 60 64

3

OFF SCALE

120 110 100 90 80 70 60 50 40 30 20 10 0

PSI

BLOCK VALVE CLOSED

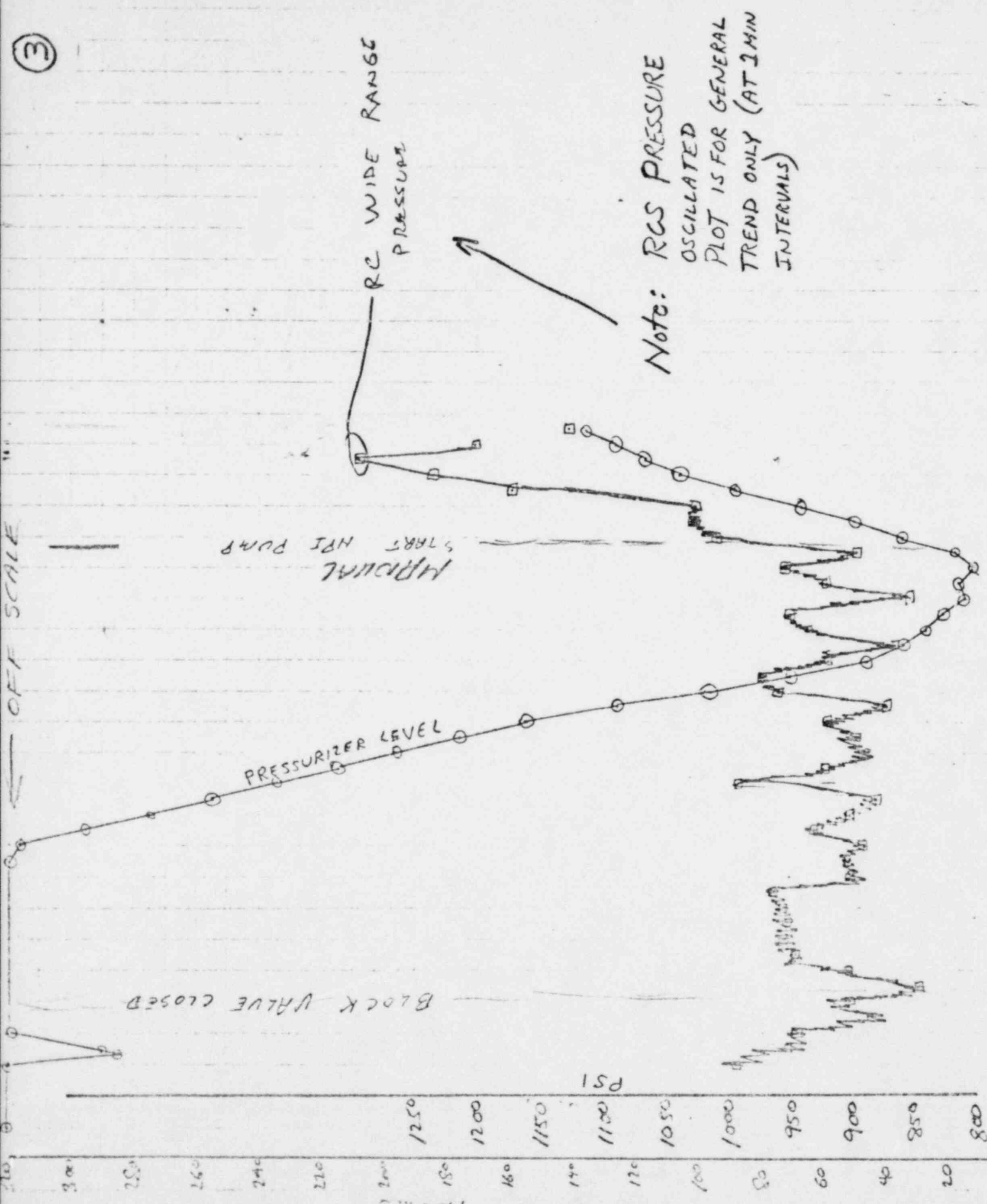
PRESSURIZER LEVEL

START NPI PUMP

RC WIDE RANGE PRESSURE

Note: RCS PRESSURE

OSCILLATED
PLOT IS FOR GENERAL
TREND ONLY (AT 1 MIN
INTERVALS)



0 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92 94

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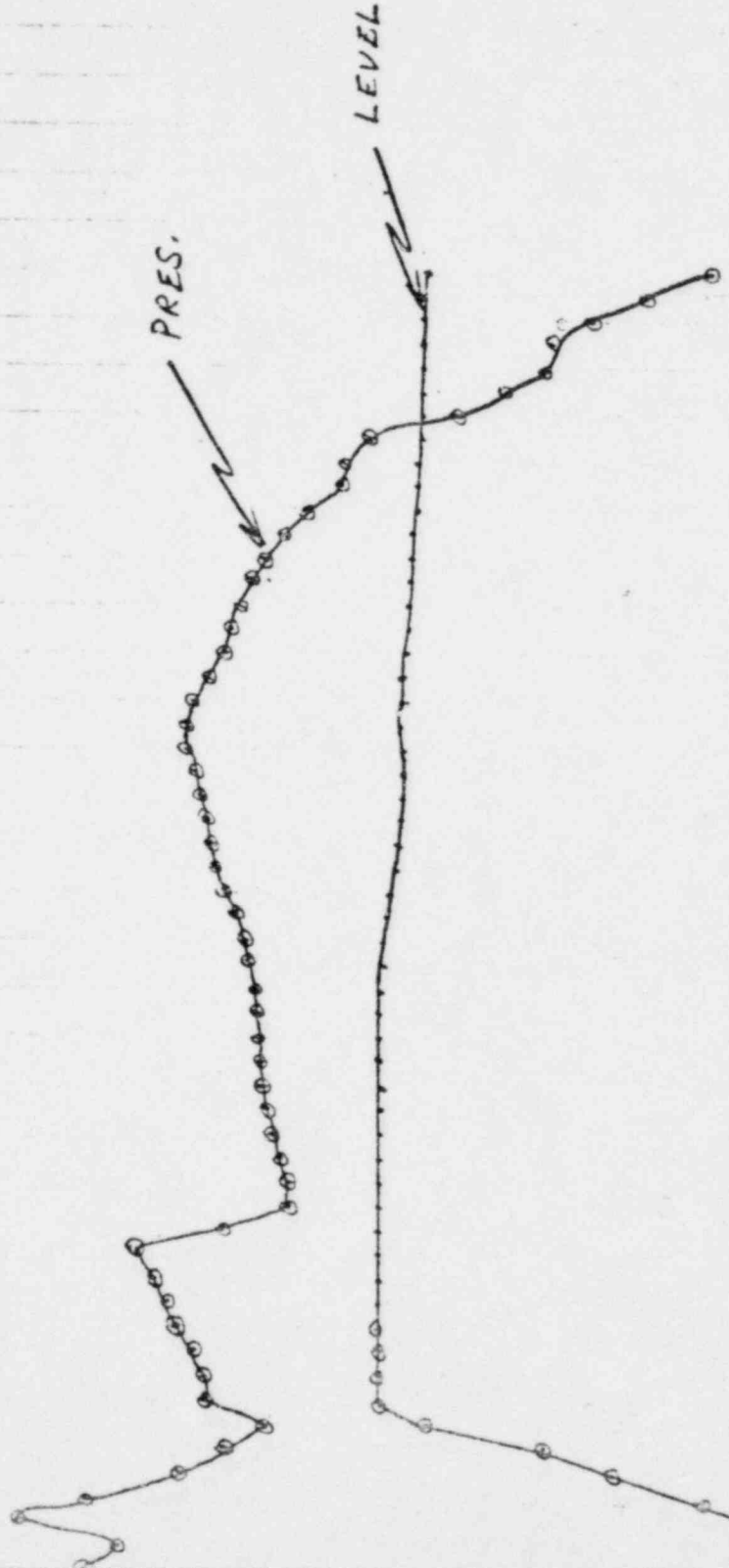
ADD 5 SEC
OR FM
TRIP

OTSG-#1

PRESSURE PSIG

1000 -
980
960
940
920
900 -
880
860
840
820
800 -
780
760
740
720
700 -
680
660
640
620
600 - 0

LEVEL (IN) WR



PRES.

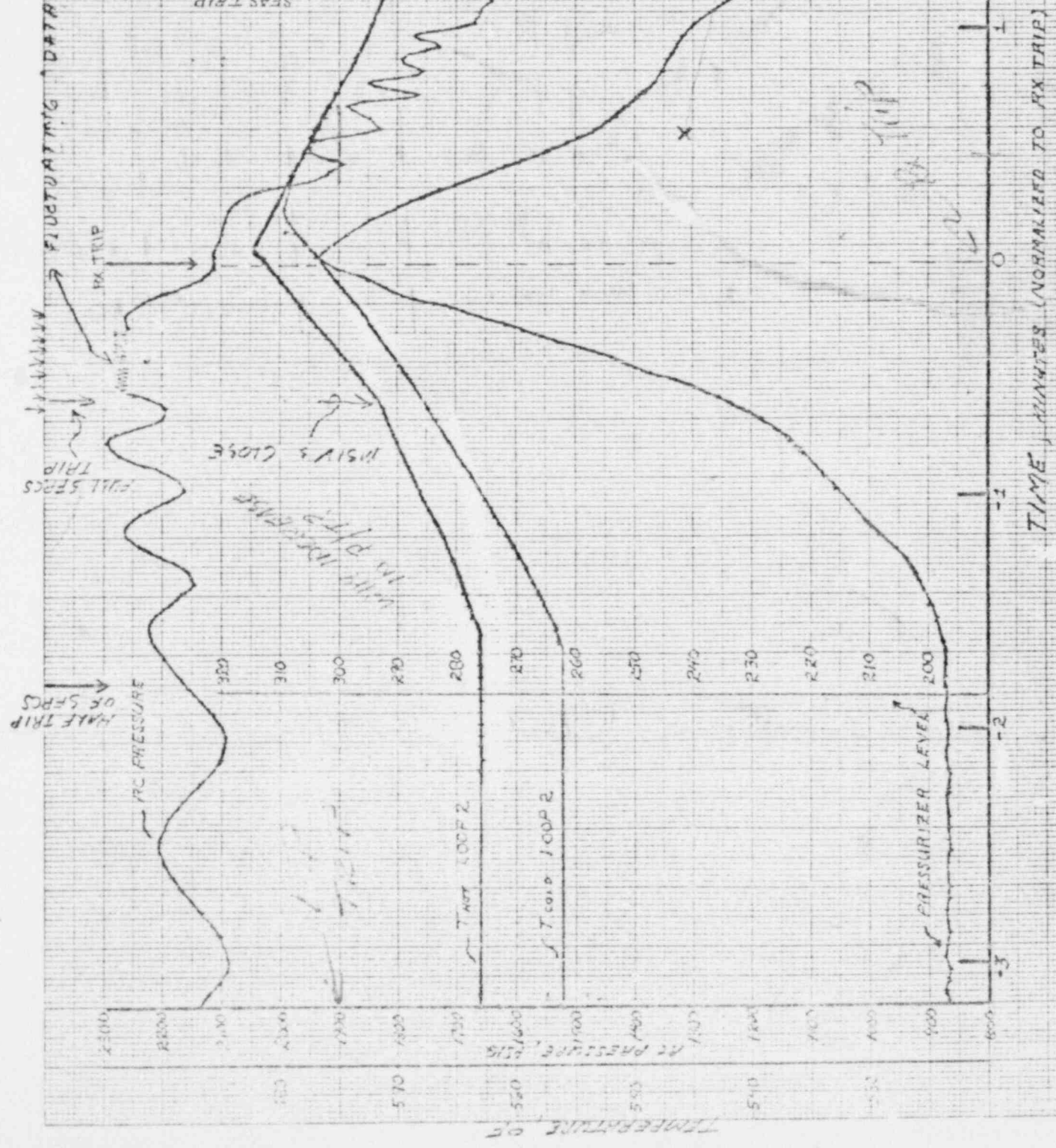
LEVEL

ADD 4-0 SEC →
FOR TIME AFTER RXTRIP

TIME → (MIN)

68

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HPI NORMAL FLOW

TIME, MINUTES (NORMALIZED TO RX TRIP)

2

10 X 10 TO THE CENTER 18 X 25 CM
KEEFEL & EDSON CO. MADE IN U.S.A.

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TOLEDO EDISON COMPANY
REACTOR TRIP FROM 10% FP
AT 2136 9-24-77

