

TEST OF THE INTEGRATED CONTROL SYSTEM AT
DAVIS-BESSE NUCLEAR POWER STATION TO DETERMINE
THE ICS RESPONSE WHEN POWER IS LOST AND
SUBSEQUENTLY RESTORED.

This test was conducted at the request of the
B&W Owners Group I&C Committee. It resolves a
question raised by the NRC as a result of the
Rancho Seco Dec. 26, 1985, Loss of ICS Power
Event.

The test was conducted March 17, 1986.

8608270192 860826
PDR ADOCK 05000346
P PDR

ICS LOSS AND RESTORATION OF POWER (TP 851.28)

SUMMARY OF TEST RESULTS

I. Purpose of Test

The test was run to determine the following:

1. Response of the memory modules for H/A stations within ICS upon loss and restoration of ICS power (AC and DC).
2. Time delay of power monitor shunt trip switches S1 and S2 on loss of DC power.
3. Performance of E/P converters on loss of AC power.
4. Performance of solenoid operated valves on loss of ICS power.

The test was performed for initial conditions of 80% and 30% demands from H/A stations to determine if the response of memory modules is repeatable and predictable.

II. Summary of Test Results

The test consisted of the following 13 phases. The order of performance of these tests was changed by T-Mod T-10452 to run the loss of AC power phases first (7.1, 7.10, 7.11, 7.12 and 7.13) and then the loss of DC power (7.2 through 7.9).

- 7.1 ICS total AC power restoration (ICS deenergized for a long period).
- 7.2 Loss of positive 24 VDC power (from 30% demand position).
- 7.3 Restoration of positive 24 VDC power (from 30% demand position).
- 7.4 Loss of negative 24 VDC power (from 30% demand position).
- 7.5 Restoration of negative 24 VDC power (from 30% demand position).
- 7.6 Loss of positive 24 VDC power (from 80% demand position).
- 7.7 Restoration of positive 24 VDC power (from 80% demand position).
- 7.8 Loss of negative 24 VDC power (from 80% demand position).
- 7.9 Restoration of negative 24 VDC power (from 80% demand position).
- 7.10 Loss of AC power (from 80% demand position).
- 7.11 Restoration of AC power (from 80% demand position).
- 7.12 Loss of AC power (from 30% demand position).

7.13 Restoration of AC power (from 30% demand position).

Since this was a data collection test only, no acceptance criteria was required to be met. The data recorded for these conditions are shown in Appendix A of the test procedure - TP 851.28 and in the strip charts attached to this summary. The results are summarized in sections A through E.

A. Loss and Restoration of AC Power

The loss of AC power testing was conducted by tripping the incoming feeder breakers which removed power from both the cabinet modules and the field mounted devices.

1. Upon loss of AC power, the H/A stations for main and startup feedwater valves and the turbine bypass valves failed to 50% position.
2. Observation at the gauges indicated a pressure of approximately 9 psig for the main and startup feedwater valves which was in agreement with the 50% position on the H/A stations. However, gauges for the turbine bypass valves indicated 0 psig to the valve positioners which verified the proper operation of solenoid valves SV SP13A1 through B3 to close the valves on loss of power.
3. Upon restoration of AC power, the H/A stations for main and startup feedwater valves returned to 100% position whereas the turbine bypass valves H/A stations returned to 0%. The 100% position on the main and startup feedwater valves and 0% on the turbine bypass valves were -10 VDC out of the analog memory modules.
4. Readings at the gauges were ≥ 15 psig for main and startup feedwater valves and ≤ 3 psig for the turbine bypass valves which was in agreement with the readings on the H/A stations for the restoration of AC power.
5. Observations at the gauges located at the valves showed instantaneous change in the readings which leads to the conclusion that E/P converters do not wander around upon loss of AC power.
6. The outputs of the memory modules overshoot before settling to the final position. The amount and direction of overshoot varies in each case but the settling time is ≤ 5 seconds. However, the effect of this overshooting will not be seen by the valves due to the slow response time of the valves. The valves will follow a gradual transition from the initial to the final position.

B. Loss of DC Power

The loss and restoration of DC power testing was conducted by removing various DC power supplies from service within the ICS cabinets.

1. The H/A stations failed to 50% in all cases of loss of DC power except for the H/A stations for atmospheric vent valves remained at their original settings. The atmospheric vent valve H/A stations are AC supplied RU6000 control stations which are different from the other regular H/A stations.
2. H/A stations for Unit Load demand, Reactor demand, FW pump demand 1 and FW pump demand 2 had red and white light 'on' (tracking mode) and their initial settings could not be changed when setting the demands to 30% or 80%. However, these stations also failed to 50% position in all cases on the loss of DC power. Upon restoration of DC power, these stations returned to 0% positions, again with both lights 'on'.
3. Upon restoration of DC power, in all cases, the H/A stations for startup and main feedwater valves went to 100%, the atmospheric vent valves remained at the initial settings; whereas, the remaining H/A stations went to 0%.
4. Transfer time (time delay) of power monitor shunt trip switches S1 and S2 was found to be approximately 0.4 seconds. This is within the manufacturers specified range of 0.3 to 0.5 seconds.
5. The outputs of the memory modules overshoot in a similar manner to the loss of AC power. However, the settling to the final position took between 8-20 seconds. In these cases, also, the valves would follow a gradual transition to the final position due to the slow response time of the valves.

C. Deficiencies

1. Annunciator "ICS/NNI FUSE BLOWN" and computer point Q533 ICS FUSE "OPEN" did not come in and hence could not clear due to the fact that AC power must exist as a prerequisite to receiving alarms indicating a blown (or open) fuse.
2. One of the one-pen AC recorders failed on the first loss of AC power test. The AC power signal was monitored with a DVM in place of the failed AC recorder. Since the test required indication of the AC power during loss of DC power tests, use of the DVM was acceptable.

D. Conclusions

1. The behavior of the memory modules is predictable and repeatable in all the cases of ICS power loss and restoration and is not dependent upon the initial settings.
2. The main and startup feedwater valves fail to 50% opening upon loss of ICS power (AC or DC).
3. The main and startup feedwater valves go fully open upon restoration of ICS power (AC or DC). This corresponds to -10 VDC output from the ICS.
4. The turbine bypass valves go closed upon loss of DC power and all external AC power. However, its ICS position demands go to the 50% position. Contacts from the DC power supply monitor trip external solenoids which in turn causes the TBV's to close. Upon restoration of power, the valves' position demand signals go to the close position.
5. Valve E/P converters did not wander around upon loss of AC power.

Chauhan
Responsible System Engineer

4/17/86
Date

M. E. Wilson 4-17-86
Process Support Engineer Date

Richard T. Russell
Test Leader

4/17/86
Date

sm e/74

48576-4756

Handwritten:
Hester
4/20/86

(T. L. L. L.)

Power Supply
#1
#24VDC

#1
#24VDC

#24VDC
BUS

#1
#24VDC

Power Supply
#2
#24VDC
BUS

#1
#24VDC

Power Supply
#3
#24VDC

CHART SPEEDS
FAST - 1 mm/sec
SLOW - 1 mm/min

19.2.16

Time - 19:24
Date: 03/17/86

THE CONTROL CORPORATION

#25
#104
#100
#1416

Power Supply
#43
#24VDC

#25
#104
#100
#1416

Power Supply
#2
#24VDC

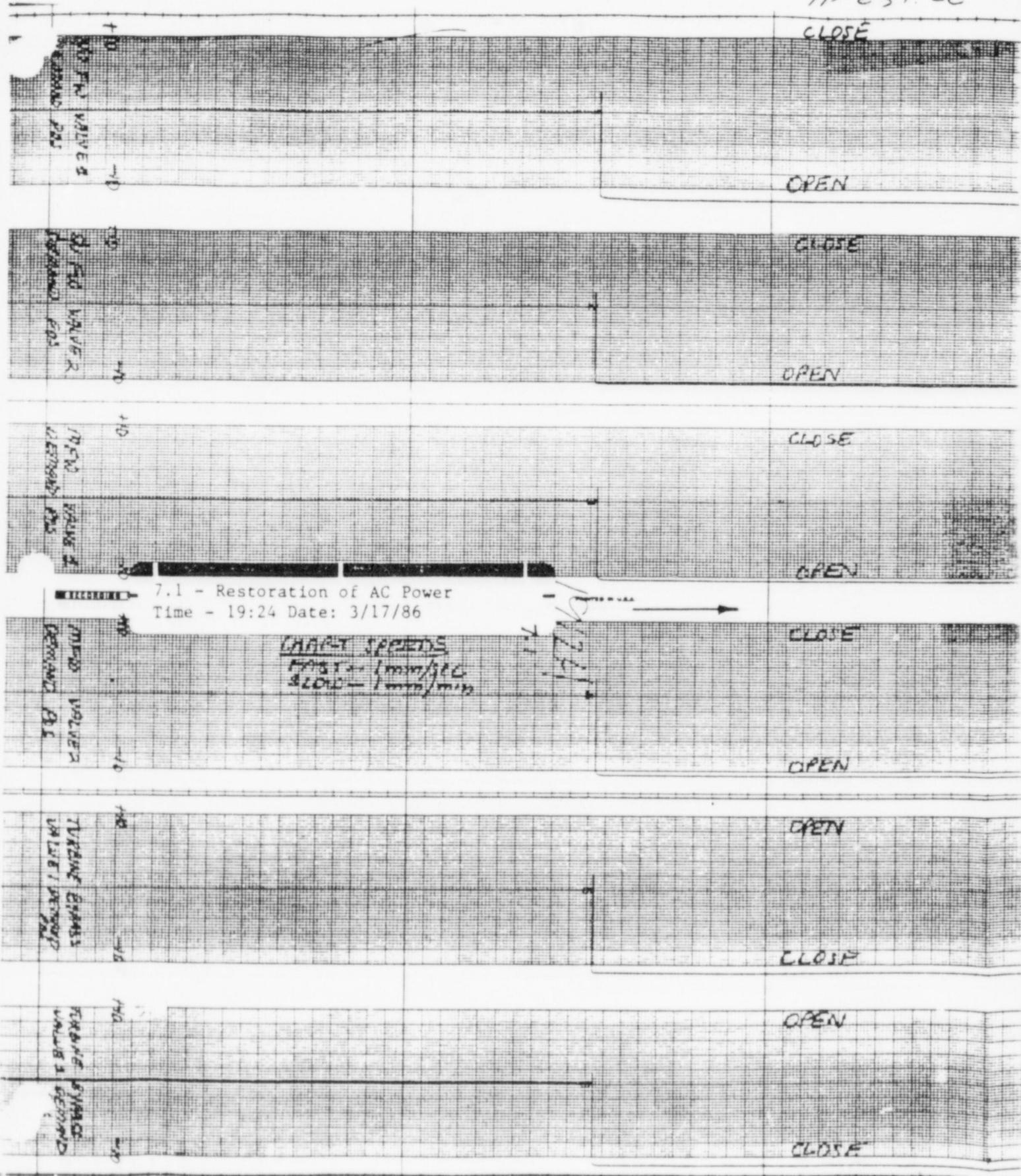
#25
#104
#100
#1416

Power Supply
#1
#24VDC

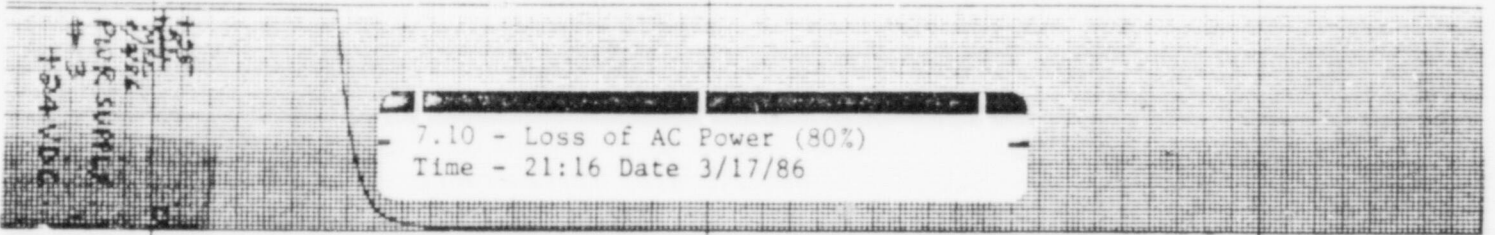
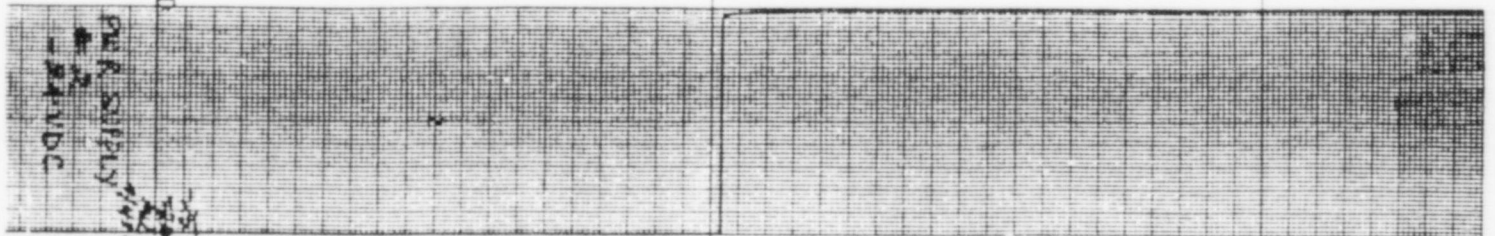
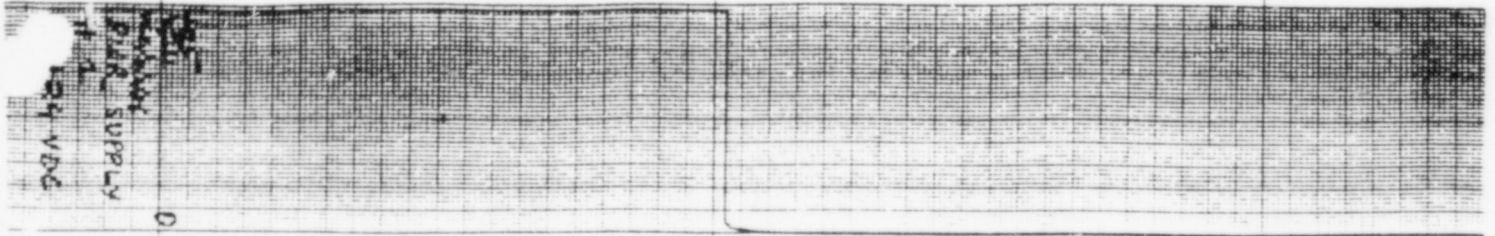
19.2.16
CHART SPEED
1 mm/sec
TEST 21
317-86
1984 ans

TP 651.23

TP 251.28

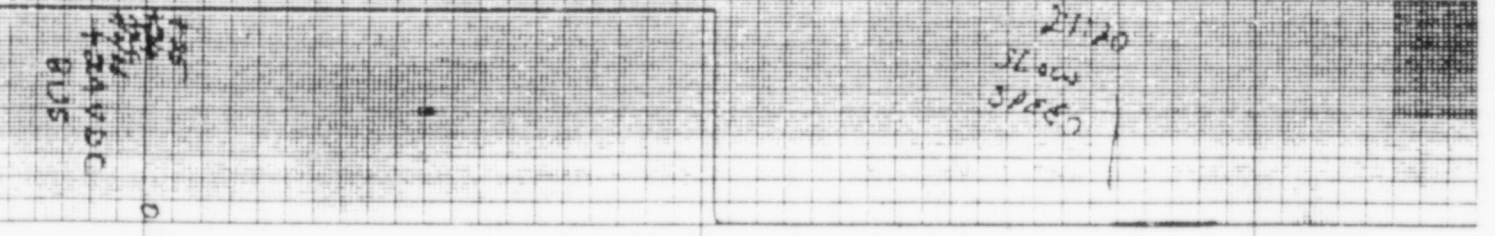
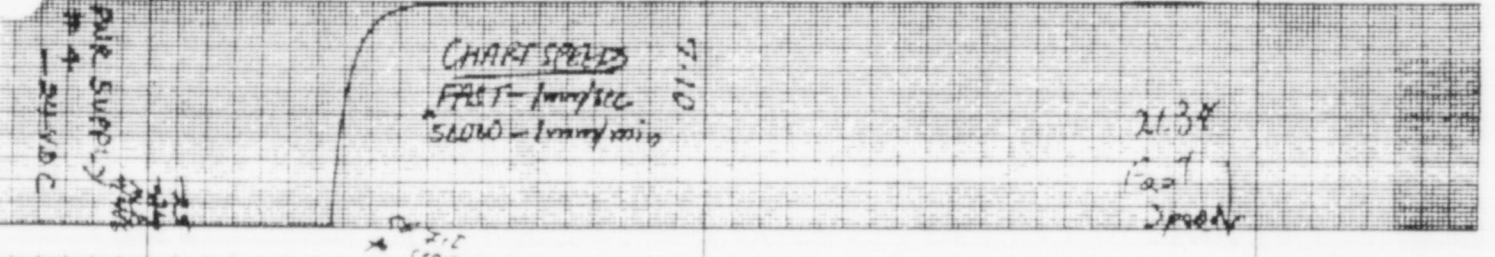


CTR 251.28

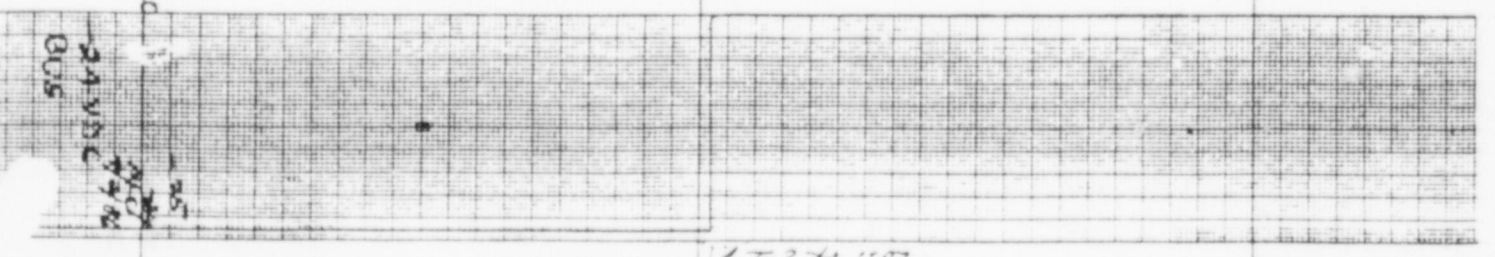


7.10 - Loss of AC Power (80%)
 Time - 21:16 Date 3/17/86

NO BSH 11-2963-21



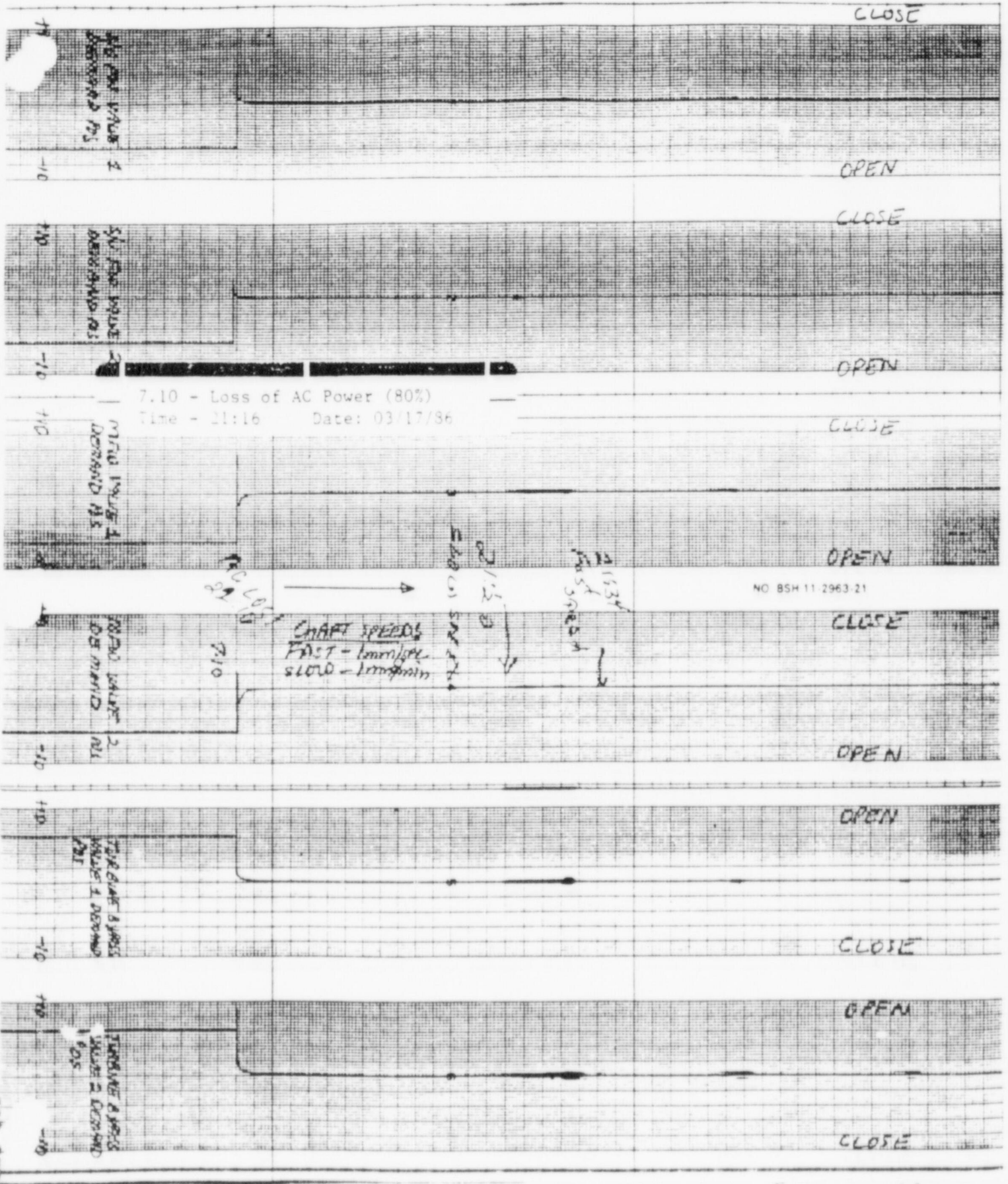
21:20
 SLOW
 SPEED



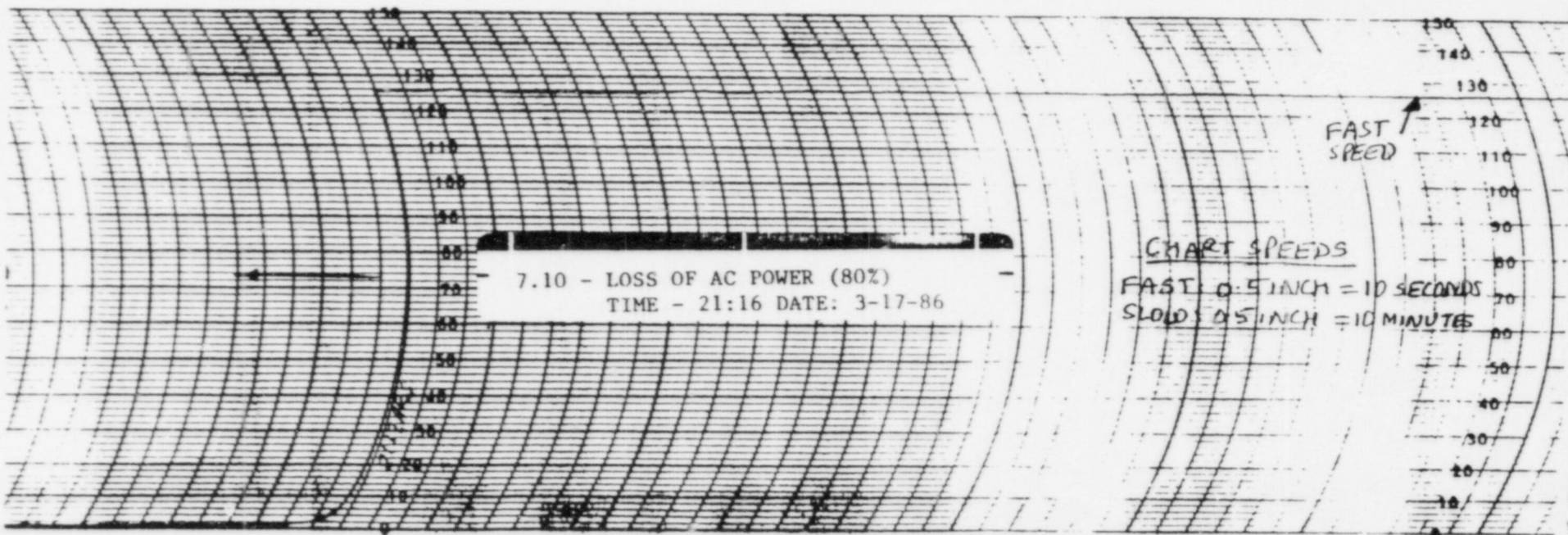
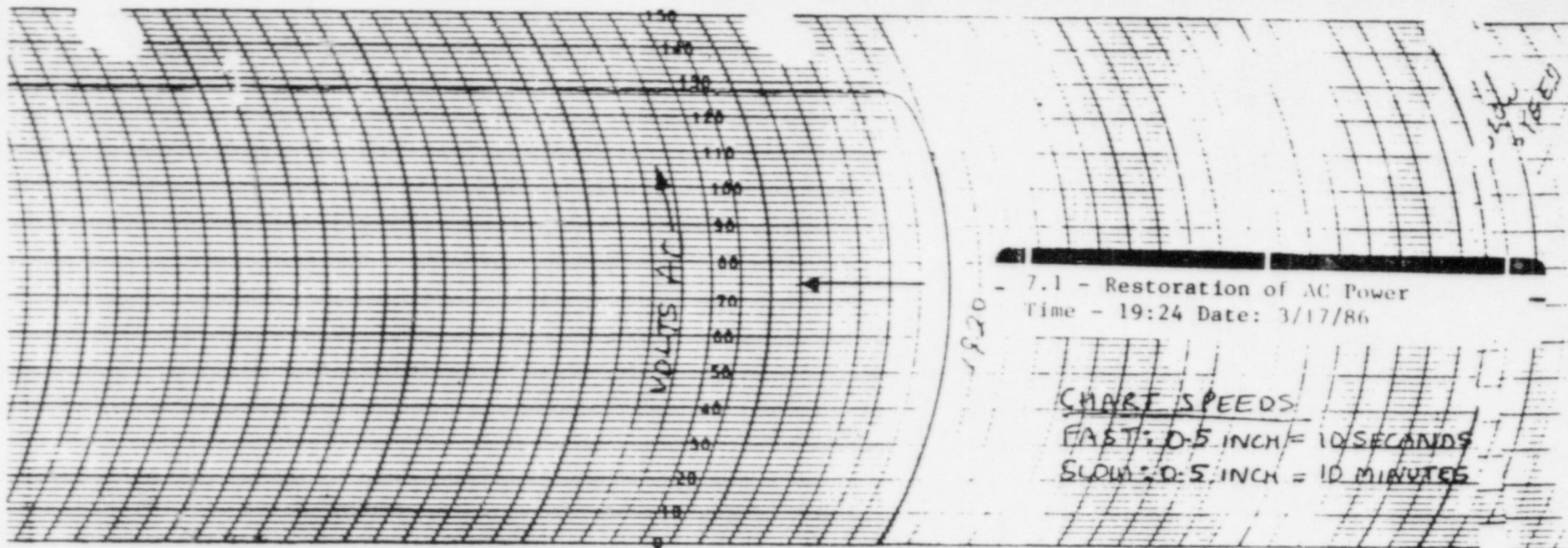
17 Feb 1986

A.T. Russell

TP EST. 28



C. R. R. R.



CTM

TP 57.25

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
PWR SUPPLY
2
+24VDC

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
PWR SUPPLY
2
+24VDC

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
PWR SUPPLY
3
+24VDC

7.11 - Restoration of AC Power (80%)
Time - 21:36 Date: 03/17/86

ROBERT H. TRAYNOR SIGNALING CONTROLS CORPORATION BUFFALO, NEW YORK

MADE IN U.S.A. →

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
PWR SUPPLY
4
+24VDC

CRASH SPEEDS
FAST - 1mm/SEC
SLOW - 1mm/1010

7.11

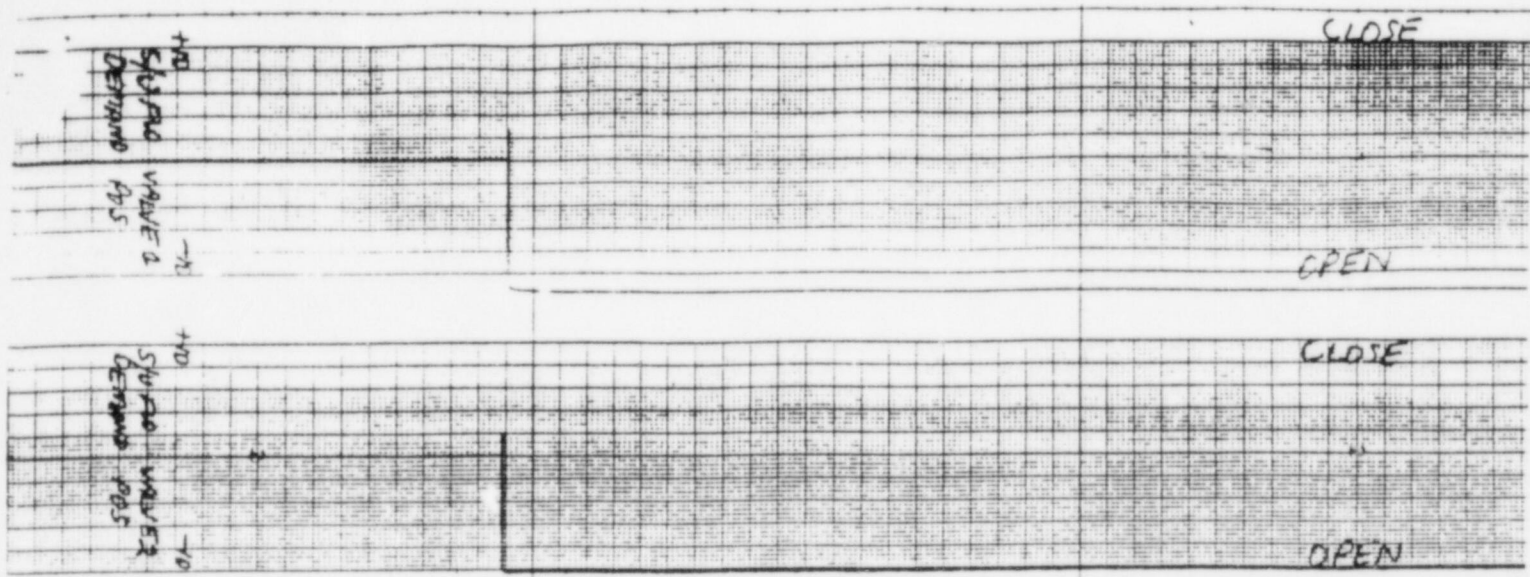
AC POWER ON
21:36
80%

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
PWR SUPPLY
5
+24VDC

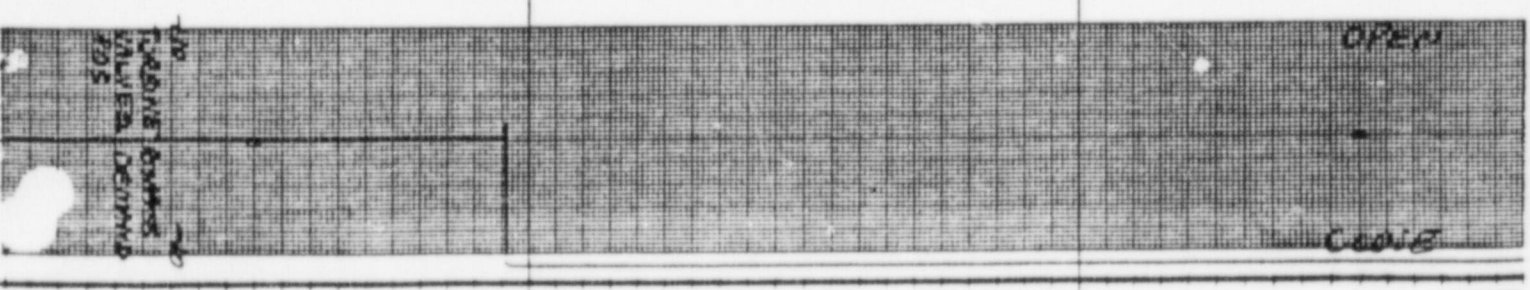
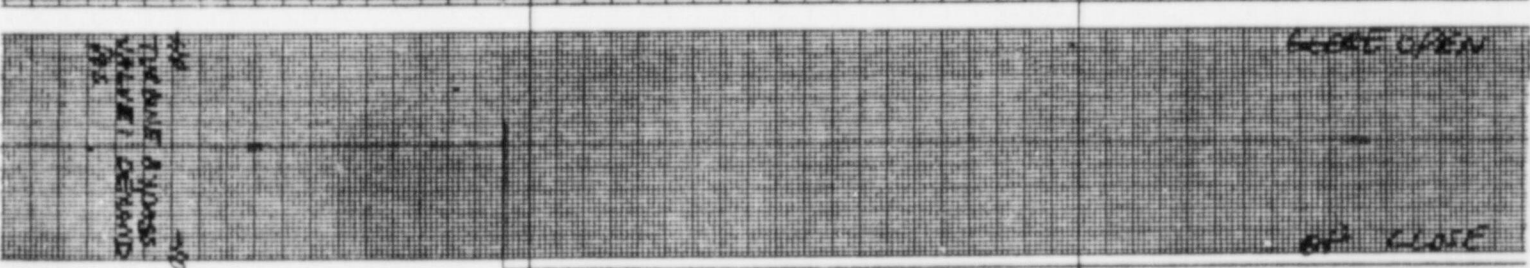
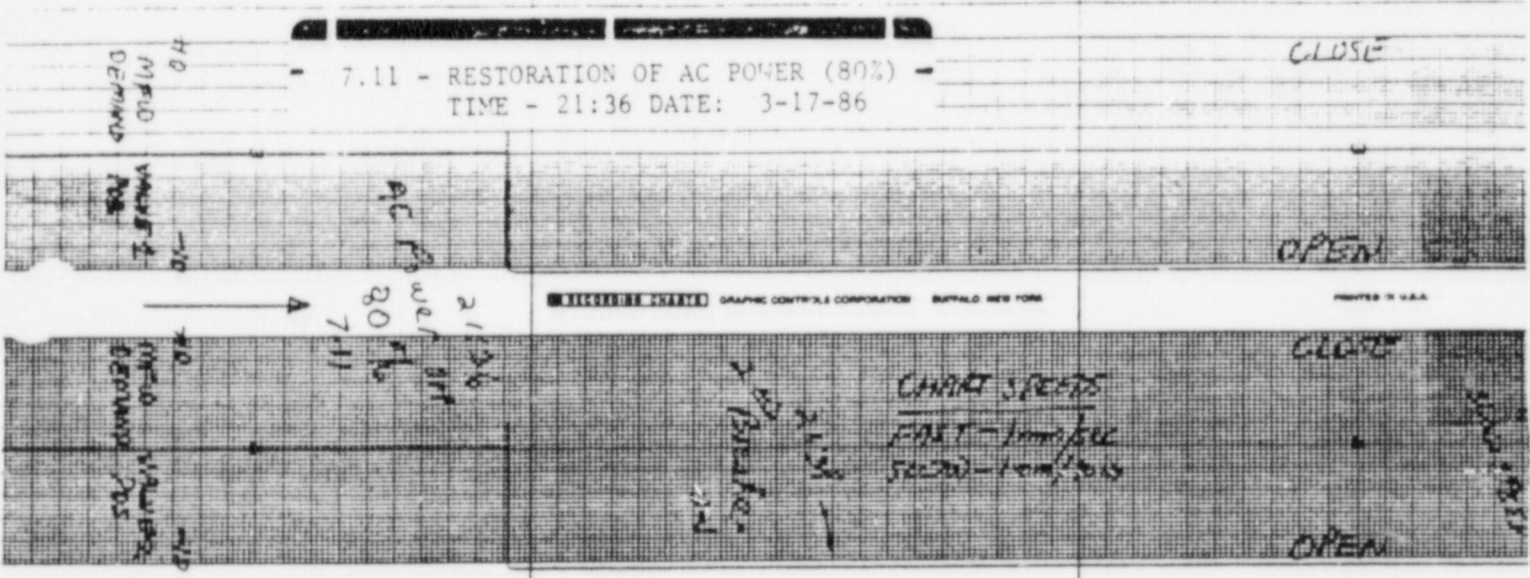
21:37
80%
AC POWER ON

+25
+20
+15
+10
+5
0
-5
-10
-15
-20
-25
BUS
+24VDC

OT Russell



7.11 - RESTORATION OF AC POWER (80%)
 TIME - 21:36 DATE: 3-17-86



CTR 11111

PLUG SUPPLY #1
-24VDC

PLUG SUPPLY #2
-24VDC

PLUG SUPPLY #3
+24VDC

PLUG SUPPLY #4
-24VDC

PLUG SUPPLY #5
+24VDC

PLUG SUPPLY #6
-24VDC

7.12 - Loss of AC Power (30%)
Time - 22:02 Date 03/17/86

RECORDED CHART GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

PRINTED IN U.S.A.

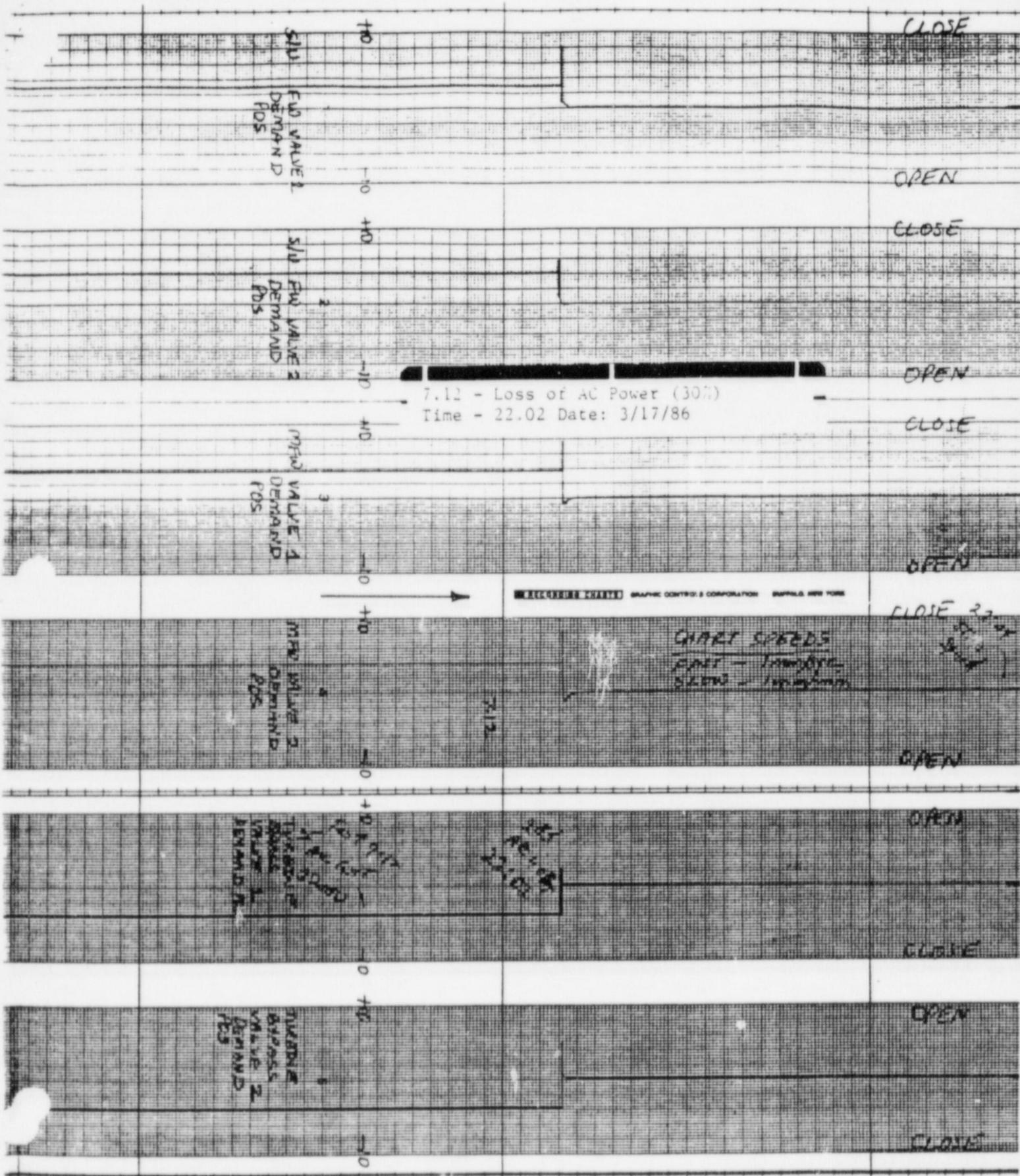
Test 712
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AC Lost

CHART SPEEDS
FAST - 1mm/sec
SLOW - 1mm/min

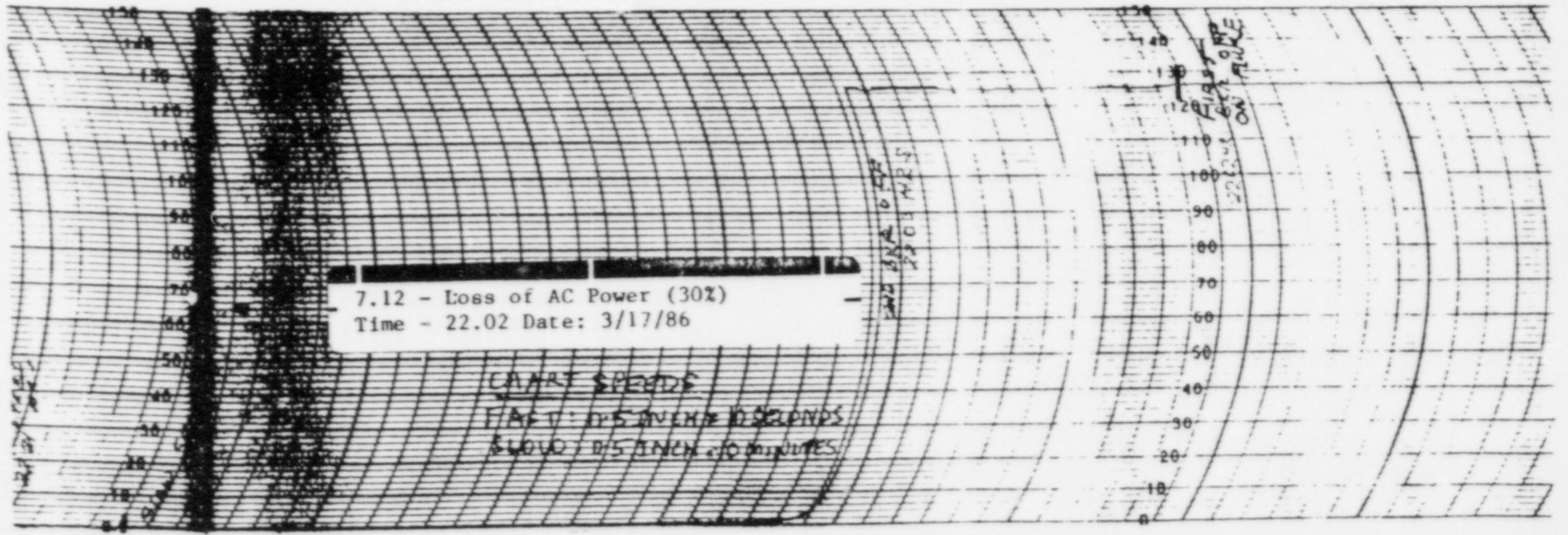
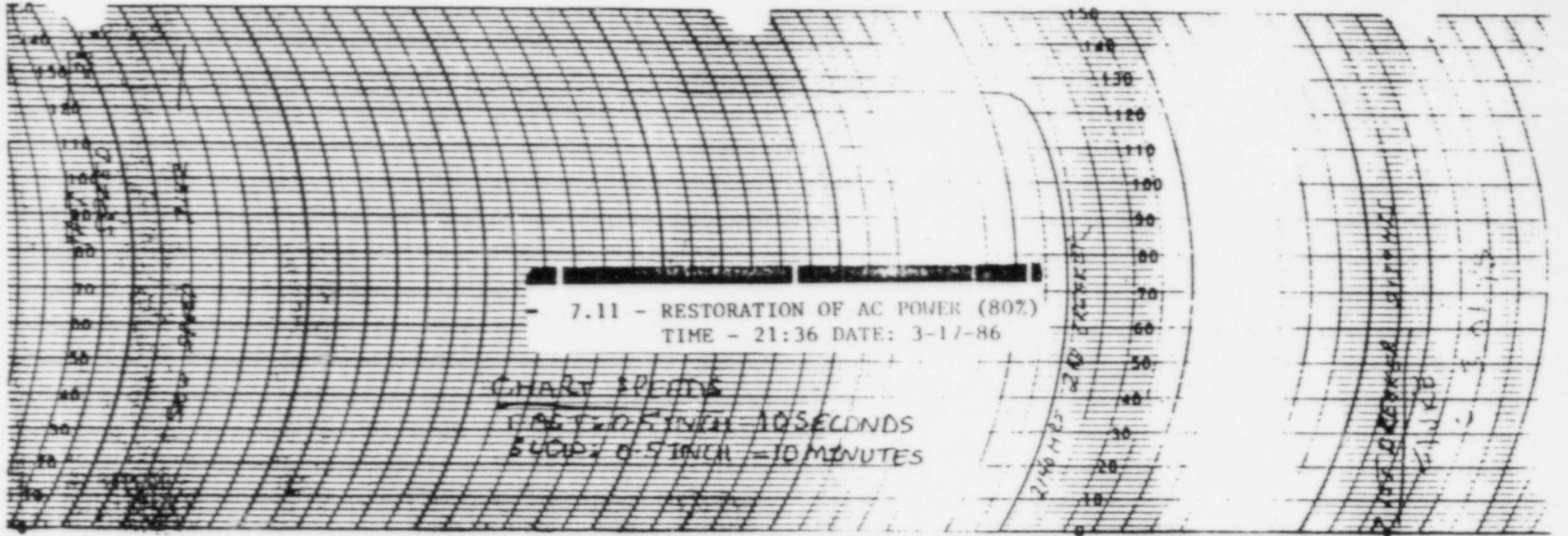
22:02
2nd AC Lost

CITRUS

TP 251.28



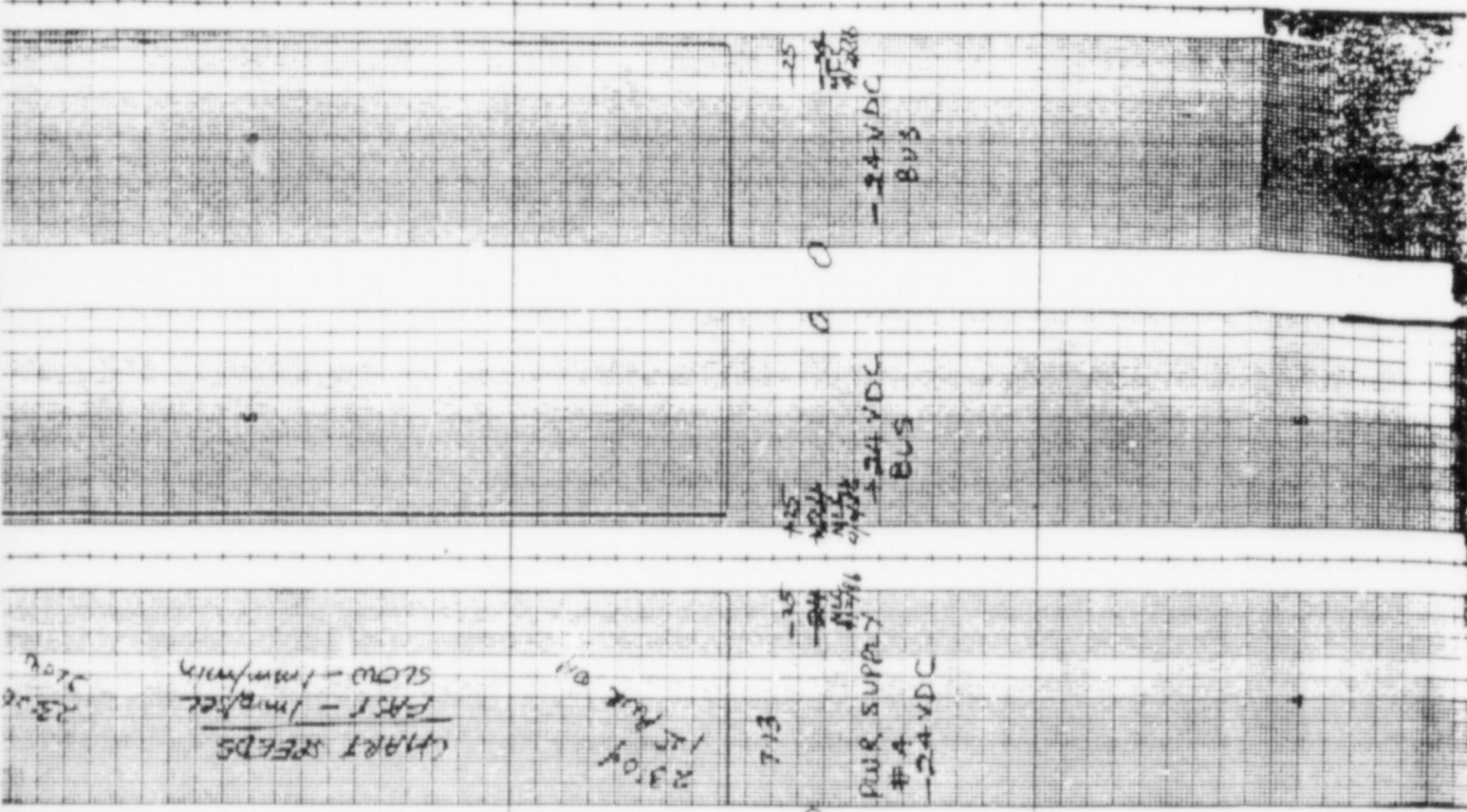
OT Russell



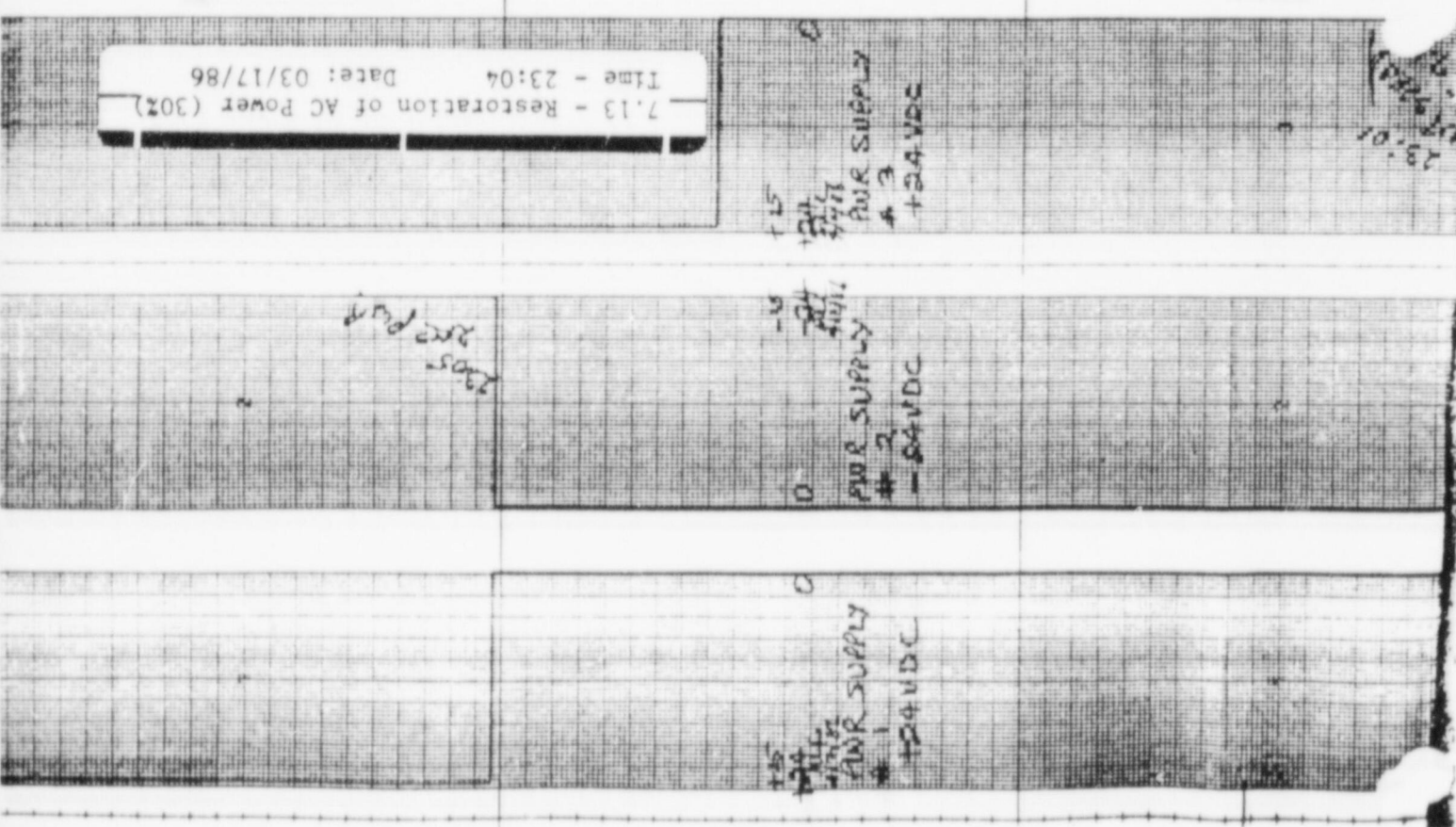
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7751.2

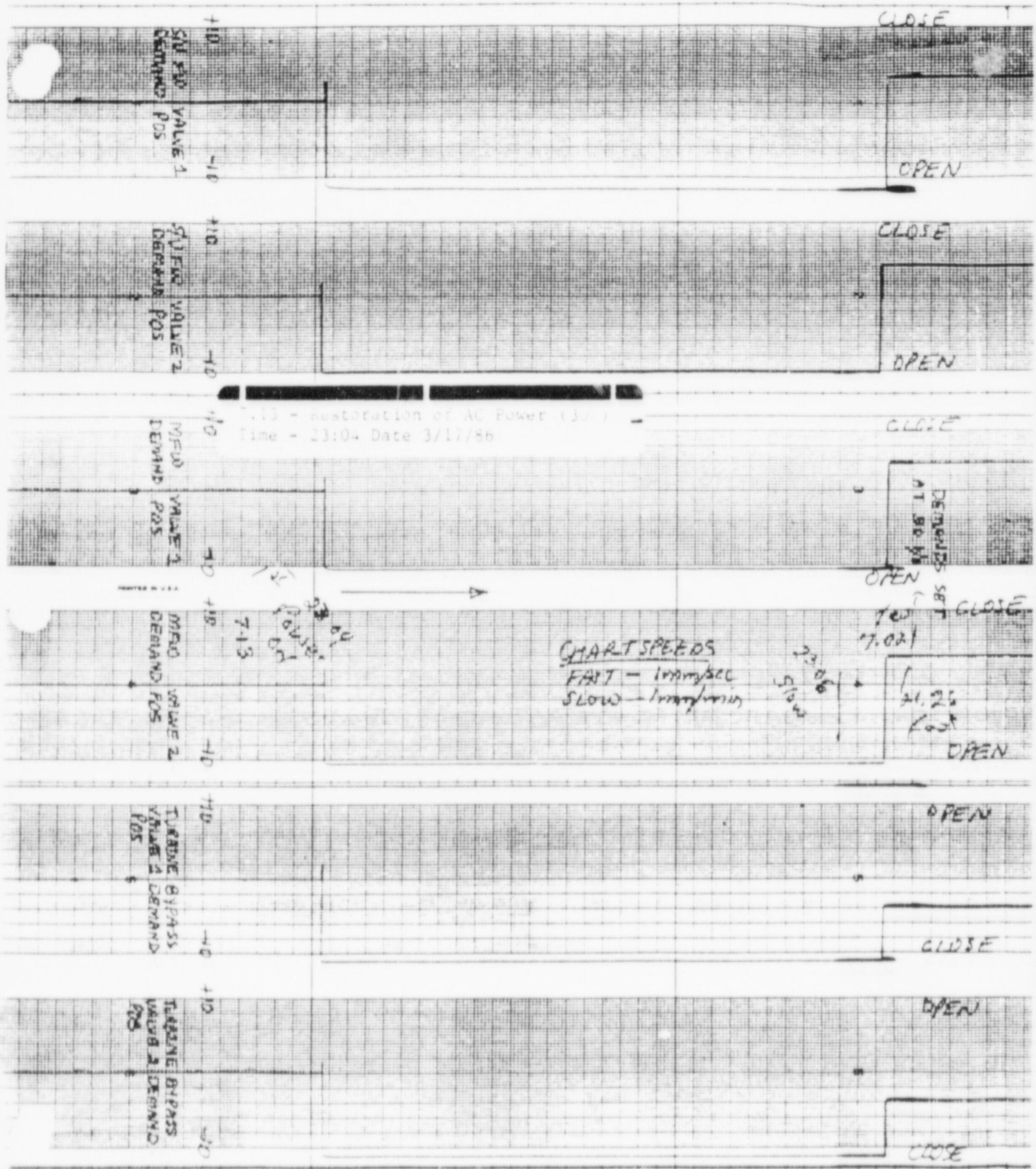
GIRARD



7.13 - Restoration of AC Power (30%)
Time - 23:04
Date: 03/17/86



7.13 23:05

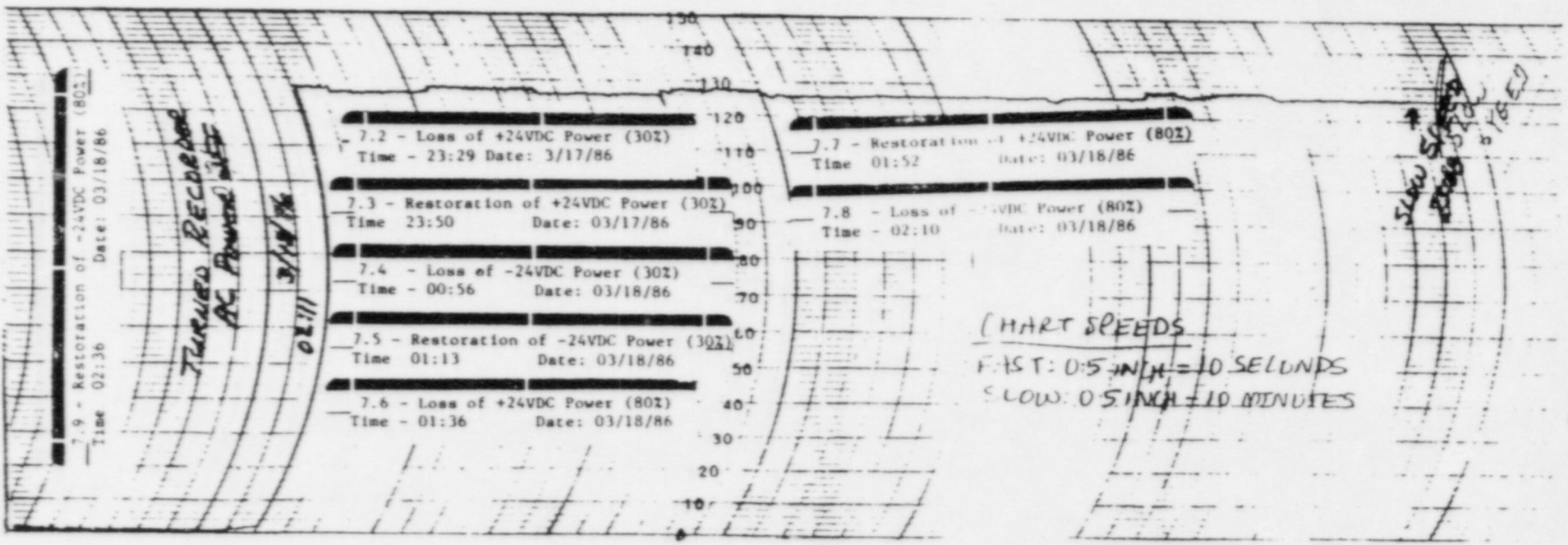
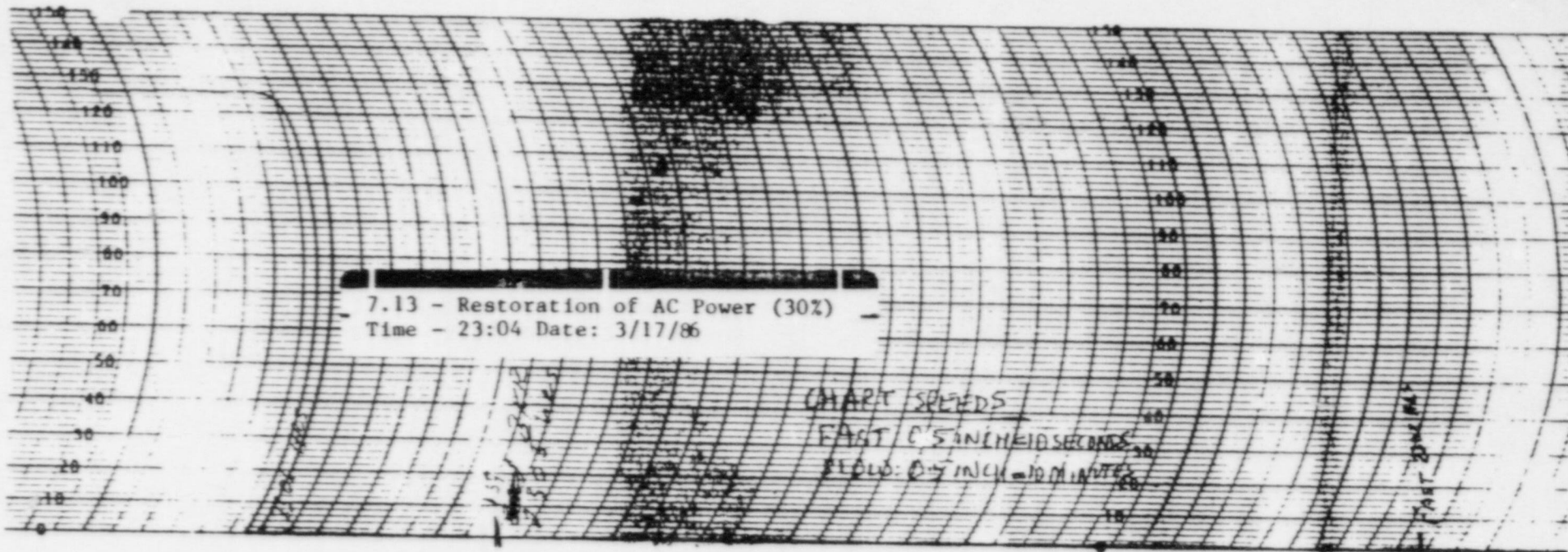


7-13
 23:04
 23:04
 23:04

CHART SPEEDS
 FAST - 1mm/sec
 SLOW - 1mm/min

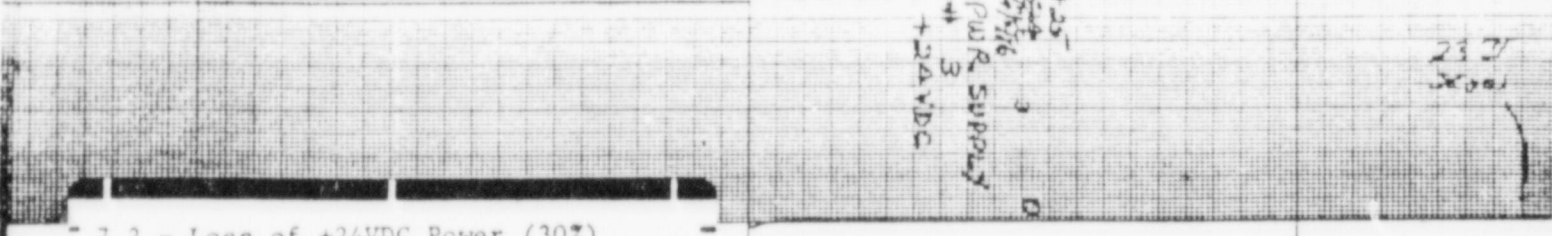
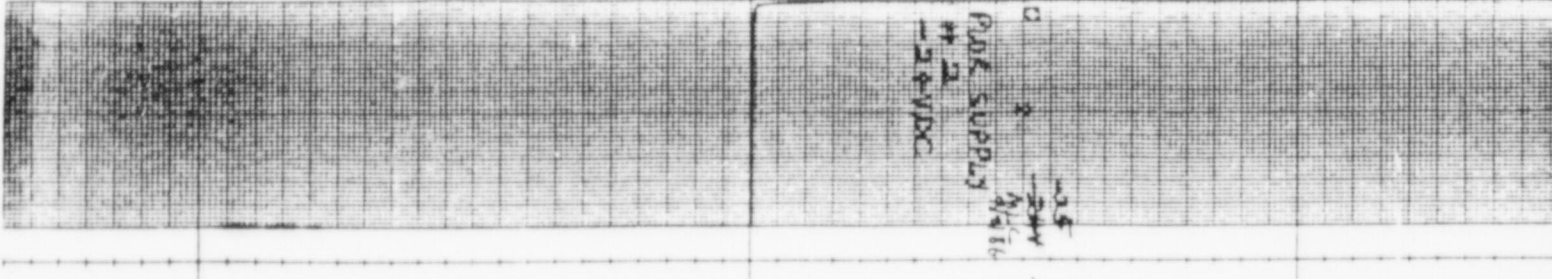
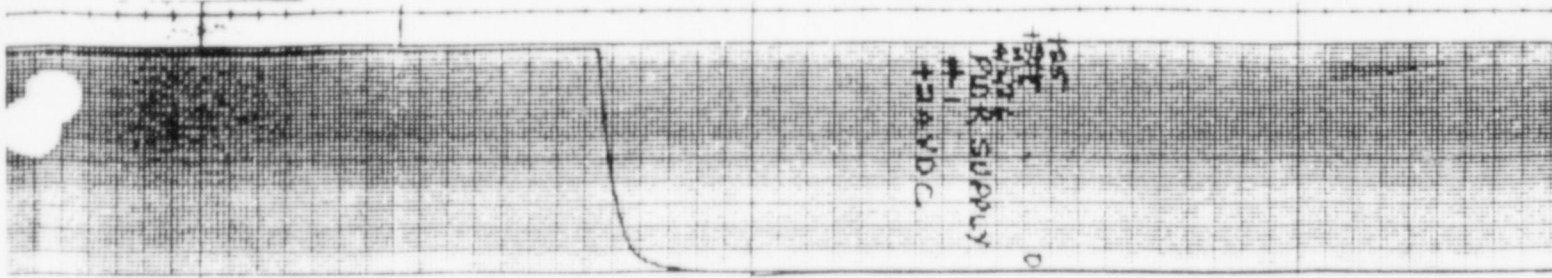
23:04
 7.02
 21.25

G. Russell

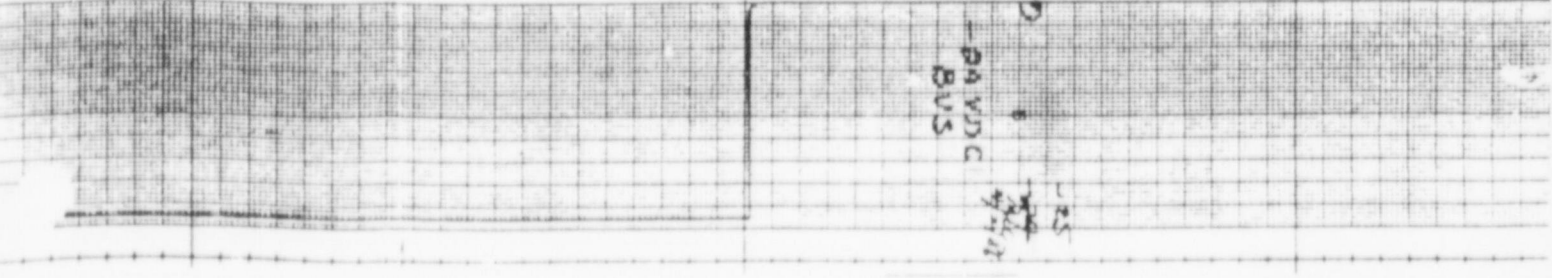
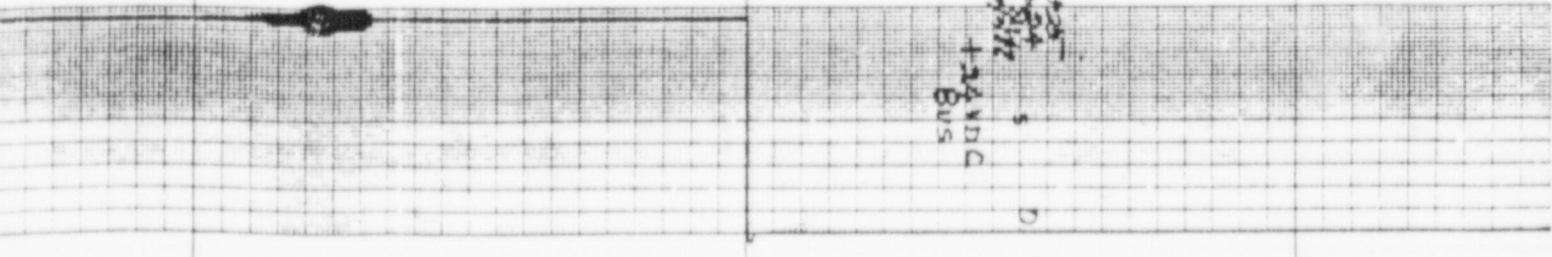
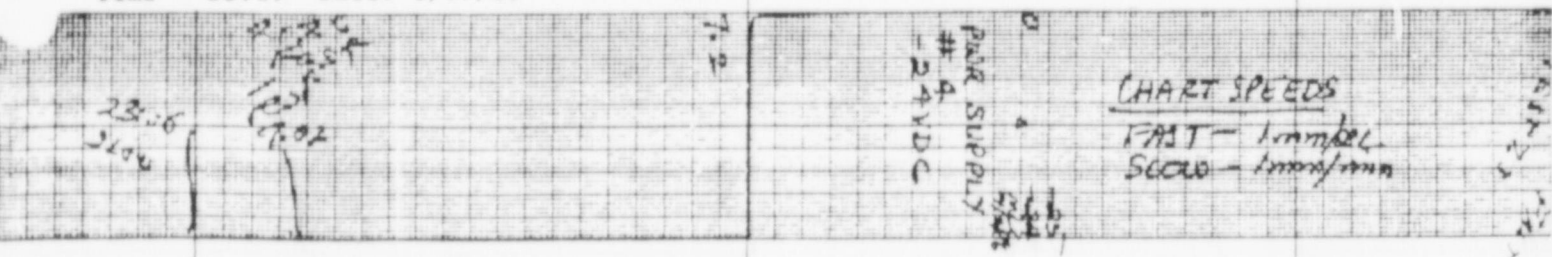


Primer

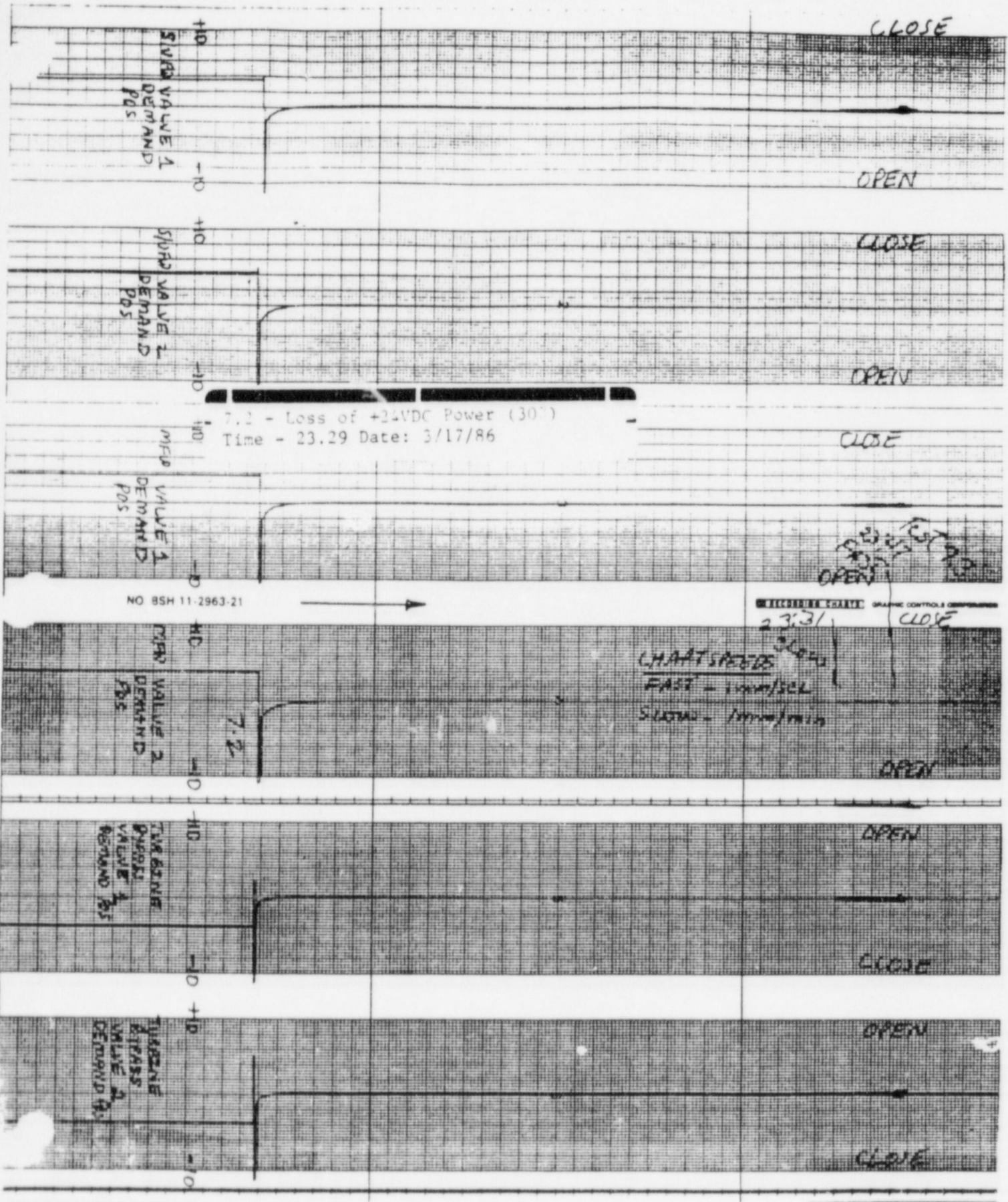
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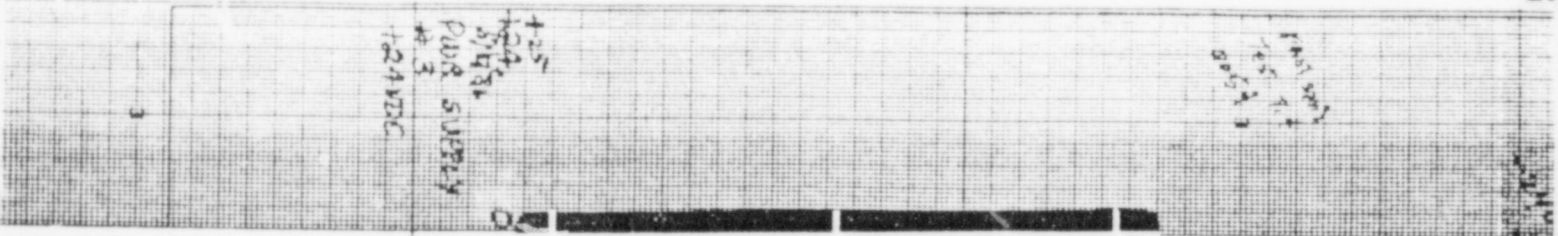
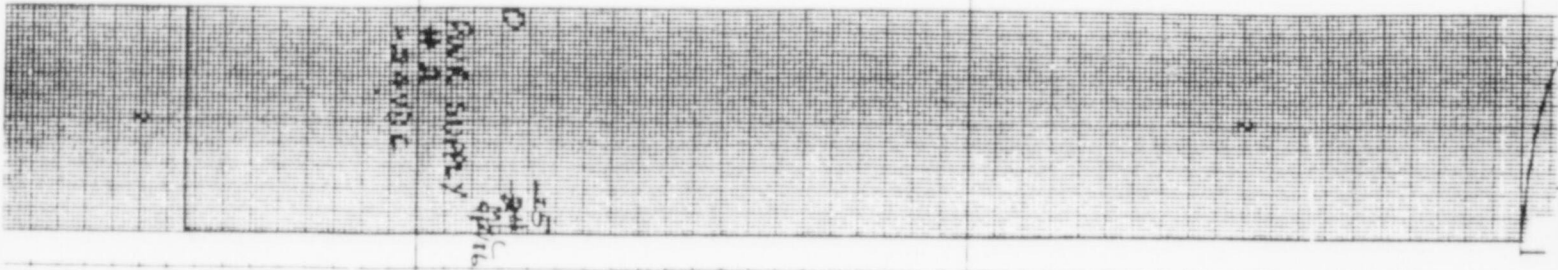
7.2 - Loss of +24VDC Power (30%)
Time - 23.29 Date: 3/17/86



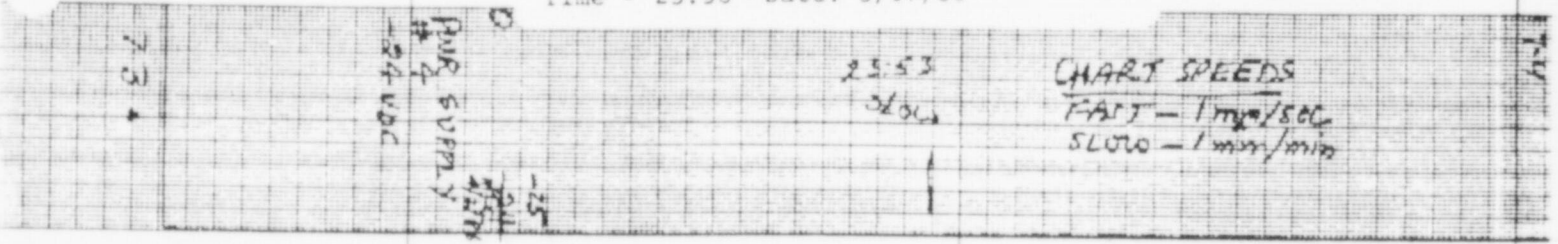
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G. Russell

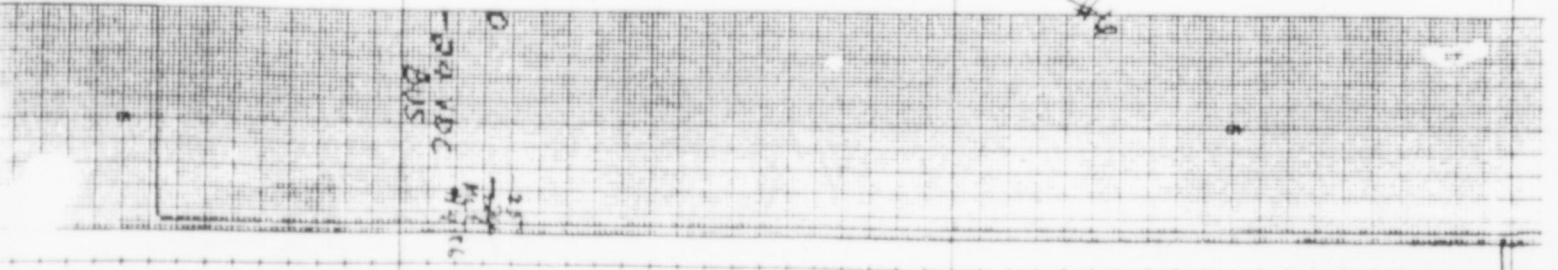
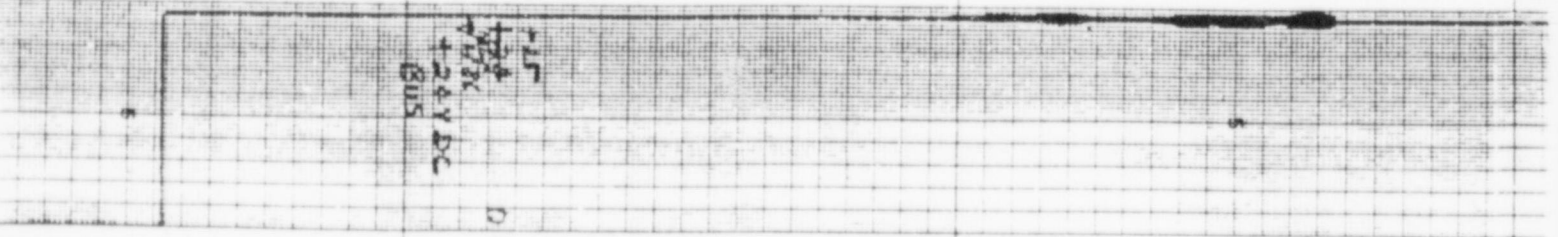


7.3 - Restoration of +24VDC Power (30%)
Time - 23:50 Date: 3/17/86



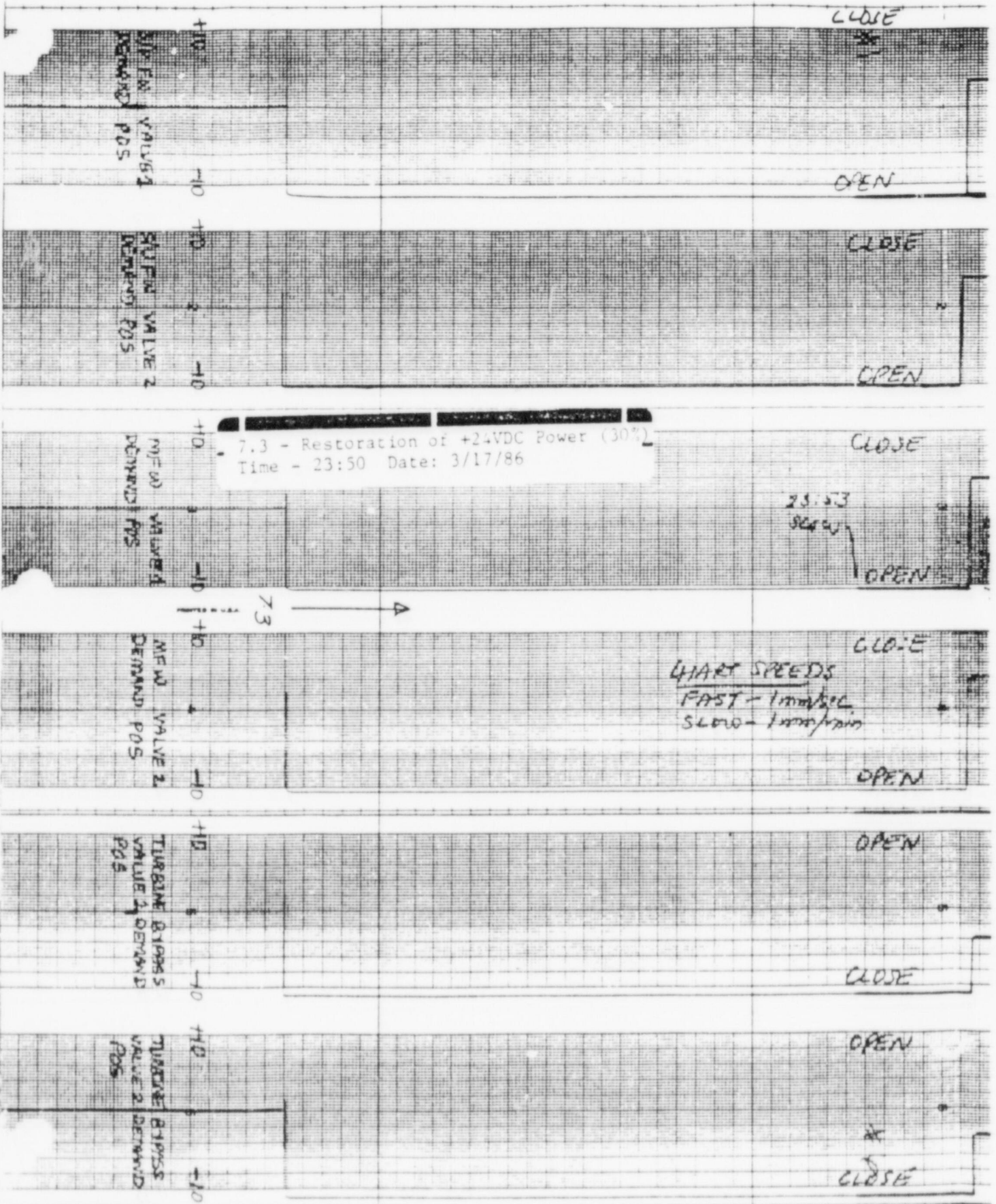
23:53
23:54

CHART SPEEDS
FAST - 1mm/SEC
SLOW - 1mm/min

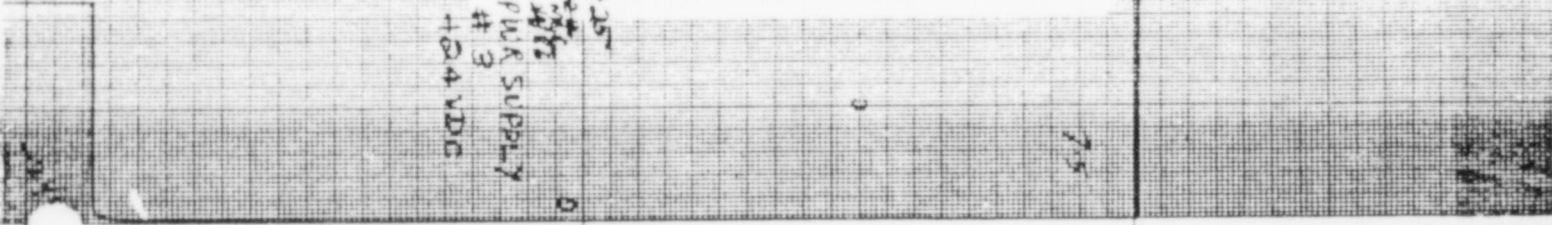
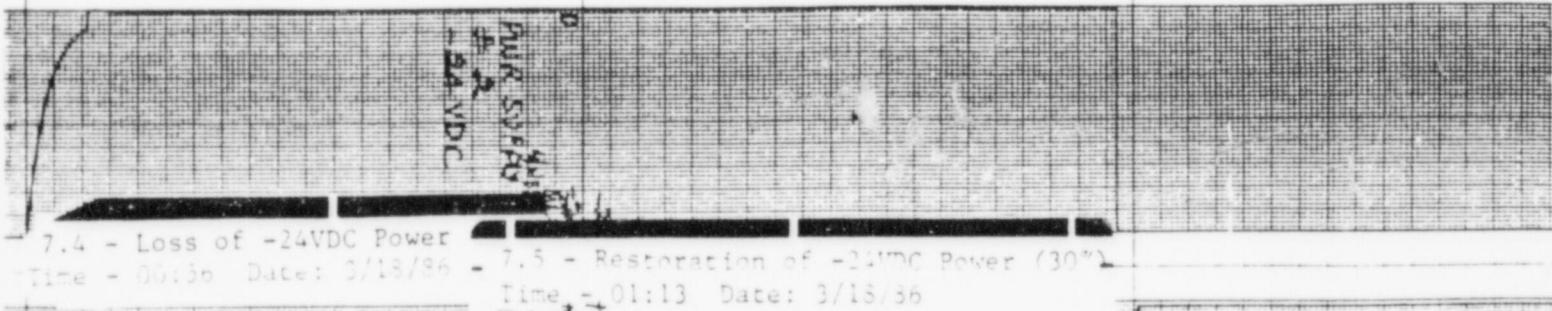
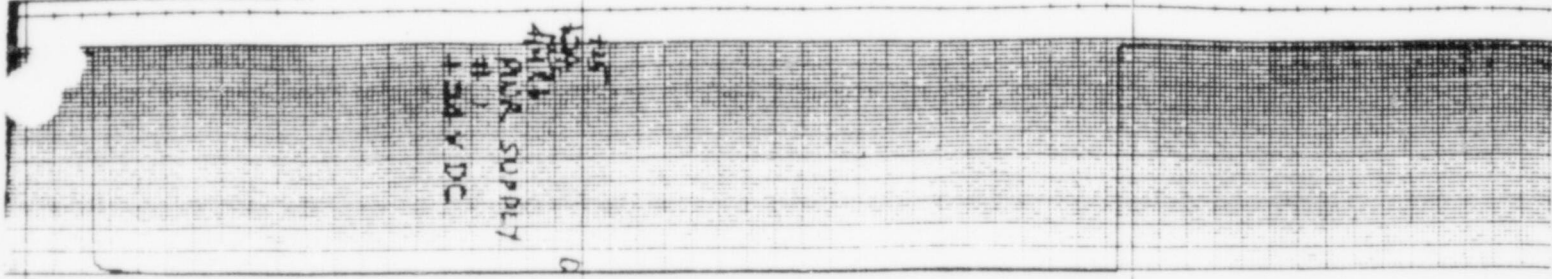


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C. Russell



NO BSH 11-2963-21

RECORDING CHARTS GRAPHIC CONTROLS CORPORATION

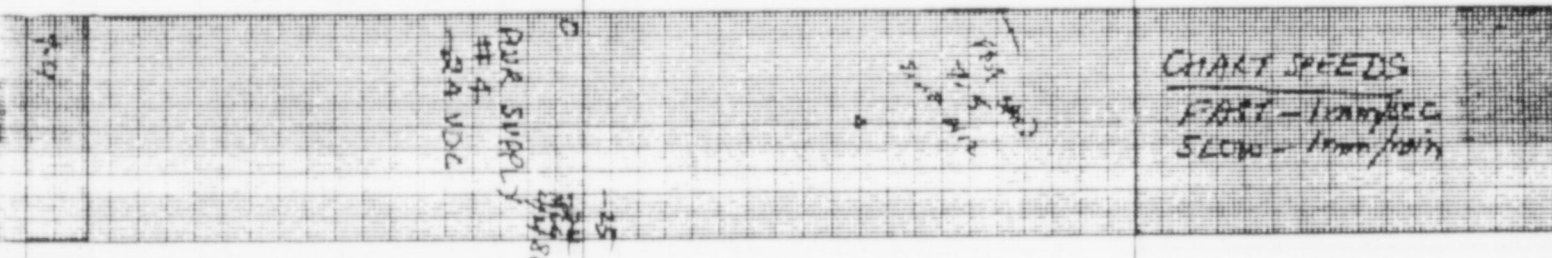
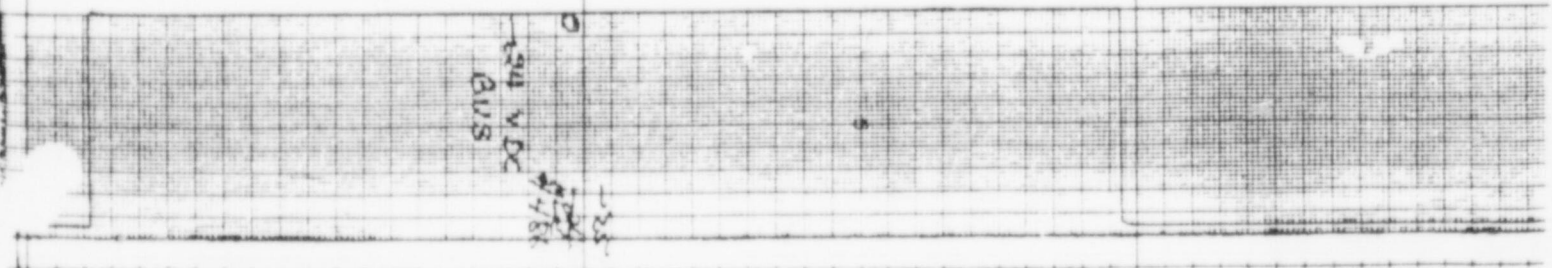
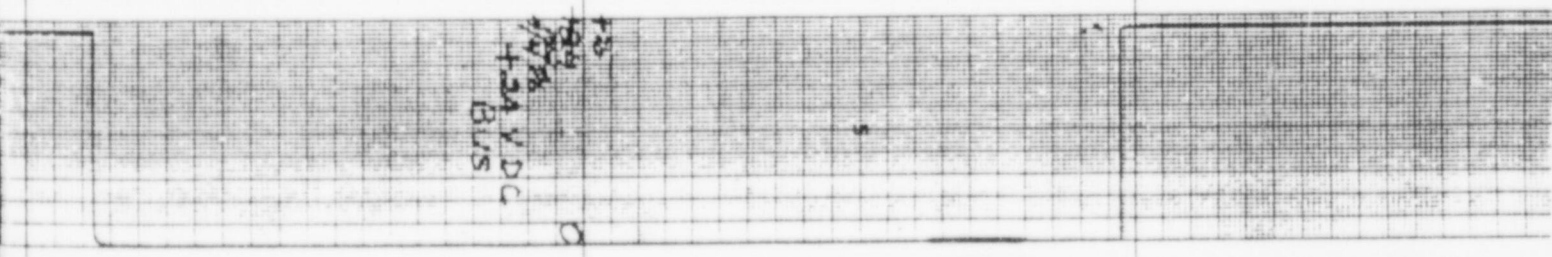
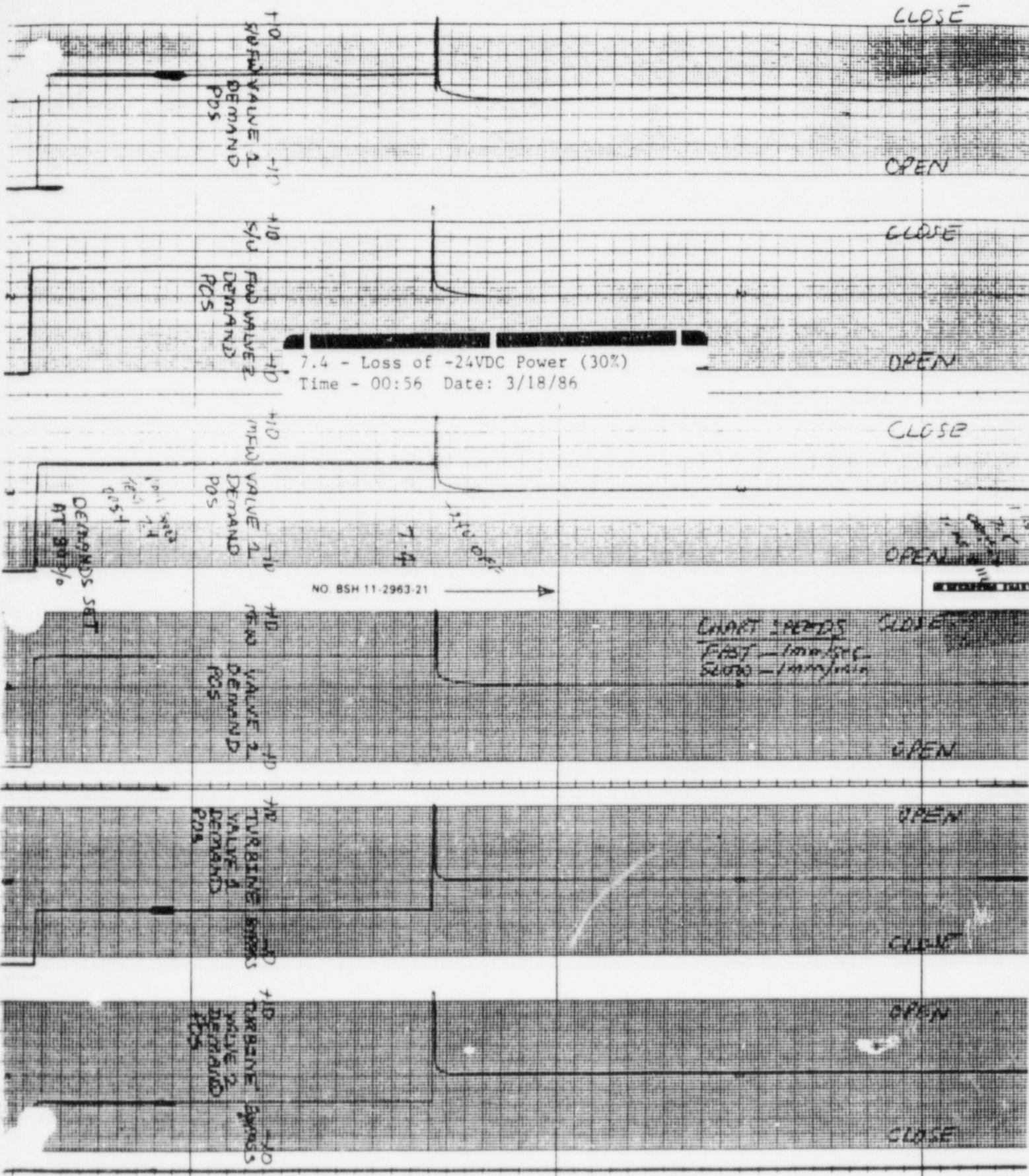


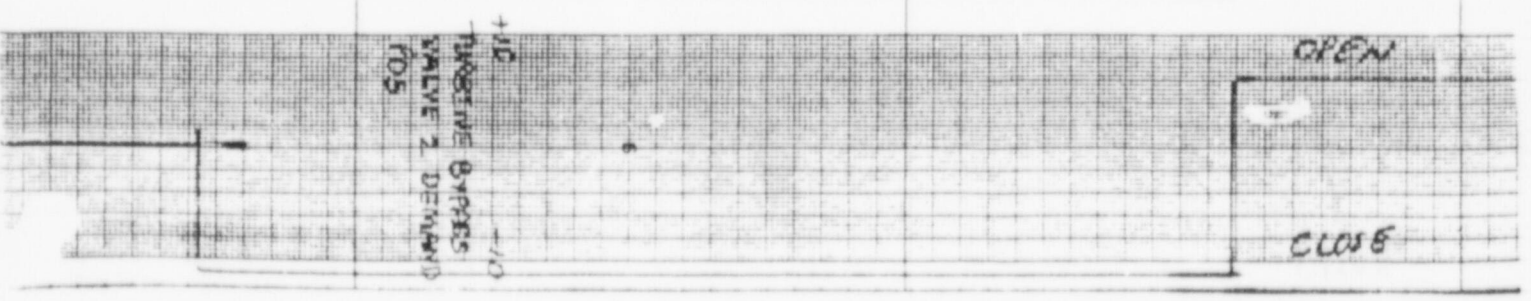
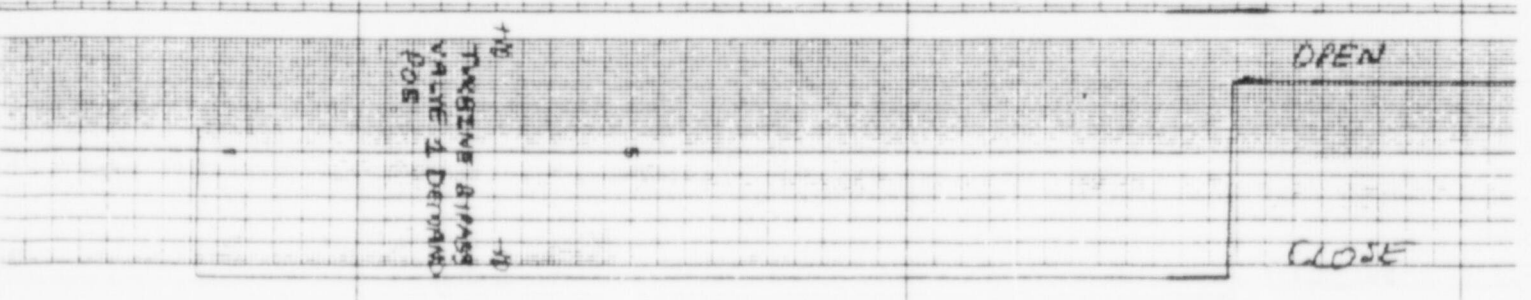
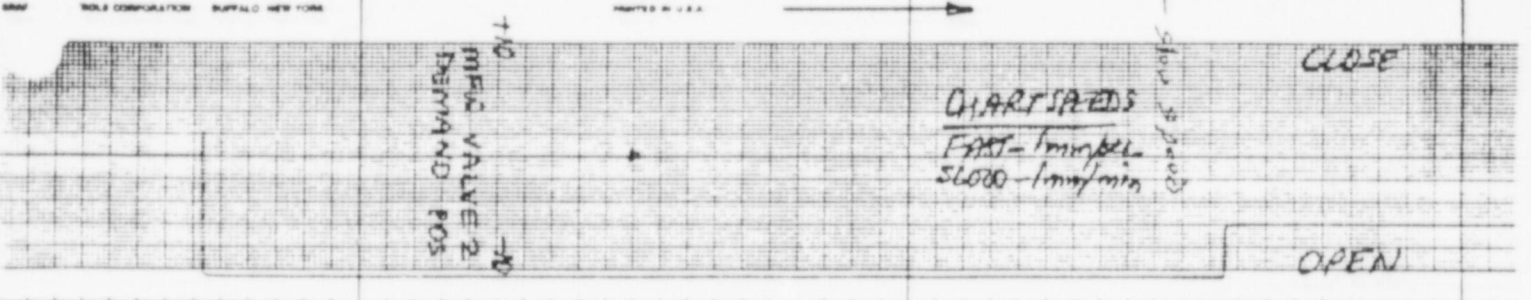
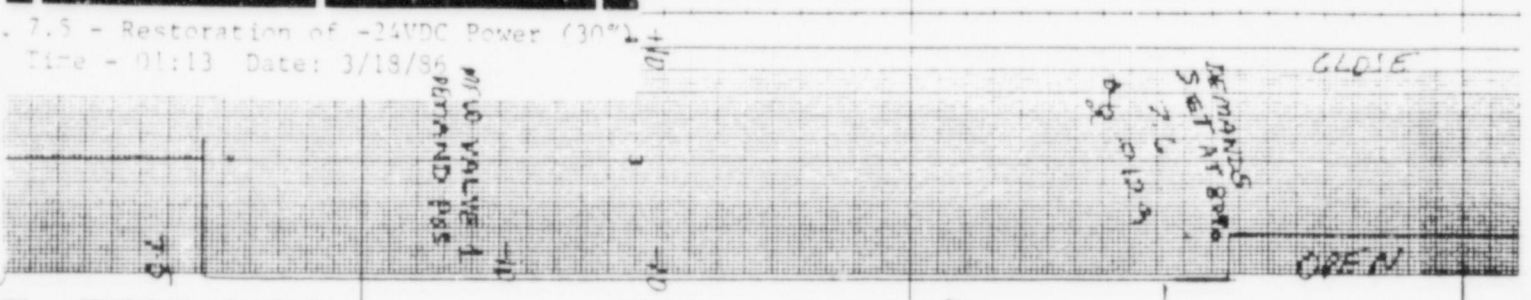
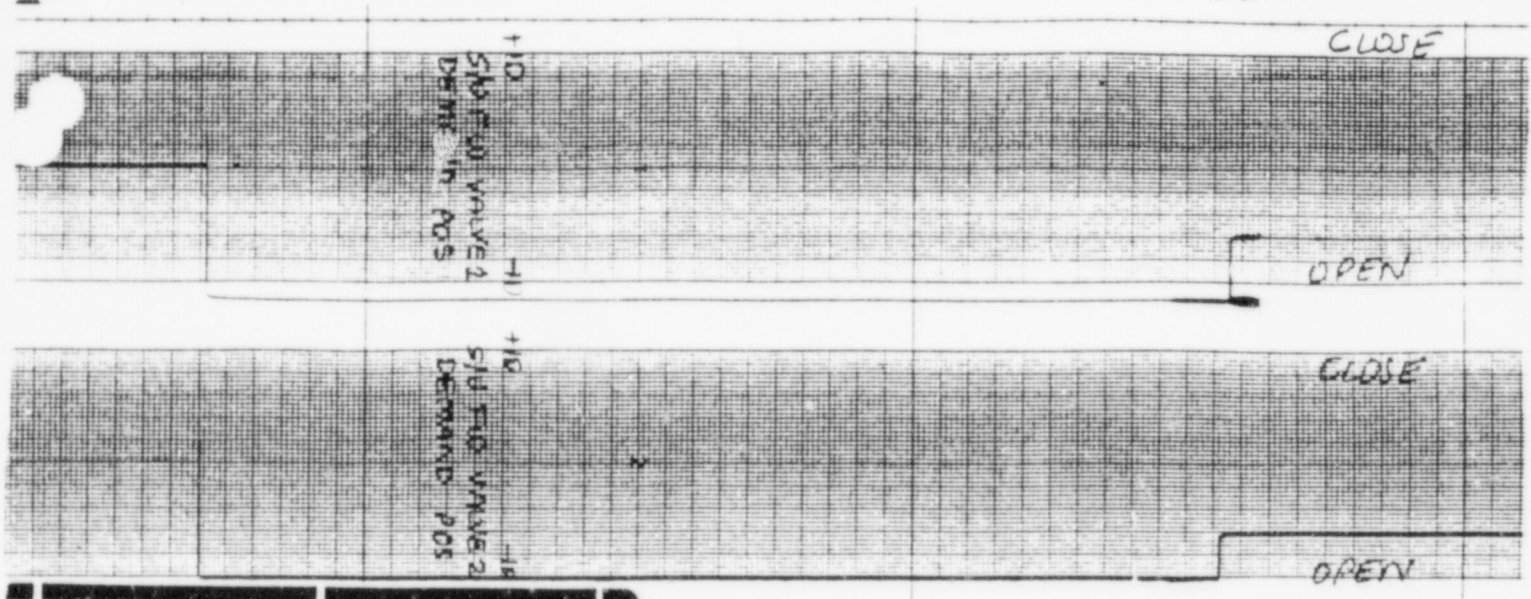
CHART SPEEDS
 FAST - 1000 SEC
 SLOW - 10000 MIN



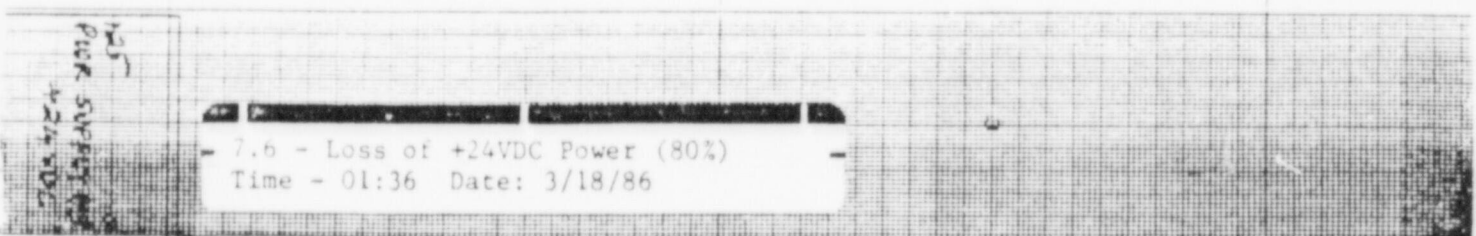
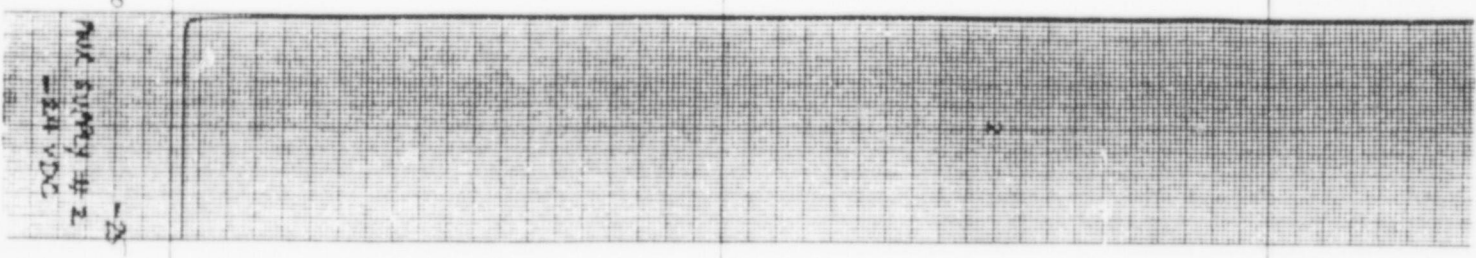
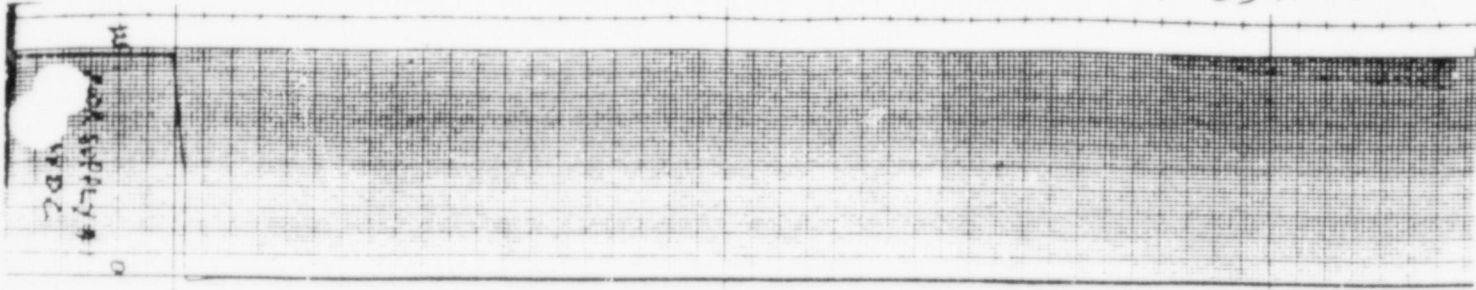
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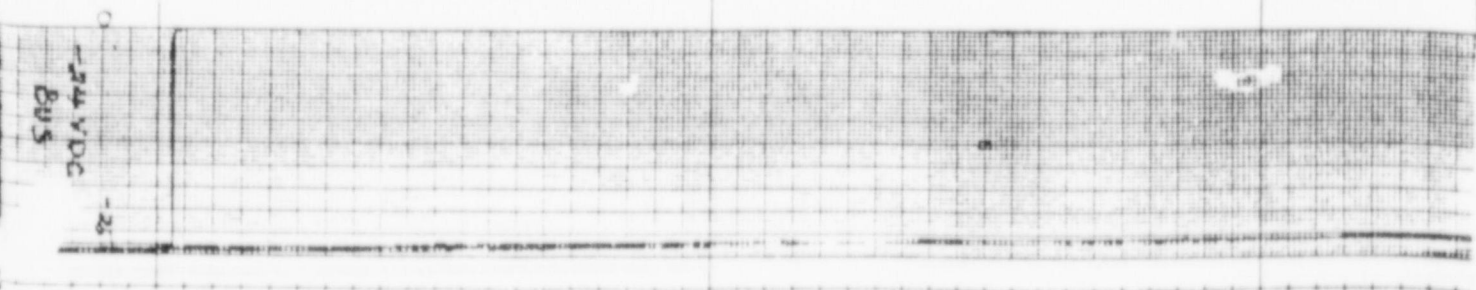
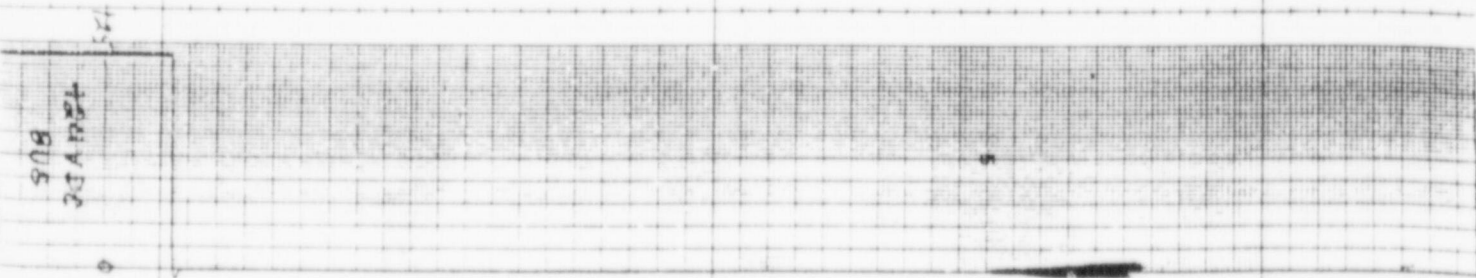
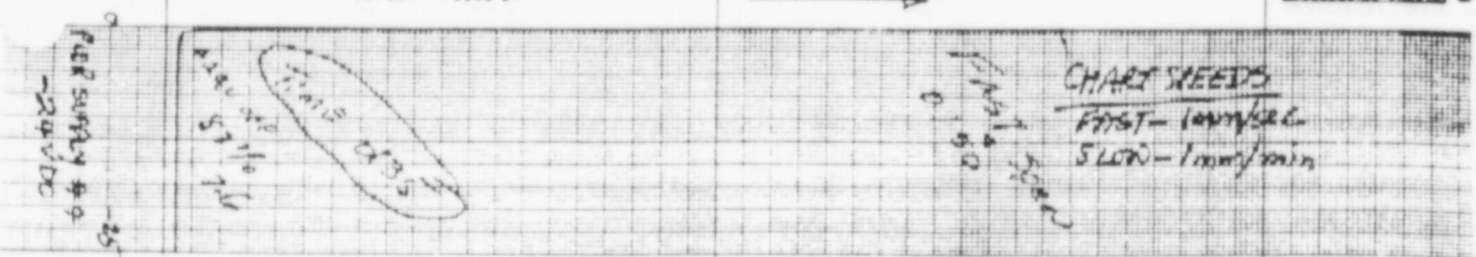


C. Russell

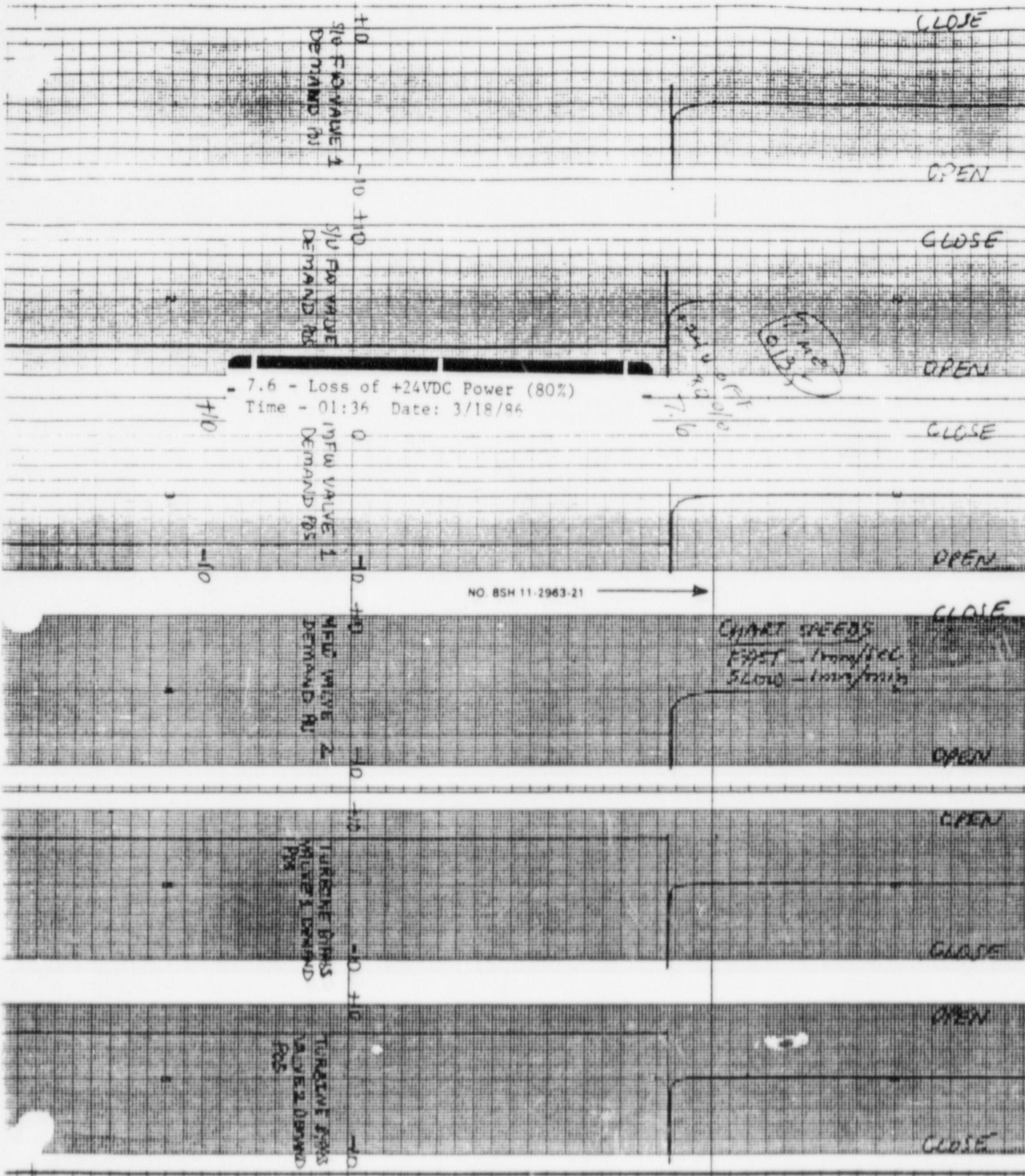


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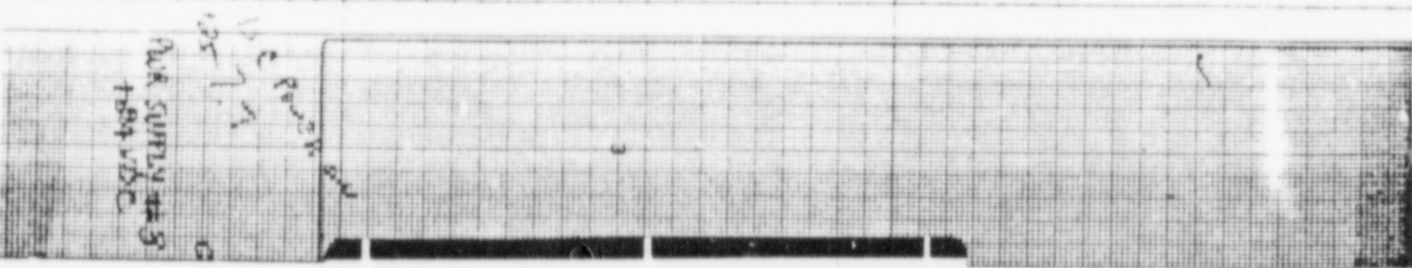
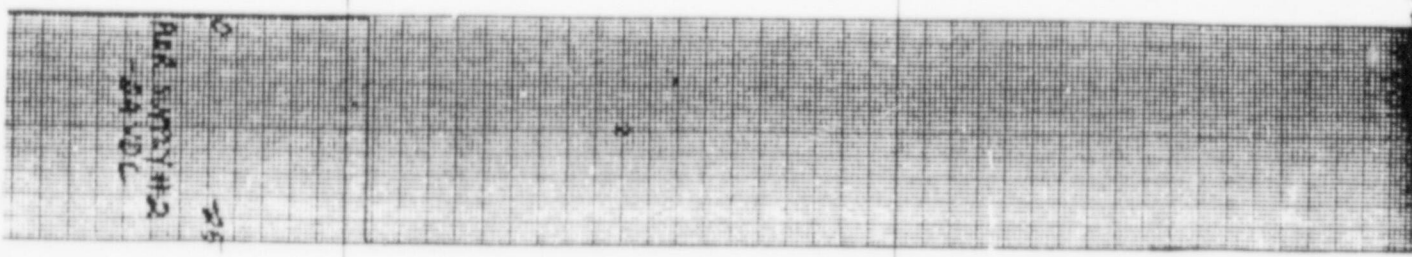
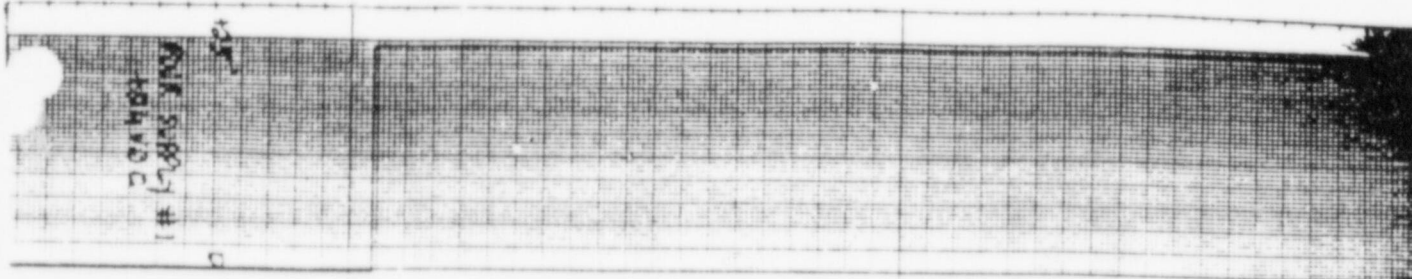
MEASURE VALUE



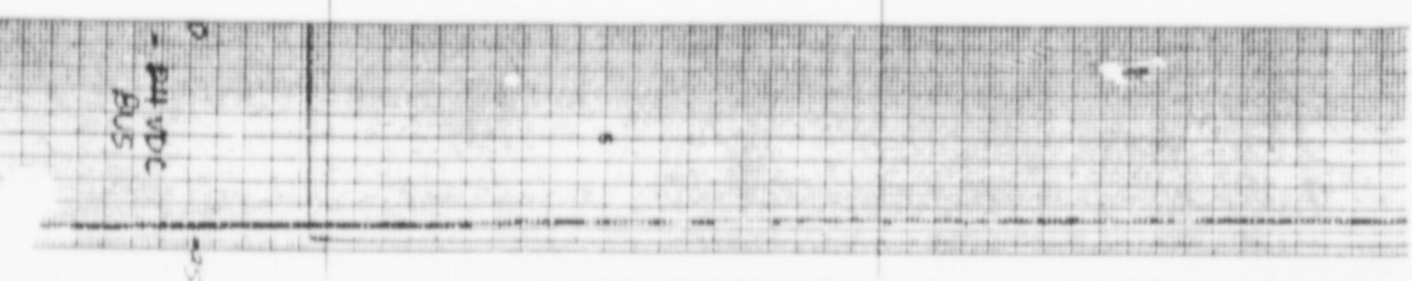
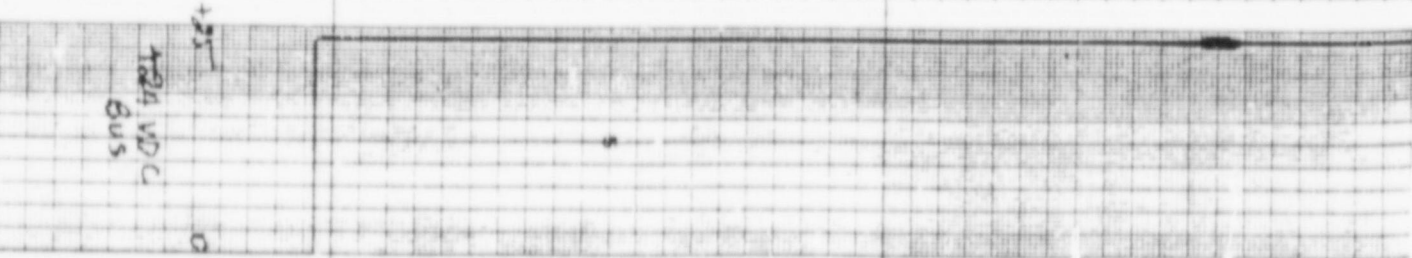
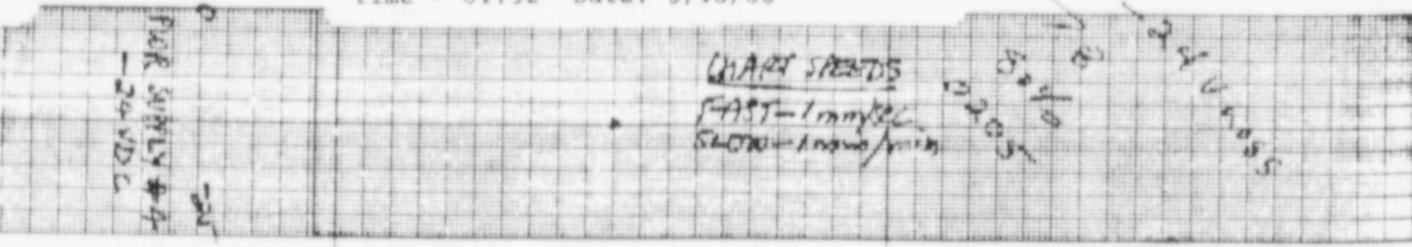
OTR... (signature)



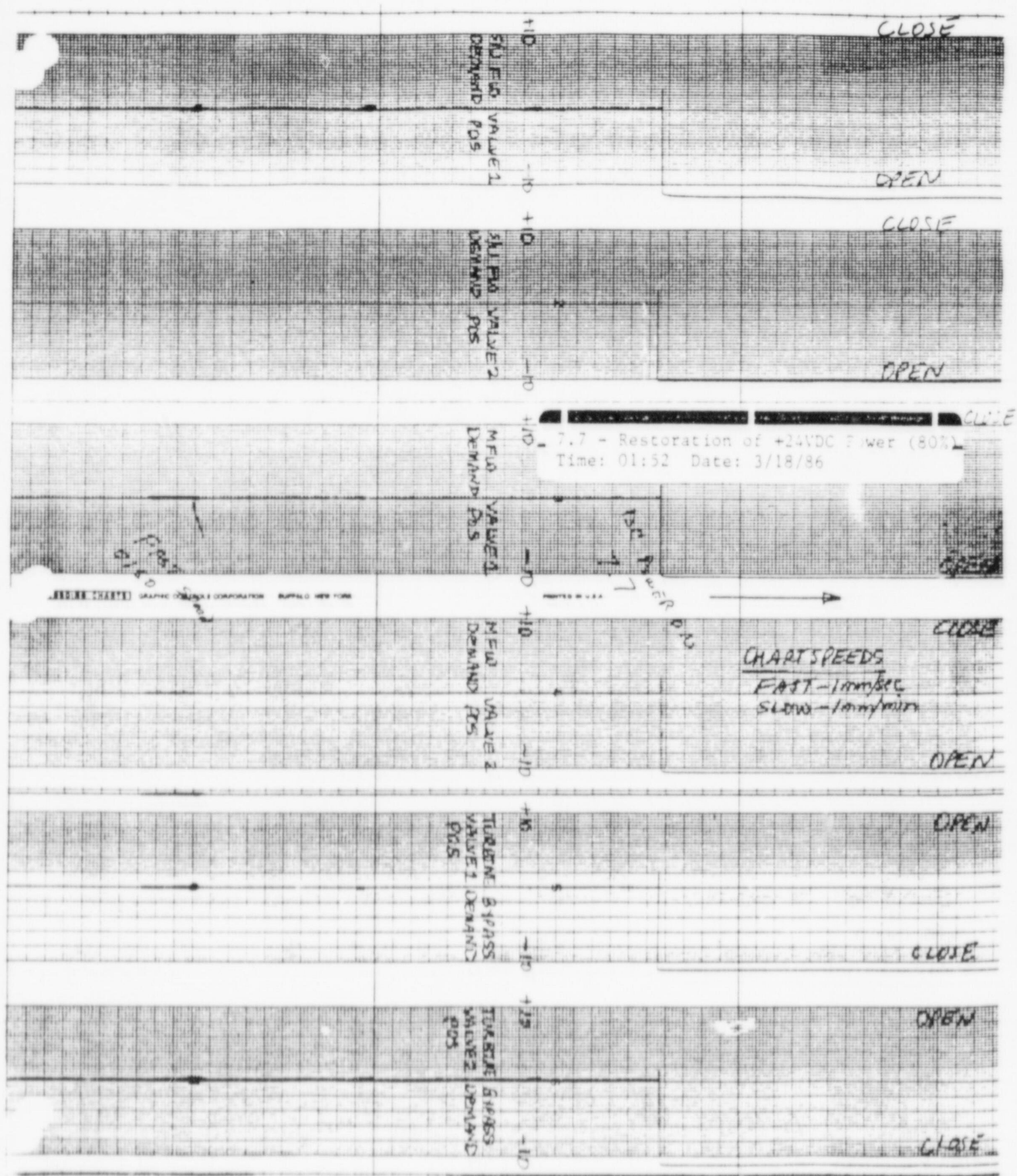
C. Russell



7.7 - Restoration of +24VDC Power (80%)
Time - 01:52 Date: 3/18/86

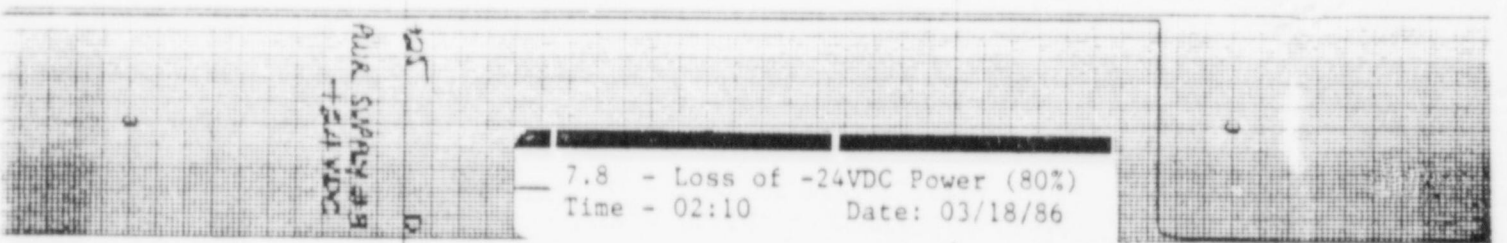
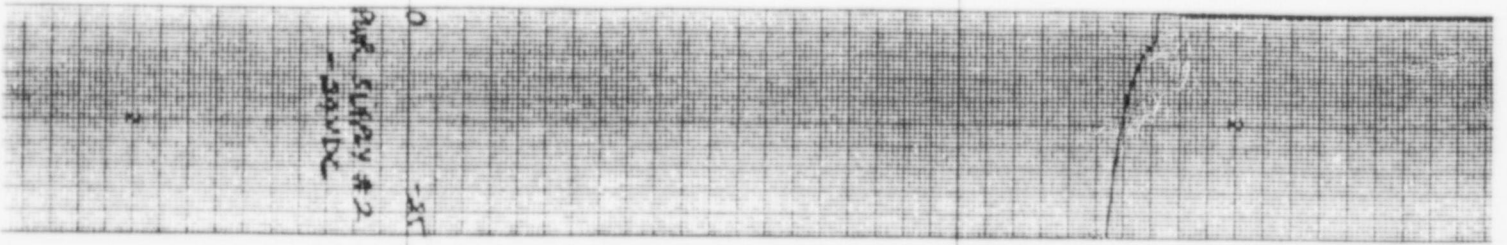


Continued

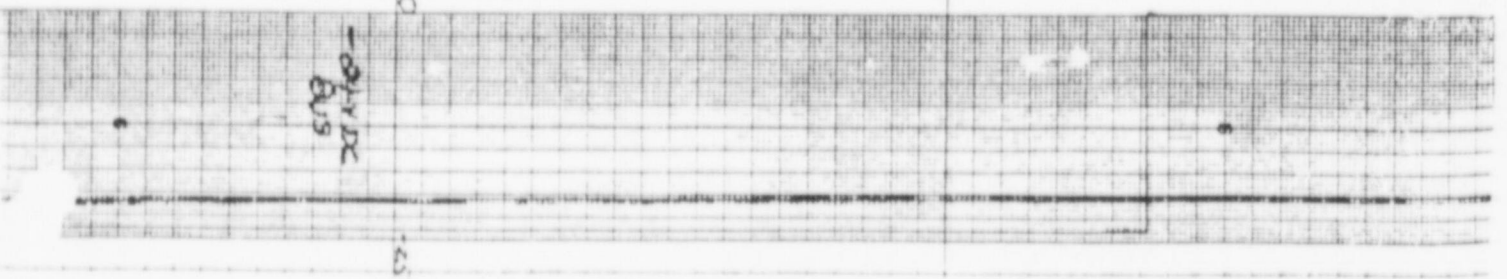
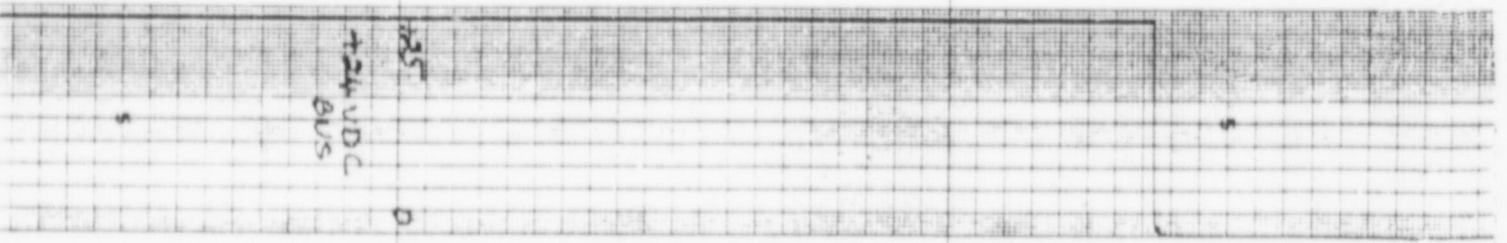
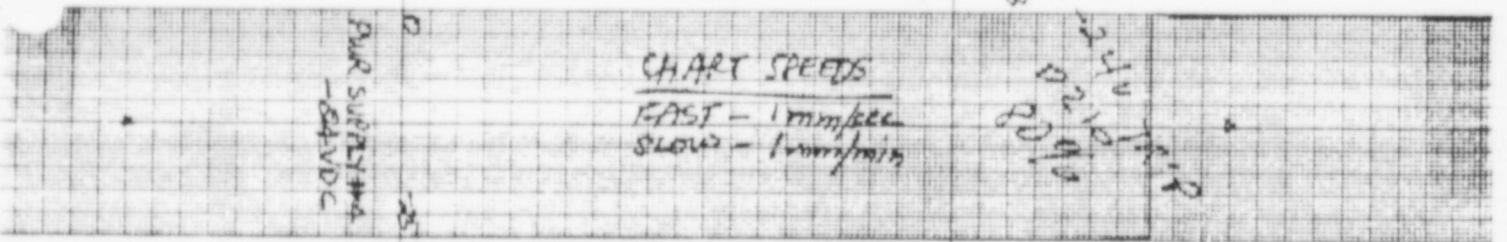


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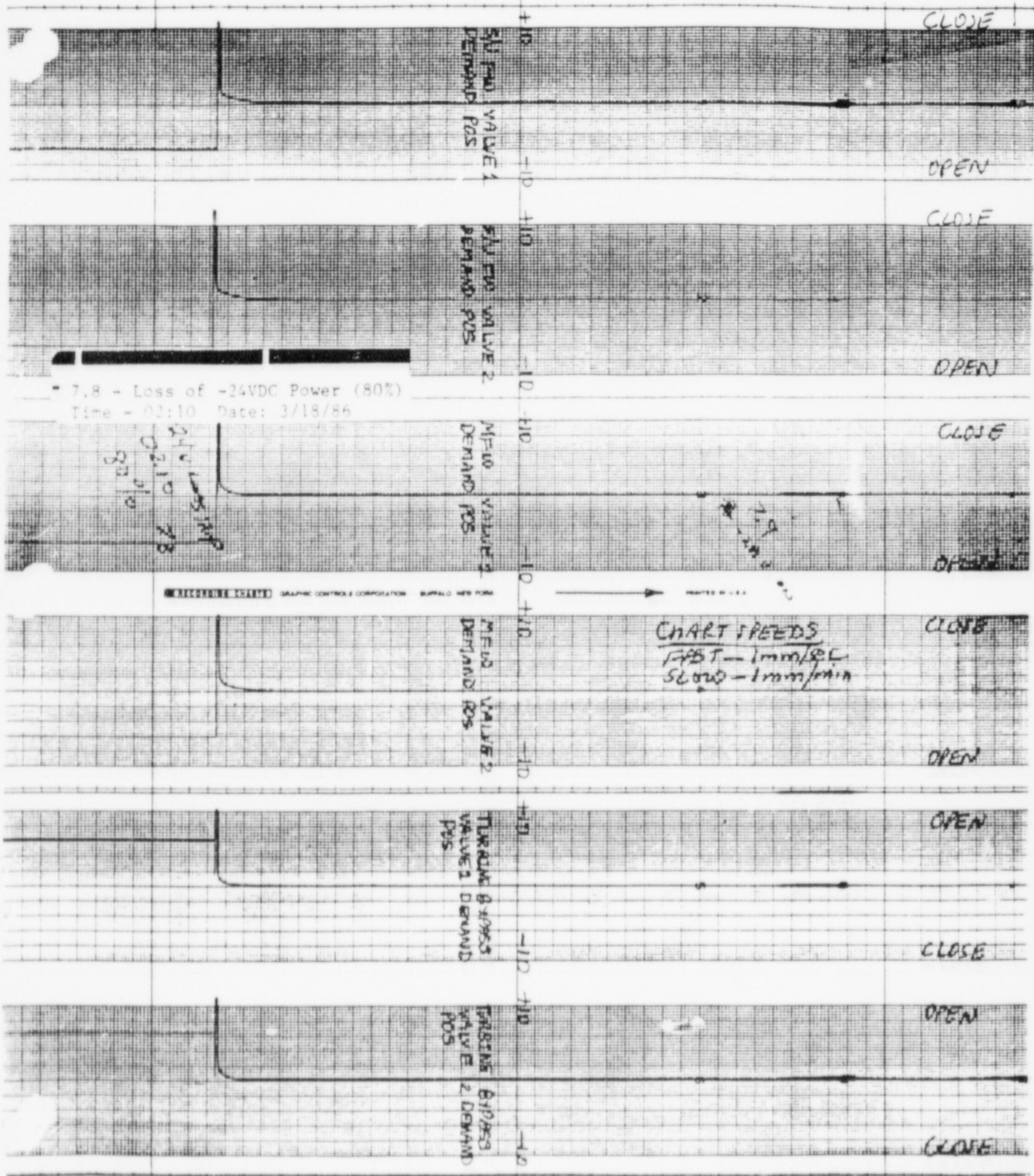
OTR...al



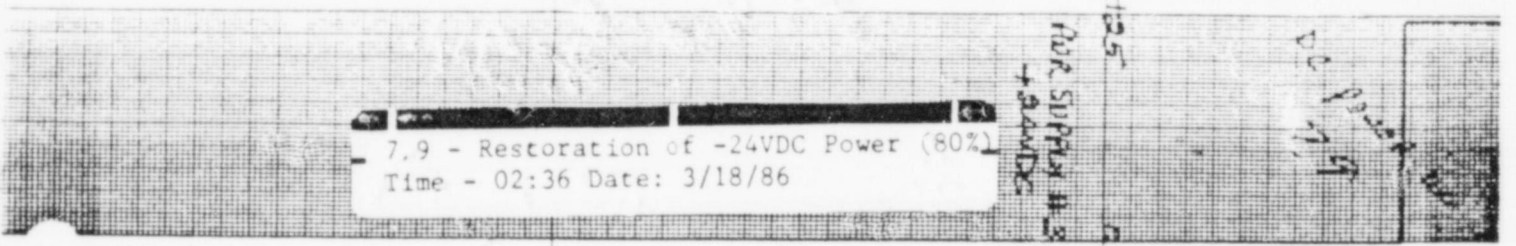
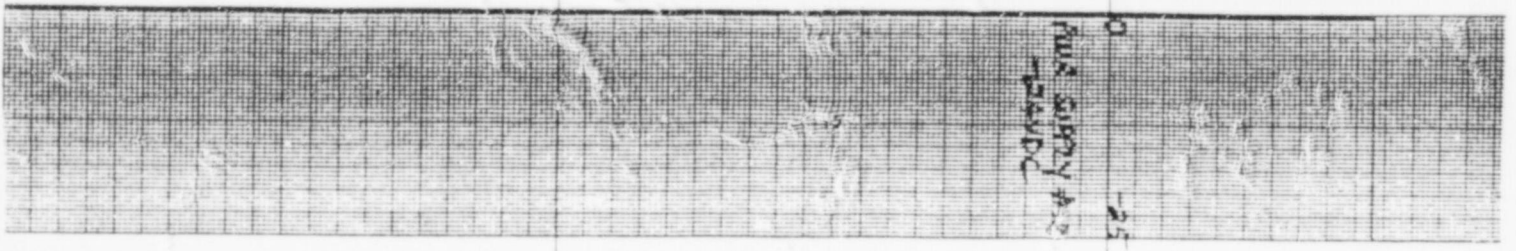
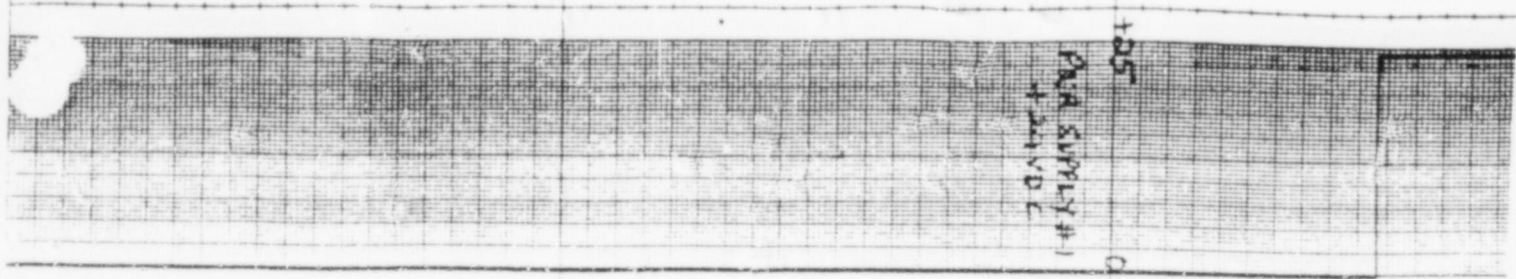
NO BSH 11 2963 21



OTK



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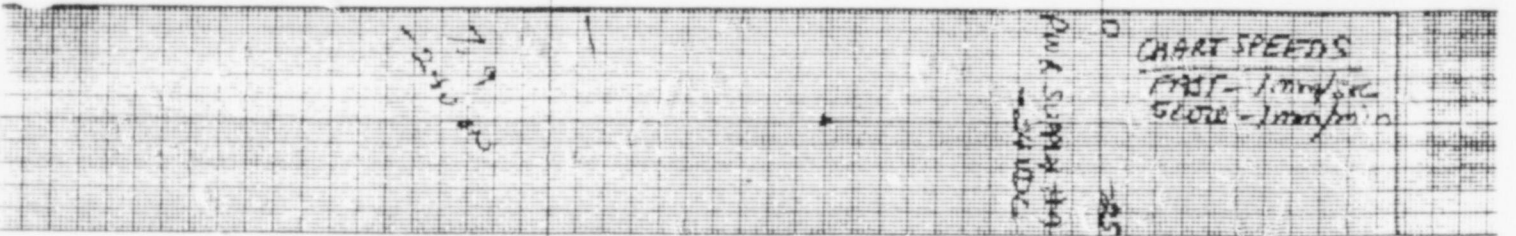
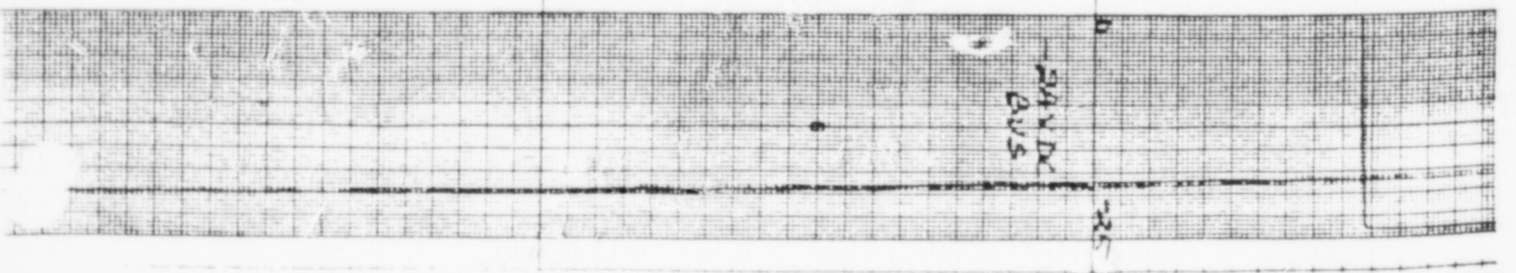
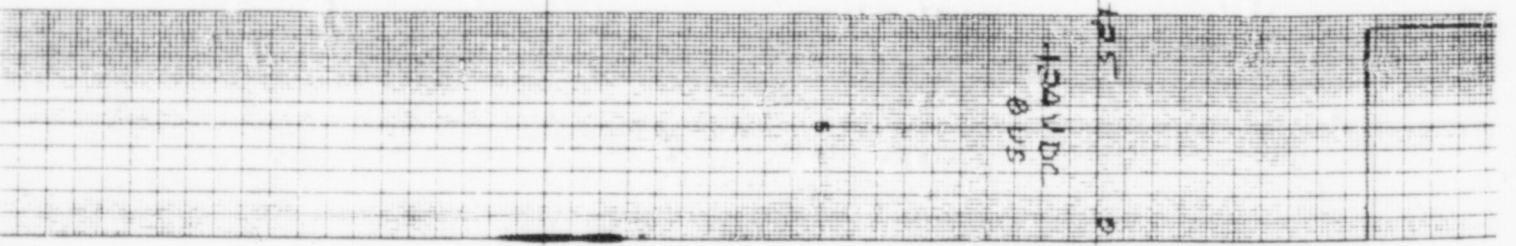
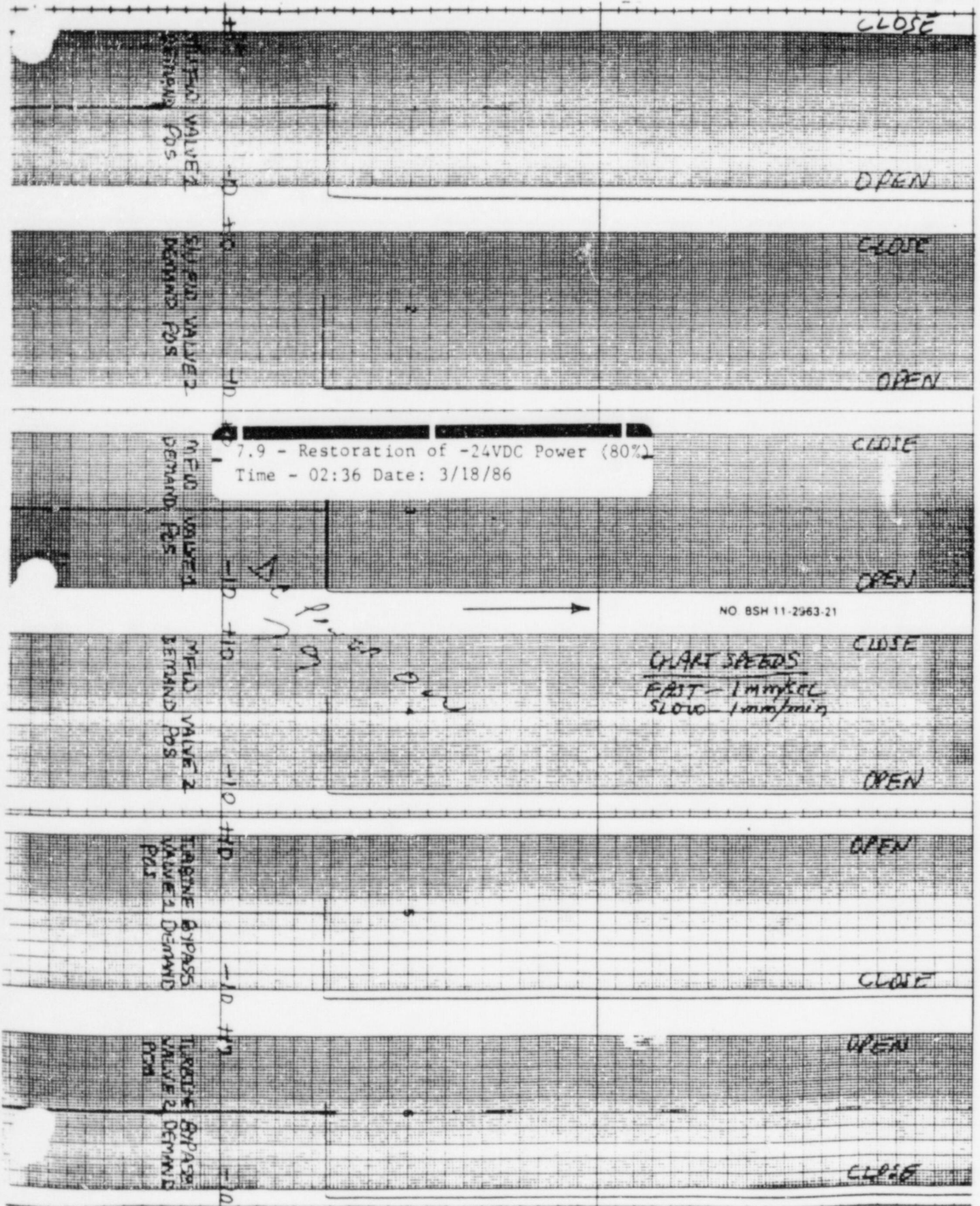


CHART SPEEDS
FAST - 1 mm/sec
SLOW - 1 mm/min



CRussell



7.9 - Restoration of -24VDC Power (80%)
 Time - 02:36 Date: 3/18/86

NO BSH 11-2963-21

CHART SPEEDS
 FAST - 1 mm/sec
 SLOW - 1 mm/min

Atkinson