Reference 9

FLORIDA POWER & LIGHT COMPANY

December 14, 1977
L-77-380

Office of Nuclear Reactor Regulation
Attention: Mr. George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Lear:

Re: Florida Power & Light Company
Docket Nos. 50-250, 50-251, and 50-335
Request for Information

The Florida Power & Light Company response to your letter of October 5, 1977 is attached. Clarifying information obtained at a November 18, 1977 meeting with members of the NRC staff has been used in preparing this response. At the meeting, a revised due date of December 15, 1977 was established.

In the context of the attached material we define Power System Stability as that attribute of a system or part of a system which enables it to develop restoring forces equal to or greater than disturbing forces so as to restore a state of equilibrium.

Very truly yours,

Robert E. Uhrig
Vice President

REU/MAS/lah

Attachment

cc: Mr. James P. O'Reilly, Region II
Robert Lowenstein, Esquire

8002150519

ATTACHMENT

FLORIDA POWER & LIGHT COMPANY
DOCKET NOS. 50-250, 50-251, & 50-335
NRC REQUEST FOR INFORMATION
SYSTEM DISTURBANCE (5/16/77)

QUESTION 1

So that we may better understand the causal relationships between the events that occurred on May 16, 1977, please provide the following information:

1.1 A time trace of the real power loading on the Ft. Myers-Ranch 240kV line for the time period 10:08-10:24 am;

1.2 The normal rating of this line (MW, MVA);

1.3 The long time and short time emergency ratings;

1.4 If the ratings are given in MW, indicate the power factor to which they apply;

1.5 The MVA load (or the power factor) on the line when it relayed open;

1.6 If the information in Items 1.4 and 1.5 is not available, provide power factor or equivalent information at points as close to this line as available; and

1.7 The line loading information (power, power factor, etc.) on this line for each occasion in the past when it relayed open.

RESPONSE 1

1.1 This line is not equipped with instrumentation from which to obtain a time trace of real power loading.

1.2 The normal rating is 1010 amperes continuous, or 420 MVA at 240kV. The conductor is 954MCM ACSR.

1.3 The continuous rating of the line is 1010 amperes, based on a conductor temperature of 75°C with an ambient of 25°C and 1.3mph wind.

The emergency rating is 1260 amperes (524 MVA @ 240kV) based on a conductor temperature of 100°C with an ambient of 35°C and 2mph wind. The time limit is 10,000 hours over the life of the conductor to restrict the loss of tensile strength to 10%. With a 7mph wind and 35°C ambient, the conductor can carry 2000 amps without exceeding the 100°C conductor limitation.

The sag for a 650' typical span is 10.5 feet with a conductor temperature of 60°F, 16.5 feet with a conductor temperature of 185°F.

1.4 Ratings were given in amperes.

1.5 This information is not available.

1.6 The combined MW load on the Ft. Myers-Ranch 138kV and 240kV circuits can be determined with reasonable accuracy by adding the "instantaneous" change in tie line flow on the TEC ties, the change in generation on the west coast plants, FM1, FM2 and MT1, and the change in load. The change in transmission losses is included with the load. From these changes, the flow west to east on the Ranch-Ft. Myers circuits is found to be 595 MW. From past history of the division of load, the MW load on the 240kV line is estimated at 420 MW.

The automatic logger of the West Palm Beach Supervisory recorded the following events:

10:08:29	Frequency declines
10:08:39	Ranch-Ft. Myers 240kV line exceeds amp limit of 959 amps
10:09:24	Ranch-Ft. Myers 240kV line exceeds MW limit of 418 MW
10:09:39	Ranch-Ft. Myers 240kV line exceeds Var limit of 147
10:09:54	Ranch-Ft. Myers 240kV line watts normal (less than 418 MW)
10:09:54	Ranch-Ft. Myers 240kV line Vars normal (less than 147 MVAR)
10:10:09	Ranch-Ft. Myers 240kV line exceeds watt limit
10:10:39	Ranch-Ft. Myers 240kV line exceeds Var limit
10:10:49	Frequency normal
10:16:24	Ranch-Ft. Myers 240kV line Vars normal
10:24:01	Ranch-Ft. Myers 240kV line opens

The oscillatory nature of the alarms tend to indicate that the loading was near the alarm set points. It can be concluded from the above that, at the time of tripping, the line load was in excess of 418 MW and less than 147 MVAR.

The Fort Myers-Ranch line tripped at both ends with a ground pilot target at Ranch and a Zone 1 and ground instantaneous targets at Fort Myers. Broward, Midway and Ringling oscillographs recorded a phase-to-ground fault at this time. The Ringling oscillogram indicated a "B" phase-to-ground fault.

The attached oscillogram from Ringling shows a discrete step

change in current, indicating a fault rather than an over-current. The oscillograph is a 32 channel machine, but due to play back limitations, the output is printed on three separate pages.

The following attachments are included to document the data and conclusions:

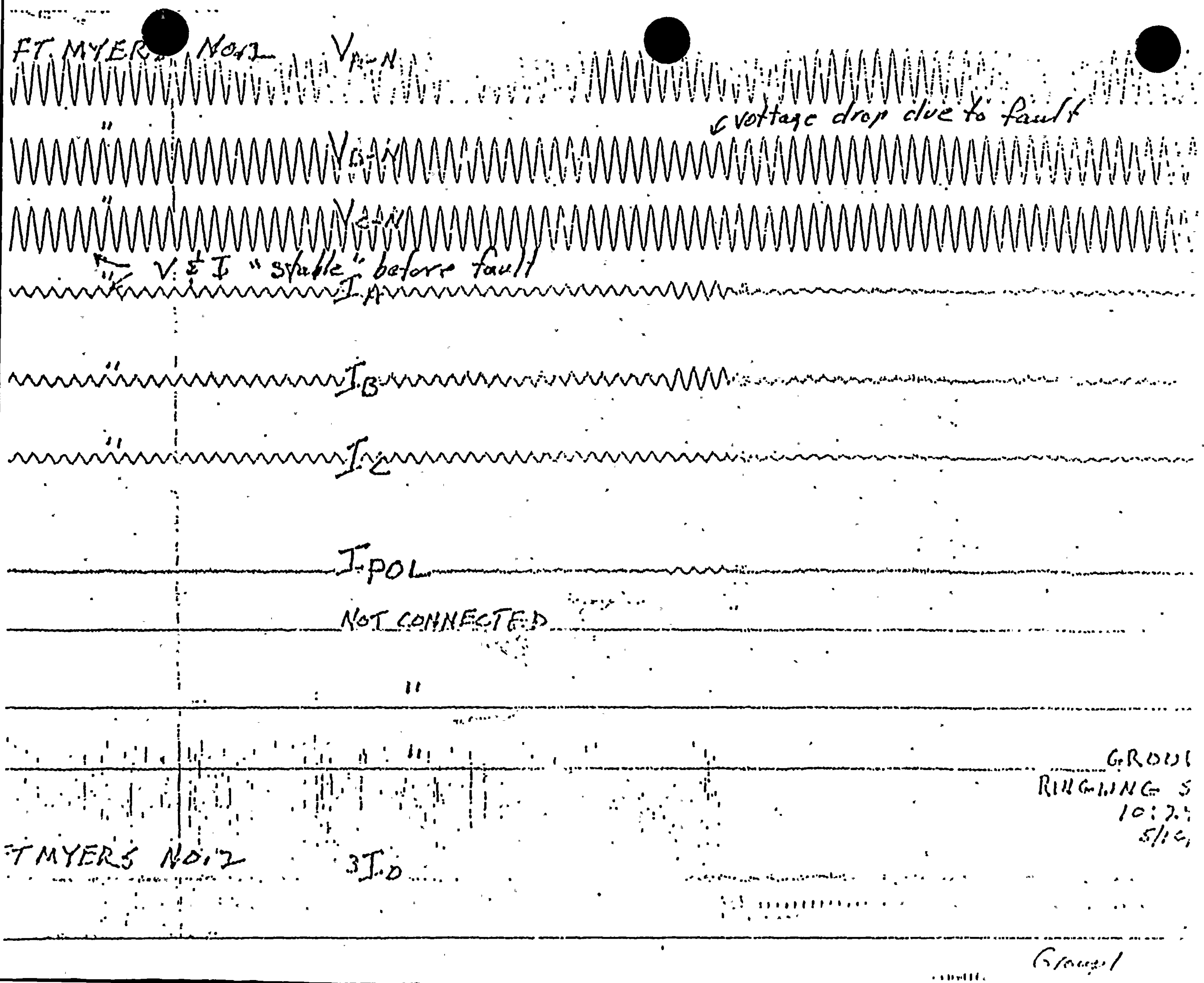
Charts of tie flows

Charts of generation of FM1, FM2, MT1

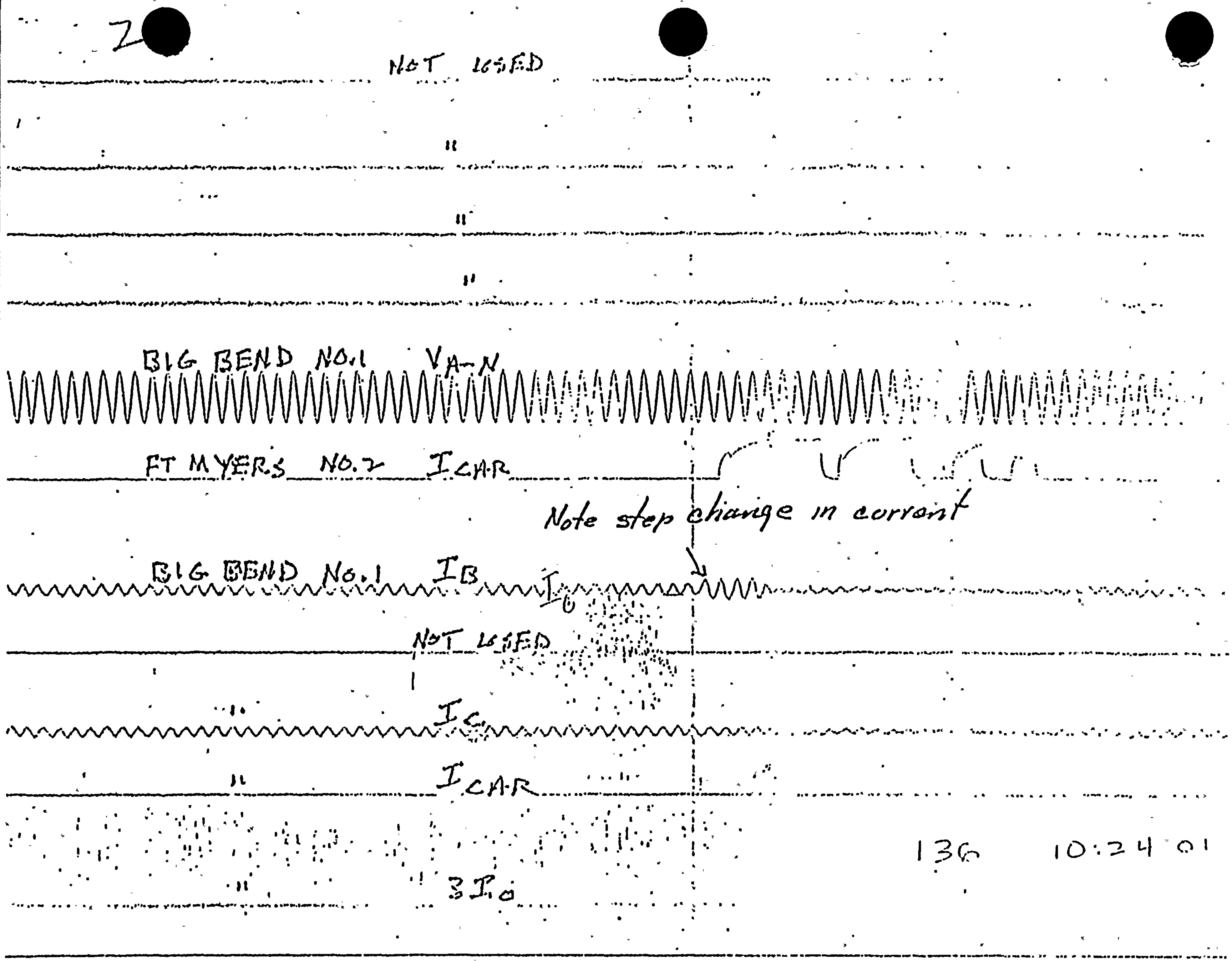
Charts of frequency at Ft. Myers (to show high frequency following the tripping and explain the load rejection of the plants). Oscillogram from Ringling which shows that the system was not swinging wildly but relatively stable following the fault.

A simplified schematic of the central portion of the FPL system to facilitate following the events.

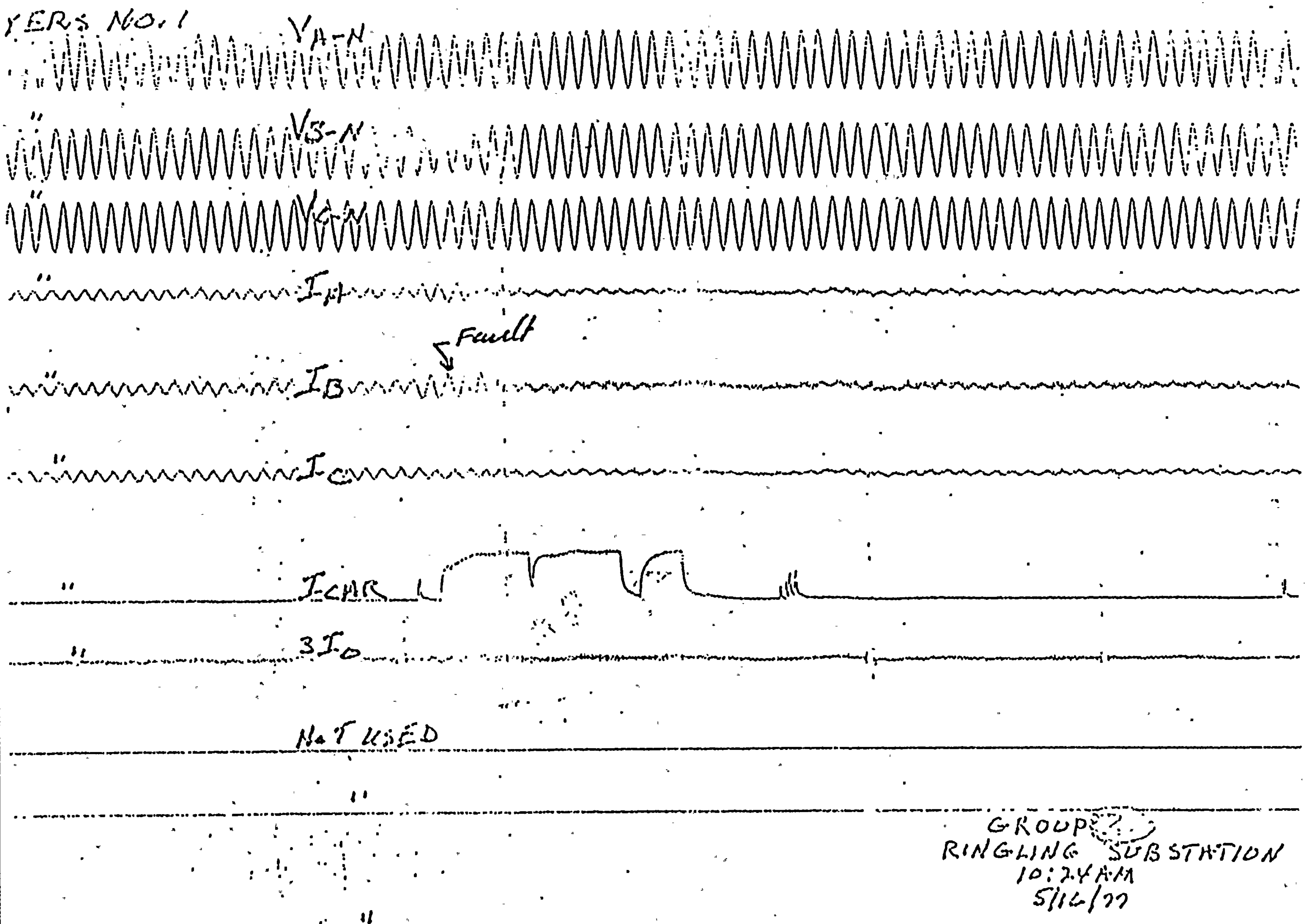
1.7 Not available.



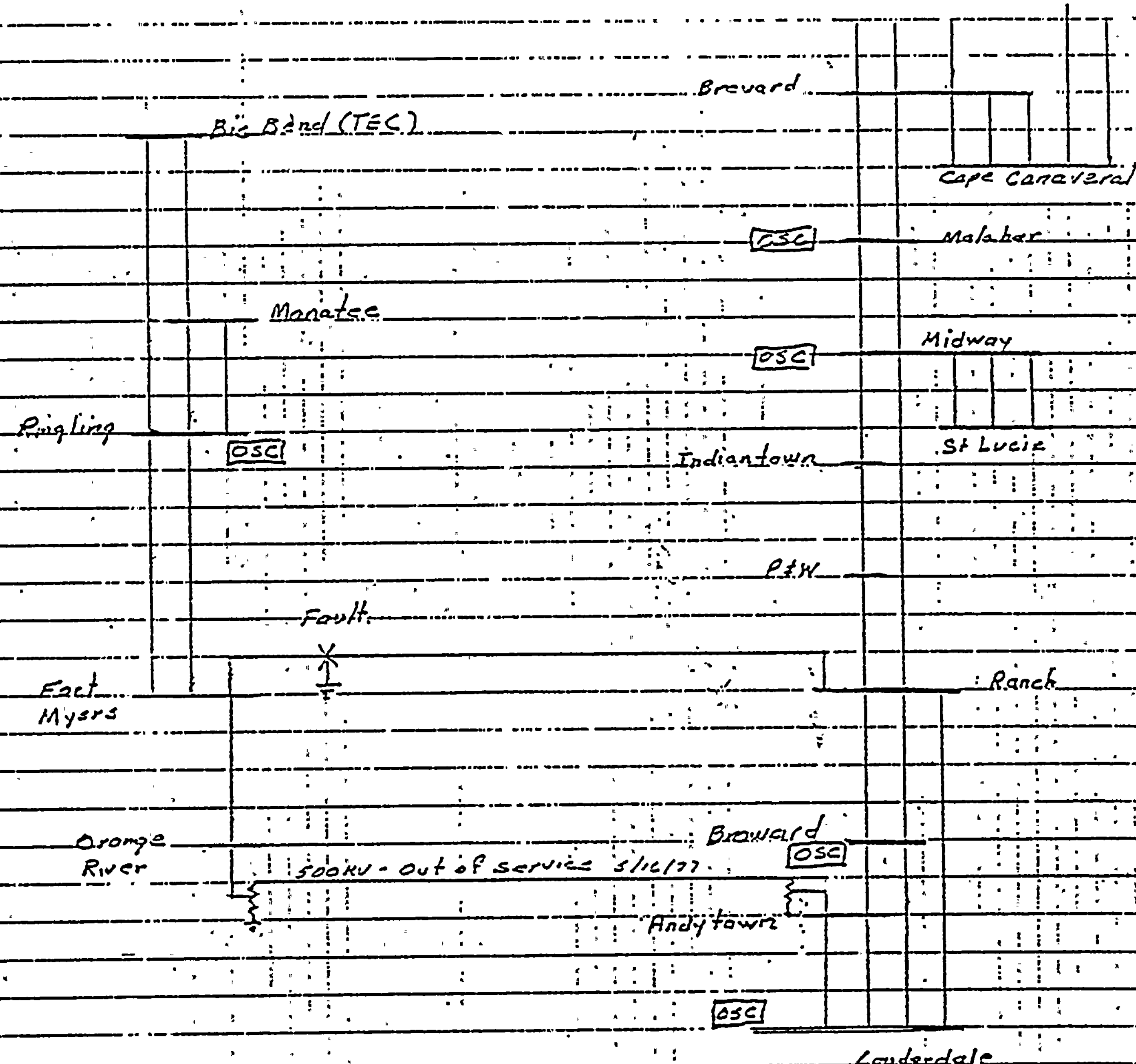
V A-N
voltage drop due to fault
V B-N
V C-N
V & I "stable" before fault
I A
I B
I C
I POL
NOT CONNECTED
FT MYERS NO 2
3I0
Group 1


2
NOT USED
"
"
"
BIG BEND NO.1 VA-N
FT MYERS NO.2 ICAR
Note step change in current
BIG BEND NO.1 IB
I0
NOT USED
"
IC
" ICAR
" 3I0
136 10:24:01

Graph 2

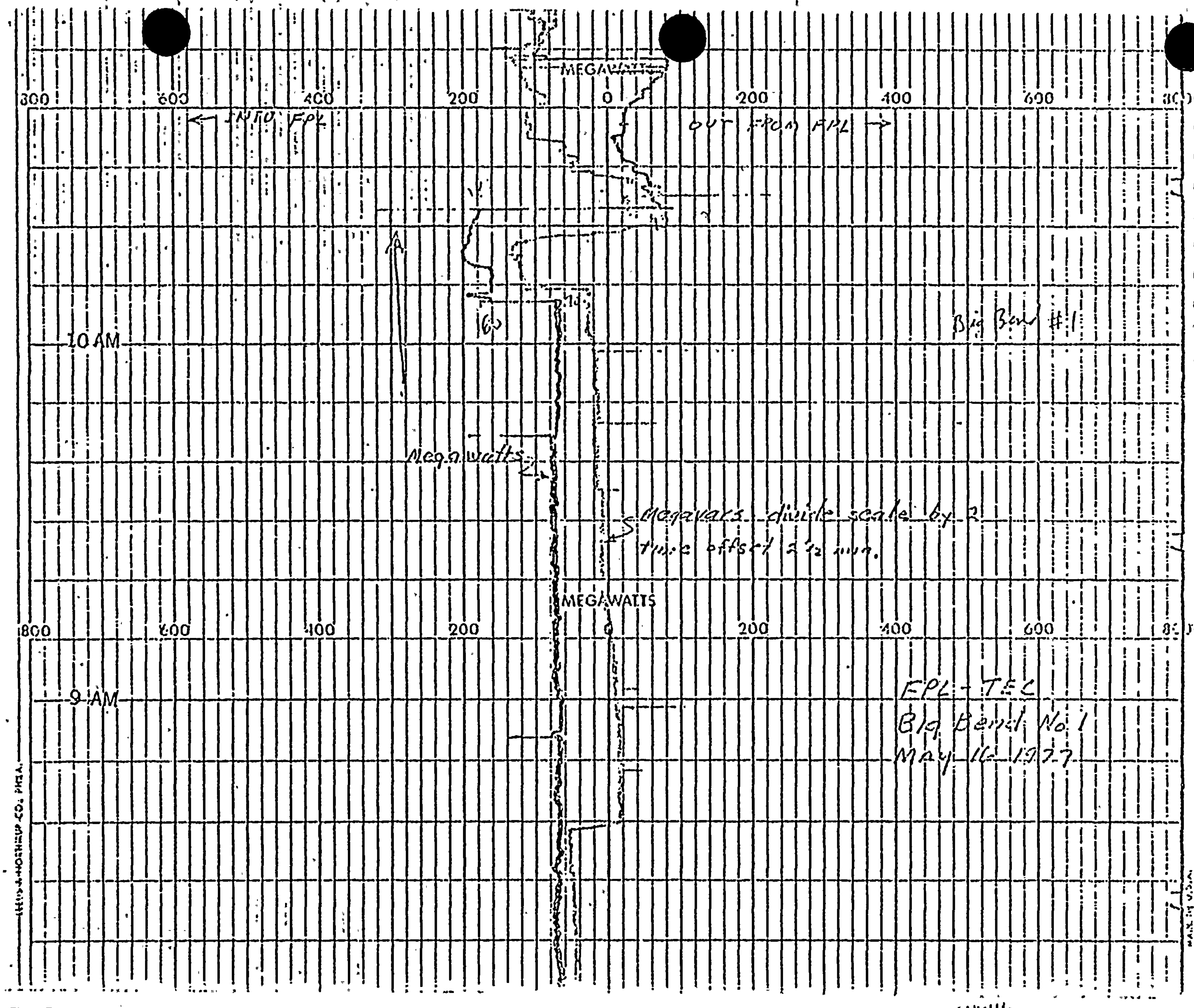


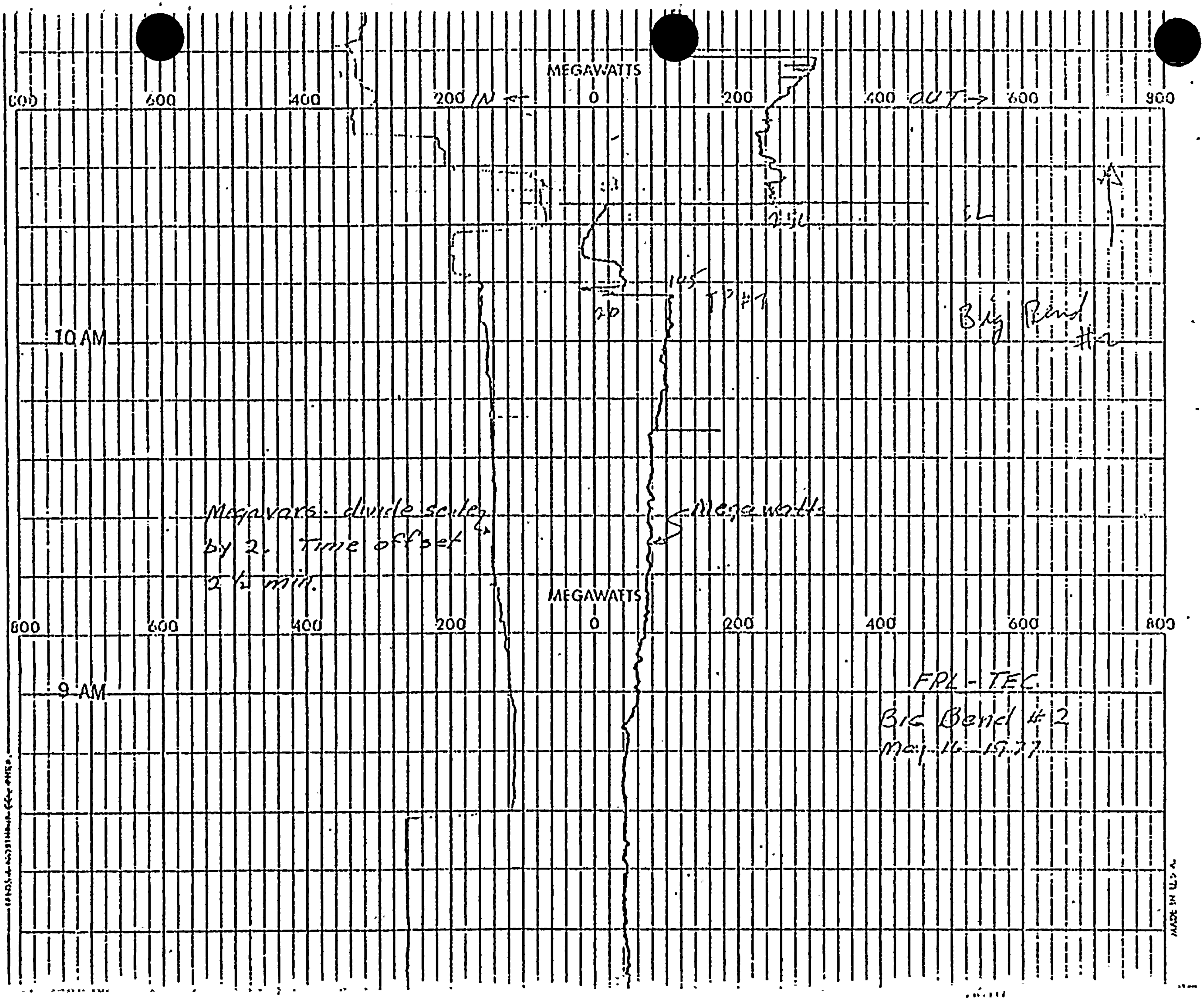
YERS NO. 1
VA-N
VB-N
VC-N
IA
Fault
IB
IC
I-CAR
3I0
NOT USED
GROUP ?
RINGLING SUBSTATION
10:24 AM
5/16/77



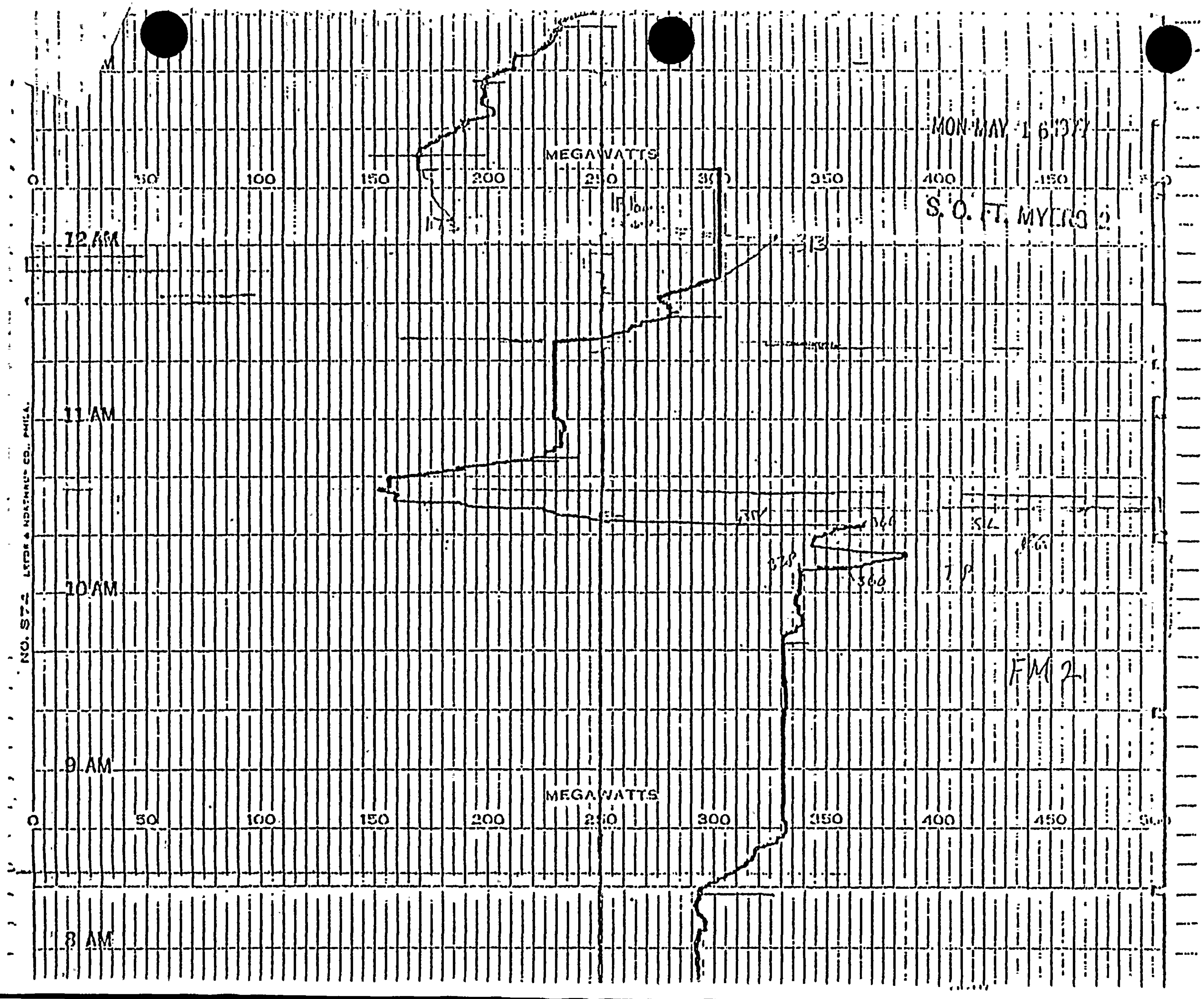
Simplified Schematic
to Show Relation of
Oscillograph to Fault

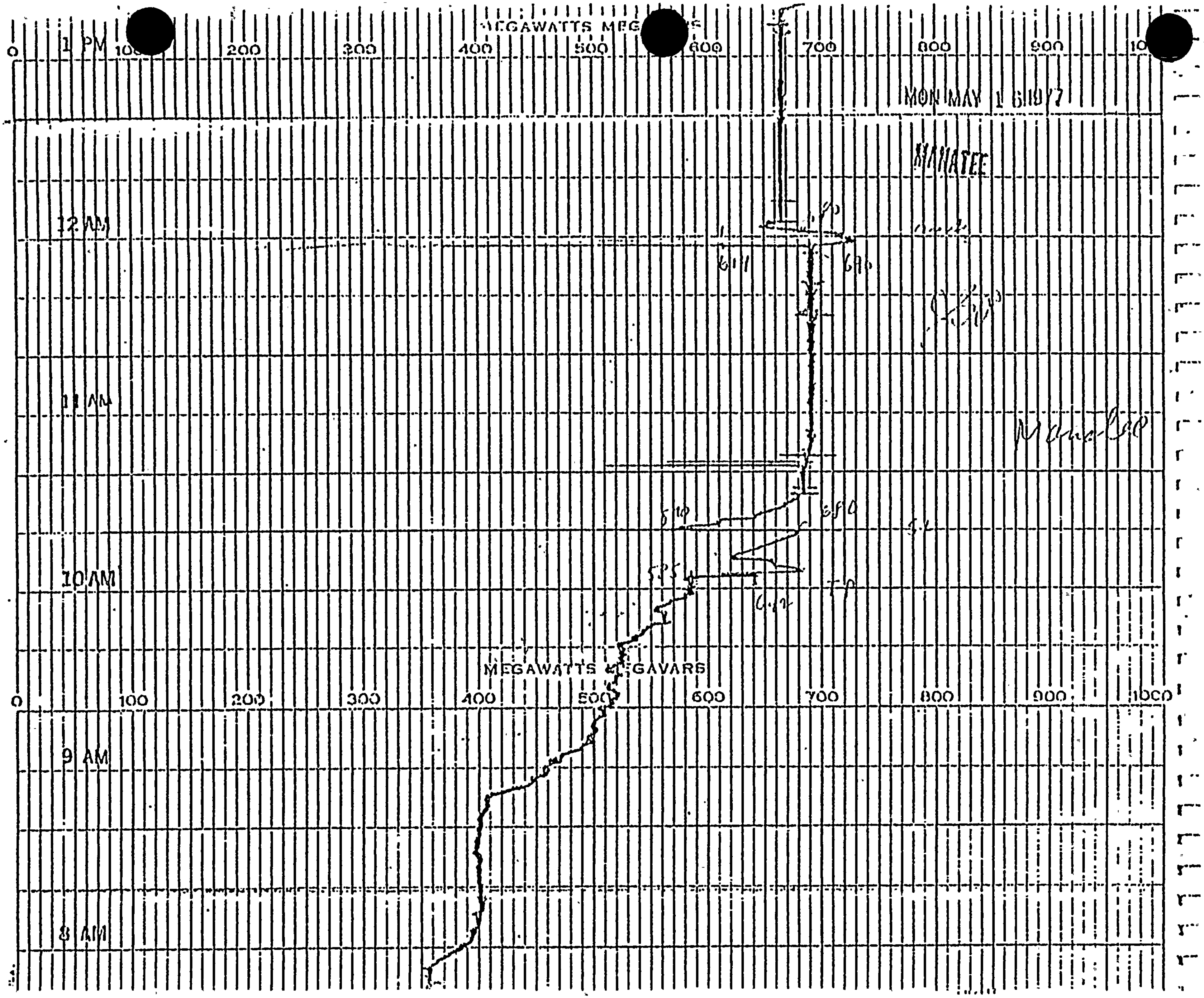
11/22/77
AWW

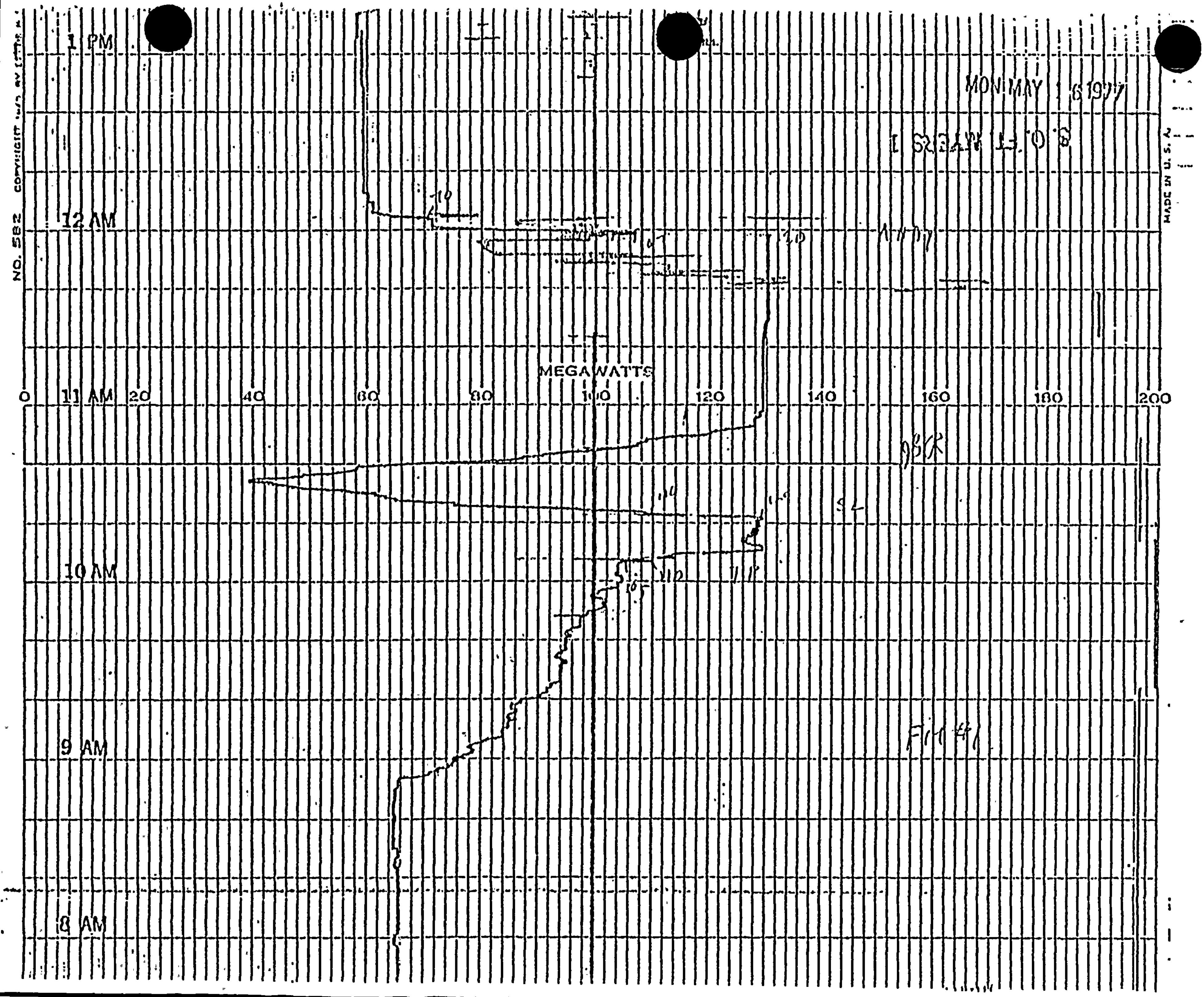

MEGAWATTS
800 600 400 200 0 200 400 600 800
← INTO FPL
OUT FROM FPL →
10 AM
Big Bend #1
Megawatts
Megavars divide scale by 2
time offset 2½ min.
MEGAWATTS
800 600 400 200 0 200 400 600 800
9 AM
FPL - TEC
Big Bend No 1
May 16 1977

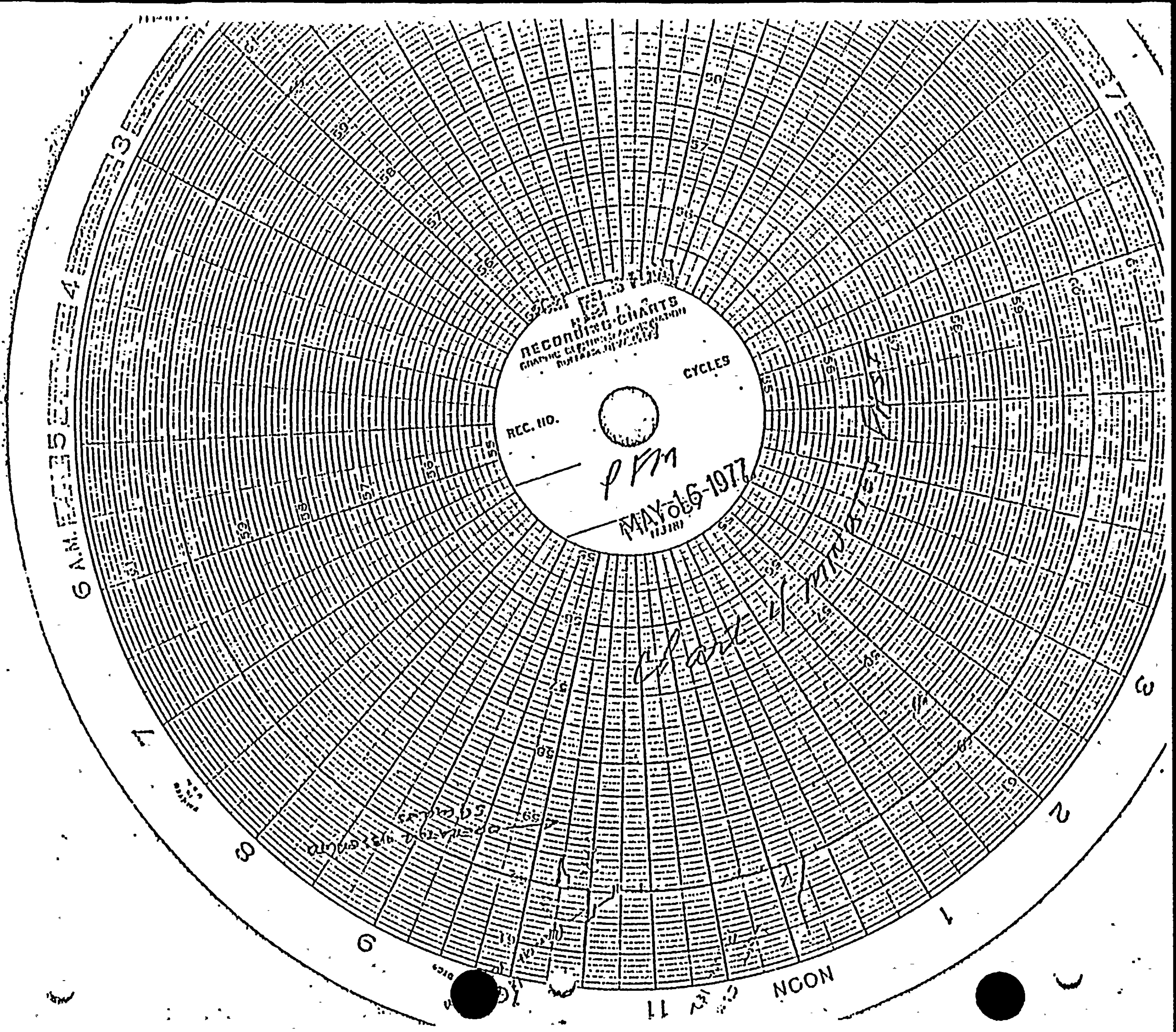


MEGAWATTS
800 600 400 200 IN ← 0 200 400 OUT → 600 800
10 AM
Big Bend #2
Megavars divide scale by 2. Time offset 2 ½ min.
Megawatts
MEGAWATTS
800 600 400 200 0 200 400 600 800
9 AM
FPL - TEC
Big Bend #2
May 16 1977
MADE IN U.S.A.


MON MAY 16 1977
MEGAWATTS
0
50
100
150
200
250
300
350
400
450
500
S. O. FT. MYERS 2
12 AM
313
11 AM
10 AM
360
FM 2
9 AM
MEGAWATTS
0
50
100
150
200
250
300
350
400
450
500
8 AM
NO. 573 LEEDS & NORTHRUP CO., PHILA.


MEGAWATTS MEG
0
100
200
300
400
500
600
700
800
900
MON MAY 1 6 1977
MANATEE
1 PM
12 AM
11 AM
10 AM
MEGAWATTS & MEGAVARS
0
100
200
300
400
500
600
700
800
900
1000
9 AM
8 AM


1 PM
12 AM
11 AM
10 AM
9 AM
8 AM
MEGAWATTS
0
20
40
60
80
100
120
140
160
180
200
NO. 582
MADE IN U.S.A.


RECORDING CHARTS
CYCLES
REC. NO.
MAY 16 1977
6 A.M.
NOON

00:00:06 ALARM/OPERATIONS LOG 05/16/77

07:41:24				
	GOOD MORNING WORLD!!!!			
07:41:34				
*08:08:17	MIDWAY	69/138KV OCB LOW AIR PRESS	ALARM	0075050
08:09:03	MIDWAY	69/138KV OCB LOW AIR PRESS	NORMAL	0075050
*08:34:57	OKEECHOBEE	66W6516 CHARLOTTE	OPEN	0049001
08:35:46	OKEECHOBEE	#66W6516 CHARLOTTE	TAG SET	1049001
08:38:16	HILLCREST NO. 2		CHECK	1000016
08:38:20	HILLCREST NO. 1		CHECK	1000015
08:38:28	ATLANTIC		CHECK	1000001
08:38:33	BELLE GLADE		CHECK	1000002
08:38:43	IBM		CHECK	1000003
08:38:44	JENSEN		CHECK	1000004
08:39:18	MONET		CHECK	1000006
08:39:21	NORTHWOOD		CHECK	1000007
08:39:26	OLYMPIA		CHECK	1000008
08:39:27	PAHOKEE		CHECK	1000009
08:40:01	PLUMOSUS		CHECK	1000012
08:40:11	RIVIERA PLANT		CHECK	1000018
08:40:31	WHITE CITY		CHECK	1000010
*08:40:48	FLORIDA STEEL	STATION SERVICE	ALARM	0064022
08:40:50	FLORIDA STEEL	STATION SERVICE	NORMAL	0064022
08:41:14	SOUTH BAY		CHECK	1000013
[illegible]:05:19	**SYSTEM**		FAILED TO CHECK	1000000
*09:08:17	YAMATO	138W32434 BROW 2/BROW 1	OPEN	0081001
*09:08:28	YAMATO	138W32441 HYPOLUXO/BROW 1	OPEN	0081000
*09:08:39	YAMATO	BROWARD 1 LINE POT	ALARM	0081032
*09:10:04	FLORIDA STEEL	STATION SERVICE	ALARM	0064022
09:10:08	FLORIDA STEEL	STATION SERVICE	NORMAL	0064022
*09:10:55	YAMATO	STATION SERVICE	ALARM	0081045
09:11:57	YAMATO	138W32434 BROW 2/BROW 1	CLOSED	0081001
09:11:57	YAMATO	BROWARD 1 LINE POT	NORMAL	0081032
09:11:59	YAMATO	STATION SERVICE	NORMAL	0081045
09:12:21	YAMATO	138W32441 HYPOLUXO/BROW 1	CLOSED	0081000
*09:24:14	IBM	TRIP CIRCUIT	ALARM	0003007
09:25:06	IBM	TRIP CIRCUIT	NORMAL	0003007
*09:25:39	FLORIDA STEEL	STATION SERVICE	ALARM	0064022
09:25:41	FLORIDA STEEL	STATION SERVICE	NORMAL	0064022
*10:[illegible]:29	BOCA TEECA	UNDERFREQUENCY TRIP	TRIPPED	0044039
*10:[illegible]:29	OSLO	UNDERFREQUENCY TRIP	TRIPPED	0039030
*10:[illegible]:29	JUNO BEACH	UNDERFREQUENCY TRIP	TRIPPED	0032038
*10:[illegible]:29	LANTANA	UNDERFREQUENCY TRIP	TRIPPED	0065039
*10:[illegible]:30	LAKE PARK	UNDERFREQUENCY TRIP	TRIPPED	0074035
*10:[illegible]:30	HILLSBORO	UNDERFREQUENCY TRIP	TRIPPED	0041038
*10:[illegible]:30	BOYNTON	UNDERFREQUENCY TRIP	TRIPPED	0068037
*10:[illegible]:30	TEN ACRES	UNDERFREQUENCY TRIP	TRIPPED	0033037
*10:[illegible]:32	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:[illegible]:32	NORTHWOOD	UNDERFREQUENCY TRIP	TRIPPED	0007017
[illegible]:[illegible]:35	SOUTH BAY	STATION SERVICE	ALARM	0017036
[illegible]:[illegible]:39	RANCH	FT. MYERS PLANT 240KV	AMPS LI. 90959	0045002
*10:[illegible]:39	RANCH	FT. MYERS PLANT 240KV	AMPS LIM 90959	0045002
*10:[illegible]:39	RANCH	LAUDERDALE PLANT	AMPS LIM 81223	0045011
*10:[illegible]:39	RANCH	LAUDERDALE PLANT	AMPS LIM 81223	0045011
*10:[illegible]:40	HYPOLUXO ROAD	BUS POTENTIAL	VOLTS LIM L131.0	0057026
*10:[illegible]:40	HYPOLUXO ROAD	BUS POTENTIAL	VOLTS LIM L131.0	0057026
*10:[illegible]:41	OKEECHOBEE	BUS POTENTIAL	VOLTS LIM L065.0	0051012

TP-3 TRIPPED

STEP ZERO REPORTING IN

2

10:10:24 (LARM/OPERATIONS LOG (16/77

*10:08:41	OKEECHOBEE	BUS POTENTIAL	VOLTS LIM L0058.0	0051012
*10:08:41	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	ALARM	0017021
*10:08:41	RANCH	FT. MYERS PLANT 138KV	VARS LIM H0075	0047011
*10:08:41	RANCH	FT. MYERS PLANT 138KV	VARS LIM H0075	0047011
*10:08:42	RANCH	EAST 240KV BUS	VOLTS LIM L219.0	0048000
*10:08:42	RANCH	EAST 240KV BUS	VOLTS LIM L219.0	0048000
*10:08:42	RANCH	EAST 138KV BUS	VOLTS LIM L131.0	0048001
*10:08:42	RANCH	EAST 138KV BUS	VOLTS LIM L131.0	0048001
10:08:43	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:08:47	LAKE PARK	STATION SERVICE	ALARM	0074036
10:08:47	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	NORMAL	0017021
*10:08:49	W.P.B. MASTER	INDIANTOWN REMOTE EQUIP	ALARM	3073109
*10:08:49	W.P.B. MASTER	INDIANTOWN SCAN STATUS	OUT	3073110
*10:08:53	SOUTH BAY	AUTOTRANS. ALARM #4	ALARM	0017033
*10:08:58	RANCH	EAST 138KV BUS	VOLTS LIM NORMAL	0048001
*10:08:58	RANCH	EAST 138KV BUS	VOLTS LIM NORMAL	0048001
10:08:59	SOUTH BAY	AUTOTRANS. ALARM #4	NORMAL	0017033
10:09:00	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:09:02	LAKE PARK	STATION SERVICE	ALARM	0074036
10:09:04	SOUTH BAY	STATION SERVICE	NORMAL	0017036
*10:09:09	RANCH	BROWARD NO. 1 240KV	AMPS LIM H1226	0045005
*10:09:09	RANCH	BROWARD NO. 1 240KV	AMPS LIM H1226	0045005
*10:09:09	PAHOKEE	STATION SERVICE	ALARM	0009017
*10:09:10	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	ALARM	0017021
10:09:13	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:09:14	RANCH	EAST 138KV BUS	VOLTS LIM L131.0	0048001
*10:09:14	RANCH	EAST 138KV BUS	VOLTS LIM L131.0	0048001
10:09:15	PAHOKEE	STATION SERVICE	NORMAL	0009017
10:09:16	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	NORMAL	0017021
*10:09:17	LAKE PARK	STATION SERVICE	ALARM	0074036
10:09:21	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:09:22	SOUTH BAY	AUTOTRANS. ALARM #4	ALARM	0017033
*10:09:24	RANCH	FT. MYERS PLANT 240KV	WATTS LIM L0413	0045000
*10:09:24	RANCH	FT. MYERS PLANT 240KV	WATTS LIM L0413	0045000
*10:09:25	RANCH	BROWARD 138KV	AMPS LIM H0959	0046011
*10:09:25	RANCH	BROWARD 138KV	AMPS LIM H0959	0046011
*10:09:26	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:09:28	RANCH	BROWARD NO. 2 240 KV	WATTS LIM H0509	0048006
*10:09:28	RANCH	BROWARD NO. 2 240 KV	WATTS LIM H0509	0048006
*10:09:28	SOUTH BAY	NORTH AUTOTRANS TROUBLE	ALARM	0017020
10:09:29	BOCA TEECA	UNDERFREQUENCY TRIP	NORMAL	0040039
10:09:32	LAKE PARK	STATION SERVICE	NORMAL	0074036
10:09:32	BOYNTON	UNDERFREQUENCY TRIP	NORMAL	0068037
*10:09:34	SOUTH BAY	AUTOTRANS. ALARM #2	ALARM	0017031
10:09:34	LANTANA	UNDERFREQUENCY TRIP	NORMAL	0065039
*10:09:35	PAHOKEE	STATION SERVICE	ALARM	0009017
10:09:35	GREEN ACRES	UNDERFREQUENCY TRIP	NORMAL	0038037
10:09:35	NORTHWOOD	UNDERFREQUENCY TRIP	NORMAL	0007017
*10:09:37	LAKE PARK	STATION SERVICE	ALARM	0074036
10:09:37	HILLSBORO	UNDERFREQUENCY TRIP	NORMAL	0041038
*10:09:39	RANCH	FT. MYERS PLANT 240KV	VARS LIM H0147	0045001
*10:09:39	RANCH	FT. MYERS PLANT 240KV	VARS LIM H0147	0045001
*10:09:39	RANCH	LAUDERDALE PLANT	WATTS LIM H0509	0045009
*10:09:39	RANCH	LAUDERDALE PLANT	WATTS LIM H0509	0045009
10:09:40	SOUTH BAY	AUTOTRANS. ALARM #4	NORMAL	0017033
10:09:41	LAKE PARK	STATION SERVICE	NORMAL	0074036

10:16:45 ALARM/OPERATIONS LOG 05/16/77

*10:09:44	BOCA TEECA	UNDERFREQUENCY TRIP	TRIPPED	0040039
10:09:45	LANTANA	UNDERFREQUENCY TRIP	TRIPPED	0065039
*10:09:45	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:09:45	HILLSBORO	UNDERFREQUENCY TRIP	TRIPPED	0041038
*10:09:45	BOYNTON	UNDERFREQUENCY TRIP	TRIPPED	0068037
*10:09:46	GREEN ACRES	UNDERFREQUENCY TRIP	TRIPPED	0038037
*10:09:46	SOUTH BAY	STATION SERVICE	ALARM	0017036
*10:09:48	NORTHWOOD	UNDERFREQUENCY TRIP	TRIPPED	0007017
10:09:50	LAKE PARK	STATION SERVICE	NORMAL	0074036
10:09:52	SOUTH BAY	NORTH AUTOTRANS TROUBLE	NORMAL	0017020
10:09:53	PAHOKEE	STATION SERVICE	NORMAL	0009017
*10:09:54	RANCH	FT. MYERS PLANT 240KV	WATTS LIM NORMAL	0045000
*10:09:54	RANCH	FT. MYERS PLANT 240KV	WATTS LIM NORMAL	0045000
*10:09:54	RANCH	FT. MYERS PLANT 240KV	VARS LIM NORMAL	0045001
*10:09:54	RANCH	FT. MYERS PLANT 240KV	VARS LIM NORMAL	0045001
*10:09:54	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
*10:09:54	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
*10:09:54	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:09:57	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	ALARM	0017021
10:10:00	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:10:02	LAKE PARK	STATION SERVICE	ALARM	0074036
10:10:03	SOUTH BAY	AUTOTRANS. ALARM #2	NORMAL	0017031
*10:10:09	RANCH	FT. MYERS PLANT 240KV	WATTS LIM L0419	0045000
*10:10:09	RANCH	FT. MYERS PLANT 240KV	WATTS LIM L0418	0045000
10:10:09	LAKE PARK	STATION SERVICE	NORMAL	0074036
10:10:09	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	NORMAL	0017021
*10:10:11	PAHOKEE	STATION SERVICE	ALARM	0009017
*10:10:13	RANCH	BROWARD NO. 2 240 KV	WATTS LIM NORMAL	0048006
*10:10:13	RANCH	BROWARD NO. 2 240 KV	WATTS LIM NORMAL	0048006
*10:10:13	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:10:16	SOUTH BAY	AUTOTRANS. ALARM #4	ALARM	0017033
10:10:20	LAKE PARK	STATION SERVICE	NORMAL	0074036
10:10:22	SOUTH BAY	AUTOTRANS. ALARM #4	NORMAL	0017033
*10:10:24	LAKE PARK	STATION SERVICE	ALARM	0074036
*10:10:27	RANCH	BROWARD NO. 2 240 KV	WATTS LIM H0509	0048006
*10:10:27	RANCH	BROWARD NO. 2 240 KV	WATTS LIM H0509	0048006
10:10:27	SOUTH BAY	STATION SERVICE	NORMAL	0017036
10:10:31	LAKE PARK	STATION SERVICE	NORMAL	0074036
*10:10:39	RANCH	FT. MYERS PLANT 240KV	VARS LIM H0147	0045001
*10:10:39	RANCH	FT. MYERS PLANT 240KV	VARS LIM H0147	0045001
10:10:49	BOCA TEECA	UNDERFREQUENCY TRIP	NORMAL	0040039
10:10:55	GREEN ACRES	UNDERFREQUENCY TRIP	NORMAL	0038037
10:10:55	NORTHWOOD	UNDERFREQUENCY TRIP	NORMAL	0007017
10:11:01	LANTANA	UNDERFREQUENCY TRIP	NORMAL	0065039
10:11:01	BOYNTON	UNDERFREQUENCY TRIP	NORMAL	0068037
10:11:03	HILLSBORO	UNDERFREQUENCY TRIP	NORMAL	0041038
10:11:04	OSLO	UNDERFREQUENCY TRIP	NORMAL	0030038
10:11:07	LAKE PARK	UNDERFREQUENCY TRIP	NORMAL	0074038
11:22	JUNO BEACH	UNDERFREQUENCY TRIP	NORMAL	0032038
11:24	RANCH	LAUDERDALE PLANT	WATTS LIM H0509	0045009
*10:11:24	RANCH	LAUDERDALE PLANT	WATTS LIM H0509	0045009
*10:11:30	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
*10:11:30	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
*10:11:55	RANCH	LAUDERDALE PLANT	WATTS LIM H0507	0045009
*10:11:55	RANCH	LAUDERDALE PLANT	WATTS LIM H0507	0045009
*10:14:24	RANCH	BROWARD 138KV	WATTS LIM H0228	0045009

10:21:44 ALARM/OPERATIONS LOG 05/16/77

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*10:14:24 RANCH              BROWARD 138KV                 WATTS LIM H0225  0046009
*10:14:25 HYPOLUXO ROAD      RANCH                         AMPS  LIM H0959  0057002
*10:14:25 HYPOLUXO ROAD      RANCH                         AMPS  LIM H0959  0057002
*10:14:26 LAKE PARK            STATION SERVICE                   ALARM      0074036
*10:14:27 SOUTH BAY            STATION SERVICE                   ALARM      0017036
*10:14:28 RANCH              BROWARD NO. 2 240 KV          AMPS  LIM H1225  0046008
*10:14:28 RANCH              BROWARD NO. 2 240 KV          AMPS  LIM H1225  0046008
 10:14:32 LAKE PARK            STATION SERVICE                   NORMAL     0074036
*10:14:34 MIDWAY             NORTH 138KV BUS               VOLTS LIM L131.0 0079010
*10:14:34 MIDWAY             NORTH 138KV BUS               VOLTS LIM L131.0 0079010
*10:14:35 LAKE PARK            STATION SERVICE                   ALARM      0074036
 10:14:41 LAKE PARK            STATION SERVICE                   NORMAL     0074036
*10:14:45 LAKE PARK            STATION SERVICE                   ALARM      0074036
 10:14:54 LAKE PARK            STATION SERVICE                   NORMAL     0074036
*10:14:58 LAKE PARK            STATION SERVICE                   ALARM      0074036
 10:15:03 LAKE PARK            STATION SERVICE                   NORMAL     0074036
*10:15:05 LAKE PARK            STATION SERVICE                   ALARM      0074036
 10:15:09 LAKE PARK            STATION SERVICE                   NORMAL     0074036
*10:15:10 RANCH              HYPOLUXO                      AMPS  LIM H0959  0046005
*10:15:10 RANCH              HYPOLUXO                      AMPS  LIM H0959  0046005
*10:15:13 LAKE PARK            STATION SERVICE                   ALARM      0074036
 10:15:20 LAKE PARK            STATION SERVICE                   NORMAL     0074036
 [illegible]:15:24 LAKE PARK   STATION SERVICE                   ALARM      0074036
 [illegible]:15:25 RANCH     RIVIERA 1                     VARS  LIM L0065  0046007
*10:15:25 RANCH              RIVIERA 1                     VARS  LIM L0065  0046007
*10:15:27 HYPOLUXO ROAD      YAMATO                        AMPS  LIM H0959  0057005
*10:25:00 0015 T064 001014
*10:25:02 0015 T065 001001
*10:25:15 0015 T065 001001
*10:25:20 0015 T065 001001
*10:25:26 0015 T065 001001
*10:25:32 0015 T065 001001
*10:25:35 0015 T065 001001
*10:25:41 0015 T065 001001
*10:25:44 0015 T065 001001
*10:15:27 HYPOLUXO ROAD      YAMATO                        AMPS  LIM H0959  0057005
*10:25:50 0015 T065 001001
*10:25:5[illegible] 0015 T065 001001
*10:26:02 0015 T065 001001
*10:26:05 0015 T065 001001
*10:26:1[illegible] 0015 T065 001001
*10:26:14 0015 T065 001001
*10:26:2[illegible] 0015 T065 001001
*10:26:35 0015 T065 001001
*10:26:44 0015 T065 001001
*10:26:46 0015 T065 001001
*10:26:52 0015 T065 001001
*10:27:0[illegible] 0015 T065 001001
 [illegible]:15:31 LAKE PARK   STATION SERVICE                   NORMAL     0074036
*10:27:0[illegible] 0015 T065 001001
*10:15:[illegible] MIDWAY    NORTH 240KV BUS               VOLTS LIM L219.0 0079009
*10:27:14 0015 T065 001001
*10:15:37 MIDWAY             NORTH 240KV BUS               VOLTS LIM L219.0 0079009
*10:27:30 0015 T065 001001
*10:15:3[illegible] MIDWAY   240/138 K AUTO                AMPS  LIM H0[illegible]25 0078005
*10:27:3[illegible] 0015 T065 001001
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10:27:30 ALARM/OPERATIONS LOG 05/16/77

*10:27:37	M015 T066 001001			
*10:27:36	M015 T066 001010			
*10:27:42	M015 T066 001001			
*10:27:50	M015 T066 001001			
*10:15:50	MIDWAY	240/138 S AUTO	AMPS	LIM H0425 0078005
*10:27:53	M015 T066 001001			
*10:16:05	MIDWAY	240/138 S AUTO	AMPS	LIM NORMAL 0078005
*10:28:00	M015 T066 001001			
*10:28:06	M015 T066 001001			
*10:16:05	MIDWAY	240/138 S AUTO	AMPS	LIM NORMAL 0078005
*10:28:09	M015 T066 001001			
*10:16:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS	LIM L219.0 0060011
*10:28:13	M015 T066 001001			
*10:16:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS	LIM L219.0 0060011
*10:28:19	M015 T066 001001			
*10:16:16	MIDWAY	RANCH	AMPS	LIM H1796 0076011
*10:28:25	M015 T066 001001			
*10:16:16	MIDWAY	RANCH	AMPS	LIM H1796 0076011
*10:28:30	M015 T066 001001			
*10:16:18	MIDWAY	240/138 S AUTO	AMPS	LIM H0425 0078005
*10:28:35	M015 T066 001001			
*10:16:18	MIDWAY	240/138 S AUTO	AMPS	LIM H0425 0078005
*10:28:41	M015 T066 001001			
*10:16:24	RANCH	FT. MYERS PLANT 240KV	VARS	LIM NORMAL 0045001
*10:28:51	M015 T066 001001			
*10:16:24	RANCH	FT. MYERS PLANT 240KV	VARS	LIM NORMAL 0045011
*10:28:53	M015 T066 001001			
*10:16:31	MIDWAY	RANCH	AMPS	LIM NORMAL 0076011
*10:28:59	M015 T066 001001			
*10:29:04	M015 T066 001001			
*10:16:31	MIDWAY	RANCH	AMPS	LIM NORMAL 0076011
*10:29:07	M044 T065 001014			
*10:16:37	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM L065.0 0053006
*10:29:12	M015 T066 001001			
*10:16:37	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM L065.0 0053006
*10:29:18	M015 T066 001001			
*10:17:19	MIDWAY	240/138 S AUTO	AMPS	LIM NORMAL 0078005
*10:29:23	M015 T066 001001			
*10:17:19	MIDWAY	240/138 S AUTO	AMPS	LIM NORMAL 0078005
*10:29:28	M015 T066 001001			
*10:17:22	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM NORMAL 0053006
*10:29:34	M015 T066 001004			
*10:17:22	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM NORMAL 0053006
*10:29:40	M015 T066 001004			
*10:17:34	MIDWAY	240/138 S AUTO	AMPS	LIM H0425 0078005
*10:29:45	M015 T066 001001			
*10:29:51	M015 T066 001001			
*10:17:34	MIDWAY	240/138 S AUTO	AMPS	LIM H0425 0078005
*10:30:02	M015 T066 001001			
*10:30:09	M015 T066 001001			
*10:17:37	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM L065.0 0053006
*10:17:37	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM L065.0 0053006
*10:17:52	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM NORMAL 0053006
*10:17:52	HARTMAN ROAD	BUS POTENTIAL	VOLTS	LIM NORMAL 0053006
*10:17:52	GERMANTOWN	STATION SERVICE	ALARM	0047036
*10:18:10	MIDWAY	240/138 S AUTO	AMPS	LIM NORMAL 0078005

10:30:37 ALARM/OPERATIONS LOG 05/16/77

*10:18:19	MIDWAY	240/138 S AUTO	AMPS LIM NORMAL	0078005
*10:18:51	MIDWAY	240/138 S AUTO	AMPS LIM H0425	0078005
*10:18:51	MIDWAY	240/138 S AUTO	AMPS LIM H0425	0078005
10:18:58	MIDWAY	NORTH 240/138 AUTO	SELECT	1079011
*10:19:07	MIDWAY	240/138 S AUTO	AMPS LIM NORMAL	0078005
*10:19:07	MIDWAY	240/138 S AUTO	AMPS LIM NORMAL	0078005
10:19:15	MIDWAY	NORTH 240/138 AUTO	TAP POS 3R/ 6R	1079011
10:19:24	MIDWAY	NORTH 240/138 AUTO	SELECT	1079011
10:19:43	MIDWAY	NORTH 240/138 AUTO	TAP POS 3R/ 3R	1079011
10:19:46	MIDWAY	NORTH 240/138 AUTO	SELECT	1079011
*10:19:59	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:19:59	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
10:20:03	MIDWAY	NORTH 240/138 AUTO	TAP POS 3R/ 3R	1079011
10:20:04	RANCH	WEST AUTOTRANSFORMER-TP	SELECT	1048002
10:20:06	MIDWAY	NORTH 240/138 AUTO	SELECT	1079011
*10:20:06	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM L065.0	0053006
*10:20:06	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM L065.0	0053006
*10:20:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:20:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
10:20:20	RANCH	WEST AUTOTRANSFORMER-TP	TAP POS 5R/ 7R	1048002
10:20:25	MIDWAY	NORTH 240/138 AUTO	TAP POS 3R/ 3R	1079011
*10:20:30	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:20:30	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:20:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:20:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:20:51	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM NORMAL	0053006
*10:20:51	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM NORMAL	0053006
*10:20:59	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:20:59	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:21:06	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM L065.0	0053006
*10:21:06	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM L065.0	0053006
*10:21:13	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:21:13	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:21:28	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:21:28	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:21:33	MIDWAY	240/138 S AUTO	AMPS LIM H0425	0078005
*10:21:33	MIDWAY	240/138 S AUTO	AMPS LIM H0425	0078005
10:21:39	RANCH	WEST AUTOTRANSFORMER-TP	SELECT	1048002
*10:21:40	RANCH	BROWARD 138KV	WATTS LIM NORMAL	0046009
*10:21:40	RANCH	BROWARD 138KV	WATTS LIM NORMAL	0046009
*10:21:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:21:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM L219.0	0060011
*10:21:48	MIDWAY	240/138 S AUTO	AMPS LIM NORMAL	0078005
*10:21:48	MIDWAY	240/138 S AUTO	AMPS LIM NORMAL	0078005
10:21:55	RANCH	WEST AUTOTRANSFORMER-TP	TAP POS 5R/ 5R	1048002
*10:21:58	RANCH	HYPOLUXO	AMPS LIM NORMAL	0046005
*10:21:58	RANCH	HYPOLUXO	AMPS LIM NORMAL	0046005
10:22:00	RANCH	WEST AUTOTRANSFORMER-TP	SELECT	1048002
*10:22:10	RANCH	HYPOLUXO	AMPS LIM H0959	0046005
*10:22:10	RANCH	HYPOLUXO	AMPS LIM H0959	0046005
*10:22:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:22:14	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LIM NORMAL	0060011
*10:22:17	RANCH	WEST AUTOTRANSFORMER-TP	FAILED TO CHANGE	1048002
*10:22:25	RANCH	BROWARD 138KV	WATTS LIM H0228	0046009
*10:22:25	RANCH	BROWARD 138KV	WATTS LIM H0228	0046009
*10:22:40	RANCH	BROWARD 138KV	WATTS LIM NORMAL	0046009

10:22:40	RANCH	BROWARD 138KV	WATTS LI NORMAL	004400
*10:22:55	RANCH	BROWARD 138KV	WATTS LI H0224	004400
*10:22:55	RANCH	BROWARD 138KV	WATTS LI H0224	004400
*10:23:29	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LI L219.0	006011
*10:23:29	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LI L219.0	006011
10:23:35	RANCH	MIDDLE AUTOTRANSFORMER-TP	SELECT	104800
*10:23:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LI NORMAL	006011
*10:23:44	ST. LUCIE PLANT	WEST 240KV BUS	VOLTS LI NORMAL	006011
10:24:00	RANCH	MIDDLE AUTOTRANSFORMER-TP	RESET	104800
*10:24:01	RANCH	240W2561 FT. MYERS/BROWARD 1	OPEN	004400
*10:24:01	NORTON	STATION SERVICE	ALARM	003903
*10:24:01	BOCA TEECA	UNDERFREQUENCY TRIP	TRIPPED	004003
*10:24:02	BELVEDERE	TRANS 1,2&3 TROUBLE	ALARM	003503
*10:24:02	BELVEDERE	STATION SERVICE	ALARM	003503
*10:24:02	DATURA	STATION SERVICE 4KV	ALARM	006203
*10:24:02	PORT MAYACA	TRANS 1&2 TROUBLE	ALARM	006303
*10:24:02	JUNO BEACH	UNDERFREQUENCY TRIP	TRIPPED	003203
*10:24:02	MIDWAY	HARTMAN	WATTS LI H0080	007700
*10:24:02	MIDWAY	HARTMAN	WATTS LI H0080	007700
*10:24:02	MIDWAY	PLUMOSUS	AMPS LI H0745	007701
*10:24:02	MIDWAY	PLUMOSUS	AMPS LI H0745	007701
*10:24:02	LANTANA	UNDERFREQUENCY TRIP	TRIPPED	006503
*10:24:02	SANDALFOOT	TRANS 1&2 TROUBLE	ALARM	007103
*10:24:02	LAKE PARK	UNDERFREQUENCY TRIP	TRIPPED	007403
*10:24:03	HILLSBORO	UNDERFREQUENCY TRIP	TRIPPED	004103
*10:24:03	TERMINAL	STATION SERVICE	ALARM	006603
*10:24:03	JUPITER	STATION SERVICE	ALARM	003703
*10:24:03	GREEN ACRES	STATION SERVICE	ALARM	003303
*10:24:03	GREEN ACRES	UNDERFREQUENCY TRIP	TRIPPED	003303
*10:24:03	LINTON	STATION SERVICE	ALARM	004303
*10:24:03	GOLF	STATION SERVICE	ALARM	003303
*10:24:03	GOLF	UNDERFREQUENCY TRIP	TRIPPED	003303
*10:24:03	RANCH	240W2516 PRATT-WHITNEY 2	OPEN	004401
*10:24:03	RANCH	240W2544 PRATT-WHITNEY2/LAUD	OPEN	004401
*10:24:03	RANCH	138W2535 WEST PALM BEACH	OPEN	004401
*10:24:03	RANCH	138W2531 WEST PALM BEACH	OPEN	004401
*10:24:03	RANCH	138W2531 HYPOLUXO/RIVIERA 1	OPEN	004401
*10:24:03	RANCH	138W2595 RIVIERA 1	OPEN	004401
*10:24:03	RANCH	138W2575 BROWARD	OPEN	004401
*10:24:03	RANCH	138W2591 BROWARD/RIVIERA 2	OPEN	004401
*10:24:03	RANCH	STATION SERVICE	ALARM	004403
*10:39:04	4015 T065 001001			
*10:39:08	4015 T065 001001			
*10:39:20	4015 T065 001001			
*10:39:23	4015 T065 001001			
*10:39:26	4015 T065 001001			
*10:39:29	4015 T065 001001			
*10:39:45	4015 T065 001001			
*10:39:50	4015 T065 001001			
10:24:03	RANCH	240W2576 FT. MYERS PLANT	OPEN	004401
10:24:03	RANCH	240W2576 FT. MYERS PLANT.	CLOSED	004402
*10:24:03	WESTWARD	UNDERFREQUENCY TRIP	TRIPPED	006103
10:24:04	PUMPY LANE	STATION SERVICE	ALARM	003403
*10:24:04	OSLO	UNDERFREQUENCY TRIP	TRIPPED	003003
10:24:04	DATURA	STATION SERVICE 4KV	NORMAL	006203
*10:24:04	MIDWAY	240W24651 MIDWAY/[illegible] CITY	OPEN	007701

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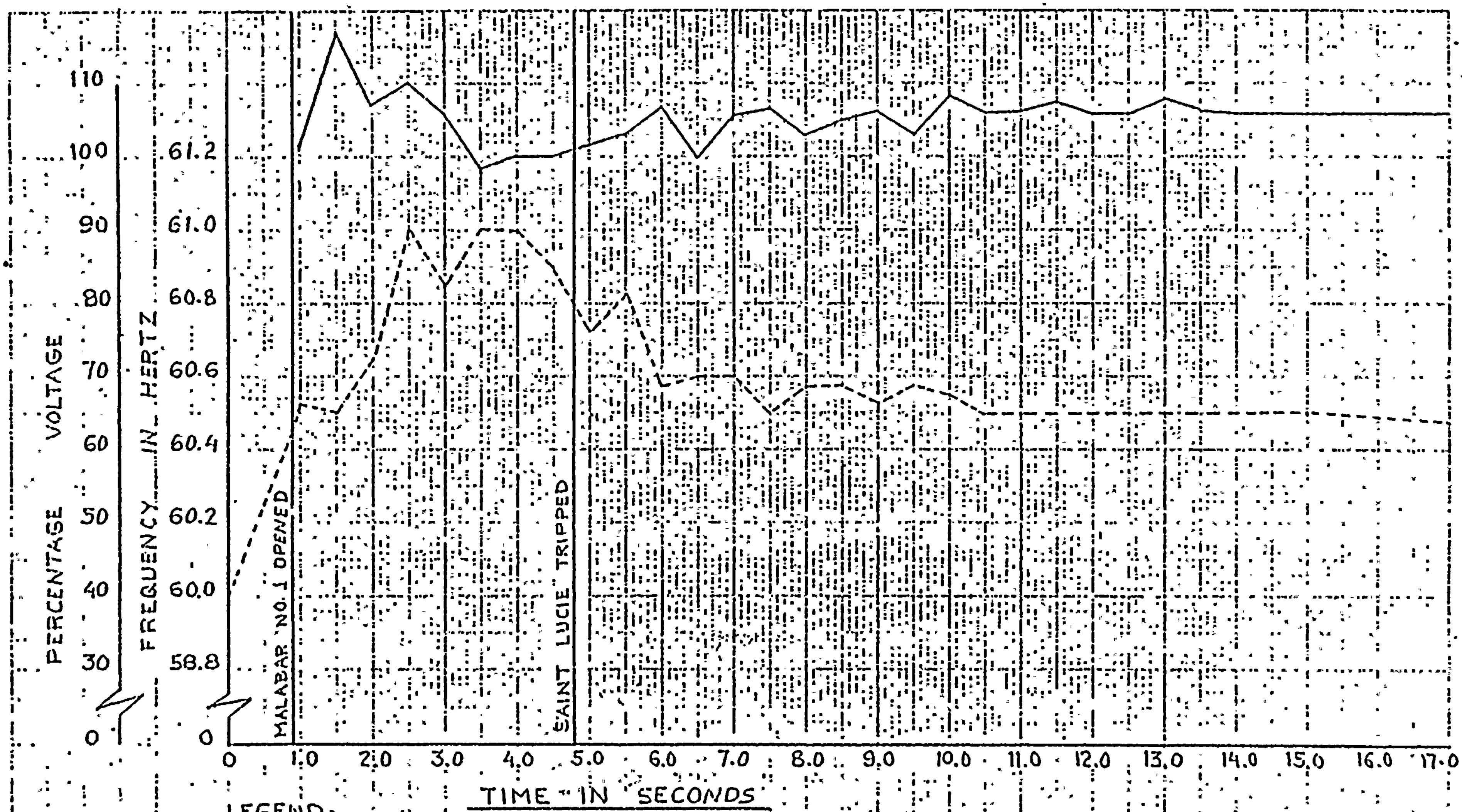
10:24:04	MIDWAY	240W24665 PRATT & WHITNEY	OPEN	0075010
10:24:04	MIDWAY	138W24785 PLUMOSUS	OPEN	0075011
10:24:04	MIDWAY	138W24747 PLUM-0/138-69 AUTO	OPEN	0075012
10:24:04	JUNO BEACH	STATION SERVICE	ALARM	0032035
10:24:05	SANDALFOOT	TRANS 1&2 TROUBLE	NORMAL	0071034
10:24:05	GERMANTOWN	UNDERFREQUENCY TRIP	TRIPPED	0067038
10:24:05	HARTMAN ROAD	66W39710 MIDWAY/CFP	OPEN	0052002
10:24:05	HARTMAN ROAD	66W39725 FT PIERCE/MIDWAY	OPEN	0052001
10:24:05	HARTMAN ROAD	66W39725 FT PIERCE/MIDWAY	CLOSED	0052001
10:24:05	NORTHWOOD	UNDERFREQUENCY TRIP	TRIPPED	0007017
10:24:05	LAKE PARK	STATION SERVICE	ALARM	0074036
10:24:05	TERMINAL	UNDERFREQUENCY TRIP	TRIPPED	0066037
10:24:05	BOYNTON	UNDERFREQUENCY TRIP	TRIPPED	0068037
10:24:05	BOCA RATON	UNDERFREQUENCY TRIP	TRIPPED	0042038
10:24:05	HOMET	TRANS 1 TROUBLE	ALARM	0008013
10:24:05	MIDWAY	NORTH 240KV BUS	VOLTS LIM NORMAL	0079009
10:24:05	MIDWAY	NORTH 240KV BUS	VOLTS LIM NORMAL	0079009
10:24:05	MIDWAY	NORTH 138KV BUS	VOLTS LIM NORMAL	0079010
10:24:05	MIDWAY	NORTH 138KV BUS	VOLTS LIM NORMAL	0079010
10:24:05	MIDWAY	NORTH 138KV BUS POTENTIAL	ALARM	0075050
10:24:05	RANCH	240W2575 FT. MYERS PLANT	OPEN	0044000
10:24:05	RANCH	BROWARD 138KV LINE POT	ALARM	0044056
10:24:06	LINTON	UNDERFREQUENCY TRIP	TRIPPED	0043039
10:24:06	ST. LUCIE PLANT	240W40330 MIDWAY 1/GEN.1	OPEN	0058032
10:24:06	ST. LUCIE PLANT	240W40326 GENERATOR 1	OPEN	0058033
10:24:06	ST. LUCIE PLANT	L O RELAY GENERATOR 1	TRIPPED	0058037
10:24:06	PORT MAYACA	TRANS 1&2 TROUBLE	NORMAL	0063034
10:24:07	TERMINAL	STATION SERVICE	NORMAL	0066035
10:24:07	GREEN ACRES	TRANS 1&2 TROUBLE	ALARM	0038033
10:24:07	PLUMOSUS	138W29586 MIDWAY/RIVIERA 2	OPEN	0014001
10:24:08	RANCH	WEST AUTOTRANS TROUBLE	ALARM	0044068
10:24:08	RANCH	EAST AUTOTRANS TROUBLE	ALARM	0044070
10:24:08	RANCH	AUTOTRANS ALARM 1	ALARM	0044071
10:24:08	RANCH	AUTOTRANS ALARM 2	ALARM	0044072
10:24:08	PORT SEWALL	STATION SERVICE	ALARM	0070036
10:24:08	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM NORMAL	0053006
10:24:08	HARTMAN ROAD	BUS POTENTIAL	VOLTS LIM NORMAL	0053006
10:24:08	STUART	TRANS 1,2&3 TROUBLE	ALARM	0031034
10:24:08	HILLCREST TRAIL	TRANS 1&2 TROUBLE	ALARM	0036033
10:24:08	HILLCREST TRAIL	STATION SERVICE	ALARM	0036036
10:24:08	RANCH	FT. MYERS PLANT 240KV	WATTS LIM NORMAL	0045000
10:24:08	RANCH	FT. MYERS PLANT 240KV	WATTS LIM NORMAL	0045000
10:24:08	RANCH	FT. MYERS PLANT 240KV	AMPS LIM NORMAL	0045002
10:24:08	RANCH	FT. MYERS PLANT 240KV	AMPS LIM NORMAL	0045002
10:24:08	RANCH	BROWARD NO. 1 240KV	AMPS LIM NORMAL	0045005
10:24:08	RANCH	BROWARD NO. 1 240KV	AMPS LIM NORMAL	0045005
10:24:08	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
10:24:08	RANCH	LAUDERDALE PLANT	WATTS LIM NORMAL	0045009
10:24:08	RANCH	LAUDERDALE PLANT	AMPS LIM NORMAL	0045011
10:24:08	RANCH	LAUDERDALE PLANT	AMPS LIM NORMAL	0045011
10:24:10	YAMATO	BATTERY LOW VOLTAGE	ALARM	0061046
10:24:10	GOLF	STATION SERVICE	NORMAL	0033036
10:24:10	LINTON	STATION SERVICE	NORMAL	0043037
10:24:10	HILLCREST NO. 1	STA. SERV/TRANS TROUBLE	ALARM	0024036
10:24:11	SOUTH BAY	SOUTH AUTOTRANS TROUBLE	ALARM	0017021
10:24:11	JUNO BEACH	STATION SERVICE	NORMAL	0032036



LEGEND:

——— VOLTAGE MEASURED AT MIDWAY

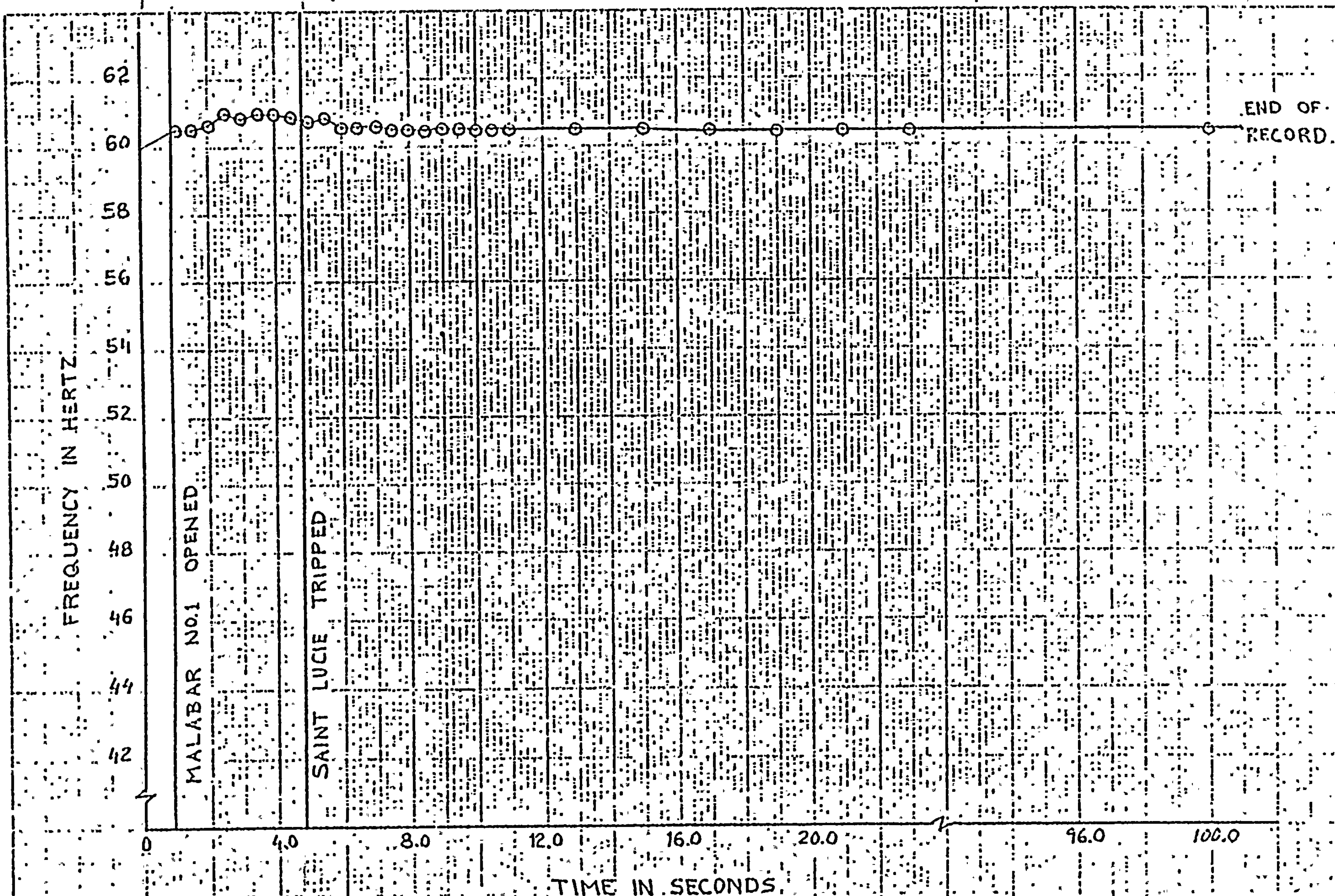
- - - - FREQUENCY MEASURED AT MALABAR

SAINT LUCIE FREQUENCY & VOLTAGE vs TIME AT 10:24 AM FOR MAY 16, 1977 DISTURBANCE.

FIGURE 2

NOTE: FREQUENCY CURVE OF FIG 1 & FIG. 2 ARE BASED ON THE SAME DATA BUT DIFFERENT SCALE

A.S.



SAINT LUCIE FREQUENCY MEASURED AT MALABAR FOR MAY 16, 1977 DISTURBANCE

FIGURE 1

A.S.

QUESTION 2

Please provide the following information:

2.1 If the likelihood of a causal relation between the Ft. Myers-Ranch line relaying and the Turkey Point, Unit 3 scram were conceded, would FPL continue to represent that the two events constituted a double rather than a single contingency?

2.2 Provide a discussion of the bases for your response to Item 2.1.

RESPONSE 2

If a hypothetical causal relation between the Ft. Myers-Ranch line relaying and the Turkey Point Unit 3 trip were assumed, it would appear, by definition, that this would constitute a single contingency under Classification Type 1 of ANSI N41.2, Section 5.1.

FPL, however, does not concede the likelihood of such a relation. There have been Turkey Point unit trips in the past and they have never led to the loss of a transmission line. Similarly, the available data from the May 16, 1977 disturbance show that the Ft. Myers-Ranch line did not relay because of an overload condition caused by the Turkey Point Unit 3 trip. The fact that these two events occurred approximately 16 minutes apart is additional indication of their independence. We have concluded that the Turkey Point trip could not, by itself, have caused the line to relay. Numerous contingencies with respect to the condition of the power grid would have to be assumed in order to "create" the hypothetical "worst case" situation in which a causal relation between the events would become at most a remote possibility. The fact remains that during the May 16 disturbance, there were two distinct malfunctions; (1) the loss of Turkey Point Unit 3 caused by a defective auxiliary relay, and (2) the loss of the Ft. Myers-Ranch 240kV line caused by a fault to ground from an undetermined origin.

QUESTION 3

What studies were made to determine the condition of the system with the outage of Turkey Point Unit 4 and the 500kV line prior to the shutdown of these two facilities? Specifically,

3.1 What information did the studies provide relative to stability limits and other system limitations?

3.2 If the studies were not made, why not?

3.3 If they were made and did not show the vulnerability of the system to a failure, why did they not?

3.4 If they were made and did show the system vulnerable to a failure, what precautionary measures were adopted?

RESPONSE 3

Florida Power & Light Company conducts transient stability studies as part of the Florida Electric Power Coordinating Group (FCG) in order to assess the effects of the various contingencies listed in SERC Guideline Number 3, "Criteria for Reliability in System Planning."

System Operations maintains and uses a current load flow model. System Planning has also just implemented an in-house stability program. However, these are batch programs run on corporate computer facilities and turn-around times of 24-48 hours are not uncommon. Therefore, while these are helpful for short-range contingency planning, they offer little or no benefit under emergency conditions. Installation of the System Control Center in 1978 will provide capability for real-time load flows, contingency planning and security analysis.

A status report of the referenced 1973 report of FPL's consultant to the Public Service Commission is attached and will be referenced again in the response to paragraph 6.

The latest FCG study, "Off-Peak Transient Stability Study for 1977," considered the loss of Turkey Point Unit 4 with a fragmented system. This fragmented transmission system simulated the simultaneous removal of three major circuits: the 500kV Andytown - Orange River circuit (FPL), the Midway - Indiantown 230kV circuit (FPL), and the Central Florida - Clermont East 230kV circuit (FPC). System recovery was normal and no load shedding or relay action was observed. There was no reason to believe that the system could not be operated satisfactorily under the May 16, 1977 conditions. In any such tests several key points are examined. These include: did any generator pull out of synchronism, did transmission lines relay, and was any customer load shed?

Indeed, from the events of May 16, 1977, we know that at 10:08 a.m.

following the sudden loss of Turkey Point Unit 3, no generator pulled out of synchronism, no transmission lines relayed, and no customer load was shed.

The stability tests made did not show the system vulnerable to a failure. The sense of paragraph 3 appears to assume that long-term dynamic stability programs are available to allow simulation of the probable status of a system for 10, 15, or 20 minutes of real-time, following a disturbance. The fact is that no such program or programs are currently available. FPL, with others, is cooperating with EPRI and General Electric in the development of such a program.

REPORT A

STATUS OF RECOMMENDATIONS OF STONE & WEBSTER ENGINEERING CORPORATION ON FPL ELECTRIC POWER SYSTEM DISTURBANCES APRIL 3 AND 4, 1973

(FROM STONE & WEBSTER REPORT TO FPSC).

As a result of our findings, we make the following recommendations:

1. *As long as the Florida companies must trip units automatically on underfrequency, FPL should revise the relay schemes so that each set of relays trips only one unit unless the total amount of generation to be tripped by one set of relays is less than 250 MW.*

   Individual underfrequency relay schemes are installed on each generating unit of 250 MW or more, except Putnam. At Putnam one relay scheme encompasses both Putnam Units 1 and 2.

2. *Each scheme as a minimum should have two relays both set to pick up at 58 cycles, with their contacts in series so that both must operate to trip the unit.*

   FPL selected a scheme comprising parallel sets of two relays with their contacts in series to provide both security and reliability.

   All generators in peninsular Florida (or tie lines on some neighboring systems) are set to trip at 58 hertz after a 12 second time delay except for FPL's area east of Ft. Myers and south of Midway where settings are 57 hertz (this includes St. Lucie Unit 1).

3. *Consideration should be given to adding out of step relays to 115 kV, 138 kV, and 240 kV circuits to block reclosing on trips due to stability swings.*

   As a result of studies by Stone & Webster and FPL engineers, it was decided to add equipment to sense out of step conditions and block reclosing following trip due to stability swings.

   Approximately forty 240 kV and 138 kV line terminals considered to be most likely to be affected by stability swings have had this equipment added to them. As new terminals are added, consideration is given as to whether they should also have this type of protection included.

On the basis of further studies by Stone & Webster and FPL, the practice of blocking high-speed reclosing following Zone 1 trip was adopted for all 240 kV lines south of Ranch Substation, and the 138 kV lines at the respective substations with 240 kV. This has been completed. A decision was reached recently to extend this blocking practice to the remainder of the transmission system. This would include all 240 kV line terminals, 138 kV line terminals at 240/138 kV substations, and 115 kV line terminals at 240/115 kV substations.

4. *FPL should thoroughly review its relaying philosophy and protective schemes to ensure that this important part of its system design provides the highest possible degree of reliability and security.*

An extensive review of FPL current practices was conducted by Stone & Webster and FPL engineers. Results were published February 22, 1974 and adopted. While there was no wholesale retrofit, except as mentioned above, all new installations and the old ones rebuilt follow the new philosophy.

5. *Provision should be made to establish and maintain digital load flow and stability models of the Florida systems representing current conditions. These models would provide day-to-day information to the operators on stability limits and other system limitations imposed by construction delays or equipment outages.*

System Operations maintains and uses a current load flow model. System Planning has also just implemented an in-house stability program. However, these are batch programs run on corporate computer facilities and turn around times of 24-48 hours are not uncommon. Therefore, while these are helpful for short range contingency planning, they offer little or no benefit in emergency conditions. Installation of the System Control Center in 1978 will provide capability for real time load flows, contingency planning and security analysis.

6. *Stability and load flow studies should be conducted for 1974 and 1975 conditions to check the effectiveness of corrective measures such as additional load shedding, blocking of reclosing, and other aspects of line relaying and system design.*

Stone & Webster was retained to conduct studies of 1974 and 1975. Analysis of these studies together with studies conducted by FPL provided operating guidelines for 1974 and 1975.

7. *These studies should include off-peak as well as peak load conditions.*

(See response to number 6.)

8. *FPL should continue to put a high priority on transmission additions to strengthen ties between the southern area and the rest of the Florida systems. Construction of transmission lines in southern Florida has been delayed by environmental considerations and labor problems. Any further delays will affect the reliability of the FPL system.*

FPL has continued to place a high priority on the expansion of its bulk transmission facilities with the major additions from 1973 to date as follows:

Placed In Service During 1973

Ft. Myers - Ringling #2, 240 kV
Ringling - Tampa (TEC) #2, 240 kV
Sanford - North Longwood (FPC) 240 kV

Placed In Service During 1974

Midway - St. Lucie 240 kV
Broward - Lauderdale #2, 240 kV
Broward - Ranch #2, 240 kV
Ft. Myers - Lauderdale 240 kV
Bradford - Normandy (JEA) 240 kV
Bradford - Palatka 240 kV

Placed In Service During 1975

Ringling - Tampa #2, 240 kV (thru Manatee)

Placed In Service During 1976

Dade - Turkey Point 240 kV
Dade - Lauderdale 240 kV
Davis - Flagami 240 kV
Flagami - Lauderdale 240 kV
} Circuit rearrangement
Baldwin - Duval 240 kV
Ringling - Manatee #2, 240 kV
Bradford - Duval 240 kV
Flagami - Miami #2, 240 kV

Placed In Service During 1977 to Date

Ft. Myers - Orange River #1 & #2, 240 kV
Andytown - Orange River 500 kV (Converted from 240 kV)
Andytown - Broward 240 kV
Andytown - Lauderdale 240 kV (2 circuits)
Ranch - Pratt & Whitney #1 & #2, 240 kV (Increase Capacity)
Midway - Pratt & Whitney #1 & #2, 240 kV (Increase Capacity)

9. *A strong 500 kV system with ties to Georgia, which is now in the planning stages, should be pursued with due regard to development of proper systems within Florida and Georgia in conjunction with interstate ties.*

A strong 500 kV system has been a part of FPL's plans for 10 years.

A 500 kV system was reported in the 1968 National Power Survey (1968 through 1990) by FPL. This included 500 kV from Miami to Ft. Myers to Sarasota, plus 500 kV from Miami to Midway to Brevard to Bunnell.

A joint study was made in 1972 by the Planning Subcommittee of the Florida Operating Committee which confirmed a coordinated 500 kV statewide expansion program through 1990.

The statewide 500 kV system is being reported annually to the Federal Power Commission under Order 383-4 (SERC-TAC). The 1971 filing indicated a 500 kV system from Turkey Point to the Georgia line, tentatively by 1980.

In 1975, an additional joint study by the FCG Planning Committee through 1995 was made to determine effects of changing load conditions and altered generation expansion plans. The 500 kV system completion need to the Georgia line from South Florida was shown to be 1986.

10. *Discussions between Southern Company and the Florida companies concerning additional 240 kV interstate ties should be given urgent priority with the objective of increasing the emergency interchange capability to Florida from Southern Company to at least 800 MW by 1976. This would allow loss of the largest unit without causing isolation of Peninsular Florida. The addition of these 240 kV lines should be considered an interim measure and should not affect the longer range plans for 500 kV ties.*

Negotiations with Georgia Power Company are continuing for a 240 kV transmission tie to be in service in the summer of 1980. Tentative agreement has been reached. FPL has authorized projects for the timely completion of this interconnection.

QUESTION 4

Please provide the following information:

4.1 The frequency versus time information at the Turkey Point bus and at the St. Lucie bus at least to tenth of a second accuracy for the ten second period following the scram of each reactor; and

4.2 The same information requested in (4.1) including MW production versus time and MVAR production versus time at the Turkey Point bus and the St. Lucie bus for the time period 10:08 to 10:24, and shortly before 10:08. This information may be provided on a coarser scale.

RESPONSE 4

The continuous high speed recorder installed at Turkey Point records bus frequency. Since other parameters are related to generator output, only bus frequency can be provided. No equivalent recording equipment is installed at the St. Lucie Plant.

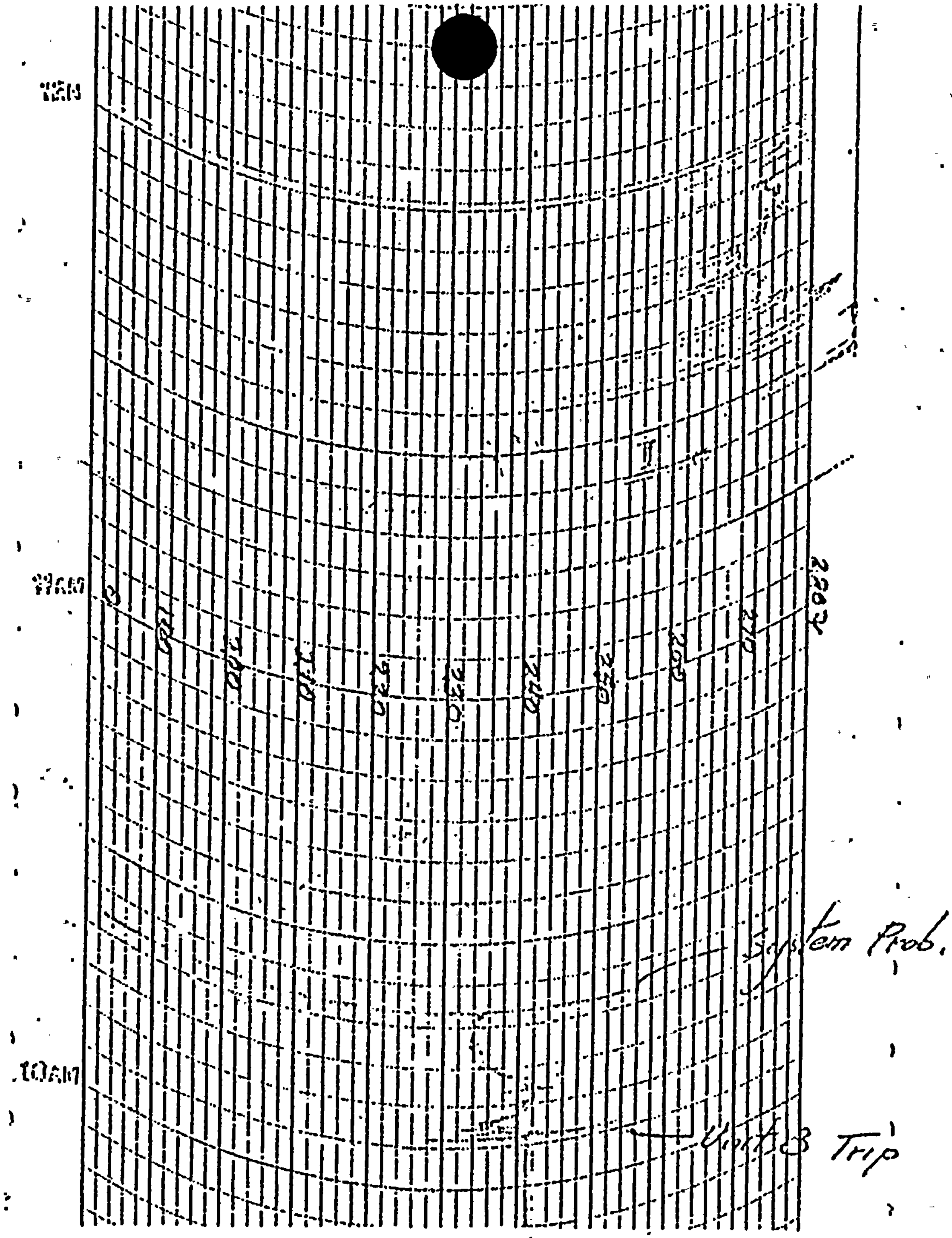
The following tabulation indicates frequency on the Turkey Point bus to which the nuclear units are connected. The time is in seconds after the reactor trip. Frequency is in Hertz.

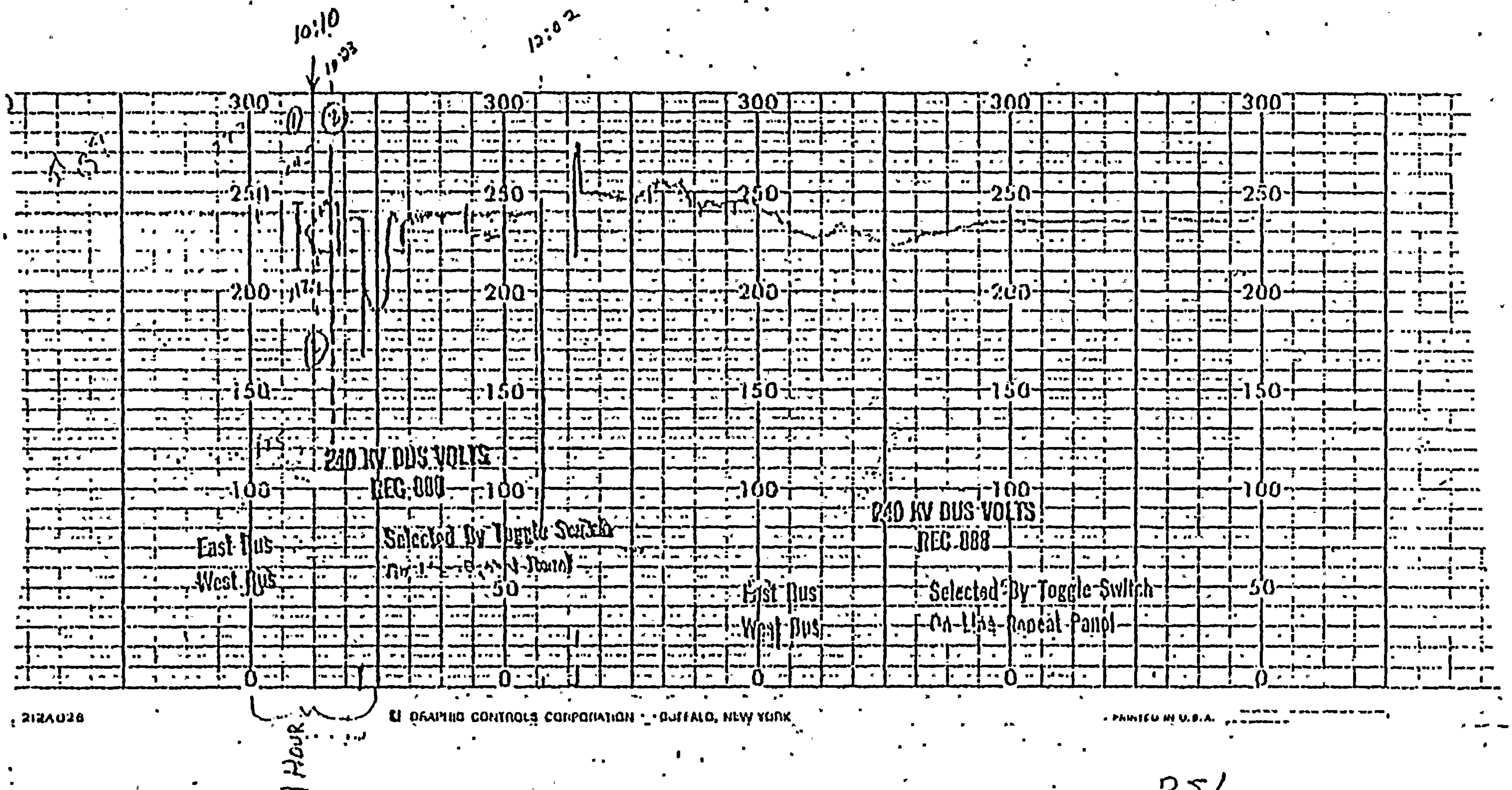
Time	Frequency	Time	Frequency
0	60.00	6	59.60
1	59.78	7	59.54
2	59.72	8	59.70
3	59.78	9	59.72
4	59.66	10	59.72
5	59.60		

The following tabulation indicates frequency on the Turkey Point bus to which the nuclear units are connected. The time is in minutes after the reactor trip. Frequency is in Hertz.

Time	Frequency	Time	Frequency
0	60.00	8	59.96
1	59.94	9	60.00
2	59.76	10	59.99
3	59.82	11	59.98
4	59.81	12	59.97
5	59.83	13	59.96
6	60.00	14	60.00
7	59.98	15	60.00

Charts of switchyard voltage vs. time for Turkey Point and St. Lucie are attached.


9AM
10AM
System Prob.
Unit 3 Trip



10:10
12:02
300
250
200
150
100
50
0
240 KV BUS VOLTS
REC 088
East Bus
West Bus
Selected By Toggle Switch
On Line Repeat Panel
1 HOUR
212A026
GRAPHIC CONTROLS CORPORATION · BUFFALO, NEW YORK
PRINTED IN U.S.A.

PSL
5-16-77

QUESTION 5

Provide the following information:

5.1 A clear definition of FPL's system requirements on spinning reserves, distinguishing between tie-line imports and spinning reserves; and

5.2 A copy of the guidelines established by the Operating Committee of the Florida Electric Power Coordinating Group relating to practices and procedures on spinning reserves, load shedding, and emergency operating procedures.

RESPONSE 5

FPL's system requirements on spinning reserves are defined by Section III of the FCG Operating Committee Handbook. The spinning reserve requirements established by this section are conservative with respect to NAPSIC Operating Guide No. 10 for Integrated Systems.

One copy each of Section III and VII of the FCG Operating Committee Handbook are attached. These sections cover spinning reserves, load shedding and emergency operating procedures.

FCG

OPERATING COMMITTEE

HANDBOOK

SECTION III

DAILY OPERATING RESERVE

1. Daily Operating Reserve is that amount of generating capability and/or equivalent load relief in excess of forecasted daily peak load which is available to provide for load variation and forecast error, frequency regulation, area protection and contingencies such as loss of generating capability. It consists of the following components:

   A. Spinning Reserve - The term "Spinning Reserve" when used herein means the reserve generating capability connected to the bus, ready to pick up load immediately, and capable of becoming fully applicable with a frequency decline to 59.5 Hz. (It is recognized that this definition of Spinning Reserve differs from that of the I.E.E.E.)

      (1) Steam Unit

      Due to special operating conditions in Peninsular Florida, no more than 16-2/3% of the Continuous Capability of a steam unit may be counted in computing the system Spinning Reserve.

      (2) Combustion Turbine Unit

      (a) A portion, generally 30%, of the base rating of combustion turbine generating units may be counted as Spinning Reserve, provided, 1) the units are operating in their automatic control mode, 2) the units are equipped with solid-state underfrequency relays in their ramp rate control circuits to change their response rate to emergency, 3) tests have been made to demonstrate that such amount counted will respond and become fully applicable with a frequency decline to 59.5 Hz, and 4) unit response is equal to, or faster than, the same amount of steam unit capacity as defined above.

(b) The capacity between base and peak load of combustion turbine units may be counted as Spinning Reserve provided, 1) the units are equipped with solid-state underfrequency relays which will automatically change the operating mode from "base" to "peak" when the frequency declines to 59.9 Hz, and 2) unit response is equal to or faster than the same amount of steam capacity as defined above.

Since contractually interruptible load, when it is interrupted, releases generating capacity that is instantly available, a participant may place such load on underfrequency relay control and count the amount of this load so placed as Spinning Reserve up to 75% of his allocation. Solid-state relays will be employed for this application in order to minimize time delay. They will be set to disconnect the interruptible load at 59.7 Hz. Use of this provision by a participant in no way changes his responsibility to provide his share of Spinning Reserve in an emergency. Interruptible loads which are utilized as part of the Operating Reserve cannot be counted as part of the load shedding obligation.

B. Supplemental Reserve - The term Supplemental Reserve when used herein means any generating capability and/or load relief measure which can be made fully applicable within 30 minutes or less. It includes, but is not limited to diesel units, combustion turbines, interruptible loads, load relief measures, and any increase in generation that may be obtained from a generating unit.

2. In normal operation the Daily Operating Reserve should be maintained by the combined systems at a value equal to, or greater than, the sum of the Peak Capability ratings of the two largest generating units in service. Spinning Reserve should be maintained equal to, or greater than, the Peak Capability rating of the largest generating unit in service to allow the combined systems to recover in an orderly manner from the instantaneous loss of such largest unit. The balance of the Daily

Operating Reserve will be Supplemental Reserve. Following the loss of a generating unit, Supplemental Reserve should be converted to Spinning Reserve, if required to restore the recommended level of Spinning Reserve.

3. The Daily Operating Reserve and the Spinning Reserve requirements, (the minimum values specified in Paragraph 2), should be allocated among the participants in proportion to each participant's maximum demand for the preceding year and the Peak Capability of his largest unit. Fifty percent should be allocated on the basis of demand and 50% on the basis of the Peak Capability of the largest unit. (See current calculation on Page 5 in this section.)

4. The Daily Operating Reserve requirement and an equitable allocation among the participants will be a continuing interest of the FCG Operating Committee. A new allocation will be calculated and used when a participant's single largest unit is off line.

5. The effect on a participant's ability to maintain his Spinning Reserve allocation should be fully considered before agreeing to sell power to another participant.

6. Protection of a new unit during shakedown will be the responsibility of the owner.

7. Each participant's Daily Operating Reserve allocation should be available to the other participants and not be restricted by transformer, line or other limitations.

8. Each participant's Spinning Reserve allocation must be distributed on enough generating units with proper governor characteristics, so that it will not take a frequency drop in excess of 0.5 Hz to realize the full benefits of each participant's Spinning Reserve. Assuming 5% governors, this means that the Spinning Reserve assigned to any one unit should be no more than 16-2/3% of the Continuous Capability of that unit.

9. Reliable operation of the combined systems requires that each participant's dispatcher know at all times the Continuous Capability rating of his generating units. Particularly during periods when forecasts indicate close operating reserves, the Continuous Capability rating of all questionable units should be verified by having these units demonstrate this capability before the time of the expected peak for the day.

10. It should be recognized that a deficiency in Spinning Reserve on the combined systems subjects all participants' customers to a risk of interruption due to underfrequency relay operation.

In abnormal situations where the Daily Operating Reserve and/or Spinning Reserve of a participant is less than his allocation, such participant will notify the others, giving full details of his operating condition, so that they may determine what assistance they can make available to be utilized. The deficient participant should take such measures that are available to him to safeguard the reliability of the combined systems. This would include: 1) purchase from other systems, 2) interrupting some of his own load, or 3) installation of underfrequency relays set to trip at 59.7 Hz, an amount of load equal to the participant's shortage in his Spinning Reserve allocation. Measure 3), known as Step Zero (Step 0), is to be used only in extreme emergencies where no other alternative is available and solid-state relays will be employed to minimize time delay. (If Step 0 is used, the load so assigned should not result in a reduction in a system's proper share of the automatic load shedding obligation described in Section XI, Paragraph 1.)

Deficiencies in Supplemental Reserve should be covered by purchase if feasible.

11. Administration of the Daily Operating Reserve and Spinning Reserve formula is the responsibility of the Florida Power Corporation. To carry out this responsibility certain information is necessary from each of the participating systems. This information is:

A. By January 15th the previous year's peak load and the Peak Capability of the largest unit.

B. Immediate notification of a change in rated capability of a system's largest unit.

C. Notification when a system's largest unit is out of service.

The Daily Operating and Spinning Reserve will be calculated at least yearly and re-calculated as necessitated by information received from a participating system.

When re-calculation is necessary, the new values will be placed on the teletype for the dispatchers' immediate use and a copy of the calculation will be mailed to each of the systems. (See following page for current calculation with largest unit in each system in service.)

DAILY OPERATING AND SPINNING RESERVE ALLOCATIONS

BOTH TURKEY POINT NUCLEAR UNITS ON LINE

EFFECTIVE AS OF: 5- 3-76

	PEAK LOAD GROSS MW	CAPABILITY OF LARGEST UNIT GROSS MW	PERCENT BASED ON PEAK LOAD	PERCENT BASED ON LARGEST UNIT
FLORIDA POWER & LIGHT COMPANY	7400.0	722.0	50.19%	27.96%
FLORIDA POWER CORPORATION	3370.0	527.0	22.86%	20.41%
TAMPA ELECTRIC COMPANY	1660.0	350.0	11.26%	13.56%
JACKSONVILLE ELECTRIC AUTHORITY	1136.0	275.0	7.70%	10.65%
ORLANDO UTILITIES COMMISSION	413.0	327.0	2.80%	12.66%
CITY OF TALLAHASSEE	223.0	75.0	1.51%	2.90%
CITY OF LAKELAND	218.0	115.0	1.48%	4.45%
CITY OF GAINESVILLE	155.0	85.0	1.05%	3.29%
CITY OF FORT PIERCE	59.0	38.0	0.40%	1.47%
CITY OF LAKE WORTH	54.0	35.0	0.37%	1.36%
CITY OF VERO BEACH	56.0	33.0	0.38%	1.28%
TOTAL	14744.0	2582.0	100.00%	100.00%

	RESERVE ALLOCATION PERCENTAGE	OPERATING RESERVE MW	SPINNING RESERVE MW	SUPPLEMENTAL RESERVE MW
FLORIDA POWER & LIGHT COMPANY	39.08	564	282	282
FLORIDA POWER CORPORATION	21.63	312	156	156
TAMPA ELECTRIC COMPANY	12.41	179	90	90
JACKSONVILLE ELECTRIC AUTHORITY	9.18	133	66	66
ORLANDO UTILITIES COMMISSION	7.73	112	56	56
CITY OF TALLAHASSEE	2.21	32	16	16
CITY OF LAKELAND	2.97	43	21	21
CITY OF GAINESVILLE	2.17	31	16	16
CITY OF FORT PIERCE	0.94	14	7	7
CITY OF LAKE WORTH	0.86	12	6	6
CITY OF VERO BEACH	0.83	12	6	6
TOTAL	100.00	1444	722	722

DATE CALCULATED: 5- 2-76

SECTION VII

EMERGENCY PROCEDURES

1. Operation During Declining System Frequency

The reliability of bulk power supply within peninsular Florida is a matter of vital concern to the electric utilities serving the area. Conditions of declining system frequency require a coordinated program of emergency procedures. This section outlines a coordinated program to which the members of the FCG Operating Committee voluntarily subscribe.

The individual utilities serving the peninsular Florida area are committed to the design and operation of an interconnected network within peninsular Florida which will not be subject to widespread system outages as a consequence of a major disturbance and over the years have developed guidelines for its safe and reliable operation. Regardless of these objectives and practices, emergency procedures are required to meet conditions such as system separation and operation at subnormal frequency. Coordination of emergency procedures, which include load shedding and power plant isolation, is essential.

In the event of a sudden serious emergency, load shedding is used to:

A. Restore the balance between load and generation in the affected area in the shortest possible time and permit the subsequent return to 60 Hz operation, so as to minimize adverse effects on customer service.

B. Minimize the risk of damage to company and customer facilities and equipment.

It is recognized that the ability to reduce firm customer load in an extreme emergency is not a substitute for proper design and good operation. It is a measure to be taken only after the system has suffered an emergency condition which may otherwise lead to widespread system outages.

Emergency Procedures During Declining System Frequency

Emergency procedures will be implemented as follows:

Phase 1: From 60.0 Hz to 59.2 Hz, all operating reserves and emergency measures should be utilized to the fullest practicable extent. The manner of utilization of these reserves will depend greatly on the behavior of the system during the emergency.

In cases where frequency declines rapidly, only that capacity on line and automatically responsive to frequency (spinning reserve), and such items as interconnection assistance, and load reductions by automatic means are of assistance in arresting the decline in frequency.

If the frequency decline is gradual, the system dispatcher(s) of the system(s) in trouble should invoke non-automatic emergency procedures. This would include the starting of gas turbines, interrupting load, purchasing power, etc. These efforts should continue until the frequency decline is arrested. Generally speaking, it is the responsibility of the system(s) in trouble to take whatever action is necessary to restore the frequency to 60 Hz, and the system dispatcher(s) of such system(s) should take the lead in taking positive action, describing the trouble, asking for assistance, etc. If his actions do not produce results fast enough, the other system dispatchers may have to apply their judgements in assessing a given situation, taking action, and/or rendering assistance without being requested. No hard and fast rules can be made except that all possible cooperation and communications between system dispatchers will be required. If interruptible loads are counted as spinning reserves they should be capable of being disconnected from the system by underfrequency relays to assure their removal prior to Phase 2.

Phase 2: Between 59.2 and 59.0 Hz inclusive, shed with automatic load shedding relays not less than 10 percent of system load. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

Phase 3: Between 58.8 and 58.7 Hz inclusive, shed additional load with automatic load shedding relays in an amount not less than 10 percent of system load existing prior to Phase 2. This amount of load should be shed in two nearly equal steps at 58.8 and 58.7 Hz. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

Phase 4: Between 58.6 and 58.5 Hz inclusive, shed additional load with automatic load shedding relays in an amount not less than 10 percent of the system load existing prior to Phase 2. This amount of load should be shed in two nearly equal steps at 58.6 and 58.5 Hz. No intentional time delay should be used beyond that absolutely required to avoid improper relay operation.

IMPORTANT NOTE !

PHASE 2, 3 AND 4 WILL HAVE BEEN ACCOMPLISHED AUTOMATICALLY. AT THIS POINT THE DISPATCHERS MUST RECOGNIZE THAT TIME IS RUNNING OUT AND THAT 7 MINUTES OR LESS TOTAL ELAPSED TIME IS ALLOWED FOR OPERATION AT FREQUENCIES BETWEEN 58.5 HZ AND 58.0 Hz. EVERY EFFORT MUST BE MADE TO (1) ARREST THE FREQUENCY DECLINE TO PREVENT THE GENERATORS FROM BEING AUTOMATICALLY ISOLATED AT 58.0 Hz, AND (2) TO RETURN THE FREQUENCY TO ABOVE 58.5 Hz TO PREVENT THE GENERATORS FROM BEING TRIPPED AT THE END OF 7 MINUTES ELAPSED TIME IF OPERATION CONTINUES IN THE RANGE 58.5 Hz - 58.0 Hz.

Phase 5: At 58.5 Hz, if frequency is declining, take any action which can be taken at this point to arrest frequency decline. This may include additional load shedding, manual or automatic, and coordinated network separation. This section shall be completed before frequency declines to 58.0 Hz.

Phase 6: At 58.0 Hz, isolate generating units in accordance with Paragraph 2 of this Section, "Isolation of Power Plants from System". In the event it becomes necessary for a system to isolate a generating unit at a frequency higher than 58.0 Hz, or in a time period shorter than stipulated in the schedule of Paragraph 2, page 5, of this Section, such system shall also simultaneously disconnect an amount of load equal to that particular generating unit's output. This amount shall

be an additional amount over any load previously shed. Automatic isolation of generating units is to be preferred over manual isolation, and if employed should provide 12 seconds time delay to permit temporary frequency excursions below this isolation frequency of 58.0 Hz.

Phase 7: If at any point in the above procedure, the decline in area frequency is arrested and it levels out between 58.0 Hz and 59.0 Hz, the systems in the low-frequency area shall shed an additional 10 percent of their remaining load and shall maintain or increase, if possible, their generating output to a value corresponding to the full open control valve position until frequency is restored to synchronizing range of the main network.

Phase 8: If after three minutes the action taken in Phase 7 above has not returned area frequency to 59.0 Hz or above, the systems in the low frequency area shall shed an additional 10 percent of their remaining load, repeating on two-minute intervals until 59.0 Hz is reached. This step must be completed within the time limits outlined in Paragraph 2 of this Section, "Isolation of Power Plants from System".

Phase 9: When area frequency has been established at 59.0 Hz or above, the system or systems in the low frequency area shall take any action necessary to permit re-synchronization of the isolated area to the main network.

Phase 10: After frequency has returned to synchronizing range, the isolated area shall be synchronized with the interconnected systems.

Phase 11: System dispatchers shall direct load restoration and the resumption of normal interconnected operation.

In taking the steps outlined the FCG Operating Committee members will utilize all reserves to the best of their abilities.

The application of all emergency measures during declining system frequency within peninsular Florida should be reviewed on a regular basis and updated as required to meet changing system conditions.

2. Isolation of Power Plants From System

Serious damage to turbines can be caused by loaded operation at subnormal speed. It is highly desirable to maintain service continuity, but it would be most imprudent to allow equipment to suffer major damage which would impede the restoration of service after a major disturbance.

To minimize the possibility of damage to equipment and still maintain reliable operation of generating plants, coordination of emergency procedures during low frequency operation is essential.

Program for Isolation of Generating Units During Low System Frequency

Generating units shall be isolated from the system when all of the procedures performed by the system dispatchers in accordance with Paragraph 1 of this Section, "Operation During Declining System Frequency", have been unsuccessful in returning system frequency to 59 Hz or above.

Isolation will be accomplished automatically or manually within the following time limits. The time periods and frequencies allowed are designed to assure that all possible opportunity is given for the system to recover and yet protect the generating units from damage. Adjustments of the times and frequencies stated may be necessary for specific units due to the cumulative effect of blade fatigue over the life of the turbine, or to conform with manufacturer's limitations.

60.0 to 59.0 Hz	No isolation
Below 59.0 Hz	30.0 minutes maximum time before unit isolation.
Below 58.5 Hz	7.0 minutes maximum time before unit isolation*
Below 58.0 Hz	Automatic isolation by underfrequency relay with 12 seconds time delay

*This 7 minutes is part of the total time of 30 minutes allowed below 59.0 Hz.

Every effort should be made by the operator to maintain unit auxiliaries and, if possible, a local load. This is to allow rapid re-synchronizing of the unit to the main network to aid in restoration of the system.

3. Procedures for Orderly Recovery After System Disturbance

Condition I - Loss of Unit or Plant Without Separating From The Interconnected Systems (No Frequency Drop)

System In Trouble

After emergency is recognized and immediate generation change has been made, request necessary power requirements from other systems. Make frequent checks to assure that requests equal net power on all ties with other systems.

Systems Not In Trouble

Fulfill requests made by the system in trouble. Florida Power Corporation system dispatcher, if necessary, will contact the other systems to be sure that the schedules are in balance.

Condition II - Loss of Unit With Resultant Separation From The Interconnected Systems

All Systems

With frequency below 59.5 Hz, plants are to pick up load without contacting their own system dispatcher until 59.5 Hz is reached, then return to control. (Systems using command or mandatory type control will remain on control). At this point all system dispatchers will set schedules to the value of system net interchange. (All systems remain on tie line bias control.)

If the frequency does not go below 59.5 Hz, all system dispatchers should set schedules equal to net interchange and remain on tie line bias control.

System in Trouble

If it is apparent that there is insufficient generation available to restore the frequency to 60 Hz, it is the responsibility of the system in trouble to take whatever action is necessary to restore the frequency to 60 Hz. After tying in with the interconnected systems, the system in trouble must contact the other systems to adjust schedules.

Condition III - Loss Of Unit With Resultant Separation From The Interconnected Systems and Loss Of Load By Underfrequency Relay Action

Generally load restoration should not be attempted until frequency has returned to normal and ties to the interconnected systems are re-established.

To prevent overloading of ties and a possible second separation from the interconnected systems, all load pickup should be coordinated with the Florida Power Corporation system dispatcher.

The system experiencing the generation loss should not attempt to pick up load until the load of all other systems has been restored, unless otherwise instructed by Florida Power Corporation system dispatcher.

As in Condition II, if it is apparent that there is insufficient generation available to restore the frequency to 60 Hz, it is the responsibility of the system in trouble to take whatever action is necessary to restore the frequency to 60 Hz.

Conditions I, II and III - Following Any Major Disturbance

To insure that schedules to the interconnected systems are held within limits, all system dispatchers should maintain close communications with the Florida Power Corporation system dispatcher until generation and tie flows are stabilized.

4. Opening Ties After Statewide Loss of Generation

Following a statewide total loss of generation (blackout), recovery will be expedited if ties are opened at prearranged points.

In preparation for startup of individual systems, ties should be opened at the switching points listed on the following page.

For other situations where the blackout is not so extensive, opening of ties may be required to effect complete restoration. Each situation will have to be individually considered.

Tie Lines

FROM	TO (Tie to be opened at this end)
Pebbledale (TEC)	West Lake Wales (FPC)
Ringling (FPL)	Big Bend (TEC)
Manatee (FPL)	Big Bend (TEC)
Lake Tarpon (FPC)	Sheldon Rd. (TEC) 2 Ckts.
Double Branch (TEC)	Higgins (FPC) Normally Open
Lake Wales (FPC)	Orchid Springs (TEC)
Ft. Meade (FPC)	Pebbledale (TEC) 230 KV
Pebbledale (TEC)	Ft. Meade (FPC) 69 KV
Ariana (TEC)	Larsen (LAK)
Sandhill (TEC)	Highland City (LAK)
Florida Power Corp. (FPC)	West (LAK) at 69 KV side breaker
Brooksville (FPC)	Dade City (TEC)
Denham (FPC)	Dade City (TEC)
Sheldon Rd. (TEC)	Denham (FPC)
West Lake Wales (FPC)	Brevard (FPL)
Turner (FPC)	Sanford (FPL)
North Longwood (FPC)	Sanford (FPL)
Putnam (FPL)	Greenland (JEA)
Baldwin (FPL)	Normandy (JEA)
Bradford (FPL)	Normandy (JEA)
Cape Canaveral (FPL)	Indian River (OUC)
Hartman (FPL)	Substation 1 (FTP)
South (VER)	West (VER) by FPL
Hypoluxo (FPL)	Lake Worth Plant Sub (LWU)
Rio Pinar (FPC)	Substation 6 (OUC)
Woodsmere (FPC)	Substation 2 (OUC)
Windermere (FPC)	Substation 5 (OUC)
Tallahassee Switch (FPC)	Substation 3 (TAL)
Crawfordville (FPC)	Purdom (TAL)
Bradfordville West (FPC)	Substation 7 (TAL)
Crawfordville (FPC)	Hopkins (TAL) 230 KV
Archer (FPC)	Parker Rd. (GVL)
Gainesville (GVL)	Idylwild (FPC)

QUESTION 6

Please provide the following information:

6.1 What is the current status of the 500 kV system of interties with Georgia which was in the planning stage according to the 1973 report?

6.2 Is there an emergency interchange capability of 800 MW from Georgia to Florida as projected for 1976?

6.3 Are the Georgia - Florida interties emergency or economic in nature?

6.4 Are the ties set to open at such a (relatively) high frequency that they are of little use in a large disturbance (such as 1973, 1974, 1977) and that in a moderate disturbance they might even make things worse by opening when only a relatively small imbalance exists?

6.5 Furnish a description of the organization of Power Coordinators and Dispatchers which includes the following:

a) The number of power coordinators and dispatchers for each shift;

b) How they interact in emergency situations and with other utility power coordinators and dispatchers; and

c) What telemetered data and what communications facilities are available to them--especially for communicating with quick-start facilities and with maintenance crews.

RESPONSE 6

6.1-6.3 The growth of any dynamic system requires additions and changes. These changes involve transmission construction, relaying practices and operating procedures and are designed to minimize the likelihood of an outage.

As a result of the April 3 and 4, 1973 outages, Florida Power & Light contracted with Stone & Webster Engineering Corporation to review the FPL power system reliability and to provide recommendations designed to improve it. Out of such recommendations and other internal studies, FPL has implemented numerous changes to our system since 1973. In brief, since 1973 transmission additions have strengthened the ties between the southern area and the rest of Florida. This includes an additional tie to Tampa Electric Company and new transmission lines down the west coast to Ft. Myers and across the Everglades to Lauderdale. The east coast transmission was strengthened by reinforcing old lines, adding new lines, and rearranging circuits from the Midway station southerly

through Lauderdale and into the Miami area. Two major additional interconnections with adjoining utilities were also established at Sanford (Florida Power Corporation) and at Bradford (Jacksonville Electric Authority). During this same time frame, additional generation was added at both Manatee and Ft. Myers. (See the status report attached, Item 8 for specifics.)

Transmission expansion now under way and scheduled for completion by 1980, includes a 230kV tie to Georgia (this will increase the transfer into Florida to about 800 MW) and 500kV lines from Levee in the Miami area northerly through Andytown and Martin (the site for two new fossil generators) to Midway. These 500kV lines will closely tie the entire South Florida area from our St. Lucie Plant to Dade County into a strong, tightly integrated network with further improvement in system reliability. This system is scheduled for completion during 1980.

A 500kV system of ties with Georgia is still in the planning stage. The latest FCG study, conducted in 1975 to determine the effects of changing load conditions and altered generation expansion plans, showed the 500kV tie to Georgia to be needed around the middle 1980's. Today, it seems more realistic to assume that the required date will be around the middle 1990's. The statewide 500kV system is being reported annually to the Federal Energy Regulatory Commission (FERC) under Order 383-4 (SERC-TAC).

The existing Georgia-Florida transmission tie lines serve both economic and emergency purposes. The present ties are between Florida Power Corporation and Georgia Power Company, and their operations conform to the operating practices of those two companies. At present their transfer capacity is approximately 400 MW.

6.4 Florida Power Corporation's ties with the systems to the north are not equipped with underfrequency relays. Separation of peninsular Florida usually occurs internal to the FPCorp. system, between Suwannee and Archer, Ft. White and Inglis, etc., but is not the result of low frequency. These lines are equipped with phase distance relays for fault protection which respond to the apparent impedance looking into the line terminal. This apparent impedance is a function of the current in the line, the voltage at the terminal, and the angular difference between these two quantities. In situations where the power transfer results in the proper combination of high current and low voltage, operation of these relays is expected. During recent years these lines have demonstrated their ability to withstand moderate overloads (loss of 400 MW units).

6.5 With respect to organization, Power Coordinators operate the system under the direction of an Assistant Manager of System Operations. They direct the activities of the Division Dispatchers.

There are two Power Coordinators on each shift; one coordinates generation and one coordinates transmission. The generation Power Coordinator works with other utilities for interchange. The transmission Power Coordinator works with Division Dispatchers. Division Dispatchers for each shift are as follows:

	7-3	3-11	11-7
Miami	3	3	1
West Palm Beach	2	1	1
Sanford	2	1	1
Punta Gorda	2	1	1

Telemetered data includes:

- Generation from each plant
- Tie line loading
- Southern Company net interchange to Florida Power Corporation
- System Load
- Total Generation
- Net Interchange
- Frequency
- Power (South of Lauderdale)
- Power (South of Ranch)
- Voltage (Dade)
- Voltage (Flagami)
- Frequency (Brevard)
- Major Load Area Information (generation, load, interchange, & net flow between adjacent major load areas)

Communication facilities are leased telephone circuits to all Division Dispatchers, all plants, and all other utilities with which FPL has tie lines.

Gas turbines are available for "quick start" by the Power Coordinators through supervisory equipment. On May 16, 1977, undetermined number of gas turbines at Port Everglades were ordered on by supervisory. They were ordered on too late and were unable to complete the programed start-up sequence before the blackout. Three gas turbines were ordered on at Lauderdale. These three completed the start-up sequence but the auto-synchronizer could not match the voltage of the machine to that of the bus and therefore would not permit the breaker to close. The minimum excita-

tion limit of the gas turbine control would not permit the machine voltage to come down low enough to match the low bus voltage.

The excitation limits on all GT's at Lauderdale and Port Everglades have been reset to permit them to synchronize at abnormally low voltages. Additionaly, main step-up power transformer taps have been reset to permit a higher machine voltage.

QUESTION 7

Please provide the following information:

7.1 Describe how, to what extent, and when the past recommendations on relays were implemented?

7.2 What effect did that implementation have on the May 16, 1977 disturbance?

7.3 Discuss the significance of the Turkey Point Unit 4 and the 500kV Orange River-Andytown line equipment outages to this event and explain why it is not necessary to include discussion of them in the "Report on System Disturbance May 16, 1977."

RESPONSE

7.1 Following the disturbances in April, 1973, Stone & Webster Engineering Corporation was retained to conduct an independent investigation of the event. A report of their findings was forwarded to the FPSC on May 18, 1973.

As a result of their findings, they made specific recommendations as to protective relay application. All of these recommendations were accepted by FPL and have been implemented. Specifically, they include:

a) Individual underfrequency relay schemes are now installed on each generating unit of 250 MW or more. For this application FPL uses a design comprising parallel sets of two underfrequency relays with their contacts in series. This provides reliability and security as well as limiting the amount of generation subject to a common failure.

b) Protective circuits on critical transmission terminals have equipment added to sense out of step power swing conditions and block reclosing following a trip. Approximately forty 240kV and 138kV line terminals considered the most likely to be affected by stability swings are so modified. As new line terminals are constructed, consideration is given on an individual basis as to whether this type of protection is required.

By so doing, FPL has limited the possibility of equipment damage or extending the area affected by an outage.

c) High speed reclosing is blocked for all but phase to ground faults on all 240kV lines south of Ranch Substation.

On the basis of operating experience, this practice will be extended to include all 240kV lines and any 138kV or

115 kV lines originating from 240kV substations.

d) An extensive review of FPL protective practices was conducted by Stone & Webster and FPL engineers. Results of this study were adopted in early 1974 and form the basis of current system protection and control design.

7.2 The disturbance of May 16 was initiated by a phase to ground fault on the Ft. Myers-Ranch 240kV line. Protective devices operated properly preventing the disturbance from spreading outside of the immediate area affected and allowing the safe shutdown of generating units without major damage.

7.3 The purpose of the report was to address the disturbance and provide an analysis of those events directly related to it.