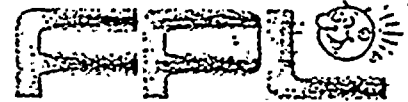


Reference 15

FLORIDA POWER & LIGHT COMPANY

May 22, 1979

RECEIVED
Licenses
Enforcement Division

United States Department of Energy
Division of Power Supply & Reliability
Office of Utility Systems
Economic Regulatory Administration
Washington, D.C. 20461

Gentlemen:

Attached is a copy of the disturbance analysis report for the power interruption which occurred on the Florida Power & Light system at 11:57 p.m. on April 4, 1979.

Further analyses of this disturbance are being done by the Florida Electric Coordinating Group - Operating Committee. The findings of their study will be furnished when completed.

Sincerely,

W. E. Coe

W. E. Coe
Director - Power Supply

WEC/ayg

Attachment

cc: Florida Public Service Commission - J. D. Jenkins
SERC - Grady L. Smith
Florida Electric Coordinating Group - W. D. Lang

bcc: E. A. Adomat
E. L. Bivans
G. E. Liebler
H. N. Paduano
A. D. Schmidt
R. E. Uhrig
G. D. Whittier ✓
C. O. Woody

8002150501



4/25/79
Rev. 5/8/79

FLORIDA POWER & LIGHT COMPANY

SYSTEM DISTURBANCE

LOSS OF GENERATION AT TURKEY POINT

WEDNESDAY, APRIL 4, 1979

11:57 PM



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PRE-DISTURBANCE CONDITIONS

During the afternoon and evening of Wednesday, April 4, 1979, the Florida Power & Light transmission system was experiencing widespread incidents of flashovers resulting in the tripping of major 230 kV transmission lines in its Southern service area. The flashovers were caused by the combination of an accumulation of salt and dust on insulators caused by a period of extremely dry weather and strong winds, followed by an increase in the humidity level. By 11:53 P.M. four of seven transmission lines leaving Florida Power and Light's Turkey Point plant were out of service as shown by the system configuration diagram and sequence of events chart on page 8. These were the Turkey Point-Davis #1 230 kV line, the Turkey Point-Davis #3 230 kV line, the Turkey Point-Flagami #1 230 kV line, and the Turkey Point-Dade #1 230 kV line. The three remaining transmission circuits out of Turkey Point Plant had a combined thermal capacity of 1621 MVA.

Prior to the disturbance Florida Power & Light's load was 3870 Mw and the net interchange was 150 Mw, out of FP&L. The system frequency was 60.03 Hertz. FPL was carrying approximately 492 Mw of spinning reserve*, while its requirement was 331 Mw. Furthermore, there were an additional 491 Mw of on-line steam available and 1778 Mw of quick start gas turbines which could be made available within 30 minutes. At the time of the disturbance Florida Power Corporation was importing 200 Mw of power from Southern Company.

* Spinning Reserve as defined by the Florida Coordinating Group.



DISTURBANCE

Between 11:53 and 11:57 P.M. the remaining three transmission lines out of Turkey Point plant tripped, and isolated Turkey Point from the rest of the system. At the time the lines tripped, three Turkey Point units were on: Turkey Point Unit 1 was carrying 352 Mw net, Turkey Point Unit 2 was carrying 181 Mw net, and Turkey Point Unit 4 was carrying 600 Mw net. With the loss of the transmission lines, Turkey Point Unit 4's instruments detected the loss of connected load, and ran the unit back. Immediately after, the unit tripped on a low steam generator level trip signal. Simultaneously, Turkey Point Unit 2 was tripped by its anti-motoring protection, and Turkey Point Unit 1 reduced its generation but remained on-line carrying the plant auxiliary uses. The resultant combined generation loss within FPL was 1133 Mw.

When the Turkey Point generation was lost, the power flow into Peninsular Florida increased. This power surge caused Florida Power Corporation's Archer-Ft. White 230 kV line and Ft. White-High Springs 69 kV line to trip, isolating Peninsular Florida from the external systems. At the time of separation FPC's interchange with Southern Company changed from 200 Mw (IN) to 20 Mw into Florida indicating the creation of an additional loss of 180 Mw within the isolated region. Thus, the loss of this import from Southern Company, coupled with the loss of Turkey Point generation resulted in a total deficiency of 1313 Mw within Peninsular Florida.

The resulting mismatch of load and generation caused the frequency to decline. Within FPL the system frequency declined to a low of 59.01 Hz, and initiated underfrequency relays which shed approximately 470 Mw of load in the areas shown below. Governor response and load shedding within Peninsular Florida stabilized the frequency at 59.85 Hertz within 10 seconds.

FPL LOAD SHED BY UNDERFREQUENCY RELAYS

<u>Division</u>	<u>Load</u>
Southern	240
Northern	95
Eastern	66
Western	69
TOTAL	<u>470</u>

In addition, other utilities within Peninsular Florida shed the following amounts of load:

Utility	Step '0' (59.7 Hz)	Step '1' (59.2-59.0 Hz)	Total
FPC	150	76	226
TECO	70	60	130
OUC	0	5	5
JEA	0	90	90
TOTAL	<u>220 Mw</u>	<u>231 Mw</u>	<u>451 Mw</u>

FPL generating units responded by providing 173 Mw (see Governor Response Table, page 6), while the FPL tie lines with other utilities provided an additional 491 Mw (see Tie Line Response, page 7). The generating unit and tie line response, coupled with the reduction in load, made up the entire loss of Turkey Point generation. A summary of the response of the FPL system is shown on page 5 .



Prior to the reestablishment of the ties with the external systems, FPL's net interchange was 310 Mw (IN) and the frequency had recovered to 59.92 Hertz as a result of an increase in generator output.

Florida Power Corporation's transmission ties with the external system were reestablished approximately two minutes after the start of the disturbance, at which time load restoration was initiated by other affected systems. Once this was completed, FPL proceeded to restore its own load. Most of the FPL load was picked up within 20 minutes after the disturbance originated.

The FPL net interchange returned to its predisturbance level 11 minutes after the origination of the disturbance.

At 1:02 AM a transmission line was closed in to tie the Turkey Point 230 kV buss to the network, but it separated at 1:05 AM. At 1:27 AM the buss was once again synchronized to the network, but the line tripped at 2:12 AM. Finally, at 6:11 AM a third and successful attempt was made to tie Turkey Point to the network permanently. A second transmission line was successfully closed in at 7:23 AM. Turkey Point Unit 2 was brought back on-line at 7:43 AM on April 5th after these two transmission circuits had been restored. The remaining transmission circuits were subsequently restored. Turkey Point Unit 4 was intentionally left off-line, as it was scheduled to come off for refueling after the system peak of April 5th.



FLORIDA POWER AND LIGHT DISTURBANCE RESPONSE SUMMARY

FPL SYSTEM DISTURBANCE RESPONSE DATA SHEET

Prepared By D. A. McInnis Date 4/16/79

Disturbance LOSS OF TURKEY POINT UNITS

Date 4/4/79 Time 11:57

Cause TRANSMISSION LINE OUTAGES

F_1 60.03 Hz, F_2 59.85 Hz, ΔF .15 Hz, F_{1+} 59.01 Hz

G_1 4020 Mw, G_2 3060 Mw, ΔGen -960 Mw

NI_1 150 OUT Mw, NI_2 341 IN Mw, ΔNI 491 IN Mw

L_1 3870 Mw, L_2 3400 Mw, ΔL 470 Mw

Loss* (Load +, Generation -) 663 Mw, Scheduled NI_1 179

Response(ΔNI - Loss) 173 Mw

* Generation Loss 1133 MW; Load Loss 470 MW

F_1 = FREQUENCY JUST BEFORE DISTURBANCE F_{1+} = MAXIMUM FREQUENCY EXCURSION

F_2 = FREQUENCY AFTER STABILIZATION BUT BEFORE CORRECTIVE CONTROL ACTION TAKES PLACE

G_1 = GENERATION JUST BEFORE DISTURBANCE

G_2 = GENERATION IMMEDIATELY AFTER FREQUENCY STABILIZES

NI_1 = NET INTERCHANGE JUST BEFORE DISTURBANCE

NI_2 = NET INTERCHANGE IMMEDIATELY AFTER FREQUENCY STABILIZES

L_1 = LOAD JUST BEFORE DISTURBANCE

L_2 = LOAD IMMEDIATELY AFTER FREQUENCY STABILIZES



**FPL GENERATING UNIT
GOVERNOR RESPONSE**

Date 4/16/79
Prepared By D.A. McInnis

UNIT	CONTINUOUS CAPACITY (MW) ⁵	ACTUAL GEN BEFORE DISTURBANCE (MW)	ESTIMATED % VALVE OPENING ¹	.15 Hz EXPECTED RESPONSE (MW) ²	ACTUAL PLANT RESPONSE (MW)
TURKEY POINT 1	369	352	95	0	0
TURKEY POINT 2	185	181	98	TRIPPED	TRIPPED
TURKEY POINT 3	OFF	OFF	--	OFF	OFF
TURKEY POINT 4	610	600	--	TRIPPED	TRIPPED
PORT EVERGLADES 1	190				
PORT EVERGLADES 2	205	391*	99	4	0
PORT EVERGLADES 3	369				
PORT EVERGLADES 4	150	457**	89	26	40
PORT EVERGLADES GT	OFF	OFF	--	OFF ³	OFF
LAUDERDALE 4	138				
LAUDERDALE 5	138	180	65	14	16
LAUDERDALE GT	OFF	OFF	--	OFF ³	OFF
RIVIERA 1	OFF	OFF	--	OFF	OFF
RIVIERA 2	OFF	OFF	--	OFF	OFF
RIVIERA 3	273	207	77	14	5
RIVIERA 4	OFF	OFF	--	OFF	OFF
ST. LUCIE 1	OFF	OFF	--	OFF	OFF
FT. MYERS 1	138	112	81	7	10
FT. MYERS 2	369	345	93	18	22
FT. MYERS GT	OFF	OFF	--	OFF ⁴	OFF
MANATEE 1	OFF	OFF	--	OFF	OFF
MANATEE 2	772	370	48	38	30
CAPE CANAVERAL 1	369	345	93	18	25
CAPE CANAVERAL 2	OFF	OFF	--	OFF	OFF
SANFORD 3	OFF	OFF	--	OFF	OFF
SANFORD 4	364	230	63	18	15
SANFORD 5	364	250	69	18	10
PUTNAM 1	OFF	OFF	--	OFF	OFF
PUTNAM 2	OFF	OFF	--	OFF	OFF
TOTALS	5003	4020	--	175	173

Notes: ¹Actual Gen/Continuous Capacity (Before Disturbance)

²The smaller of:

- a) Continuous capacity X .167 X Hz/.5 (Max Hz to be used = .5 or
- b) Continuous capacity - actual gen.

³No. of units on line X (37-28) if (F₁ +) ≤ 59.9 Hz.

⁴No. of units on line X (57-40) if (F₁ +) ≤ 59.9 Hz.

No. of units on line X (23.5 X Hz) if (F₁ +) > 59.7 Hz.

⁵Actual Continuous Capacity

* Generation for Pt. Everglades Unit 1 and 2 are combined into a single value.

** Generation for Pt. Everglades units 3 and 4 are combined into a single value.



14

1

21



1

1

1

1



FPL
TIE LINE RESPONSE

Prepared By D.A. McInnis Date 4/16/79

Disturbance LOSS OF TURKEY POINT UNITS

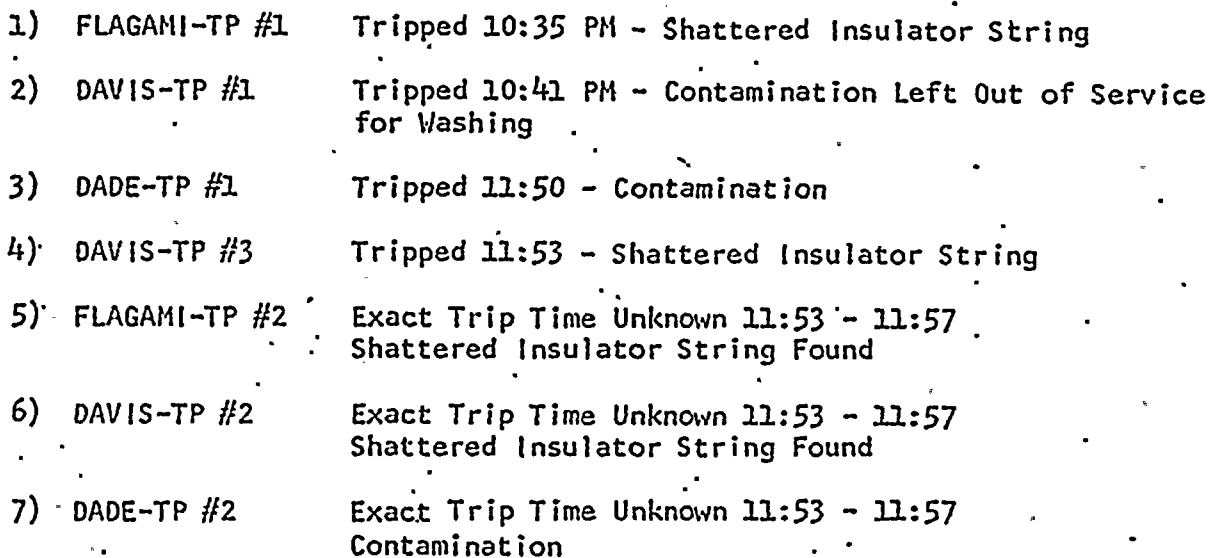
Date 4/4/79 Time 11:57

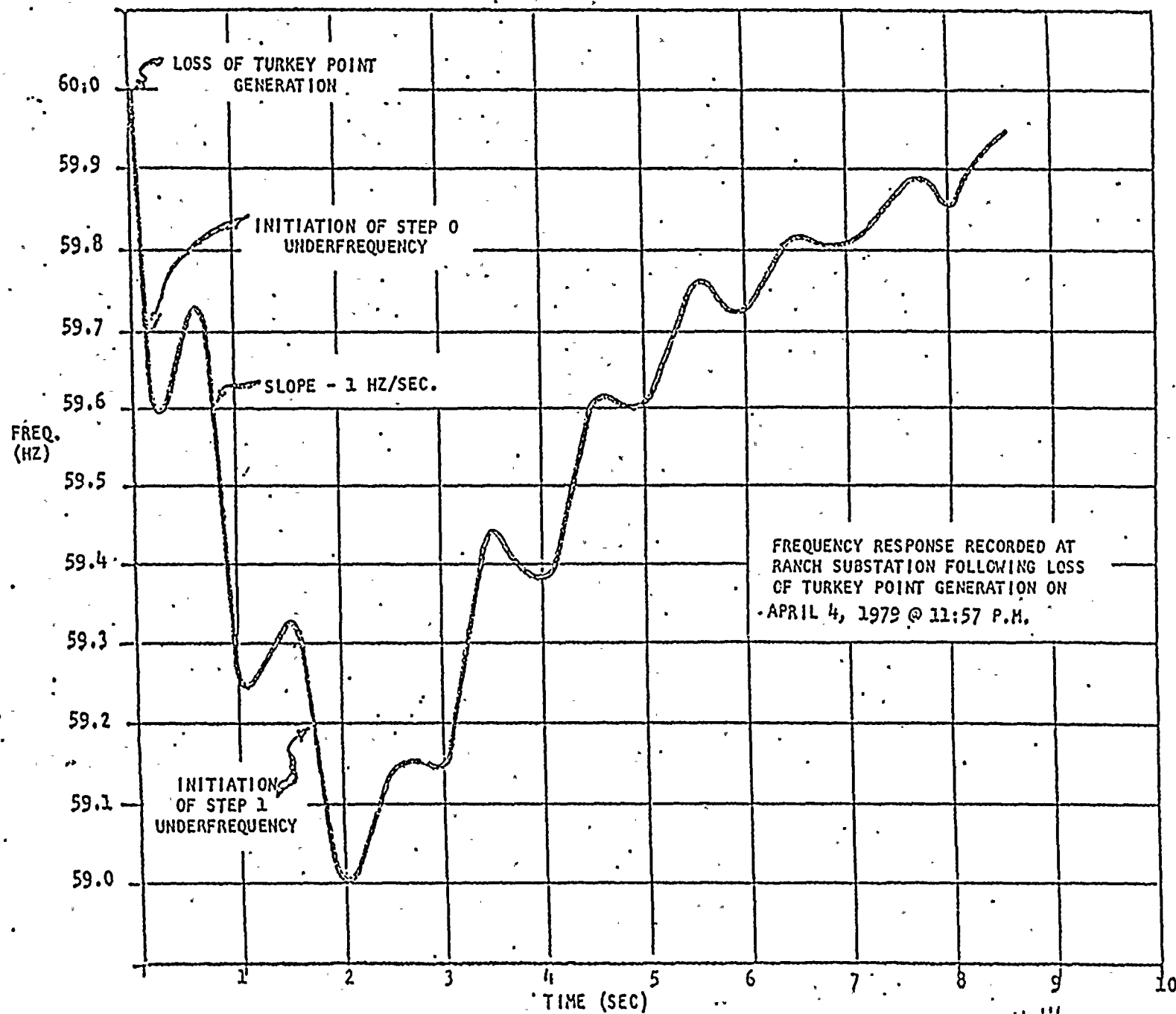
TIE	FLOW BEFORE DISTURBANCE	SUBTOTAL	CHANGE	SUBTOTAL	FLOW AFTER DISTURBANCE
Big Bend-Ringling 230kV	70 IN				190 IN
Big Bend-Manatee 230kV	38 OUT	32 IN	258 IN 53%	290 IN	100 IN
Sanford-Turner 115kV	12 IN				8 IN
North Longwood-Sanford 230kV	80 OUT				115 OUT
Brevard-West Lake Wales 230kV	10 OUT	12 IN	93 IN 19%	105 IN	50 IN
Indian River-Cape Canaveral 230kV	90 IN				162 IN
Greenland-Putnam 230kV	125 OUT				50 OUT
Baldwin-Normandy 115kV	5 OUT	170 OUT	133 IN 27%	37 OUT	8 IN
Duval-Normandy 230kV	40 OUT				5 IN
* New Smyrna Beach 115kV	13 OUT				13 OUT
Vero Beach 138kV	18 OUT				14 OUT
Ft. Pierce 138kV		37 OUT	7 IN 1%	30 OUT	3 OUT
Lake Worth 138kV	6 OUT				0
Homestead 138kV	0				0
TOTAL	163 OUT		491 100%		328 IN

*Discrepancy between net interchange total and sum of individual ties due to New Smyrna Beach not included in total.



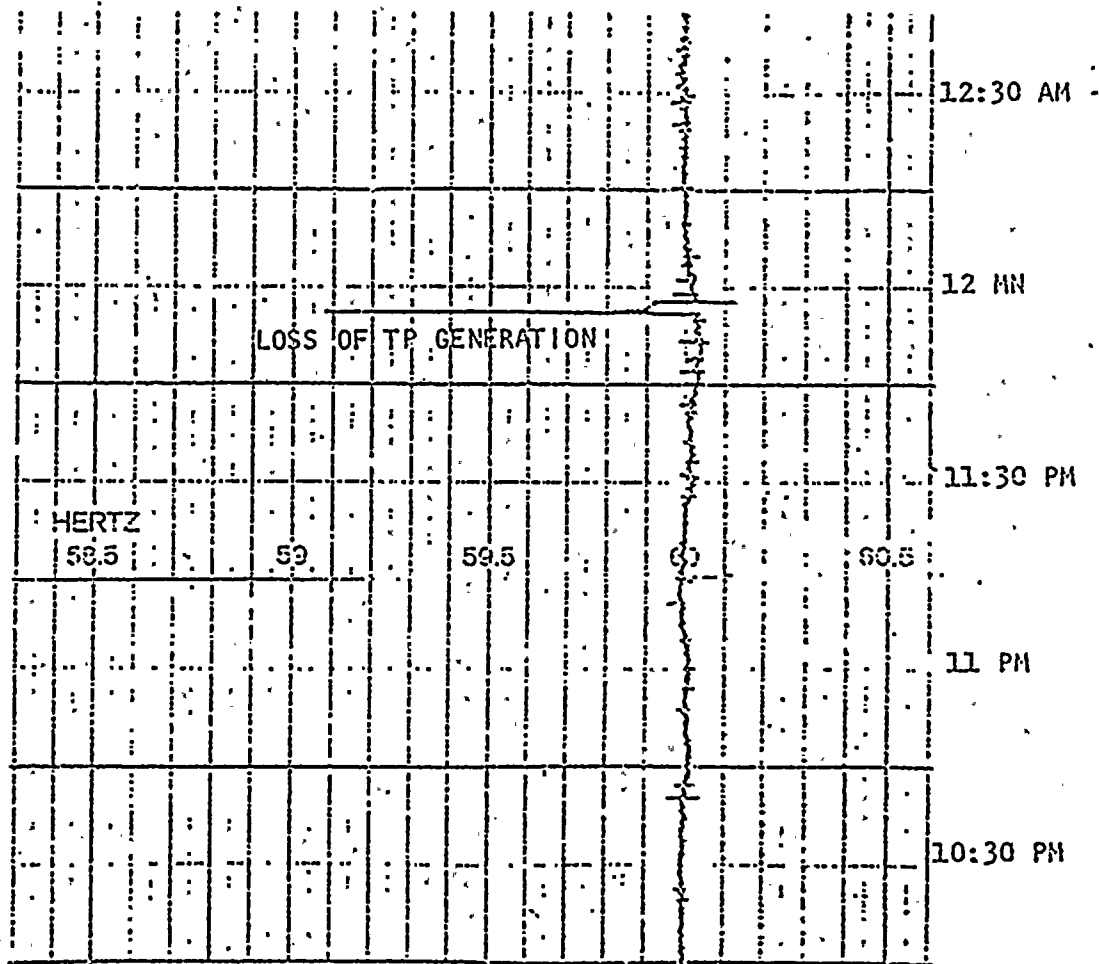
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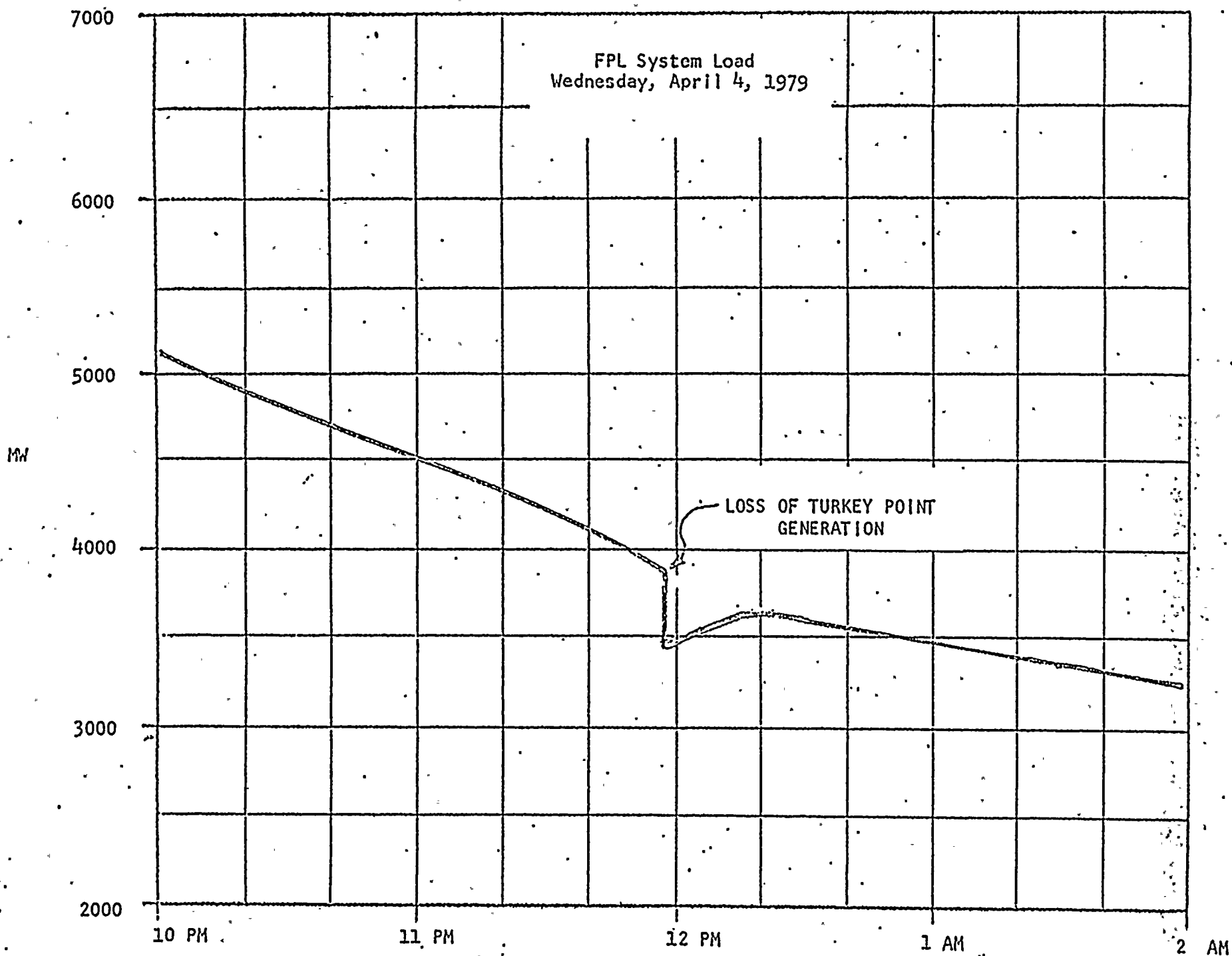




SYSTEM FREQUENCY
AT PORT EVERGLADES 138KV BUSS
APRIL 4, 1979

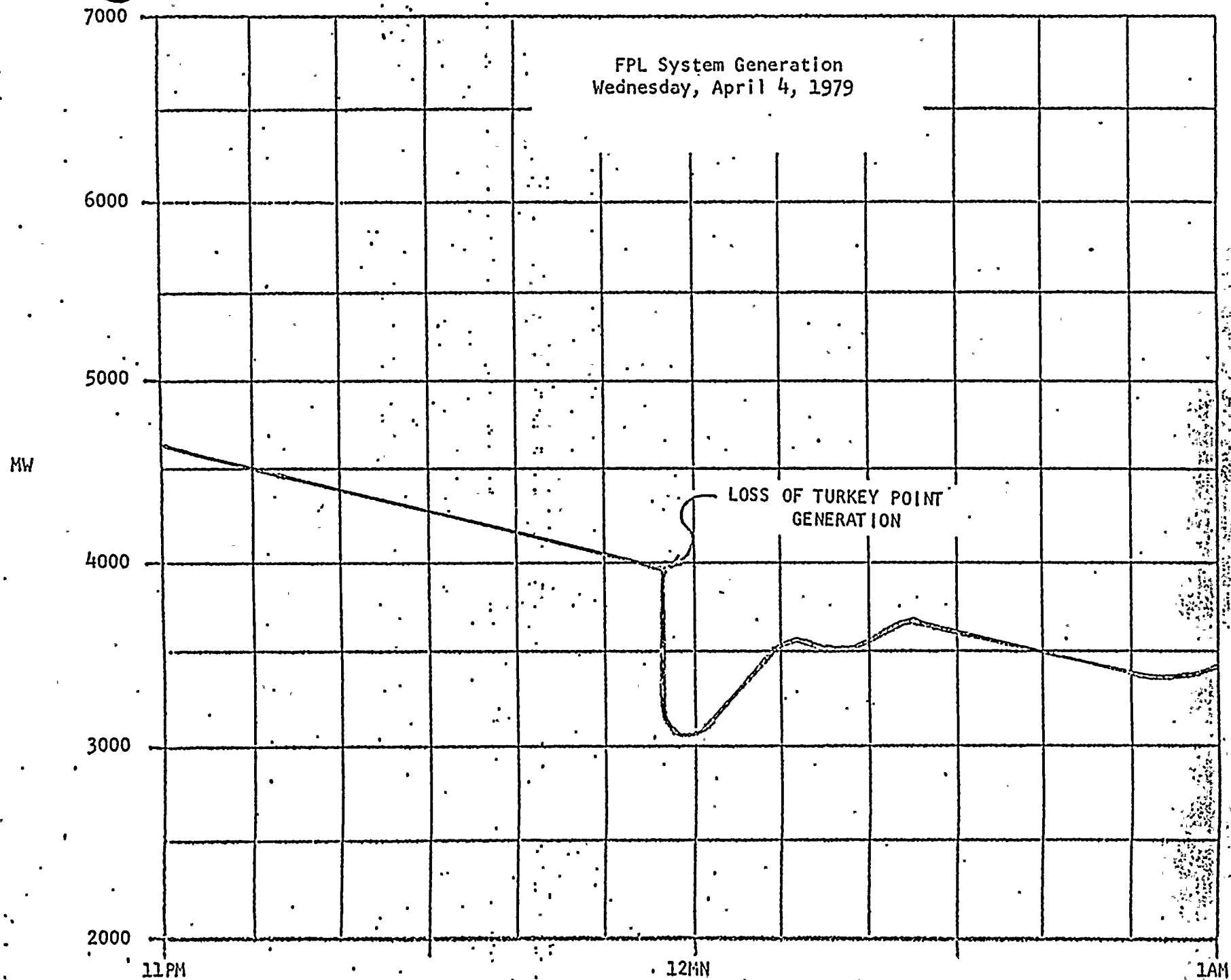






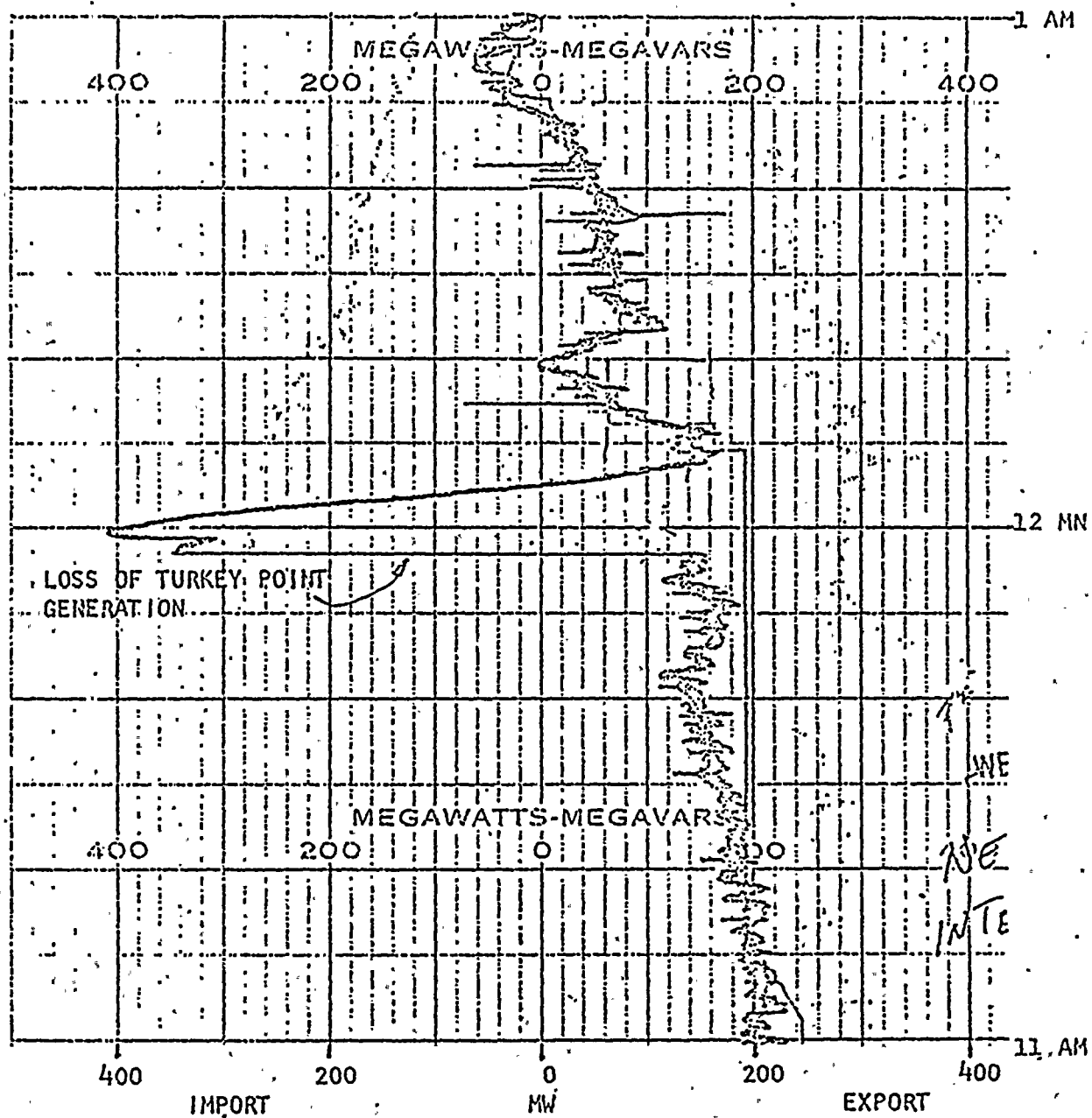


FPL System Generation
Wednesday, April 4, 1979





FLORIDA POWER & LIGHT
NET INTERCHANGE
APRIL 4/5, 1979





SOUTHERN COMPANY
NET INTERCHANGE
APRIL 4/5, 1979

