

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

July 10, 1981

R. H. LEASBURG
VICE PRESIDENT
NUCLEAR OPERATIONS

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
Attn: Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 414
NO/LEN:ms
Docket No. 50-338
License No. NPF-4

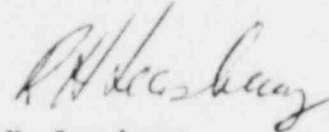
Gentlemen:

AUXILIARY FEEDWATER (AFW) PUMP ENDURANCE TEST RESULTS
NORTH ANNA POWER STATION UNIT NO. 1

As requested by Mr. A. Schwencer's letter of December 14, 1979, we are forwarding the attached endurance test summaries of the steam turbine-driven and motor-driven AFW pumps at North Anna Unit 1. It should be noted that Vepco's response to NUREG 0737, Item II.E.1.1, "Additional Short-Term Recommendations", No. 3 is in error. This item states that the North Anna Unit 1 motor-driven pump endurance test results have previously been submitted. This will be corrected in our next scheduled revision.

If you have any questions or require additional information, please contact this office.

Very truly yours,



R. H. Leasburg
Vice President - Nuclear Operations

Attachment



8107150123 810710
PDR ADOCK 05000338
P PDR

A001
2/1

NORTH ANNA POWER STATION UNIT 1

MOTOR DRIVEN AUXILIARY FEEDWATER PUMP ENDURANCE TEST

I. DESCRIPTION OF TEST METHOD

The purpose of this testing was to ensure that the motor driven auxiliary feedwater pumps remained within design limits with respect to bearing/bearing oil temperatures, and that ambient pump room conditions (temperature, humidity) did not exceed environmental qualification limits for safety-related equipment in the room during the 48 hour endurance run.

Before testing began, the initial conditions below were verified:

1. Cooling water is available for the test flow loop, which includes a temporary heat exchanger connected to chilled water via 1-CD-29 and 1-CD-36.
2. 110,000 gallon emergency condensate storage tank (1-CN-TK-1) is available for use with greater than 20% level indication.
3. Vibration and temperature measurement is available and in calibration.
4. All installed instrumentation is in calibration.
5. The instrumentation support tube for 1-PI-FW-156C and 1-PT-FW-103C has been temporarily moved to make room for temporary piping.

Following verification of the initial conditions, the system was flushed. A ferris turbine suction spool piece was connected at 1-FW-143 upon completion of system flushing. Pumps 1-FW-P-3A and 1-FW-P-3B were then started and run for 48 hours. The emergency condensate storage tank (ECST) temperature was maintained at $< 120^{\circ}\text{F}$ by directing the flow through the temporary heat exchanger. After a little more than 48 hours of continuous operation, both pumps were secured. The pumps were allowed to cool for 8 hours, and until pump bearing temperatures were within 20°F of their initial reading of the 48 hour run. The pumps were then restarted and run for one hour. Outboard and inboard pump bearing (surface) temperatures were recorded, as well as outboard and inboard motor bearing temperatures (computer points T2327A and T2326A respectively). Vertical and horizontal vibration displacements on the outboard and inboard bearings on both pumps were also recorded. Data was recorded at 1 hour intervals during the 48 hour run, and every fifteen minutes during the one hour run after cooling.

- II. The design operating capacity of the motor driven auxiliary pumps is 370 gpm, which includes the required 350 gpm capacity plus minimum flow recirculation. The flow during the 48 hour testing was approximately 330 gpm.

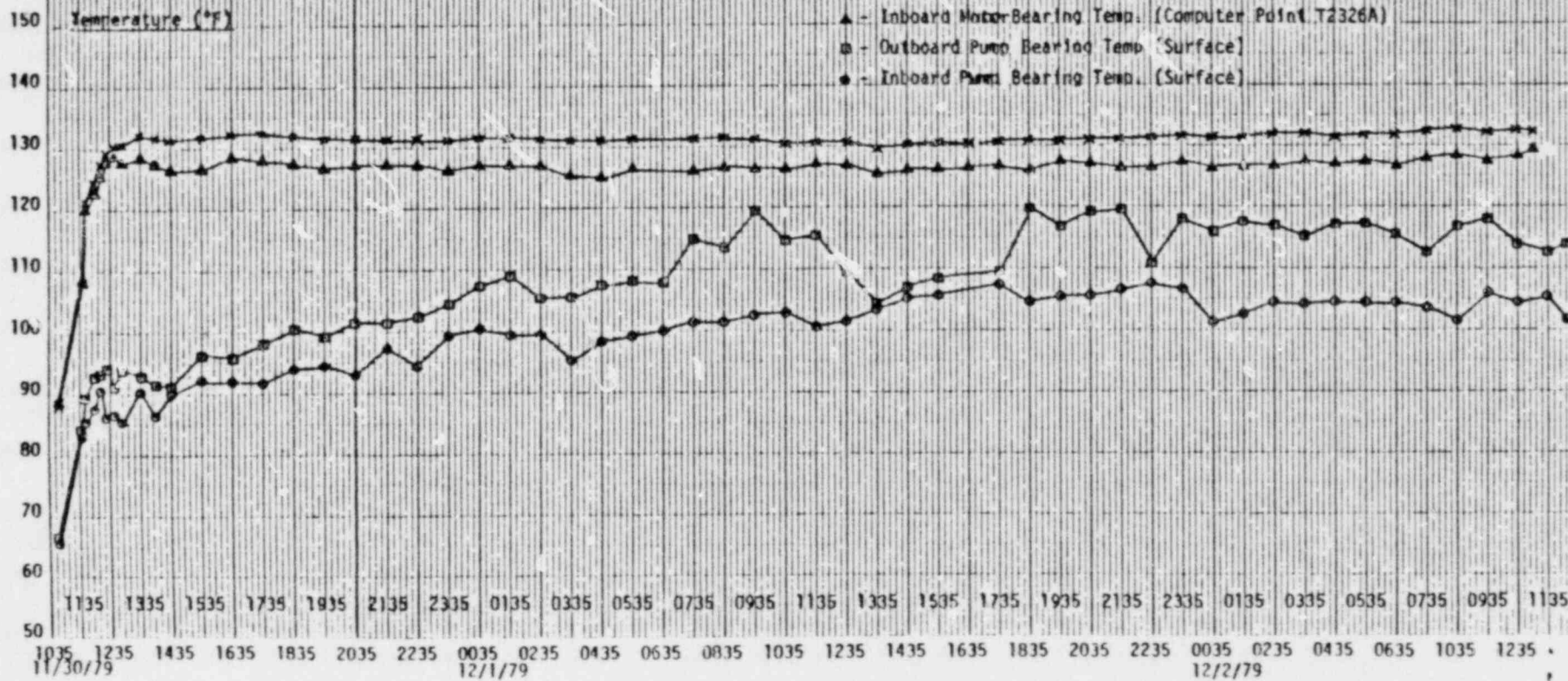
The operating head for both motor driven pumps is 1,216 psig. Pump head during the 48 hour testing ranged from 5.3% to 13.5% below design operating conditions for 1-FW-P-3A. For 1-FW-P-5B, head ranged from 0.4% to 6.1% below design operating conditions.

- III. Pump bearing temperatures remained less than 160° F during the 48 hour run, and therefore met the acceptable criteria for the testing.
- IV. The safety related equipment in the room is PCV-FW-159A and PCV-FW-159B (Category I Valves). The highest temperature recorded in the pumphouse during the 48 hour test was 90° F. The design operating temperature for these valves is 100 ° F, and therefore test conditions did not exceed the environmental qualification limit for the equipment used.
- V. Vibration amplitude of the outboard and inboard bearings of both motor driven auxiliary feedwater pumps remained below the maximum acceptable level of 1.0 mil. The largest amplitude recorded was 0.8 mil, detected in the vertical mode of the inboard bearing of 1-FW-P-3A.

Temperature Readings
of Bearings on
1-FW-P-3A during
48-Hour Endurance Test

Temperature (°F)

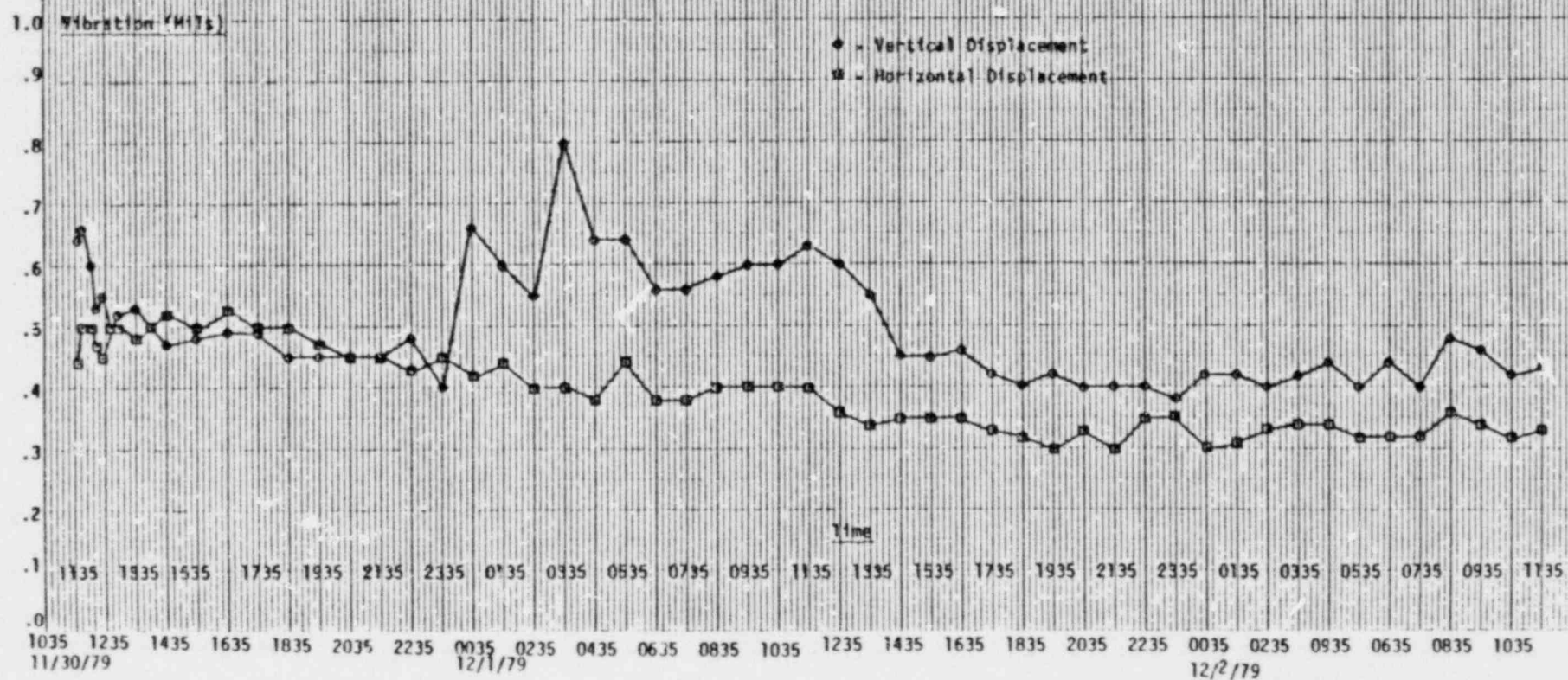
- x - Outboard Motor Bearing Temp. (Computer Point T2327A)
- ▲ - Inboard Motor Bearing Temp. (Computer Point T2326A)
- - Outboard Pump Bearing Temp. (Surface)
- - Inboard Pump Bearing Temp. (Surface)



VIBRATION DISPLACEMENT OF
INBOARD BEARING ON
1-FW-P.3A DURING
48-HOUR ENDURANCE TEST

1.0 Vibration (Wits)

♦ - Vertical Displacement
■ - Horizontal Displacement



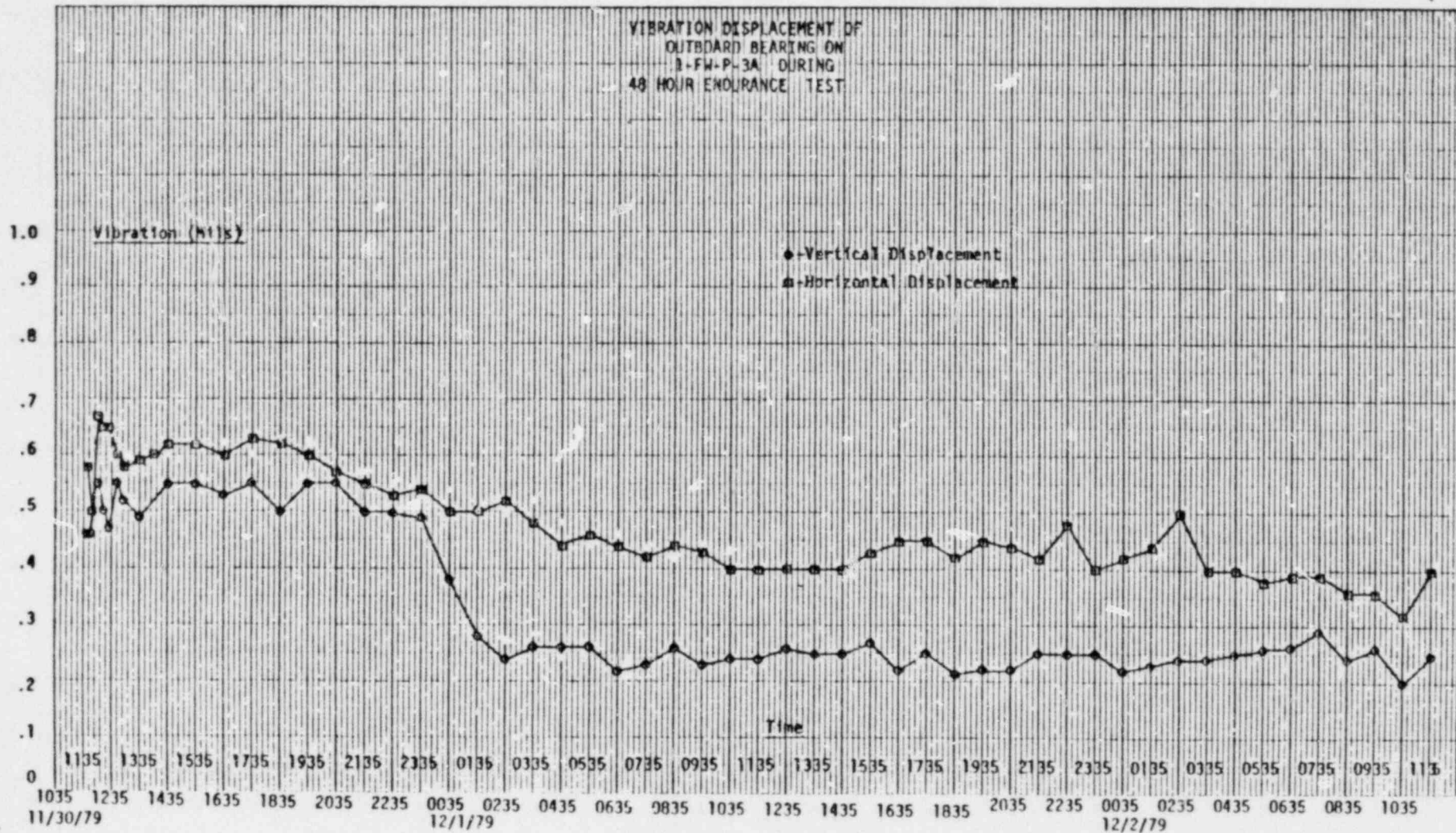
VIBRATION DISPLACEMENT OF
OUTBOARD BEARING ON
B-FW-P-3A DURING
48 HOUR ENDURANCE TEST

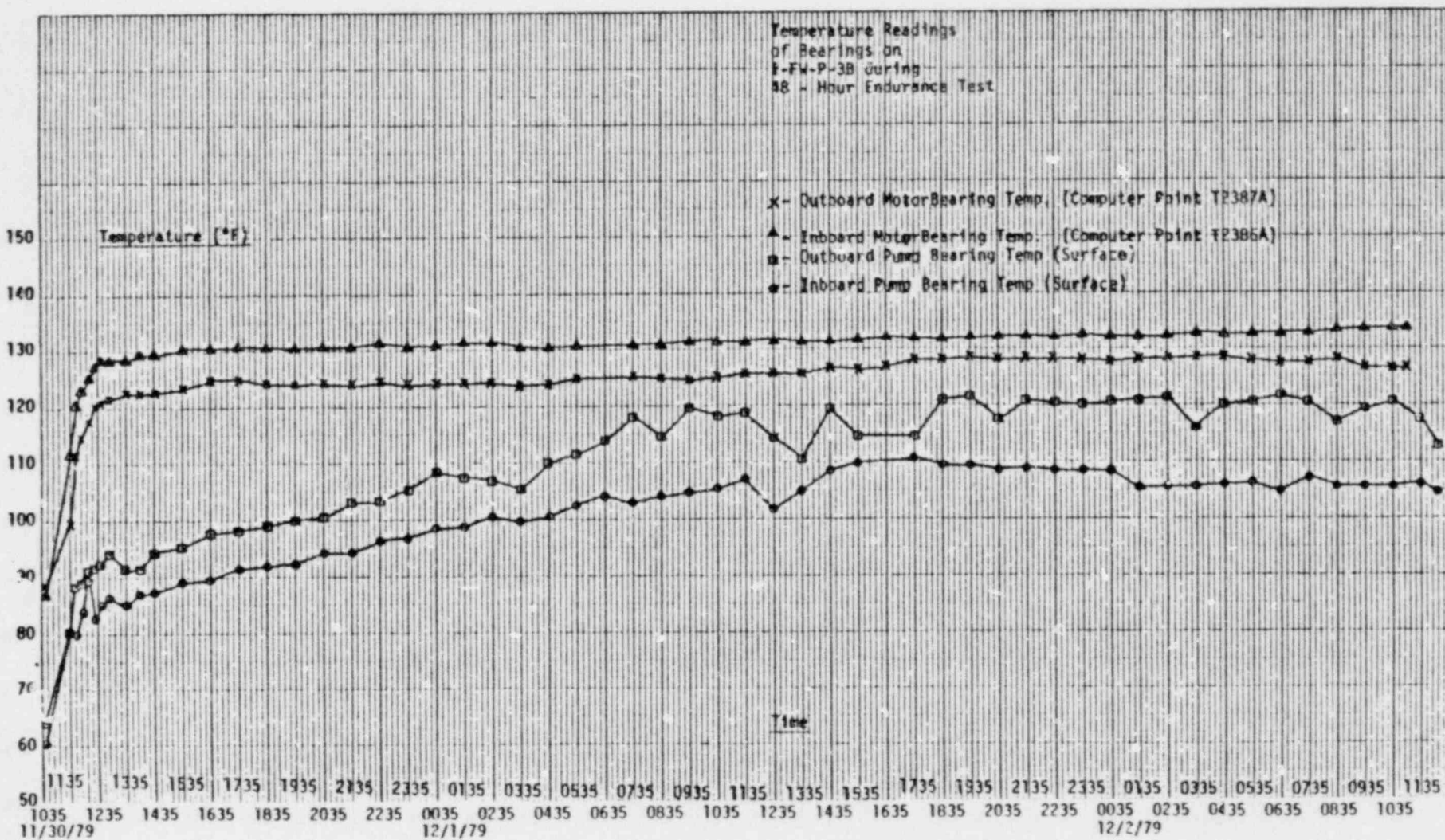
Vibration (Mils)

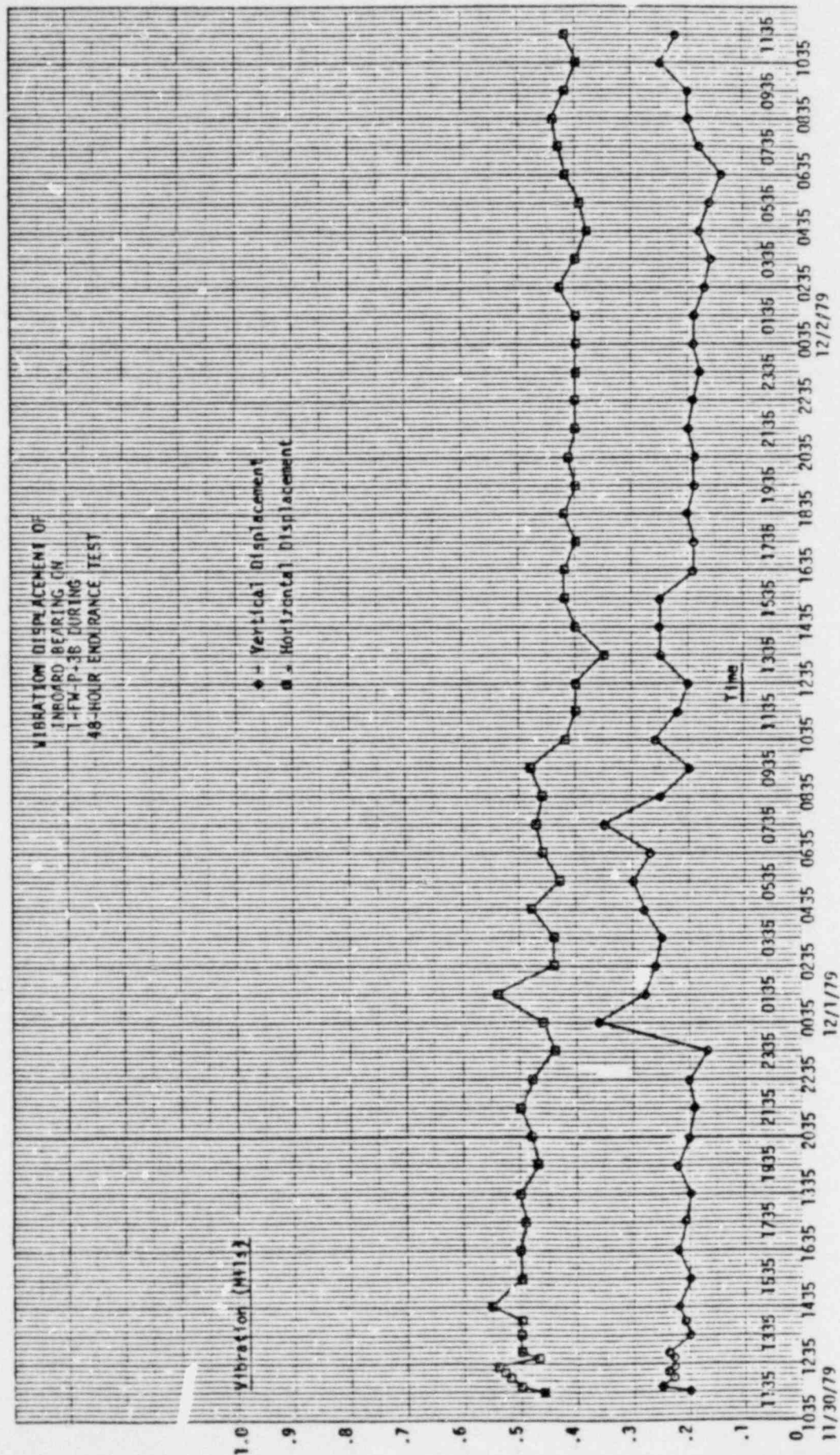
• Vertical Displacement
■ Horizontal Displacement

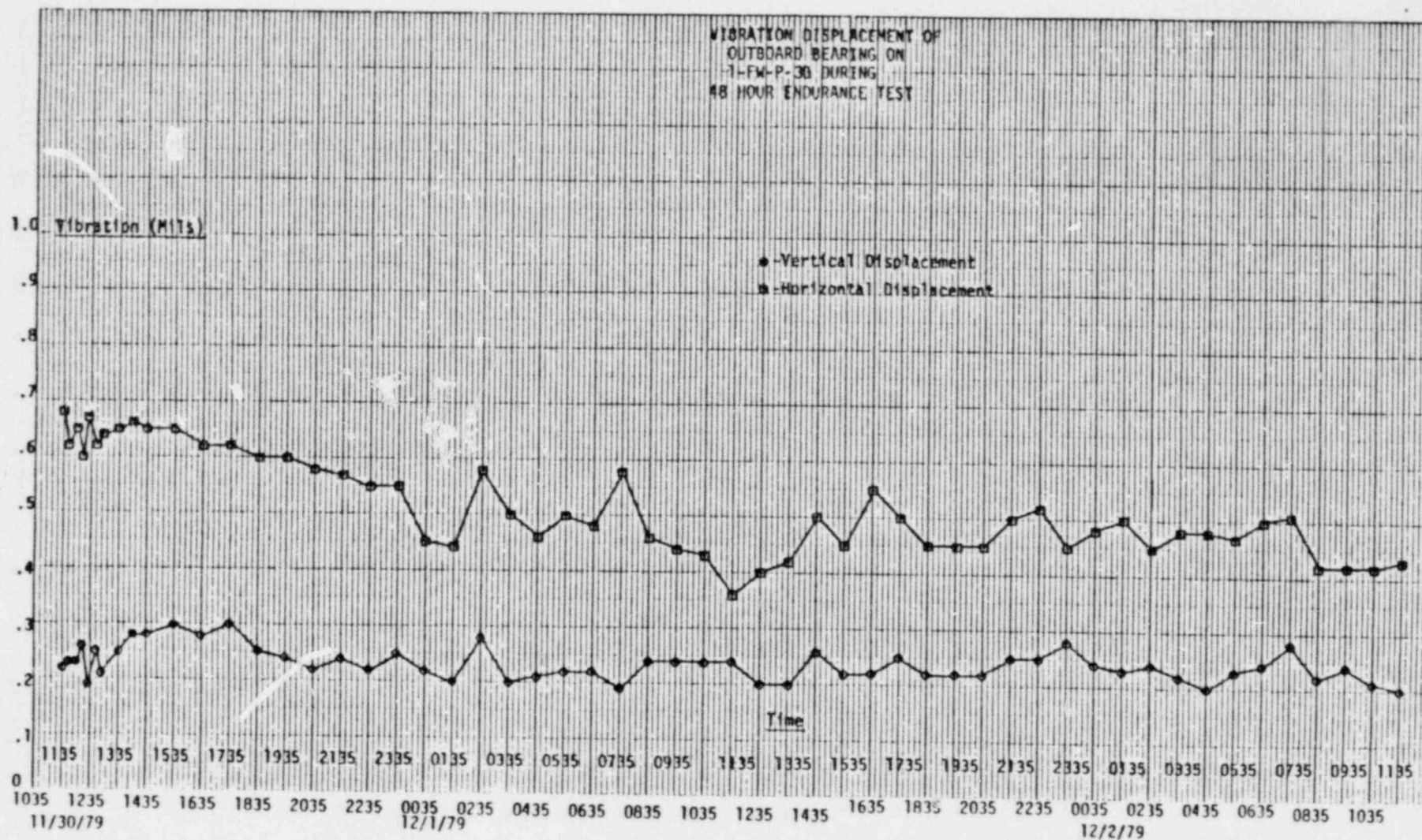
Time

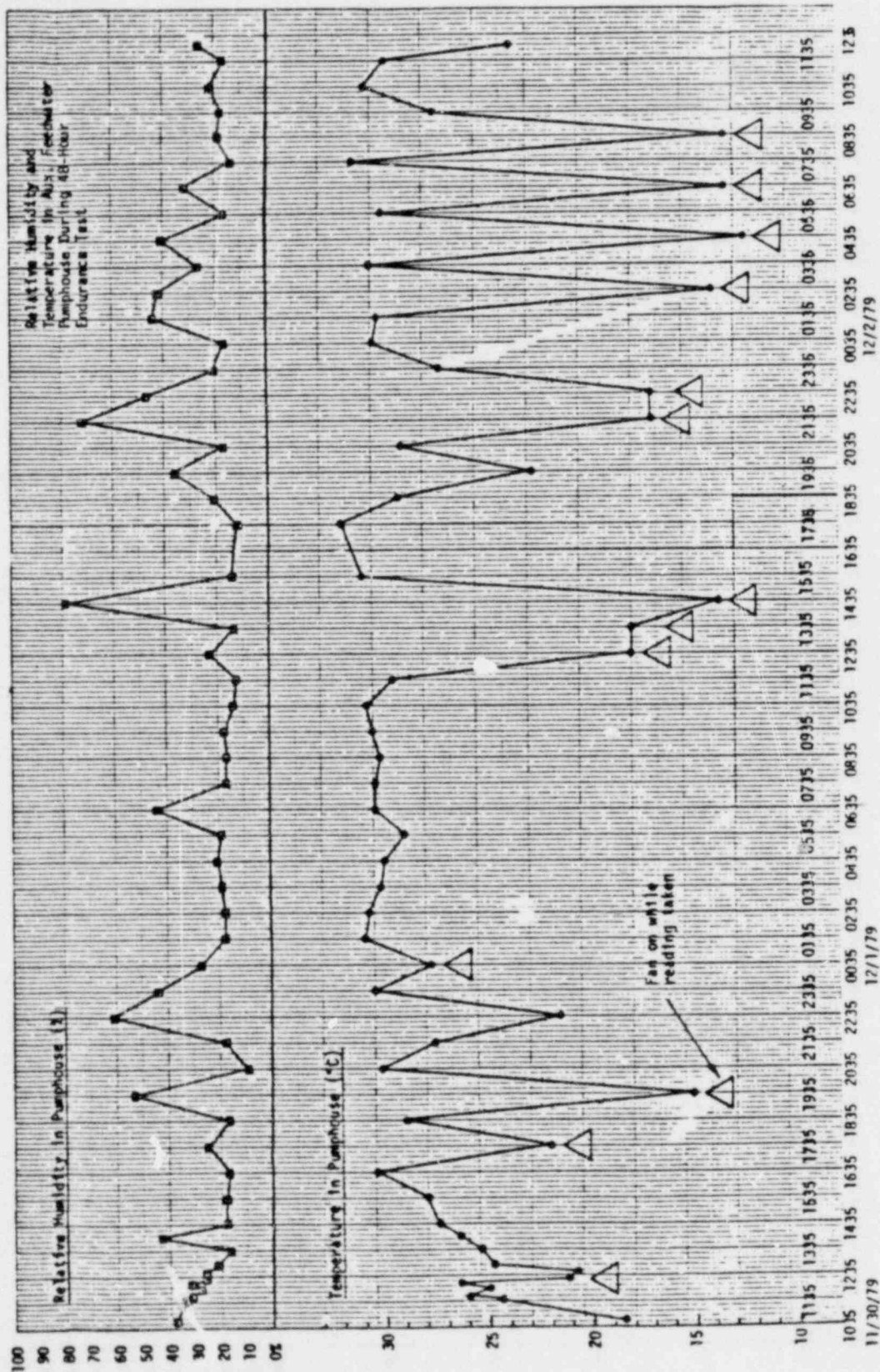
1135 1235 1335 1435 1535 1635 1735 1835 1935 2035 2135 2235 0035 0135 0235 0335 0435 0535 0635 0735 0835 0935 1035 1135
11/30/79 12/1/79 12/2/79

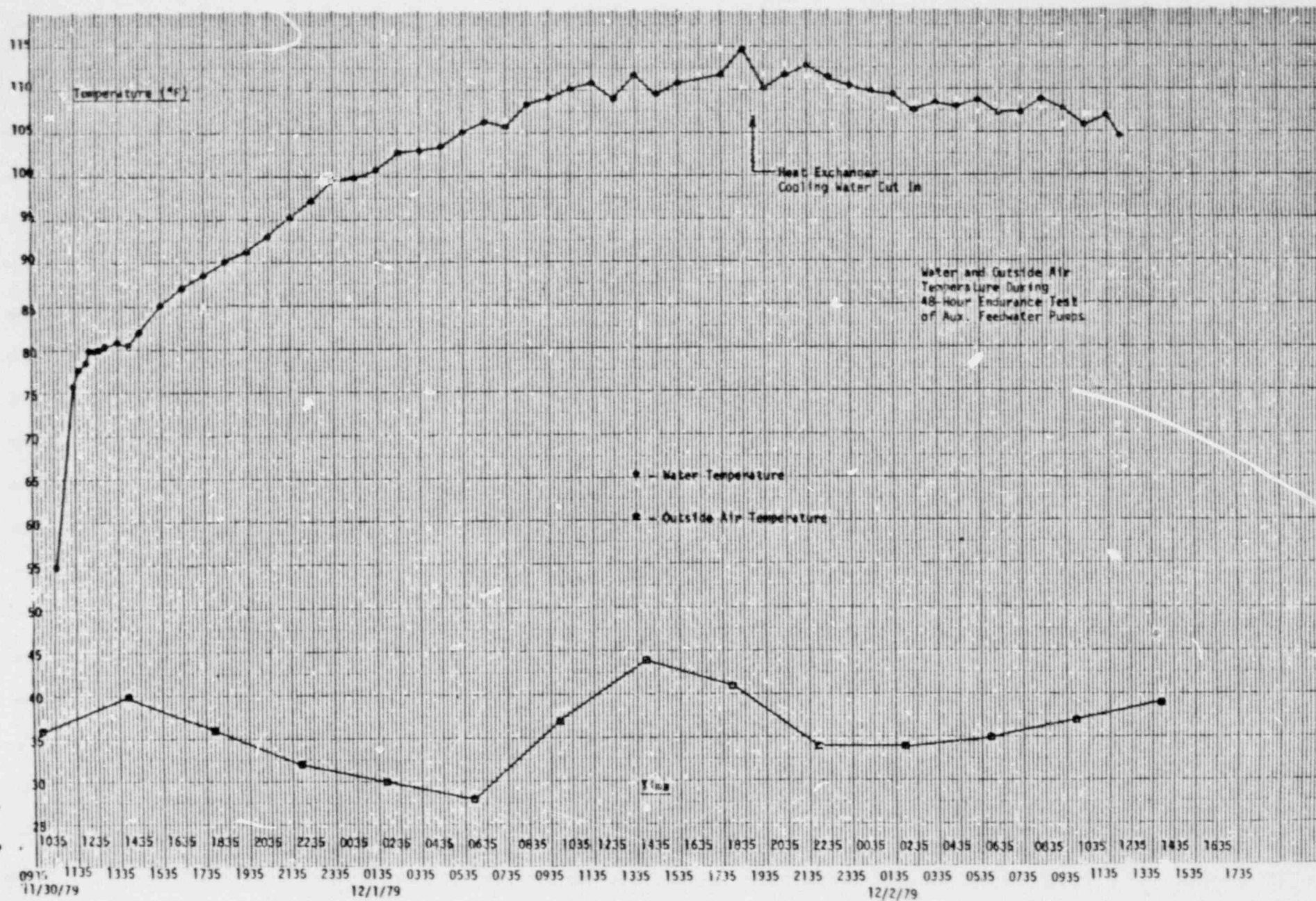












NORTH ANNA POWER STATION

SUMMARY OF UNIT 1 TURBINE DRIVEN AUXILIARY FEEDWATER PUMP ENDURANCE TEST

I. DESCRIPTION OF TEST METHOD

The purpose of this test was to ensure that the Unit 1 Turbine Driven Auxiliary Feedwater Pump remained within design limits with respect to bearing/bearing oil temperatures and vibration, and that the ambient pump room conditions (temperature, humidity) do not exceed environmental qualification limits for safety-related equipment during a 48 hour endurance run.

To begin testing, the following initial conditions were verified:

1. The 110,000 gallon Emergency Condensate Storage Tank (1-CN-TK-1) was available for use with greater than or equal to 98% level indication.
2. A sample of 1-CN-TK-1 was taken and analyzed as satisfactory.
3. The Terry Turbine governor setting was verified
4. Vibration and temperature measurement instrumentation was available and in calibration.
5. The flash evaporator was available for use to supply makeup as necessary.

The normal lineup of the Auxiliary Feedwater System at North Anna Unit 1 consists of two motor driven pumps and one steam driven auxiliary feedwater pump, each providing auxiliary feedwater to one of the three steam generators. For this endurance test, the turbine driven pump was aligned to all three steam generators. The motor driven auxiliary feedwater pumps were available for use as required.

Total flow to the steam generators was required to be maintained above 250 gpm for the entire 48 hours of operation of the turbine drive auxiliary feedwater pump. Pump 1-FW-P-2 was started and the required flow was established. Data was recorded at 15 minute intervals until stable conditions existed. After stable conditions were attained, data was recorded at 1 hour intervals. Bearing surface and bearing oil temperatures were measured at the inboard and outboard bearings of the turbine drive pump. Vertical and horizontal vibration displacements were also measured at these bearings. The relative humidity and temperature of the auxiliary feedwater pumphouse were also recorded during the 48 hour test run.

After 48 hours of continuous operation, pump 1-FW-P-2 was secured. The pump was then allowed to cool for 8 hours and until bearing temperatures were within 20 F of their initial readings.

The pump was then restarted and run for 1 hour. Data was recorded every 15 minutes and, at the end of the hour, the pump was secured.

II. TEST CONDITIONS VS. DESIGN OPERATING CONDITIONS

The minimum flow requirement of 250 gpm for pump 1-FW-P-2 was maintained throughout the test run and the pump head remained within the designed operating range of the pump.

III. PLOTS OF BEARING/BEARING OIL TEMPERATURE VS. TIME FOR THE INBOARD AND OUTBOARD BEARING OF 1-FW-P-2

Pump 1-FW-P-2 is the only safety-related equipment in the pumphouse. Since the highest temperature recorded in the pumphouse was 101 F, which is below the design operating temperature of the turbine driven auxiliary feedwater pump, the ambient conditions did not exceed the environmental qualification limits during testing. Plots of bearing/bearing oil temperatures vs. time for the inboard and outboard bearings are attached.

IV. PUMP VIBRATION

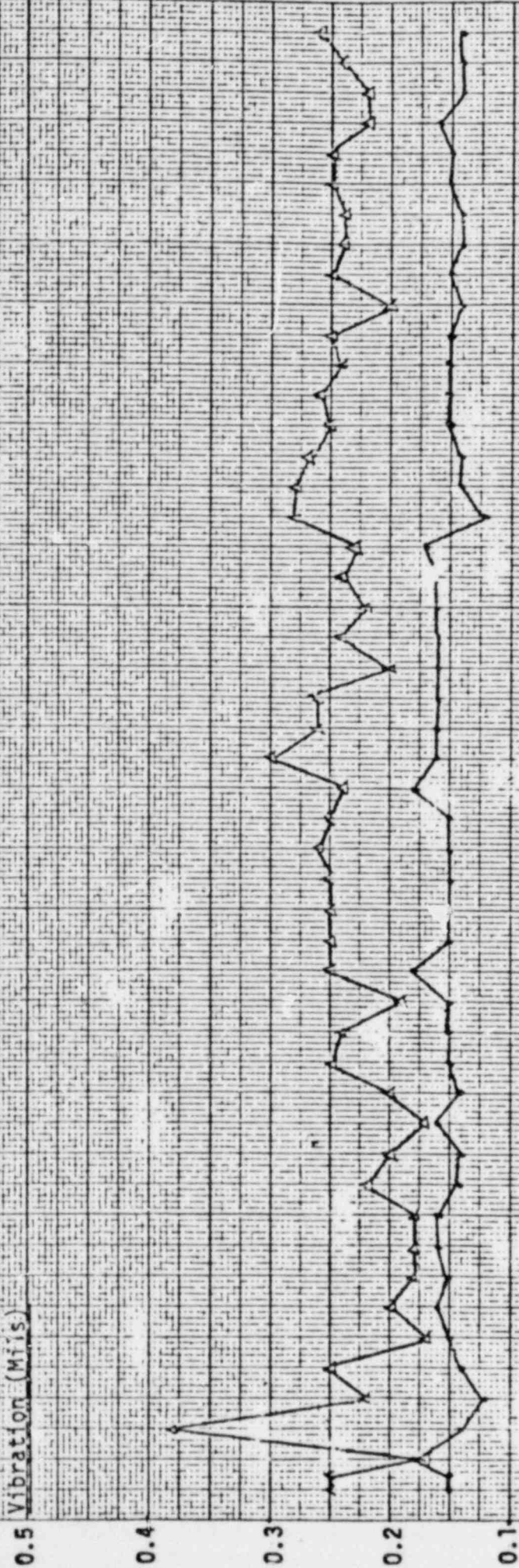
The largest vibration amplitude recorded during the testing was 0.38 mils which was detected in the horizontal mode of the outboard bearing of 1-FW-P-2. Therefore, the turbine driven auxiliary feedwater pump bearing vibration did not exceed the maximum allowable amplitude of 1.5 mils during the endurance test.

Vibration Displacement of
Outboard Bearing-On

1-FW-P-2
During 48 Hour
Endurance Test

Δ - Horizontal Displacement
• - Vertical Displacement

Vibration (Mils)



TIME 4/12/81

Vibration Displacement of
Inboard Bearing On
1-FW-P-2
During 48 Hour
Endurance Test

Δ Horizontal Displacement
• Vertical Displacement

Vibration (Mils)

0.5
0.4
0.3
0.2
0.1

2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600 1800 2000

4/11/81

TIME 4/12/81

