TENNESSEE VALLEY AUTHORITY

DIVISION OF NUCLEAR SERVICES

WATTS BAR NUCLEAR PLANT
MAIN CONTROL ROOM, MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE TEST AND ANALYSIS
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1.0 Introduction

1.1 Objective

The objective of this test was to define the lowest natural frequencies of the Main Control Boards as installed at Watts Bar Nuclear Plant.

1.2 Background

The Main Control Boards consist of six separate sections welded both together and to the foundation sill plate in a horseshoe shaped configuration.

1.3 Scope

In-situ structural dynamic response testing was conducted to identify the lowest natural frequencies of the Main Control Boards. An electromechanical shaker supplied an input forcing function to excite the Main Control Boards and piezoelectric accelerometers measured the response at selected points around the horseshoe shaped structure.

2.0 Test Methodology

2.1 Sensor Locations

The ends of the six control board sections were selectd to provide six data locations. Figure 1 illustrates these locations. Beeswax was used to attach triaxial aluminum mounting blocks to the top, middle, and bottom of the control boards at each data location.

2.2 Sensors

Endevco model 2273AM20 piezoelectric accelerometers were stud mounted to the aluminum triaxial mounting blocks forming a triaxial accelerometer array. Each data point was instrumented with a triaxial accelerometer array.

2.3 Signal Conditioning

Response signals from the accelerometers were connected to Unholtz-Dickie RCA-2TR remote charge preamplifiers by Endevco 3090B low noise coaxial cables. Outputs from the remote charge preamplifiers were conditioned and amplified by Unholtz-Dickie D22PMHS(0)-1 signal conditioning amplifiers.

2.4 Electromechanical Shaker

An Acoustic Power Systems Electro-Seis model 113 shaker was clamped to the Main Control Boards at data location A-1 (see figure 1). This shaker, which provided the input forcing function for the testing, was driven by an Acoustic Power Systems

Dual Mod[redacted]odel 124 amplifier. Sine wave[redacted]nput signals for the amplifier were produced by a Hewlett-Packard 3325A synthesizer-function generator, while white noise input signals were produced by a Wavetek 132 function generator.

2.5 Data Acquisition

Structural response was recorded as swept sine wave signals or white noise signals were injected into the power amplifier driving the electromechanical shaker. The first sine wave signal was swept from 10 Hz to 20 Hz, the second sine wave signal was swept from 10 Hz to 45 Hz, and the white noise signal had an approximate bandwidth from 0 Hz to 50 Hz. Test information was recorded in a frequency modulated format on VHS magnetic tape with a TEAC XR-50 tape recorder.

2.6 Data Analysis

Test signals were reproduced on the same TEAC XR-50 instrumentation tape recorder as used for recording. The reproduced signals were analyzed on a Hewlett-Packard 5423 structural dynamics analyzer.

3.0 Results

Response spectrums reveal a first natural frequency of 14.6 Hz $\pm$ 0.2 Hz and a second natural frequency of 19.2 Hz $\pm$ 0.3 Hz. Representative spectrums showing the first and second natural frequencies are attached as figures 2 through 7. These data were measured at data location F-1, in the Y-direction (reference figure 1). No resonances below 10 Hz were found during preliminary testing.

JRO:JLR
Attachments
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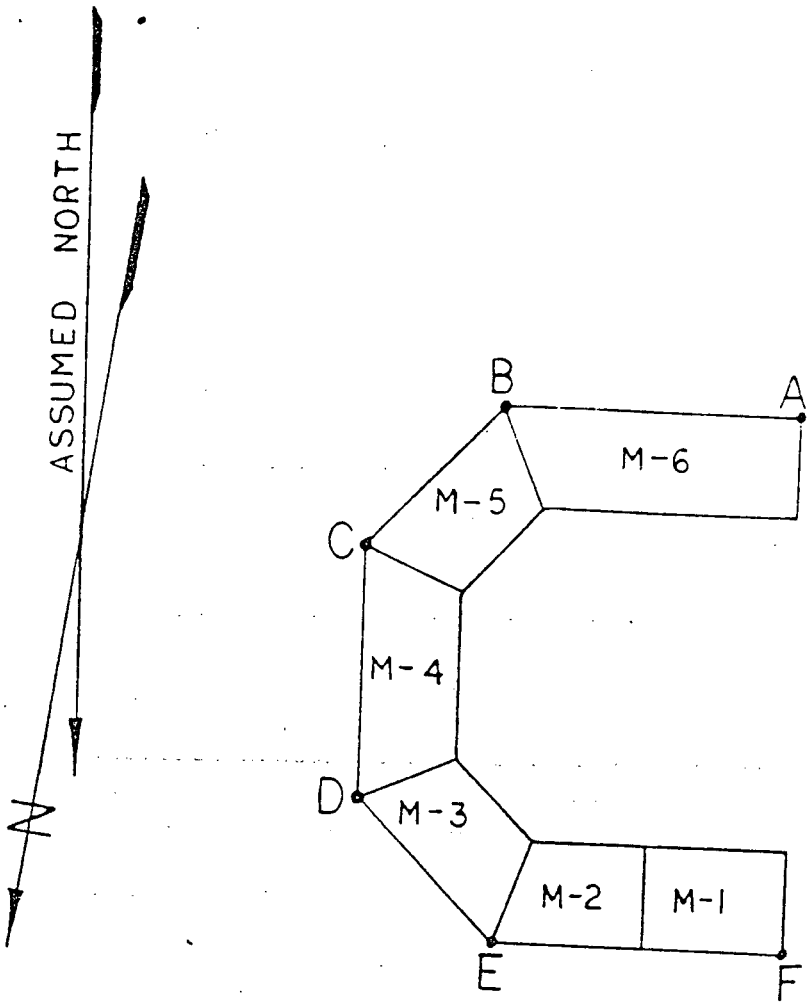
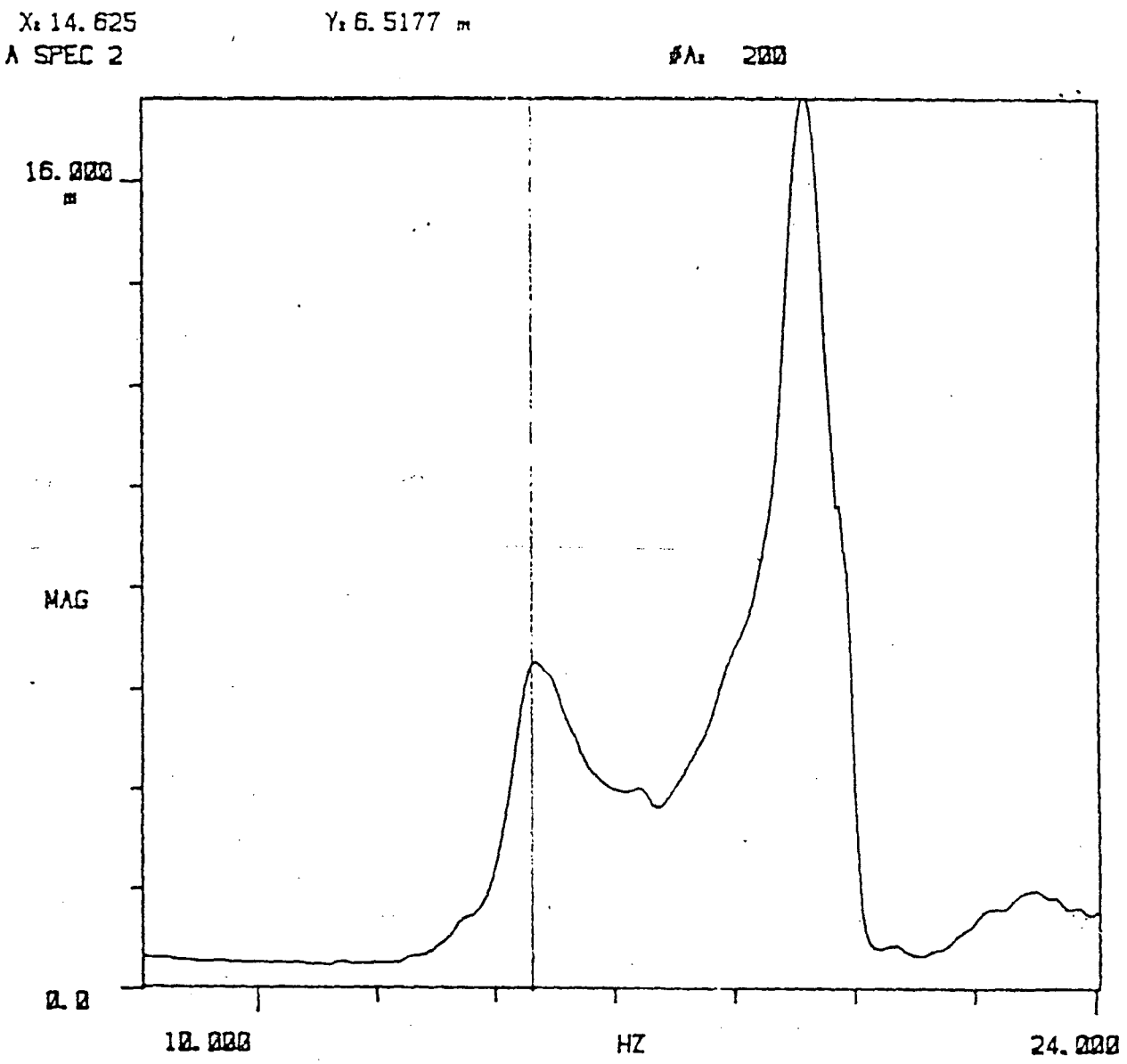


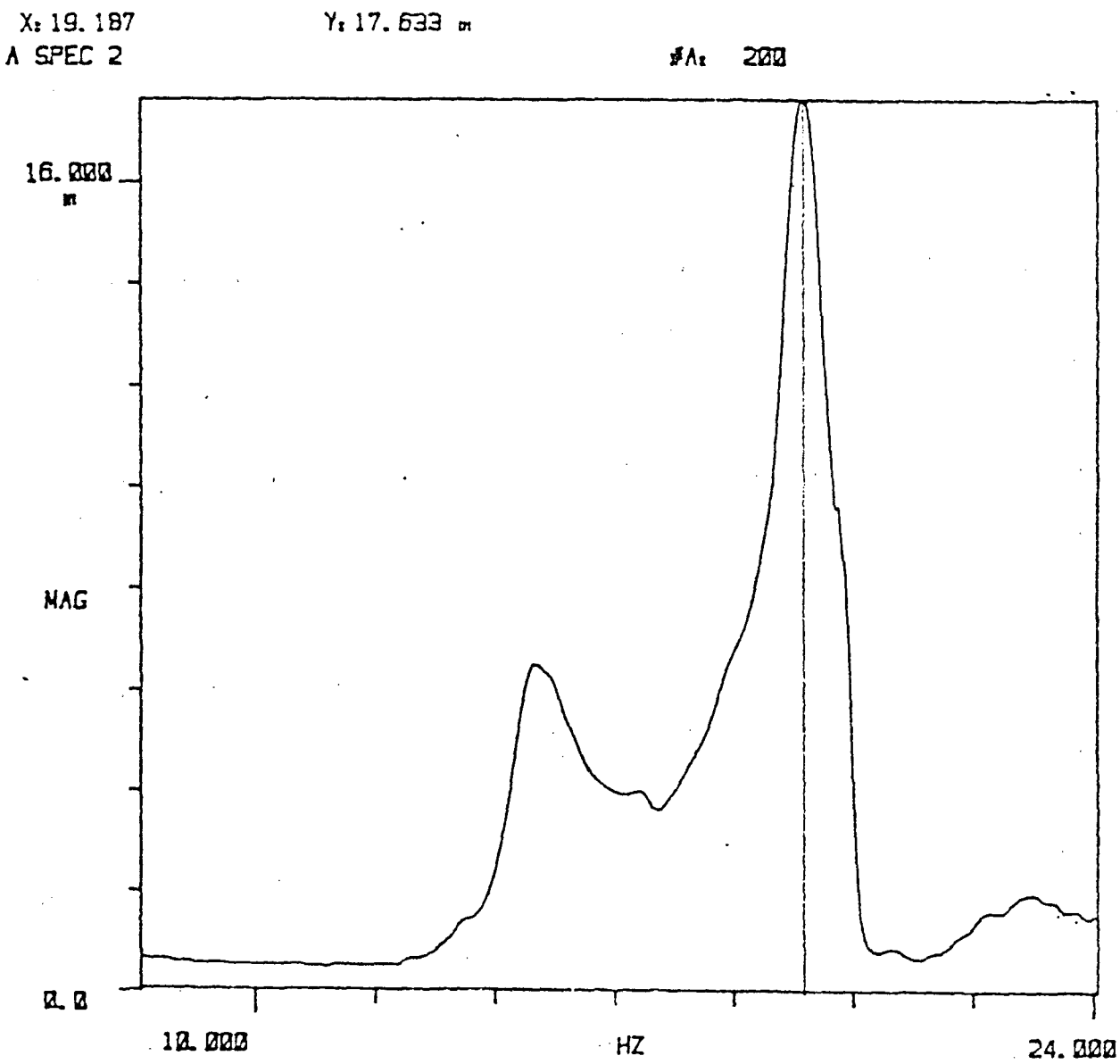
WBNP UNIT TWO MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE TEST
DATA LOCATIONS ~ A ~ B ~ C ~ D ~ E ~ F
ELECTROMECHANICAL SHAKER LOCATION ~ A

FIGURE 1



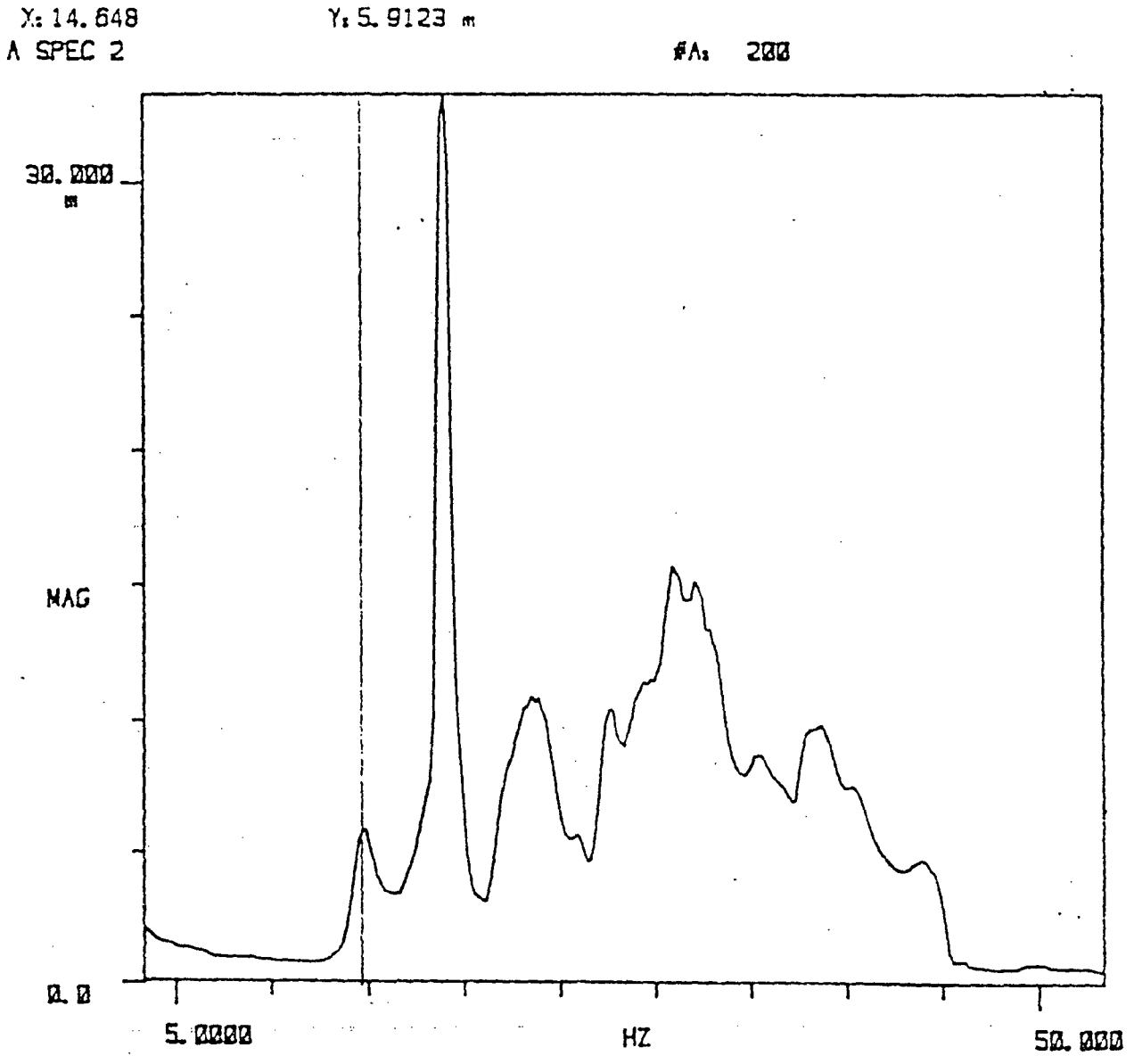
WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
SWEPT SINE INPUT (10 TO 20 HZ)
FIRST NATURAL FREQUENCY AT 14.6 HZ

FIGURE 2



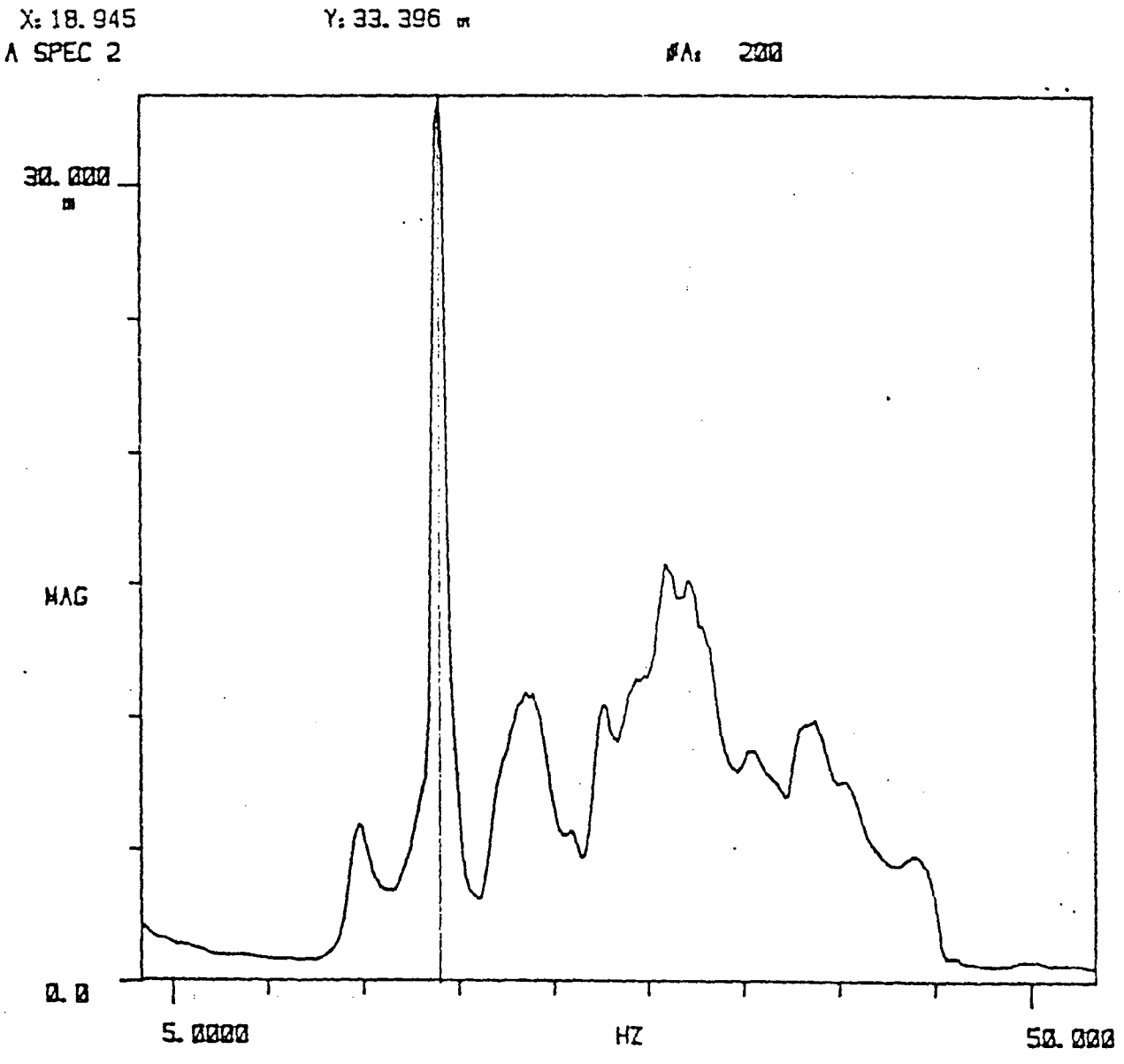
WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
SWEPT SINE INPUT (10 TO 20 HZ)
SECOND NATURAL FREQUENCY AT 19.1 HZ

FIGURE 3



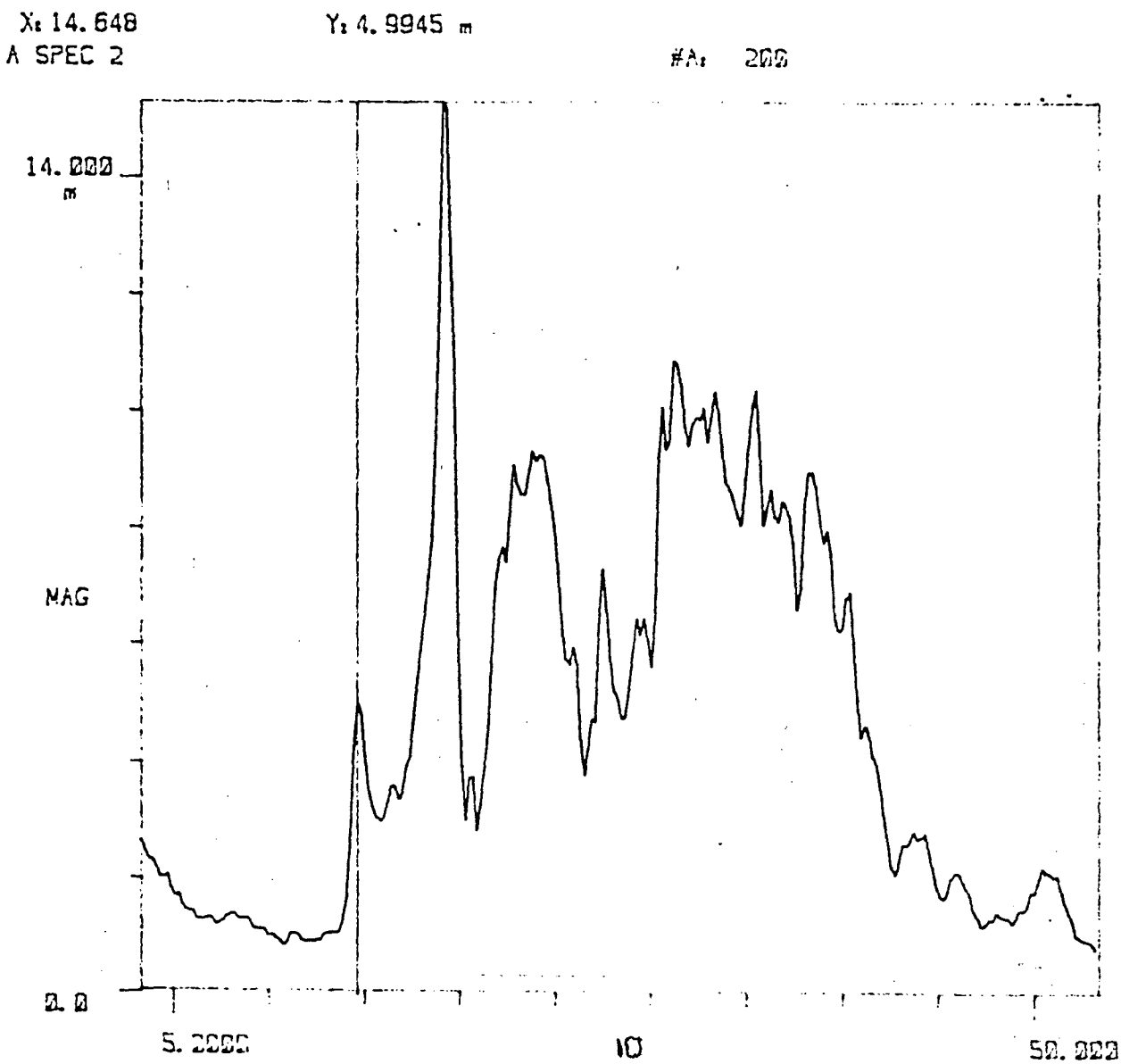
WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
SWEPT SINE INPUT (10 TO 45 HZ)
FIRST NATURAL FREQUENCY AT 14.6 HZ

FIGURE 4



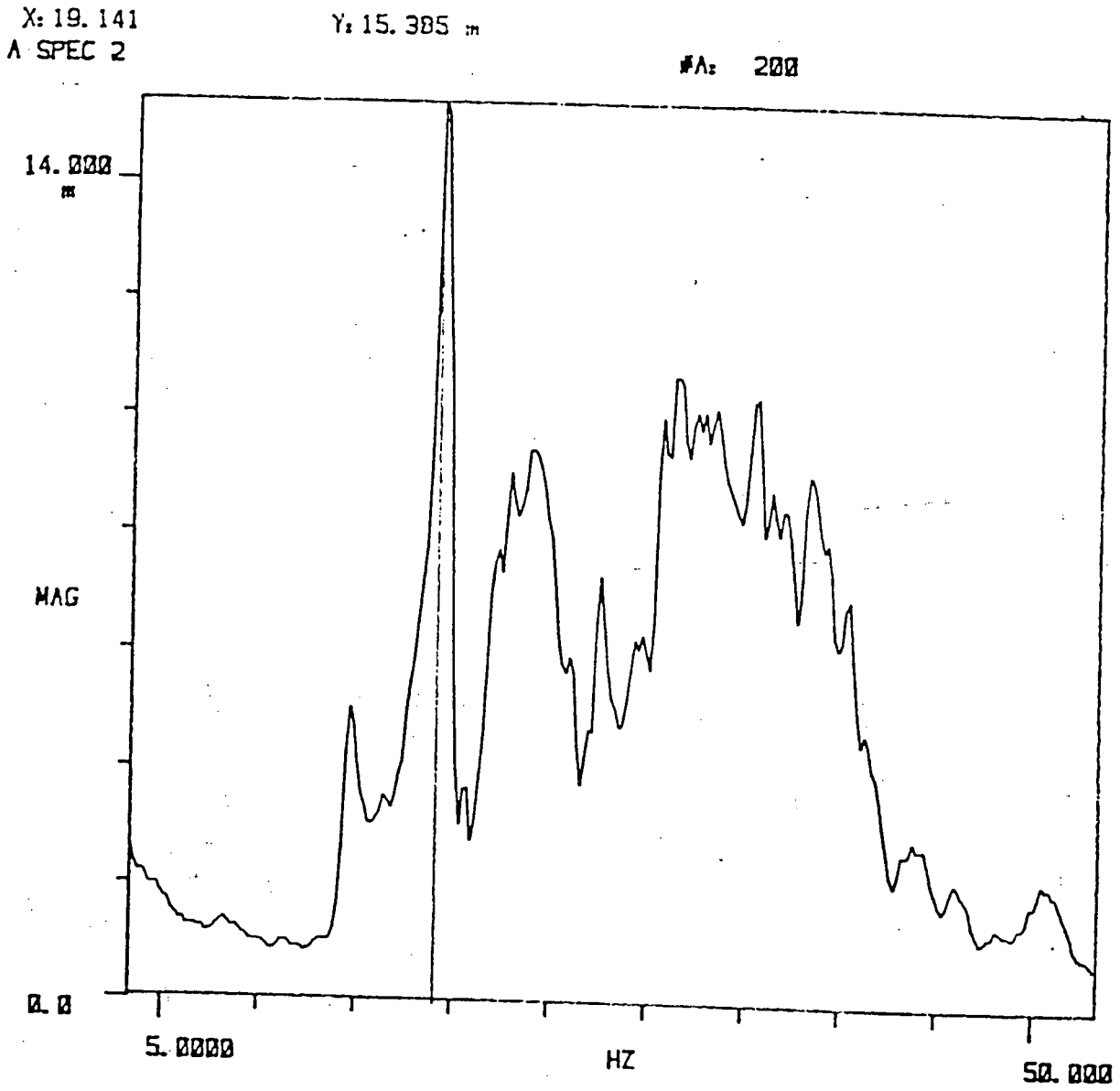
WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
SWEPT SINE INPUT (10 TO 45 HZ)
SECOND NATURAL FREQUENCY AT 18.9 HZ

FIGURE 5



WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
WHITE NOISE INPUT (0 TO 50 HZ)
FIRST NATURAL FREQUENCY AT 14.6 HZ

FIGURE 6



WBNP MCR MAIN CONTROL BOARDS
STRUCTURAL DYNAMIC RESPONSE AT DATA LOCATION F-1
WHITE NOISE INPUT (0 TO 50 HZ)
SECOND NATURAL FREQUENCY AT 19.1 HZ

FIGURE 7