TR-90-10

TRAVELERS: K. W. FRIZELL, R. J. WITTLER
D. E. RAMIREZ

SUBJECT: VIBRATION MEASUREMENTS ON THE OUTLET WORKS PIPE AT PLATORO DAM

TRAVEL PERIOD: JULY 25, 1990

PLACES VISITED: PLATORO DAM, COLORADO

TR-90-10

D-3751 file

BUREAU OF RECLAMATION
Denver Office
Denver, Colodrado

TRAVEL REPORT

Code : D-3752 July 25, 1990

To : Chief, Division of Research and Laboratory Services

From : K. Warren Frizell, Rodney J. Wittler, Daniel E. Ramirez

Subject: Vibration Measurements on the Outlet Works Pipe at Platoro Dam (Travel)

1. **Travel period:** July 10-11, 1990.

2. **Places or offices visited:** Platoro Dam, Colorado.

3. **Purpose of trip:** To perform vibration measurements on the outlet works piping at Platoro Dam.

4. **Synopsis of trip:** July 10, 1990: We departed the Denver Federal Center in a government vehicle at 10:00 am, arriving at Platoro, Colorado, about 4:30 p.m.

July 11, 1990: We were met at 9:00 a.m. by Isidoro Manzanares of the Chama Field Office. We travelled to the damsite and began to set up our instrumentation. In addition to Manzanares, several members of the Conejos River Conservancy District were present to witness the tests. We placed two accelerometers on the outlet works pipe at similar locations to those used by Isbester in previous tests (TR-85-17 and TR-85-38). When all the instruments had been installed and tested, we began our tests. The test procedure consisted of adjusting the valves to specified openings, and recording output from the accelerometers on a digital audio tape. In addition, two power spectra were measured and printed out for each valve position, one at a bandwidth of 250 Hz and one at 1000 Hz. Valve positions tested included 19, 50, 70, 75, 80, 85, and 90 percent. The recorded reservoir elevation was 9980.62 ft, giving a head at the gate of 87.62 ft.

We completed testing at about 12:30 p.m. We packed up our equipment and departed the damsite at 1:30 p.m., arriving back at the Denver Federal Center at 8:00 p.m.

5. **Conclusions:** As with the previous tests, vibration occurred as a result of a shift in control from the butterfly valves to the 56-in pipe upstream of the bifurcation. The shift in control was evident at an 82- to 83-percent balanced opening. A large increase in audible noise and an increase in vibration amplitude

from the installed accelerometers accompanied the shift in control. In addition, power spectra reveal an increase in dominant frequency with increasing valve opening. With the shift in control, the backpressure on the bifurcation is reduced to such a level that cavitation begins, initiating the majority of the noise. Because the noise and vibration result from an area related problem (less area in the 56-inch pipe than in the two butterfly valves open above ~82 percent), the influence of the reservoir elevation is minimal. The intensity of both the noise and vibration increase with reservoir elevation, as can be seen when comparing the present measurements with those taken in 1985 (reservoir elevation 10 004.6 ft, head on valves, 111.6 ft). This was expected since the available energy in the flow is a function of the velocity squared (head dependant).

Therefore, balanced valve operations up to 80 percent would be acceptable for the present and all lower reservoir conditions. With valve openings above 80 percent, cavitation and increased vibration will occur at all reservoir conditions, providing for undesirable operation. Test data are included as an appendix to this report.

6. **Action Correspondence Initiated:** None.

CP 7-25-90

William Frizell Daniel K. Ramirez Rodney Jay Wittler

PBS 7-26-90

cc: Regional Director, Salt Lake City UT, Attention: UC-400
Project Manager, Albuquerque NM, Attention: Mike Hammon
Chief, Chama Field Division, Chama NM

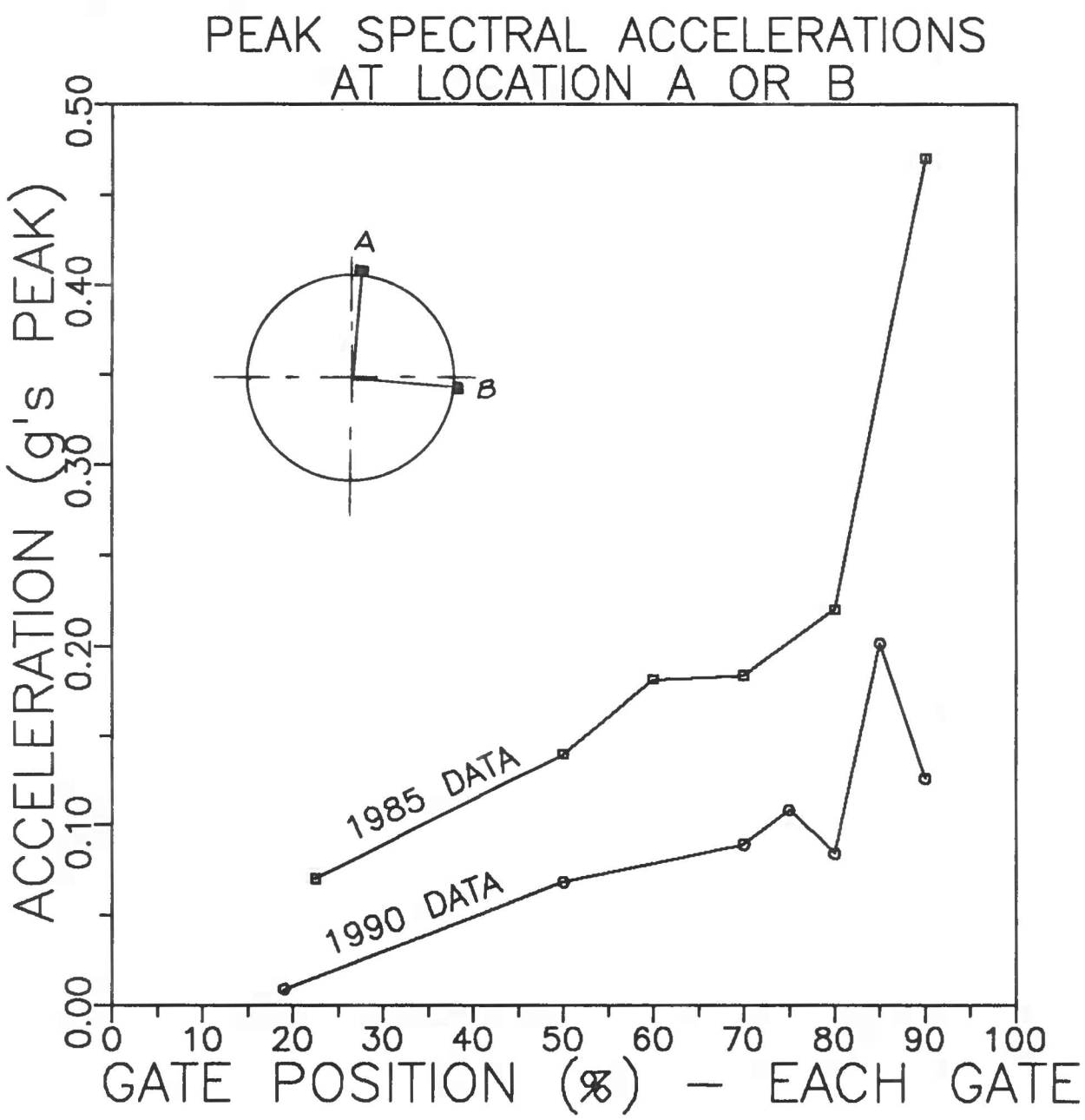
bc: D-3750
D-3751 (file)
D-3752 (Frizell)
D-3423 (Frisz)
D-5210 (Hoffman)

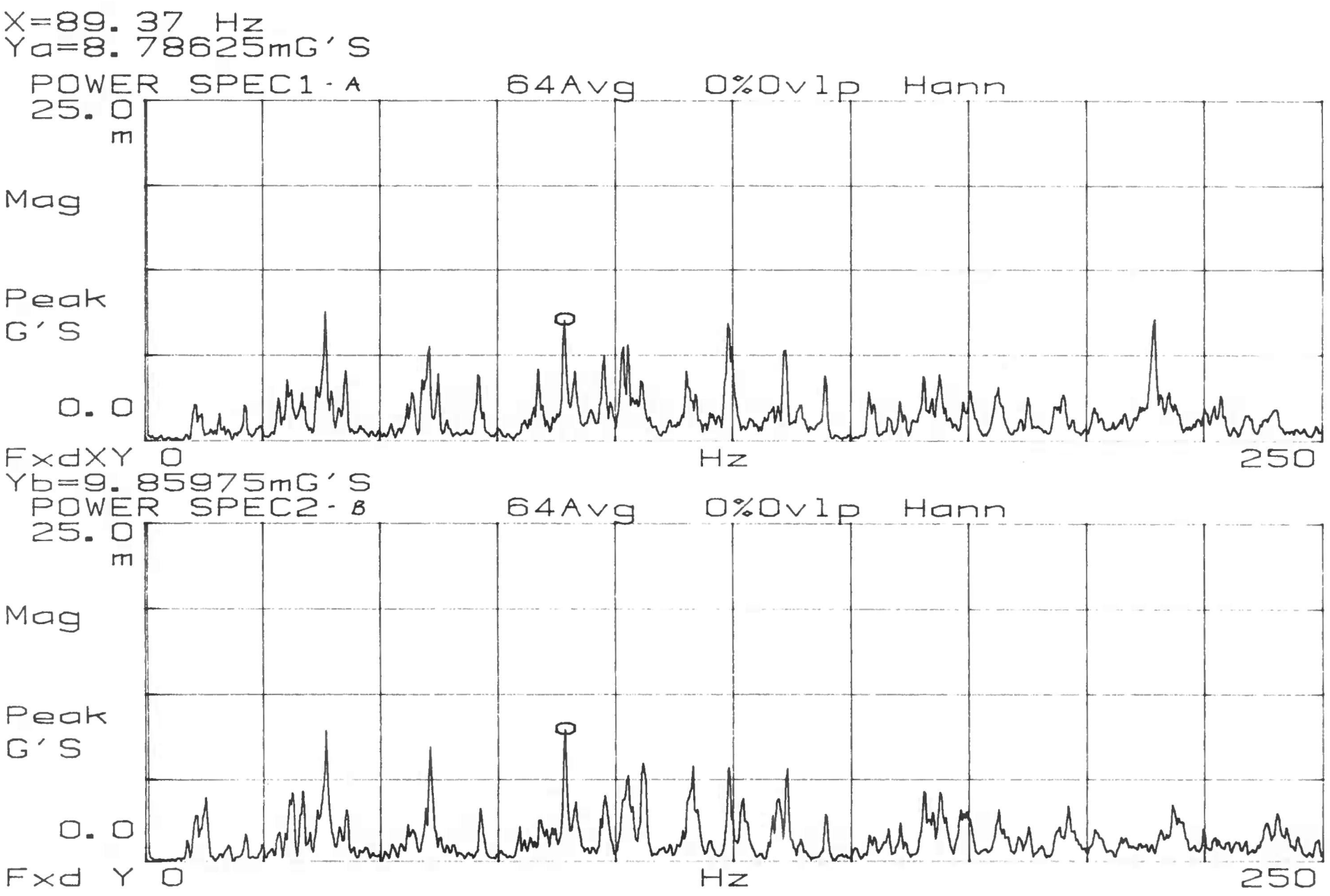
Noted: 7/27/90
R. Graham
For Chief, Research and Laboratory Services Division

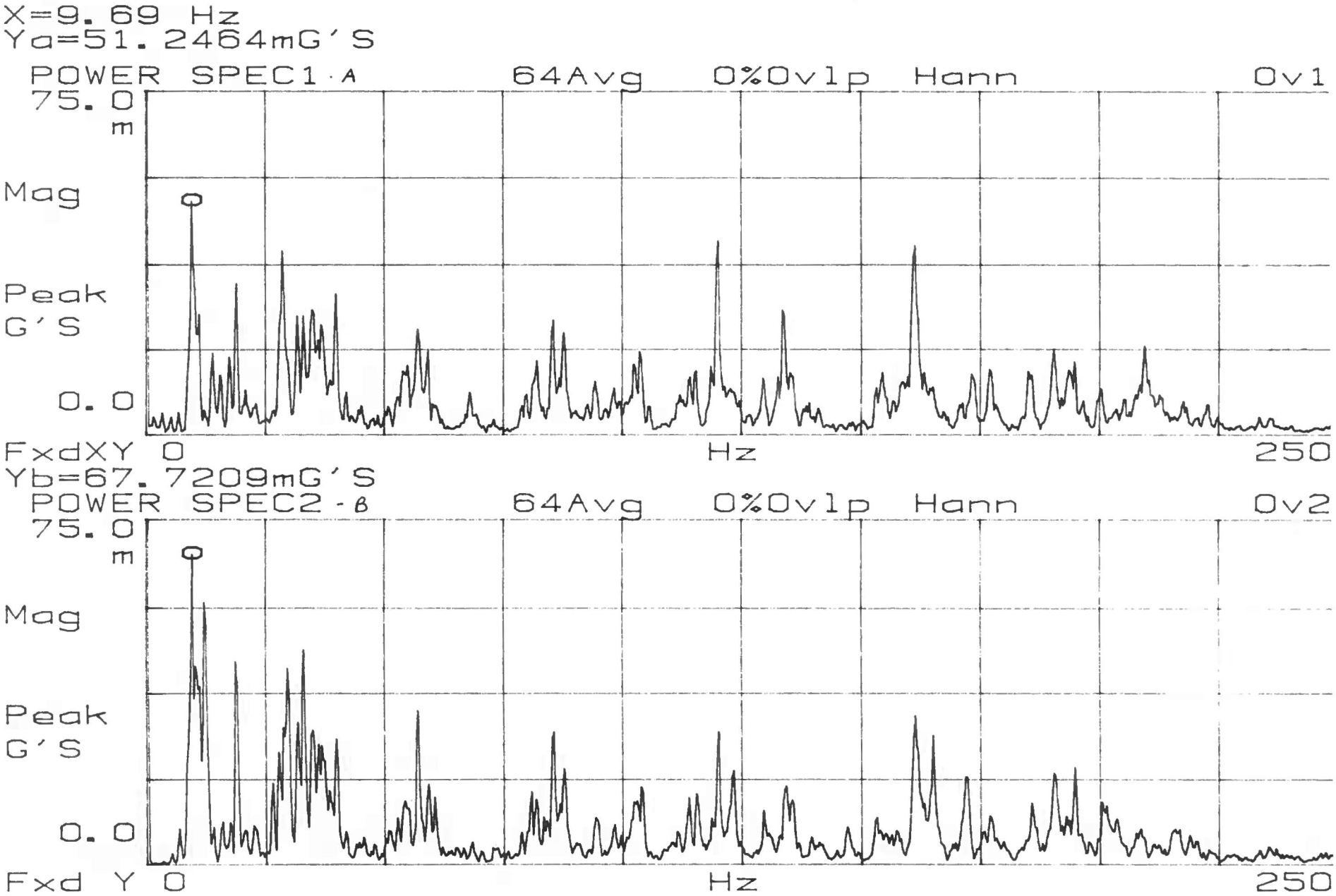
WBR:KWFrizell:flh:7/25/90/236-6156
(c:\wp\d3752\platoro.tr)

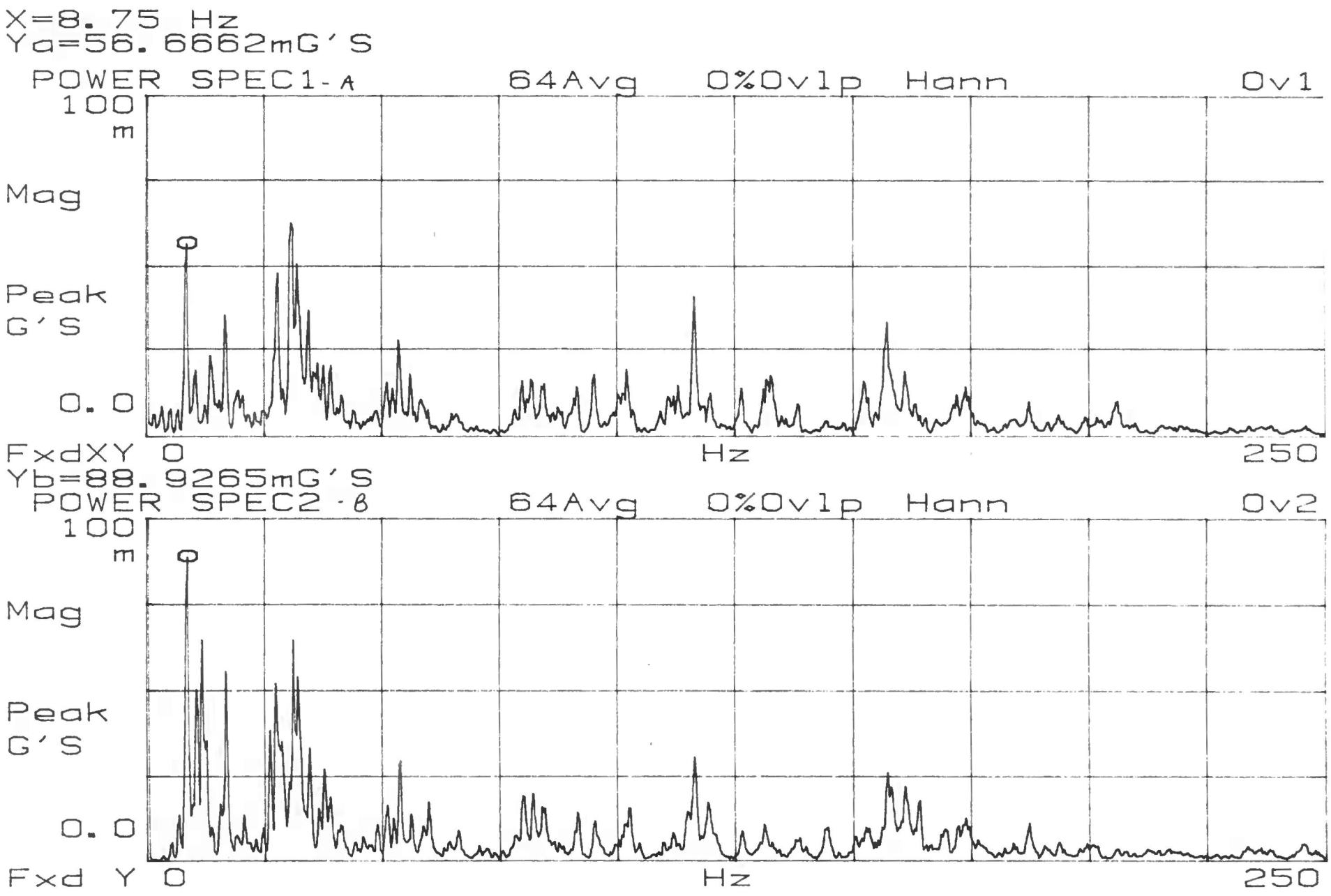
APPENDIX

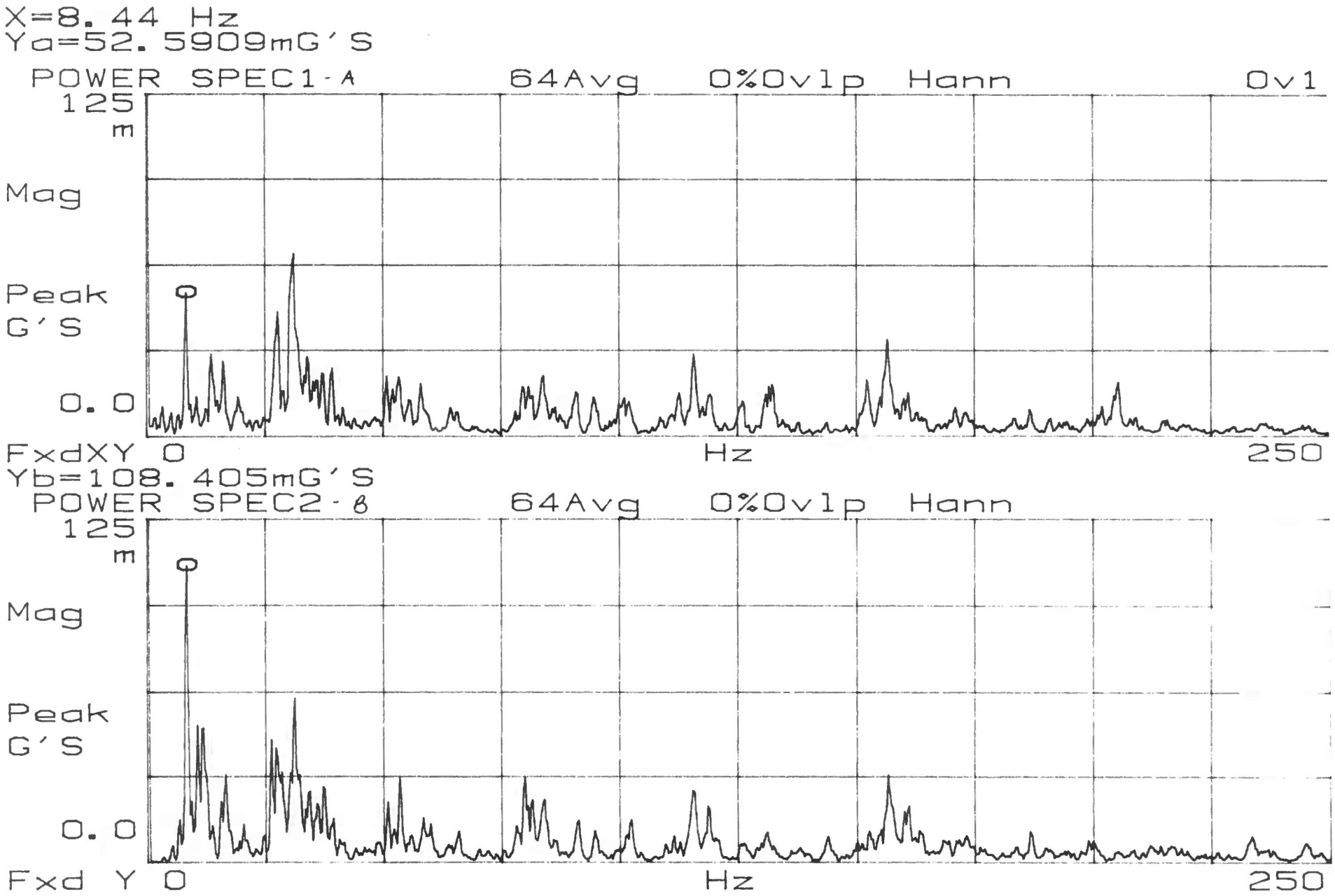
This appendix contains data from the vibration tests at Platoro Dam on July 11, 1990. Included are: a comparative plot of peak spectral accelerations showing 1985 and 1990 data, power spectra of the current data showing peak spectral accelerations versus frequency for accelerometers A and B at balanced gate openings of 19-, 50-, 70-, 75-, 80-, 85-, and 90-percent.

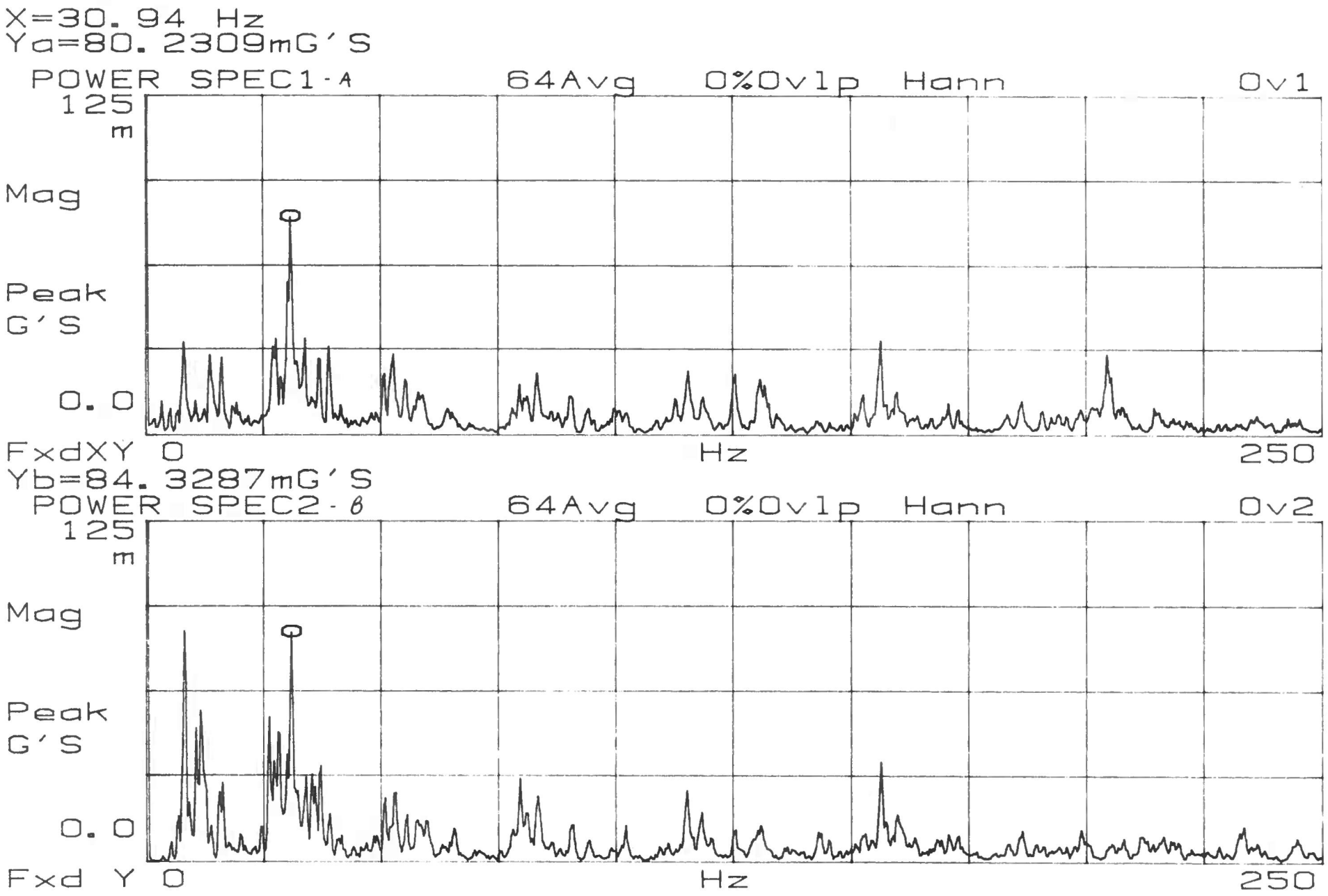

PEAK SPECTRAL ACCELERATIONS
AT LOCATION A OR B
ACCELERATION (g's PEAK)
0.00
0.10
0.20
0.30
0.40
0.50
A
B
1985 DATA
1990 DATA
0
10
20
30
40
50
60
70
80
90
100
GATE POSITION (%) — EACH GATE

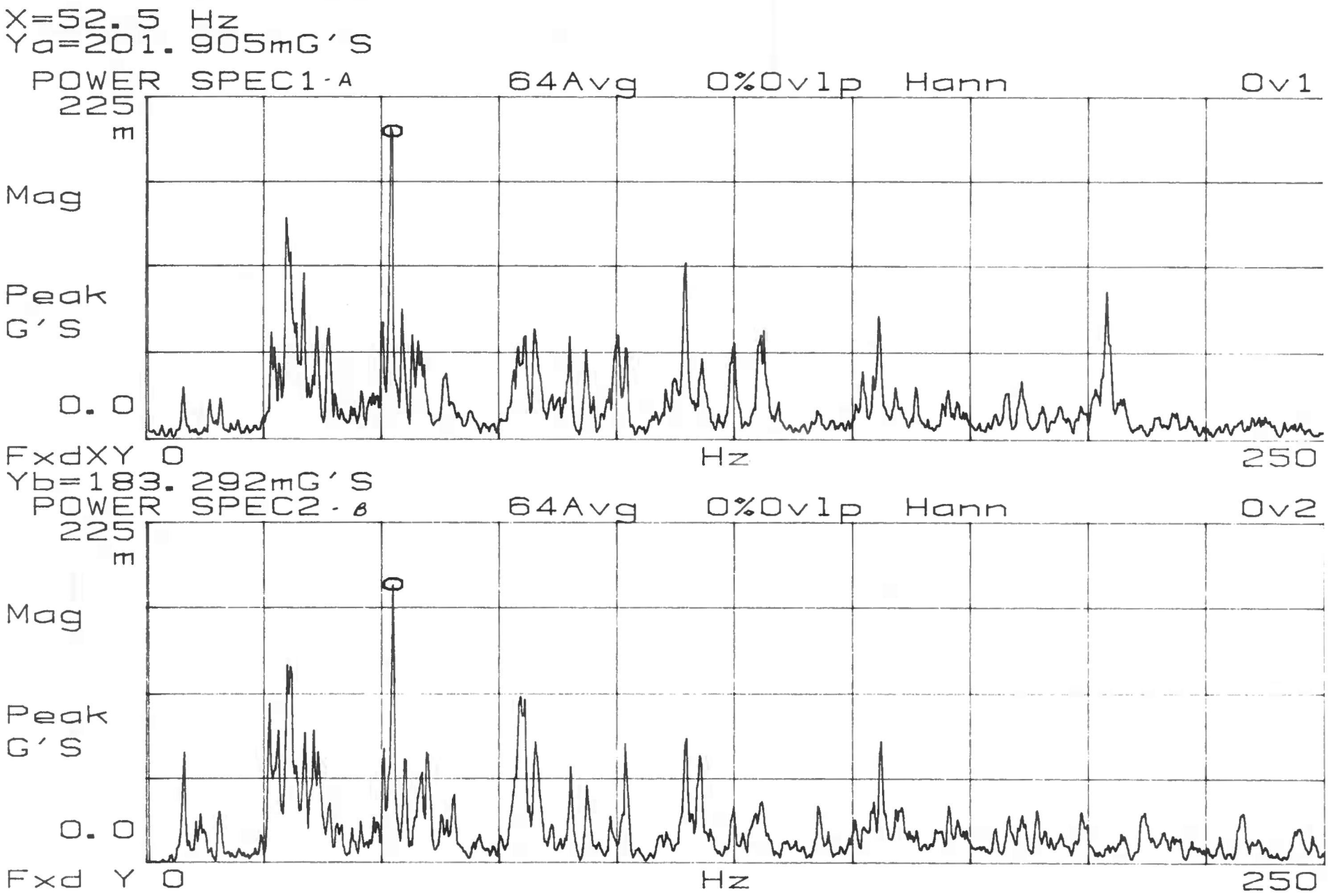

X=89.37 Hz
Ya=8.78625mG'S
POWER SPEC1-A
64Avg
0%Ovlp
Hann
25.0
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=9.85975mG'S
POWER SPEC2-B
64Avg
0%Ovlp
Hann
25.0
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250

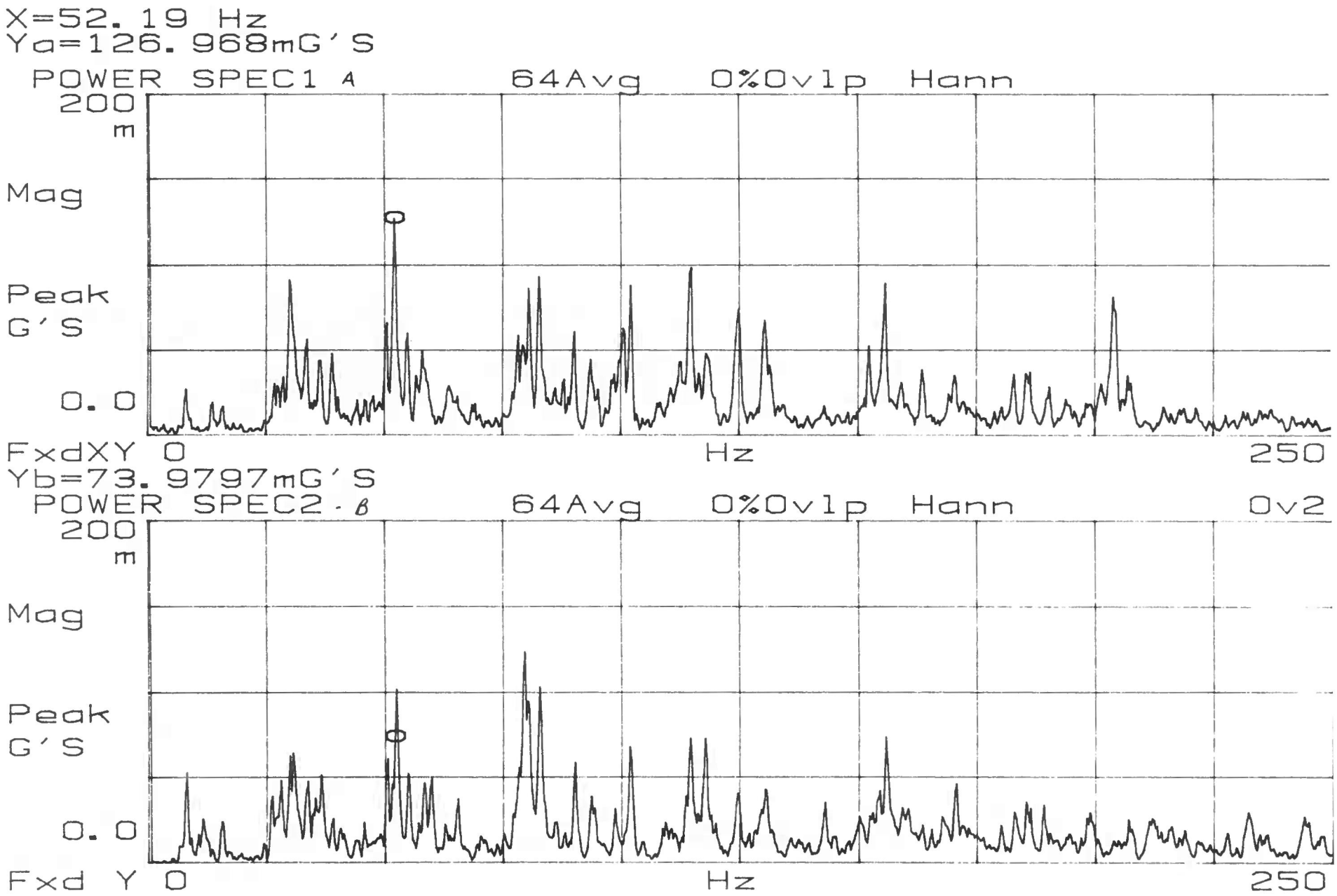

X=9.69 Hz
Ya=51.2464mG'S
POWER SPEC1 A
64Avg
0%Ovlp
Hann
Ov1
75.0
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=67.7209mG'S
POWER SPEC2 B
64Avg
0%Ovlp
Hann
Ov2
75.0
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250


X=8.75 Hz
Ya=56.6662mG'S
POWER SPEC1-A
64Avg
0%Ovlp
Hann
Ov1
100
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=88.9265mG'S
POWER SPEC2-B
64Avg
0%Ovlp
Hann
Ov2
100
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250


X=8.44 Hz
Ya=52.5909mG'S
POWER SPEC1-A
64Avg
0%Ovlp
Hann
Ov1
125
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=108.405mG'S
POWER SPEC2-B
64Avg
0%Ovlp
Hann
125
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250


X=30.94 Hz
Ya=80.2309mG'S
POWER SPEC1-A
64Avg
0%Ovlp
Hann
Ov1
125
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=84.3287mG'S
POWER SPEC2-B
64Avg
0%Ovlp
Hann
Ov2
125
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250


X=52.5 Hz
Ya=201.905mG'S
POWER SPEC1-A
64Avg
0%Ovlp
Hann
Ov1
225
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=183.292mG'S
POWER SPEC2-B
64Avg
0%Ovlp
Hann
Ov2
225
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250


X=52.19 Hz
Ya=126.968mG'S
POWER SPEC1 A
64Avg
0%Ovlp
Hann
200
m
Mag
Peak
G'S
0.0
FxdXY 0
Hz
250
Yb=73.9797mG'S
POWER SPEC2 B
64Avg
0%Ovlp
Hann
Ov2
200
m
Mag
Peak
G'S
0.0
Fxd Y 0
Hz
250