Iowa Electric Light and Power Company

September 21, 1992
NG-92-3961

JOHN F. FRANZ, JR.
VICE PRESIDENT, NUCLEAR

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Response to Supplement 1 to Generic Letter 87-02 on SQUG Resolution of USI A-46
File: A-18, A-101b

Dear Dr. Murley:

On February 19, 1987, the NRC issued Generic Letter 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46." This Generic Letter encouraged utilities to participate in a generic program to resolve the seismic verification issues associated with USI A-46. As a result, the Seismic Qualification Utility Group (SQUG) developed the "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment." On May 22, 1992, the NRC Staff issued Generic Letter 87-02, Supplement 1, which transmitted Supplemental Safety Evaluation Report No. 2 (SSER-2) on the GIP, Revision 2 (corrected on February 14, 1992). Supplement 1 to Generic Letter 87-02 requests that within 120 days, each SQUG member utility provide a schedule for implementing the GIP. By letter dated August 21, 1992, to James G. Partlow, NRR-NRC, SQUG clarified that the 120 days would expire on September 21, 1992. This letter responds to the Staff's request in Supplement 1 to Generic Letter 87-02.

Iowa Electric Light and Power (IELP) commits to use the SQUG methodology as documented in the GIP Revision 2 (corrected February 14, 1992) to resolve USI A-46 at the Duane Arnold Energy Center (DAEC). The GIP, as evaluated by the Staff, permits licensees to deviate from the SQUG commitments embodied in the Commitment sections, provided the Staff is notified of substantial deviations prior to implementation. IELP recognizes that the Staff's position in SSER-2 "is that if licensees use other methods that deviate from the criteria and procedures as described in SQUG commitments and in the implementation guidance

A001
1/1

of the GIP, Rev. 2, without prior NRC staff approval, the method may not be acceptable to the staff and, therefore, may result in a deviation from the provisions of Generic Letter 87-02.

IELP generally will be guided by other sections of the GIP which are not commitments, i.e., GIP implementation guidance, which comprises suggested methods for implementing the applicable commitments. IELP will notify the NRC as soon as practicable, but no later than the final USI A-46 summary report, of any significant or programmatic deviations from the guidance portions of the GIP. Justifications for such deviations, as well as for other, minor deviations, will be retained on site for NRC review.]

To define seismic demand, IELP will use the options provided in the GIP for conservative design in-structure response spectra depending on the building, the location of equipment in the building, and equipment characteristics.

The licensing-basis spectra, approved by the AEC in the Safety Evaluation of the DAEC (January 23, 1973) will be used and are considered to be conservative design. The procedures and criteria which were used to generate the licensing-basis in-structure response spectra are described in the Attachment to this letter

Given the magnitude of the effort required to achieve resolution of USI A-46, final implementation will be integrated with scheduled refuel outages and the seismic IPEEE response, the completion of which may be affected by the USI A-46 implementation start date. A Seismic Evaluation Report summarizing the results of the USI A-46 program at DAEC will be submitted to the NRC by November 21, 1995. However, the schedule for completion of the USI A-46 program may be affected by coordination with the seismic IPEEE response, the scope and schedule for completing the necessary SQUG training and by the availability of industry resources which may be adversely impacted by the large number of licensees implementing this program.

The above schedule assumes that we are notified promptly that the schedule and commitments stated in this letter are acceptable. If such notification is not received by November 20, 1992, we must reschedule the USI A-46 completion date to permit coordination with planned refueling outages scheduled for July 1993 and February 1995.

This letter is true and accurate to the best of my knowledge and belief.

IOWA ELECTRIC LIGHT AND POWER COMPANY

By _____
John F. Franz, Jr.
Vice President, Nuclear

State of Iowa
(County) of Linn

Signed and sworn to before me on this 15th day of September, 1992, by John F. Franz, Jr.

_____
Notary Public in and for the State of Iowa

September 28, 1992
Commission Expires

JFF/SCR/pjv

Attachment: Description of Licensing Basis In-Structure Response Spectra For Use in Resolving USI A-46

cc: B. Catron w/att
L. Liu w/o
L. Root w/o
R. McGaughy w/o
C. Shiraki (NRC-NRR) w/att
A. Bert Davis (Region III) w/att
NRC Resident Office w/att
DCRC w/att
Commitment Control Nos. 880428, 920067

Description of Licensing Basis In-Structure Response Spectra for Use in Resolving USI A-46

The in-structure response spectra to be used by IELP in resolving USI A-46 are existing licensing-basis spectra. The spectra were generated using procedures described in sections 3.7.1 and 3.7.2 of the FSAR. These procedures are summarized below.

The seismic inputs for the design basis earthquake (DBE) for the DAEC are ground motion spectra with a peak horizontal ground acceleration (PGA) of 0.12g. The operating basis earthquake (OBE) ground motion spectra are one-half the DBE spectra.

An artificial time history of the horizontal ground motion was developed based on the 1940 El Centro, California earthquake for use as input to the dynamic building models. The calculated response spectra from the artificial time history enveloped the target seismic design ground spectra. The artificial time history was applied to dynamic seismic models of the Seismic Category I structures and the time history response at each floor was computed. In-structure response spectra were then generated from the floor time histories. These spectra are considered to be conservative design in-structure response spectra as defined in the GIP.

The seismic building models consisted of three-dimensional lumped mass analytical models. The generalized mass and stiffness properties were calculated using conventional structural mechanics methods. Structural damping was based on the composite model damping technique. Individual damping coefficients ranged from 1 to 5 percent such that the overall equivalent damping was less than or equal to 5 percent. Seismic models for the reactor building, control building, intake structure, pump house and turbine building are shown in Figures 1 through 5, respectively. Calculated model frequencies are tabulated in Tables 1 through 5.

Soil-structure interaction effects were accounted for by the use of soil springs between the structure and the foundation in the seismic models. The soil springs modeled the vertical and translational stiffness of the foundation. The stiffness properties of the soil springs were based on the procedure provided by Whitman and Richard ("Design Procedures for Dynamically Loaded Foundations," by R. V. Whitman and F. E. Richard, Jr., J. Soil Mech. and Fnd. Div., ASCE, SM7, November 1967, pp 169-193).

Typical in-structure response spectra for the reactor building, control building, intake structure, pump house and turbine building are provided in Figures 6 through 10, respectively. These spectra are OBE. In-structure response spectra for the DBE are two times the OBE spectra. The in-structure response spectra provided in Figures 7 through 10 show a maximum of 2 percent damping. These curves will be adjusted for 5 percent damping for use in GIP implementation.

Table 1

Reactor Building Natural Frequencies

Mode No.	Natural Frequency (Hz)	
	North-South	East-West
1	3.5	3.4
2	4.4	4.4
3	8.3	8.3
4	13.9	13.9
5	16.9	16.9
6	21.3	21.3
7	23.3	22.7
8	27.8	27.8
9 through 15	31.2 | 50.0	29.4 | 45.5

Table 2

Control Building Natural Frequencies

Mode No.	Natural Frequency (Hz)	
	North-South	East-West
1	1.9 to 3.2	1.7 to 2.4
2	4.0 to 7.1	3.2 to 5.3
3	25.0	4.0 to 6.7
4	33.3	6.7 to 9.1
5	Rigid	20.0
6	Rigid	33.3

Table 3

Intake Structure Natural Frequencies

Mode No.	Natural Frequency (Hz)	
	North-South	East-West
1	8.1	12.8
2	21.7	33.3
3	43.5	58.8
4	52.6	66.7
5	66.7	83.3
6	83.3	125.0
7	100.0	142.9

Table 4

Pump House Natural Frequencies

Mode No.	Natural Frequency (Hz)	
	North-South	East-West
1	2.0 to 3.3	1.9 to 3.1
2	5.6 to 7.7	4.5 to 6.7
3	20.0	23.8
4	50.0	50.0
5	66.7	76.9

Table 5

Turbine Building Natural Frequencies

Mode No.	Natural Frequency (Hz)	
	North-South	East-West
1	2.3	1.4
2	2.6	3.5
3	4.3	5.0
4	5.8	9.2
5	52.6	62.5

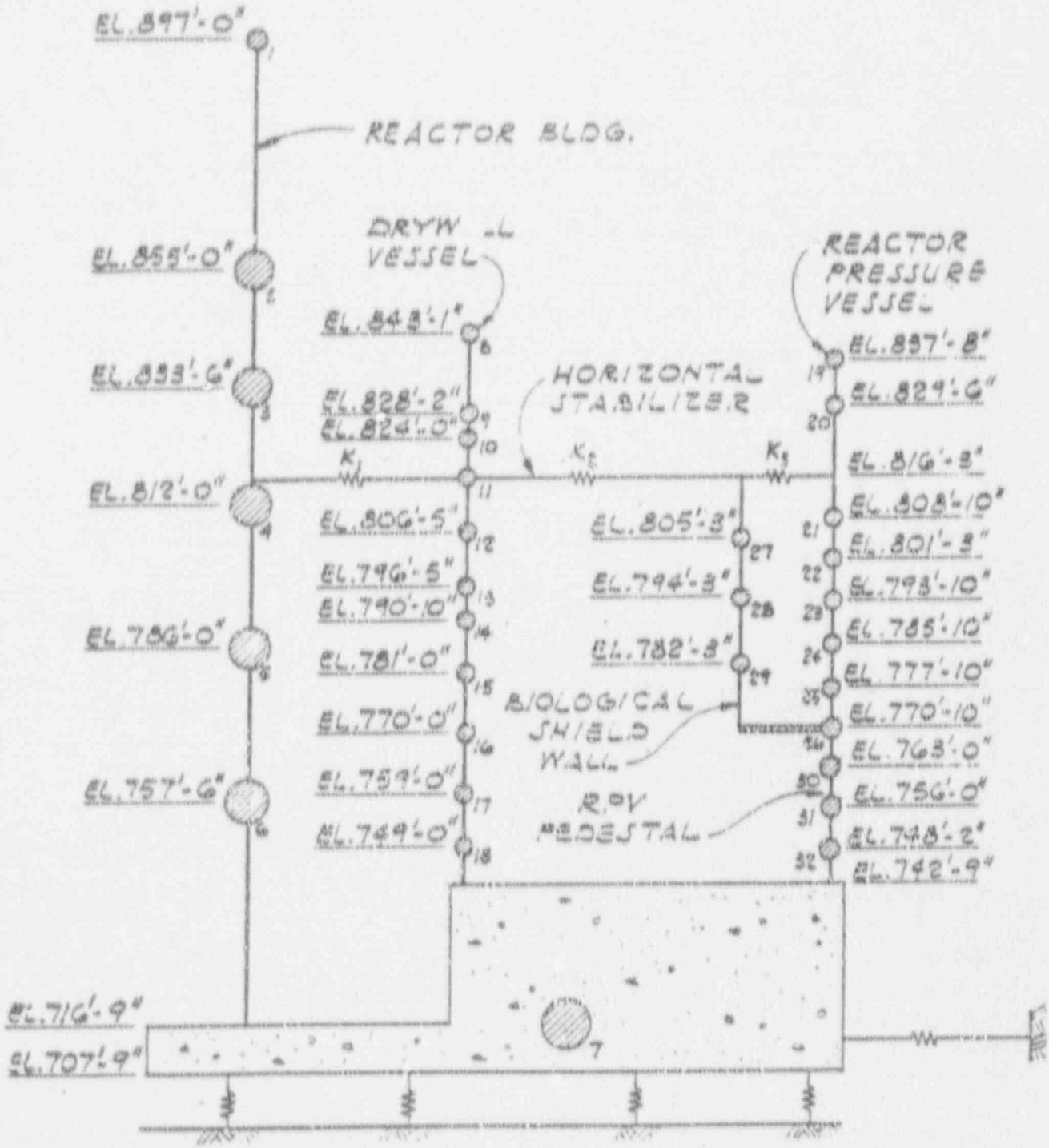
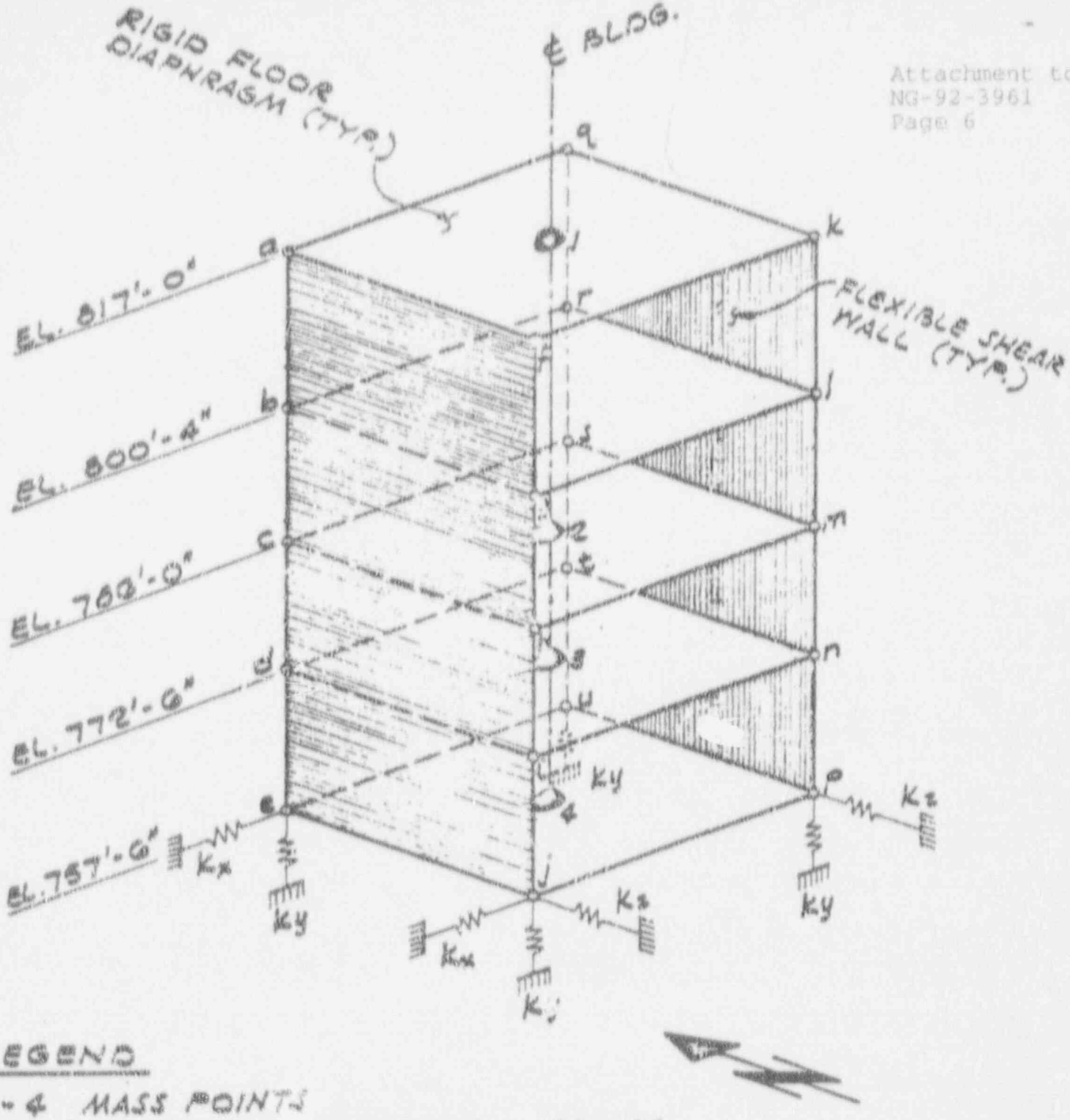


Figure 1
DAEC Reactor Building
Mathematical Model



LEGEND

1 - 4 MASS POINTS

k_x, k_z LATERAL FOUNDATION SPRINGS

k_y VERTICAL FOUNDATION SPRINGS

a - w NODAL POINTS

NOTE: BRACED FRAME MEMBERS OF SOUTH WALL NOT SHOWN

Figure 2
DAEC Control Building
Mathematical Model

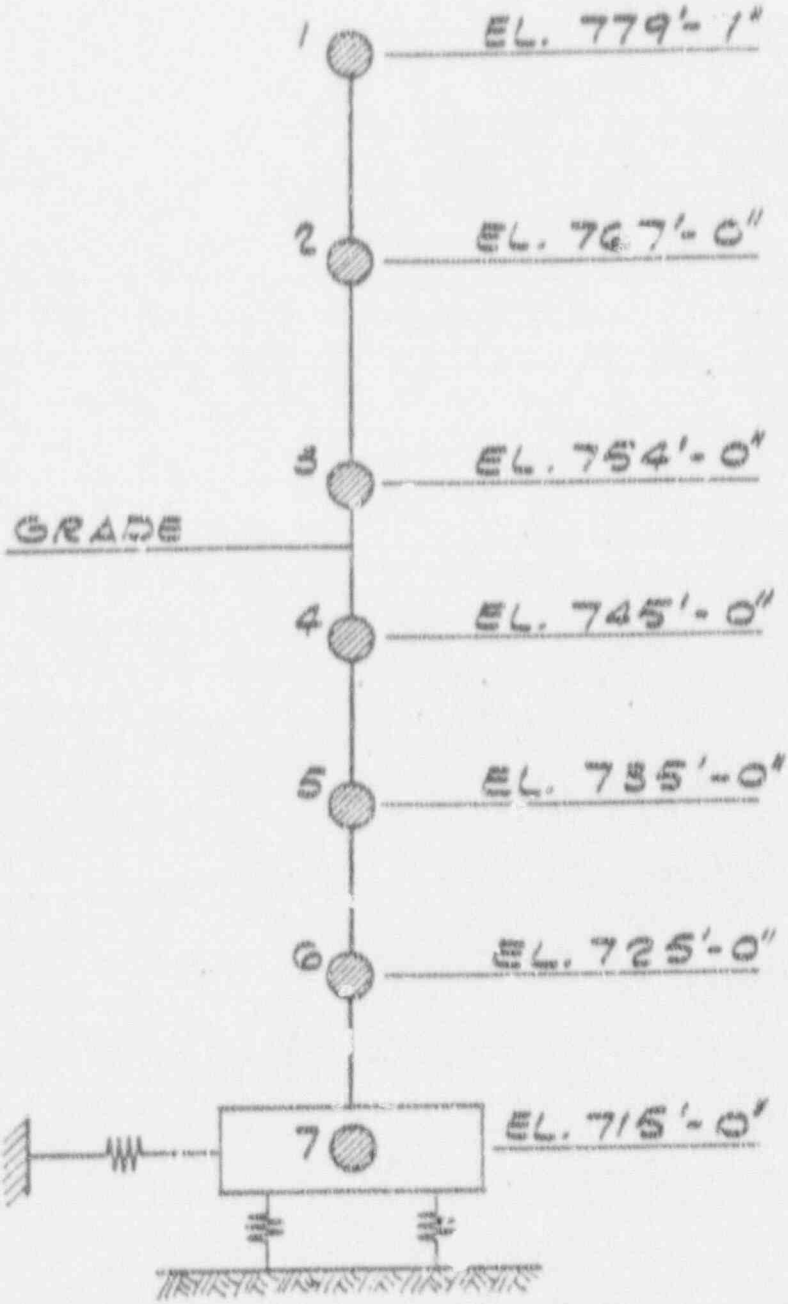


Figure 3
DAEC Intake Structure
Mathematical Model (NE-SW Direction)

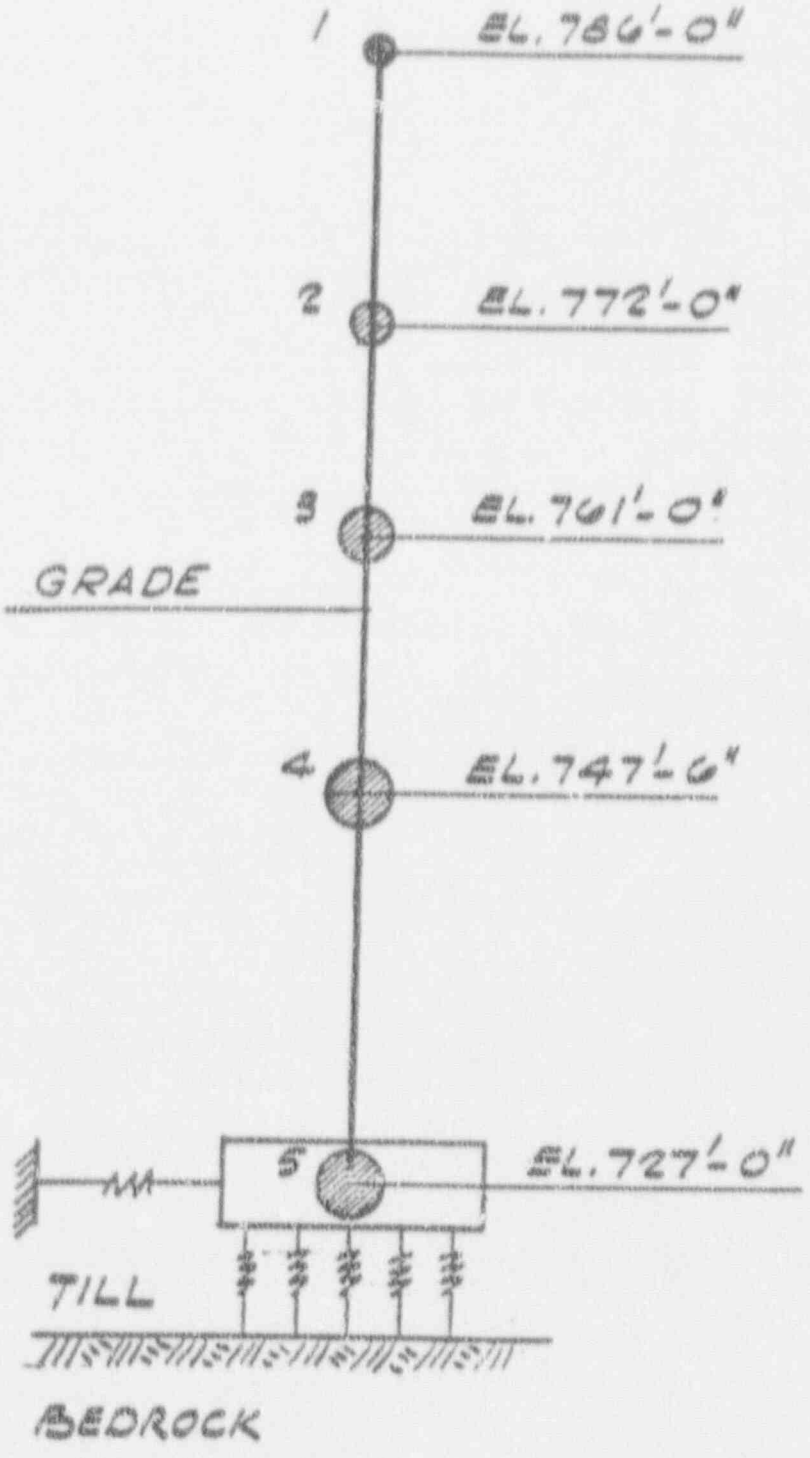
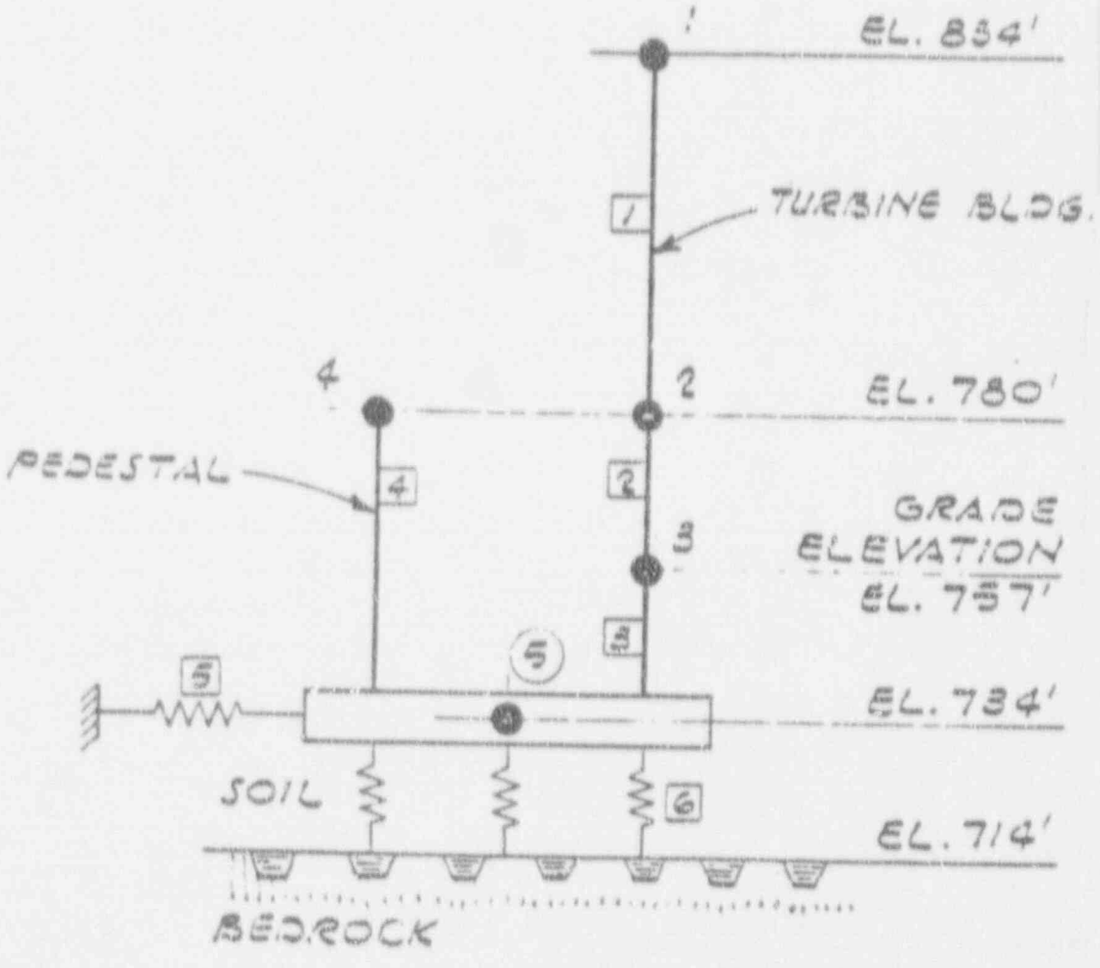


Figure 4
DAEC Pump House
Mathematical Model



LEGEND

1 MASS NUMBER

[1] MEMBER NUMBER

Figure 5
DAEC Turbine Building and Pedestal
Mathematical Model

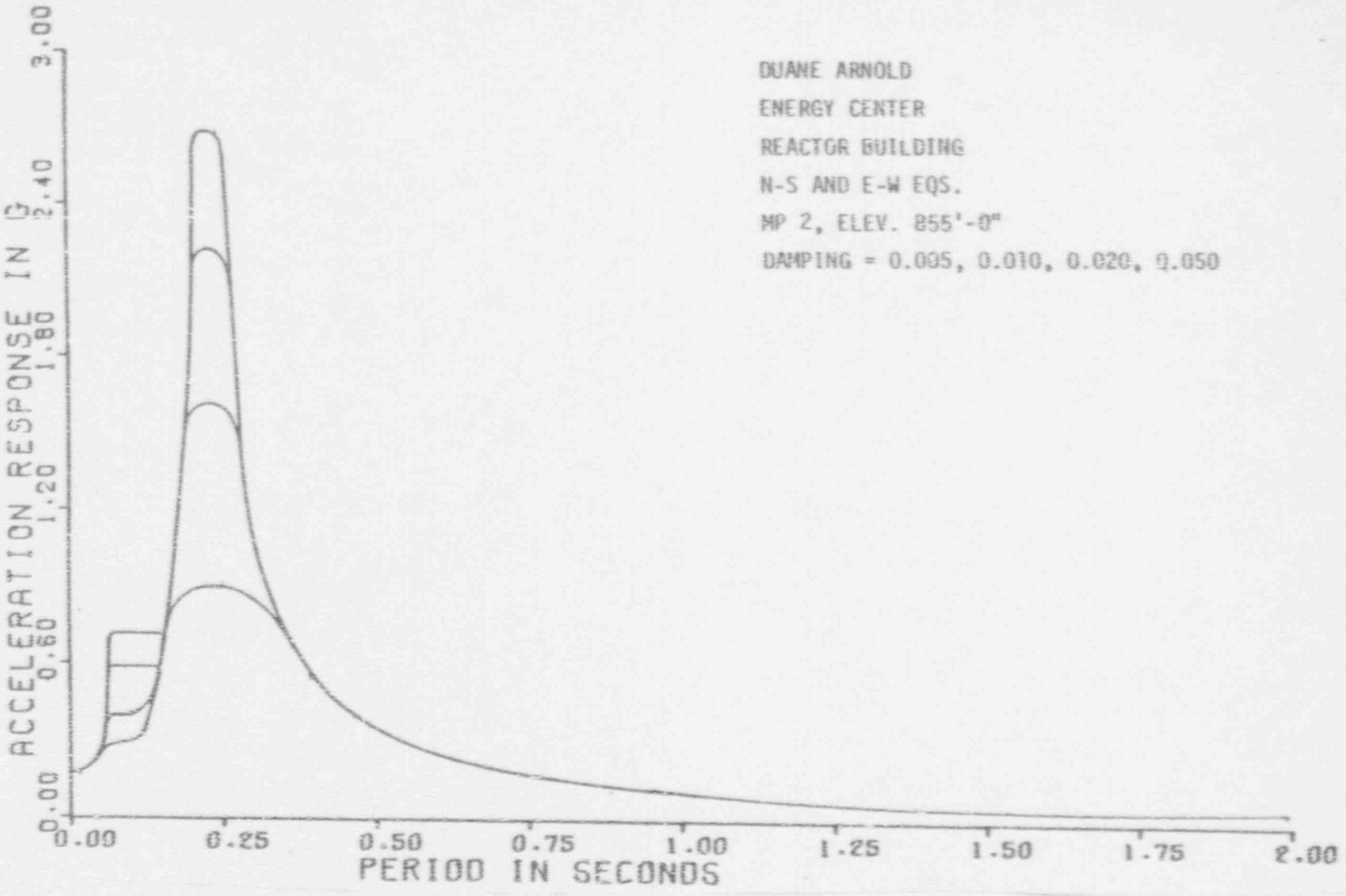

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
MP 2, ELEV. 855'-0"
DAMPING = 0.005, 0.010, 0.020, 0.050
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 6.1

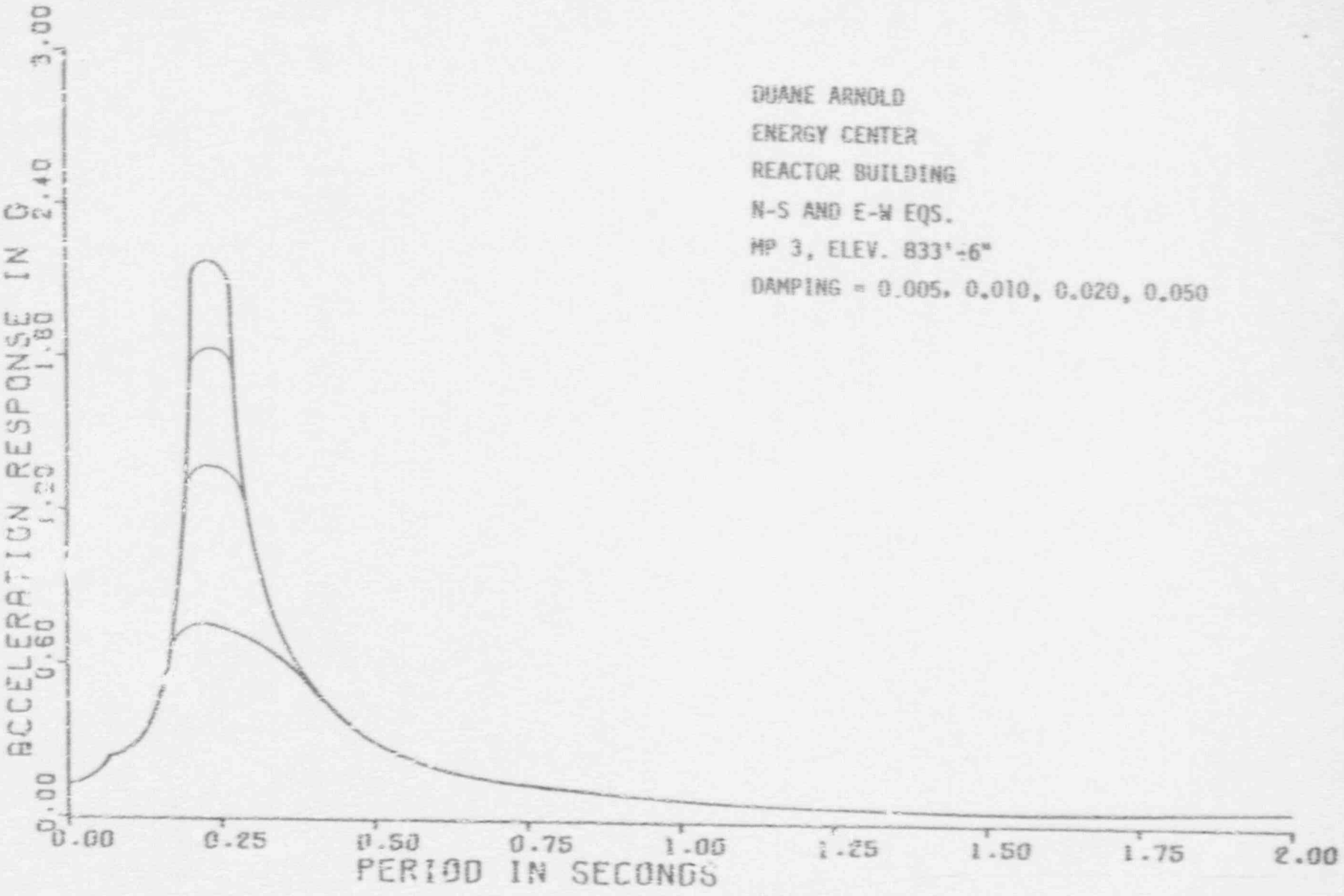

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
MP 3, ELEV. 833'-6"
DAMPING = 0.005, 0.010, 0.020, 0.050
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 6.2

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
MP 4, ELEV. 812'-0"
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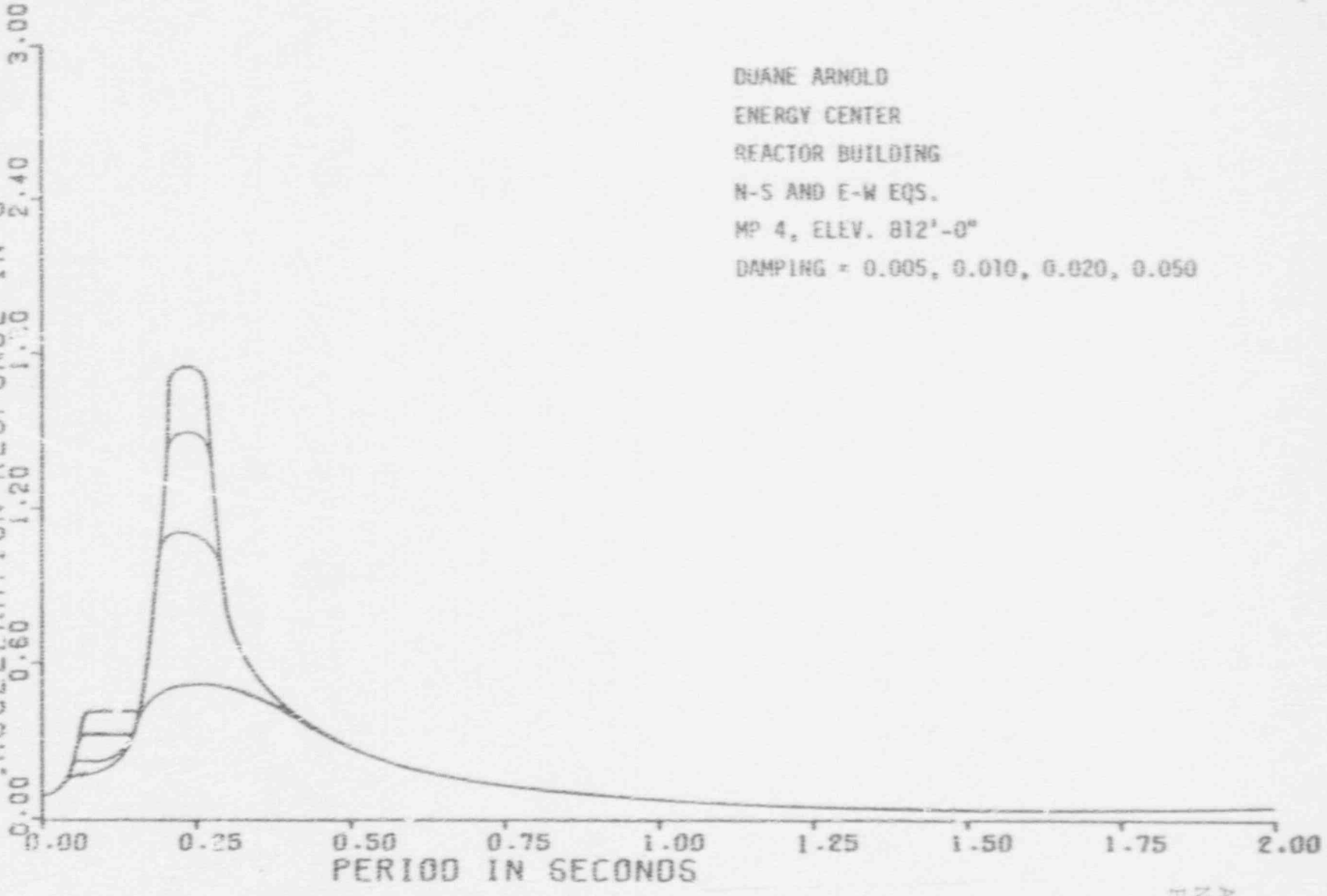

Figure 6.3

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
MP 5, ELEV. 786' 0"
DAMPING = 0.005, 0.010, 0.020, 0.050

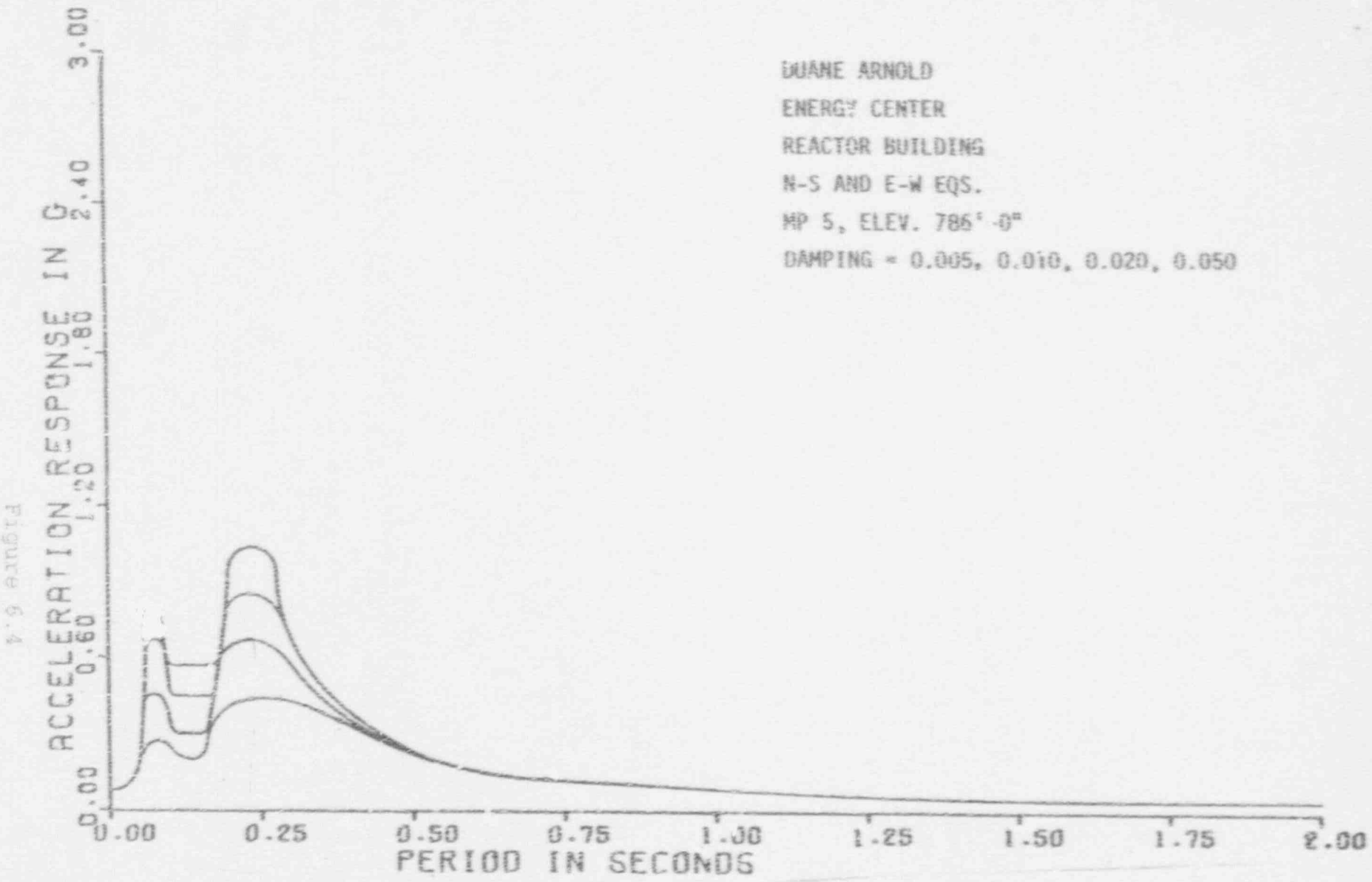

Figure 6.4

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
MP 6, ELEV. 757'-6"
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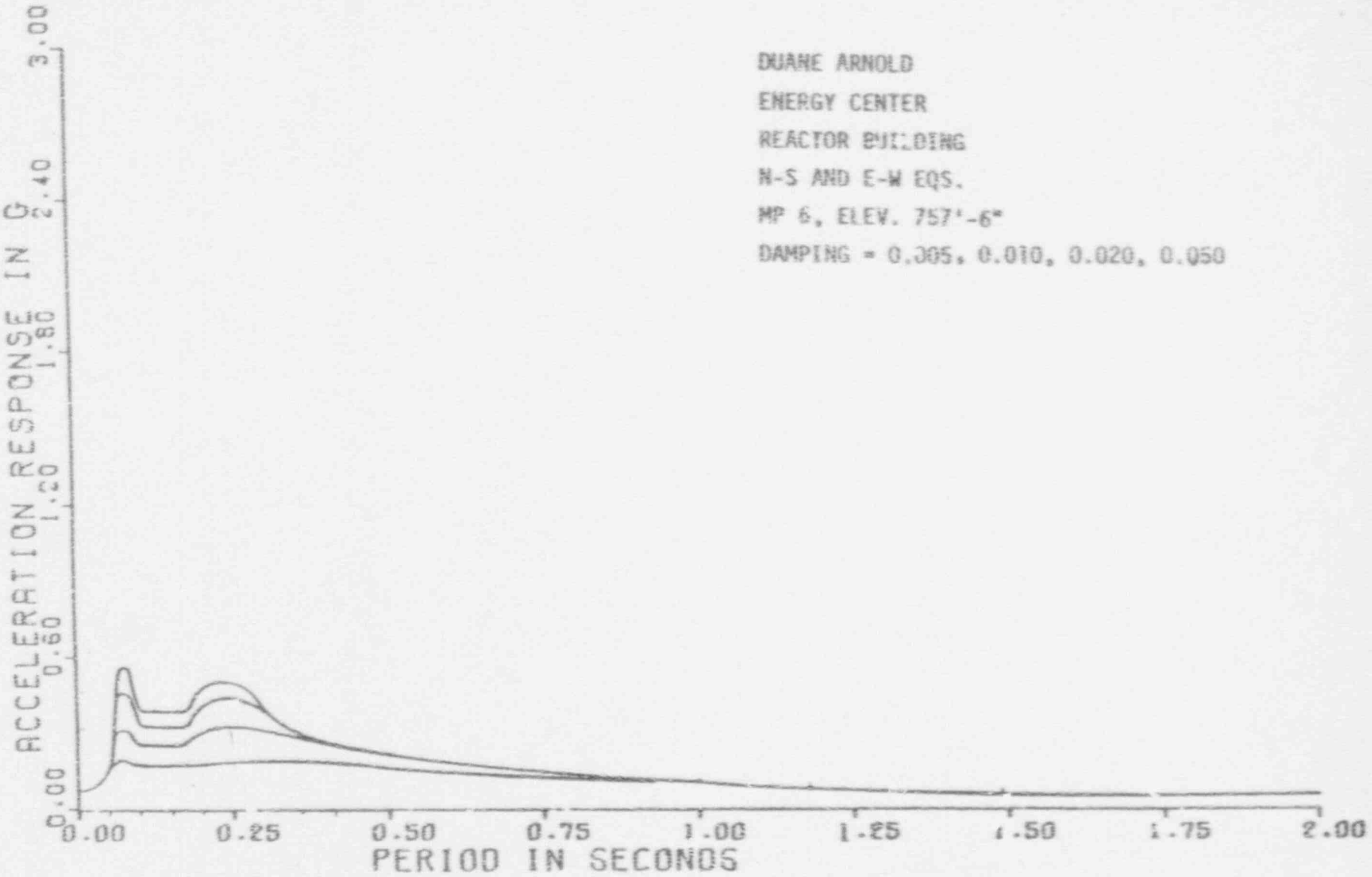

Figure 6.5

DUANE ARNOLD
ENERGY CENTER
REACTOR BUILDING
N-S AND E-W EQS.
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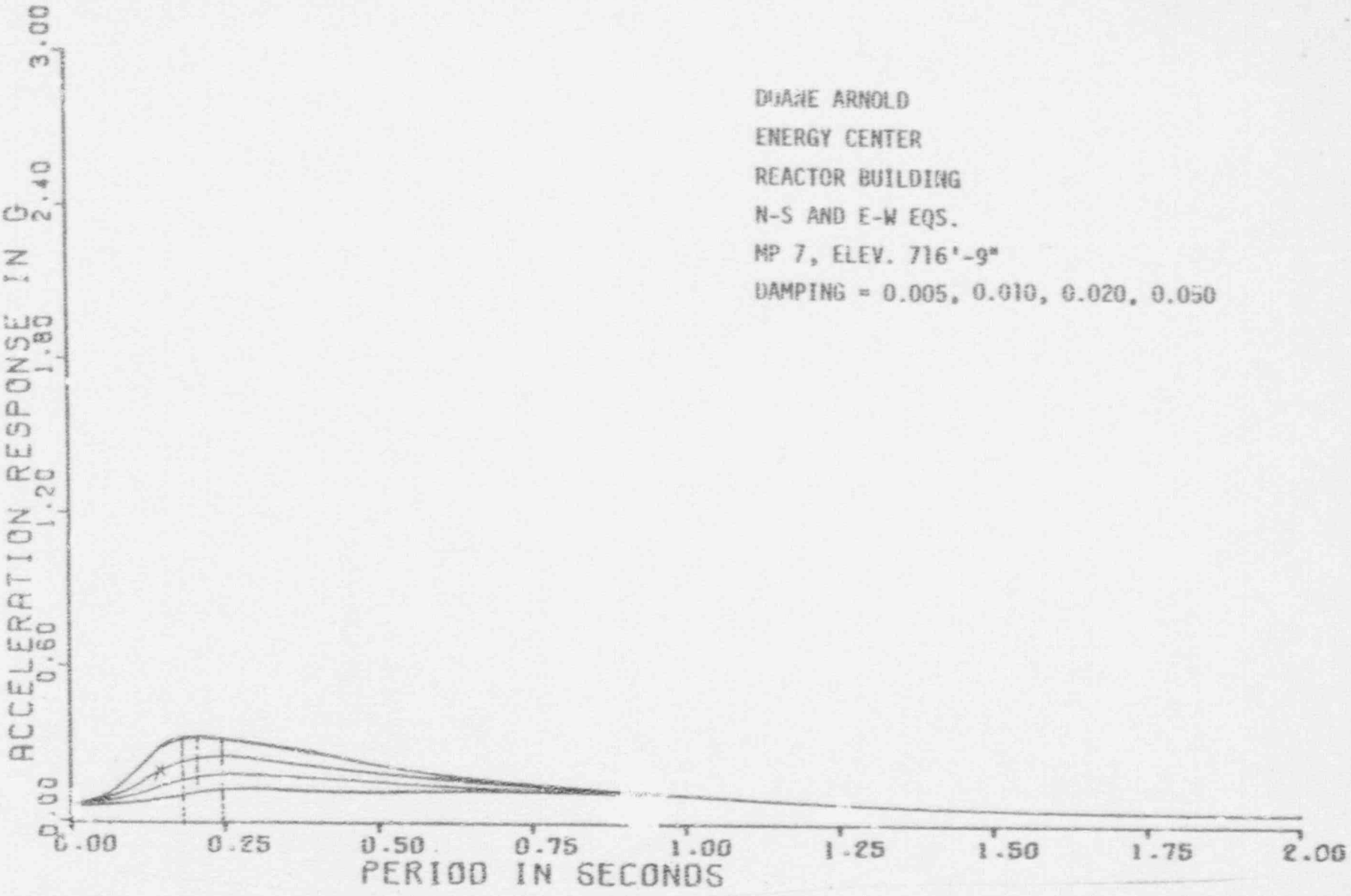
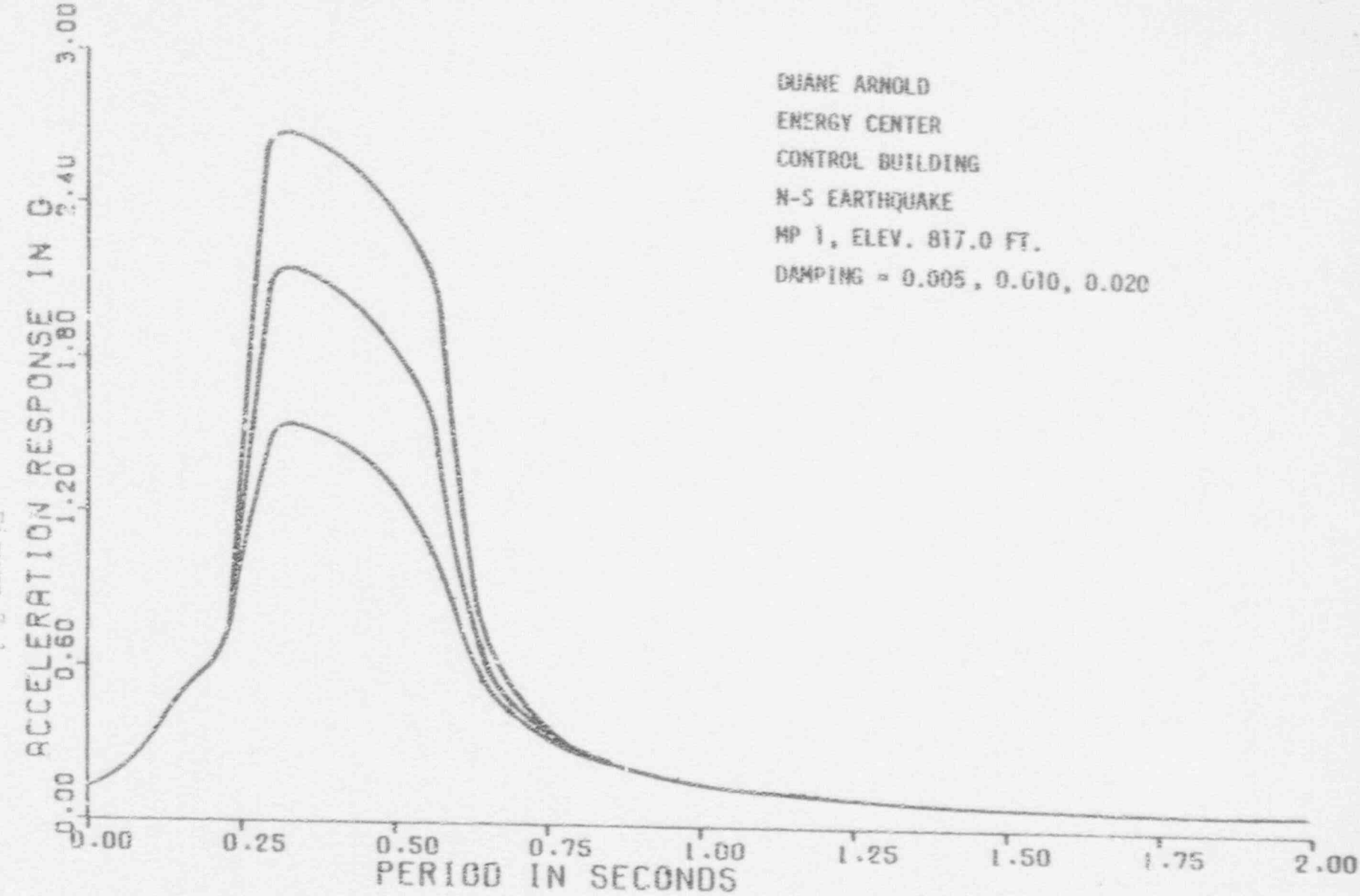


9'9 ernsTd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ENERGY CENTER
CONTROL BUILDING
N-S EARTHQUAKE
MP 1, ELEV. 817.0 FT.
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ACCELERATION RESPONSE IN G
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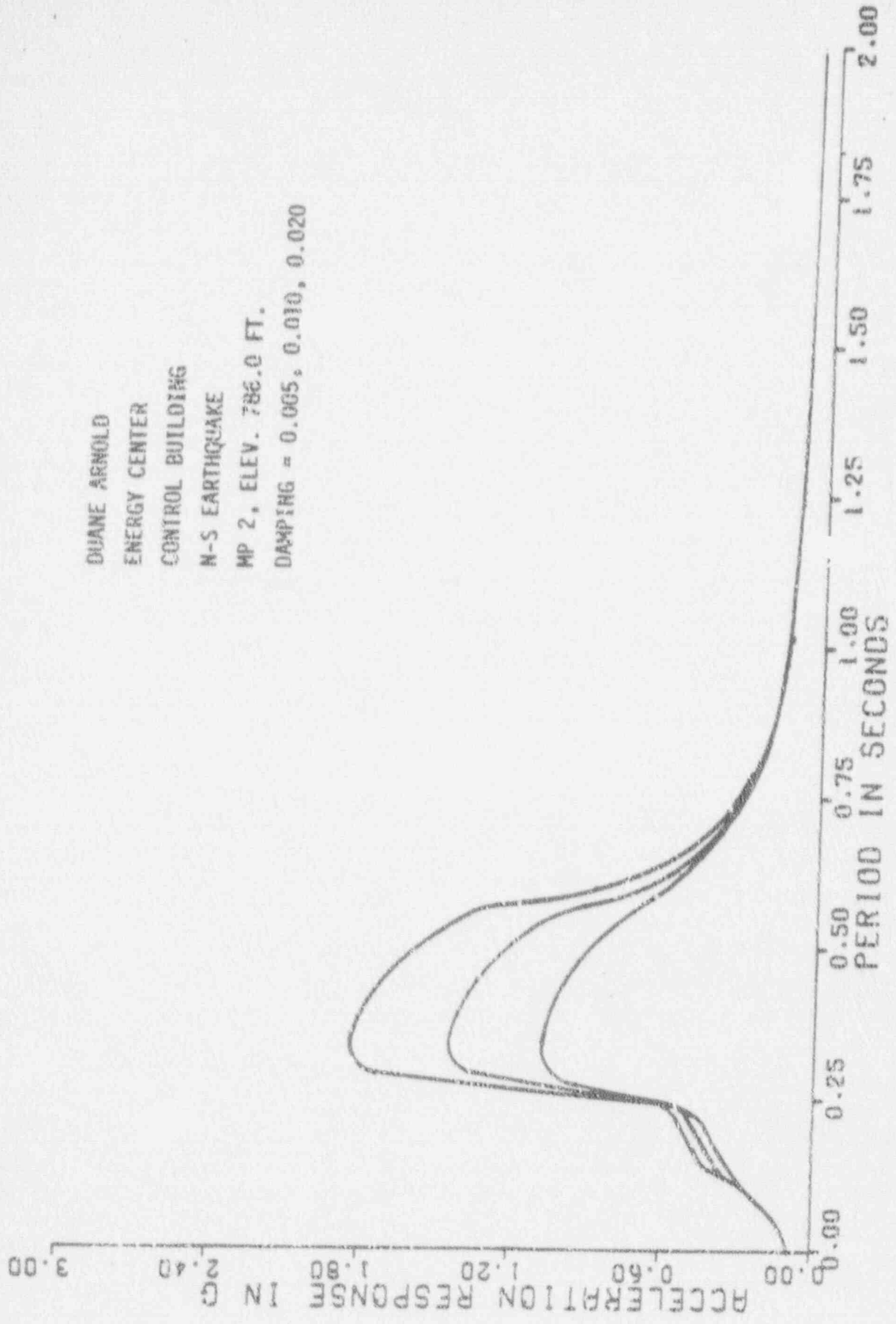
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.1


DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
N-S EARTHQUAKE
MP 2, ELEV. 786.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
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0.60
1.20
1.80
2.40
3.00
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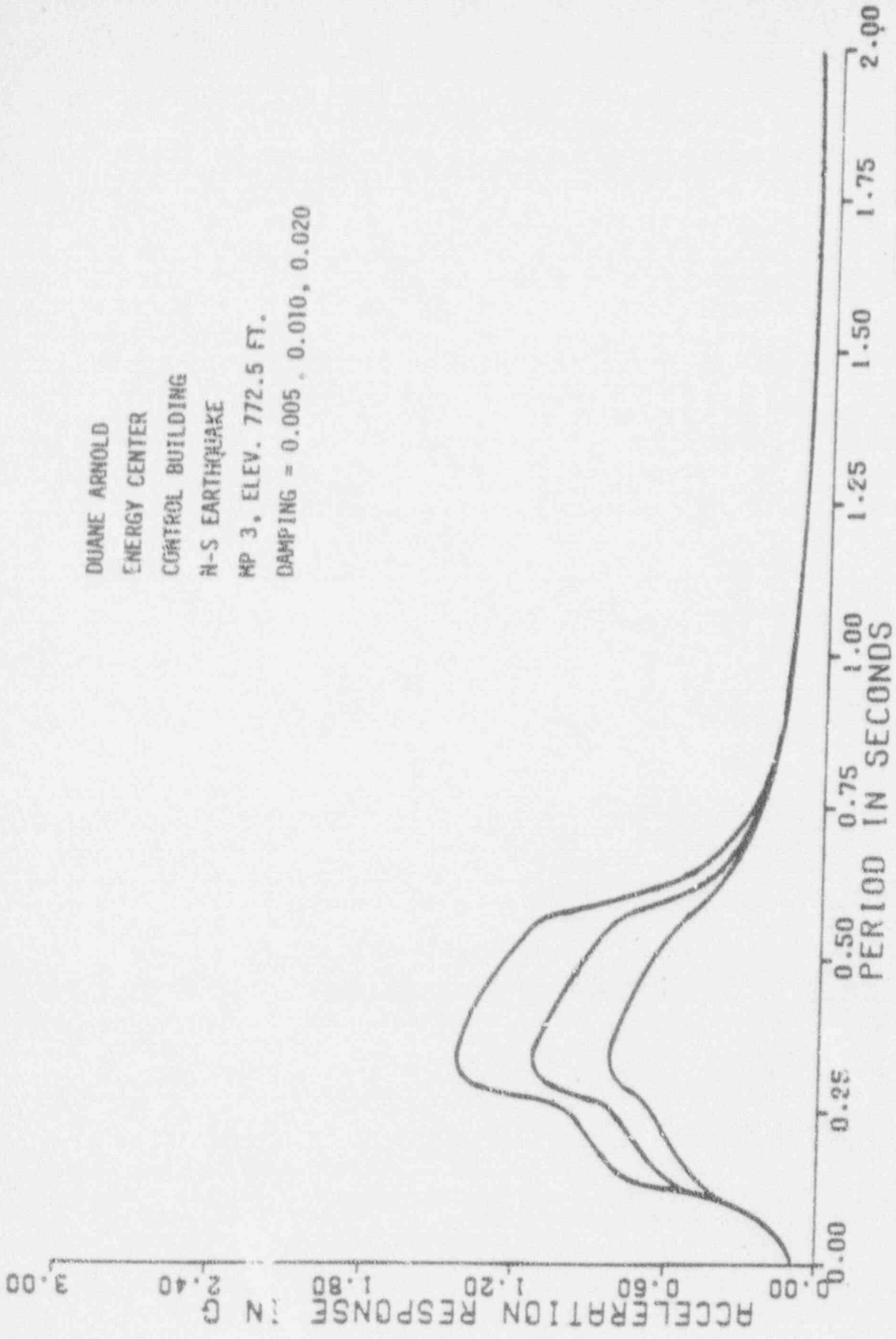
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.2


DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
N-S EARTHQUAKE
HP 3, ELEV. 772.5 FT.
DAMPING = 0.005 , 0.010, 0.020
ACCELERATION RESPONSE IN G
PERIOD IN SECONDS
0.00
0.60
1.20
1.80
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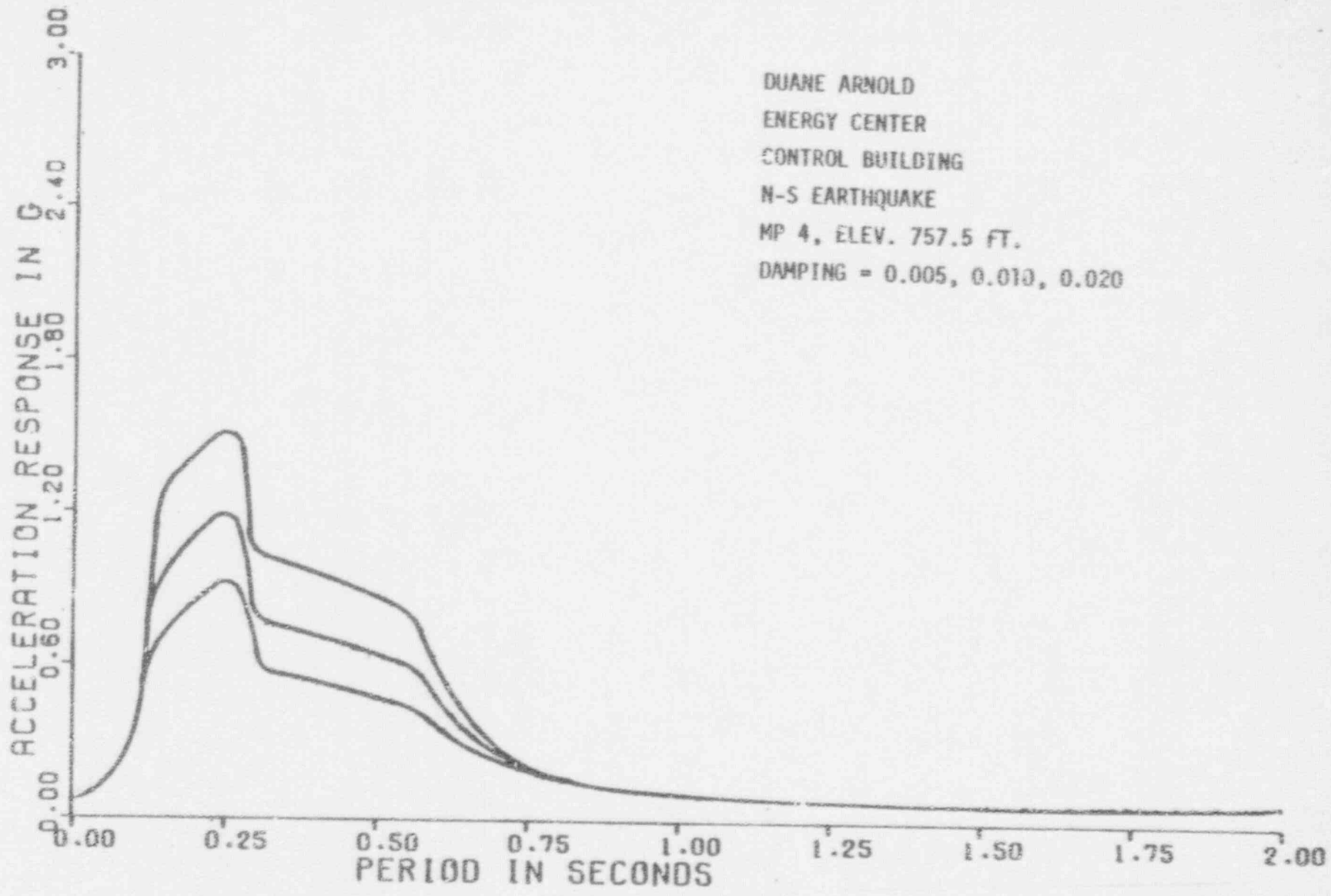
1.75
2.00

Figure 7.3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ENERGY CENTER
CONTROL BUILDING
N-S EARTHQUAKE
MP 4, ELEV. 757.5 FT.
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ACCELERATION RESPONSE IN G
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1.20
1.80
2.40
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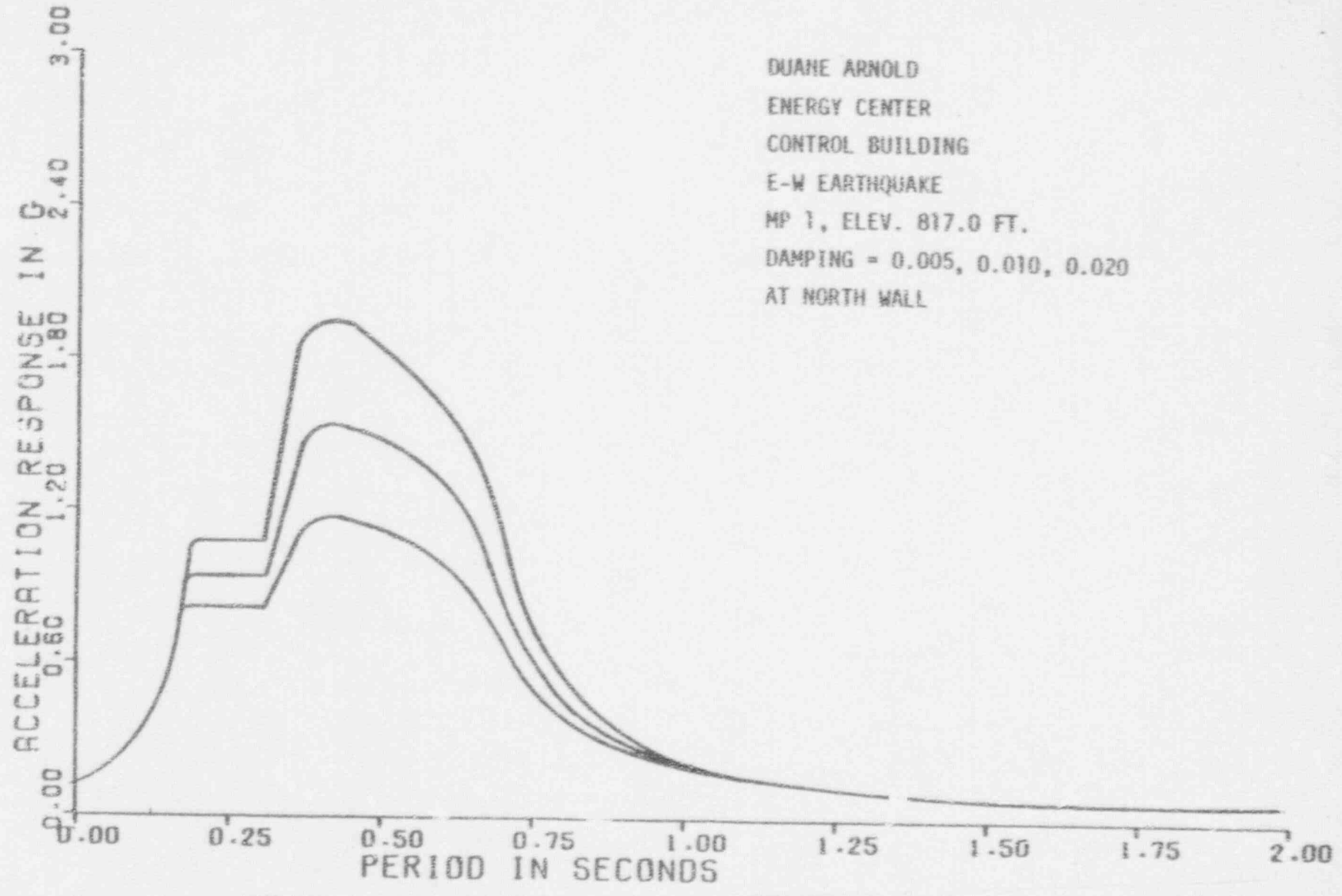
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.4


DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 1, ELEV. 817.0 FT.
DAMPING = 0.005, 0.010, 0.020
AT NORTH WALL
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
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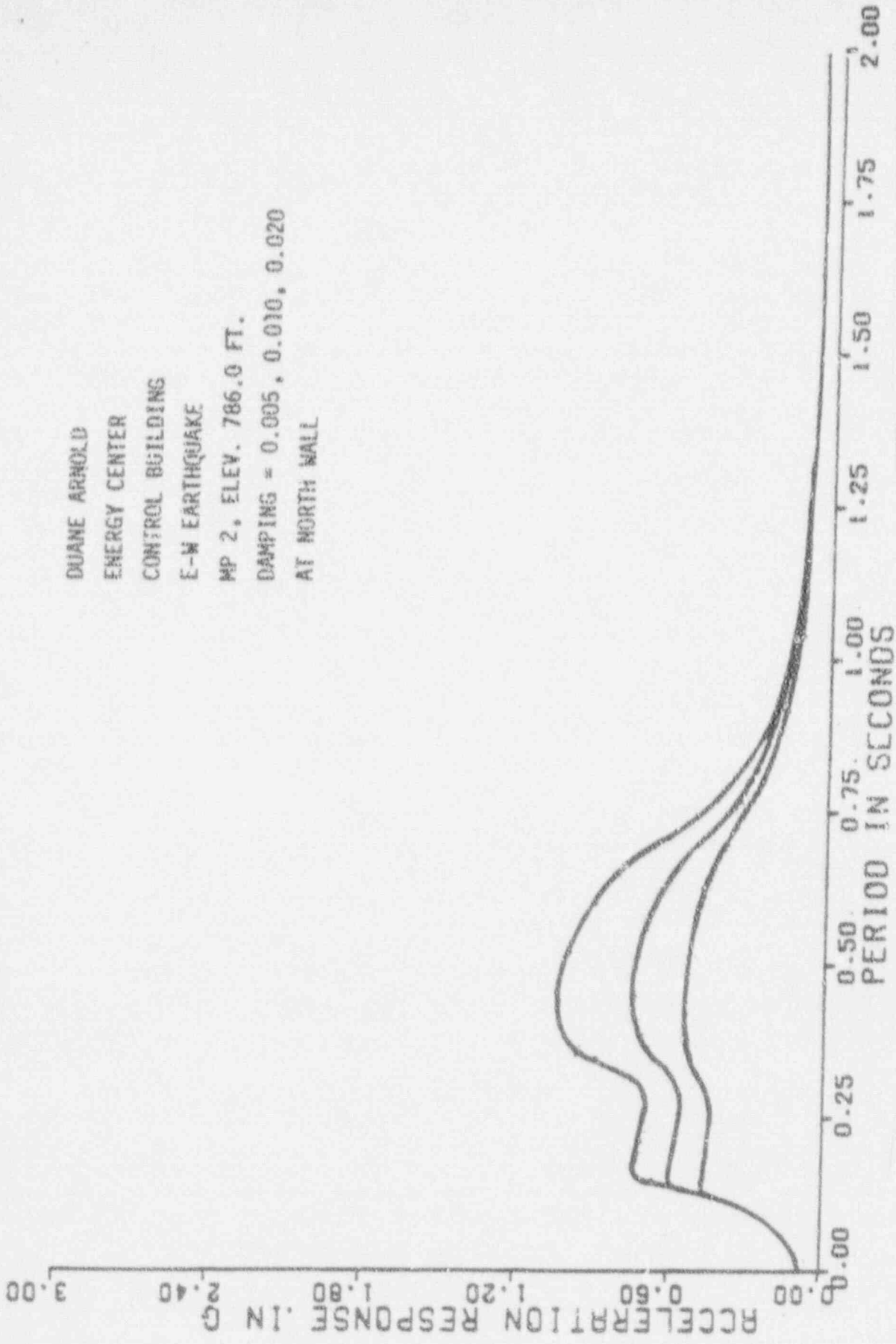
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.5


DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 2, ELEV. 786.0 FT.
DAMPING = 0.005, 0.010, 0.020
AT NORTH WALL
ACCELERATION RESPONSE IN G
0.00
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1.20
1.80
2.40
3.00
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1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.6

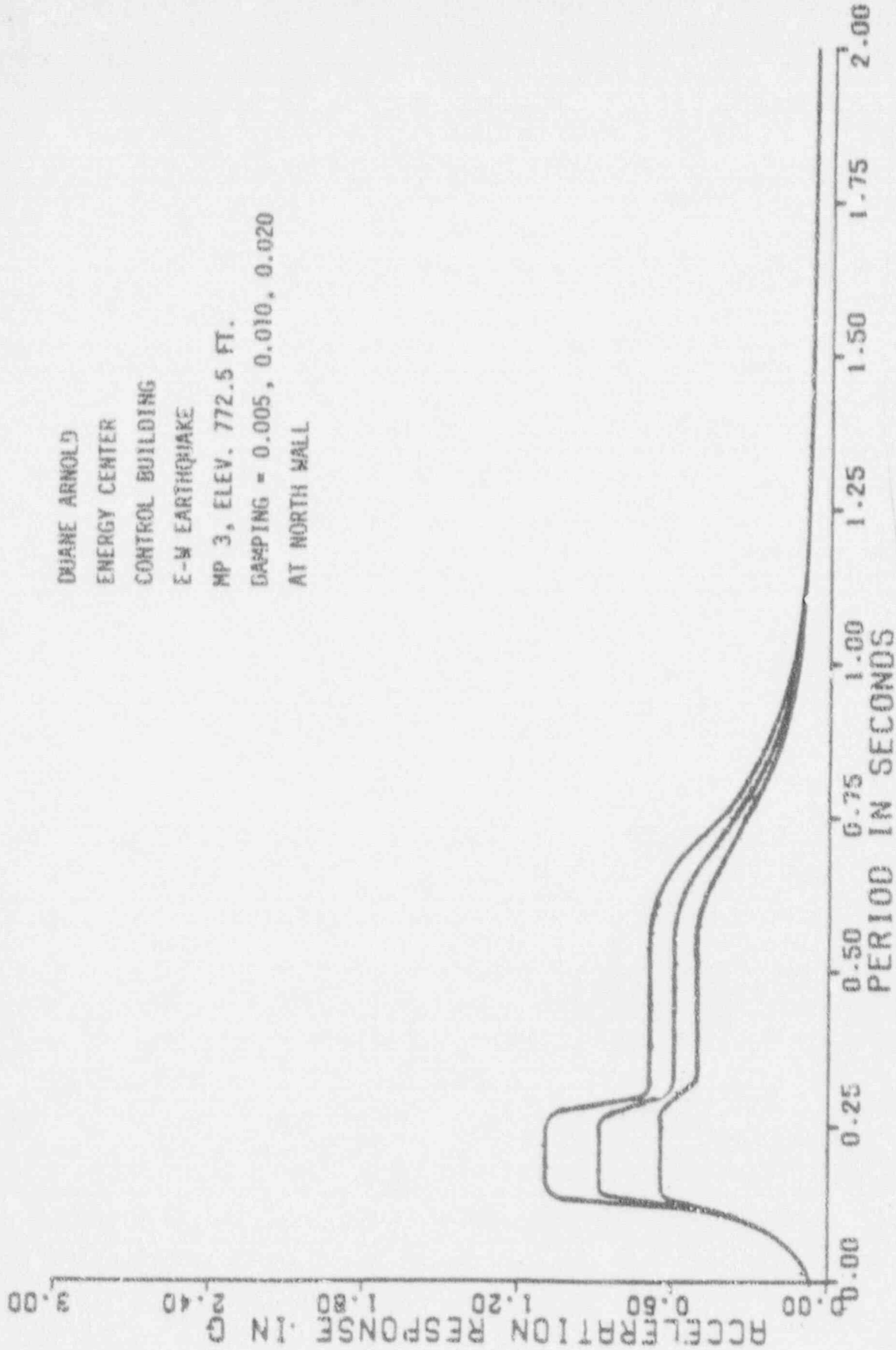

DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 3, ELEV. 772.5 FT.
DAMPING = 0.005, 0.010, 0.020
AT NORTH WALL
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.7

DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 4, ELEV. 757.5 FT.
DAMPING = 0.005, 0.010, 0.020
AT NORTH WALL

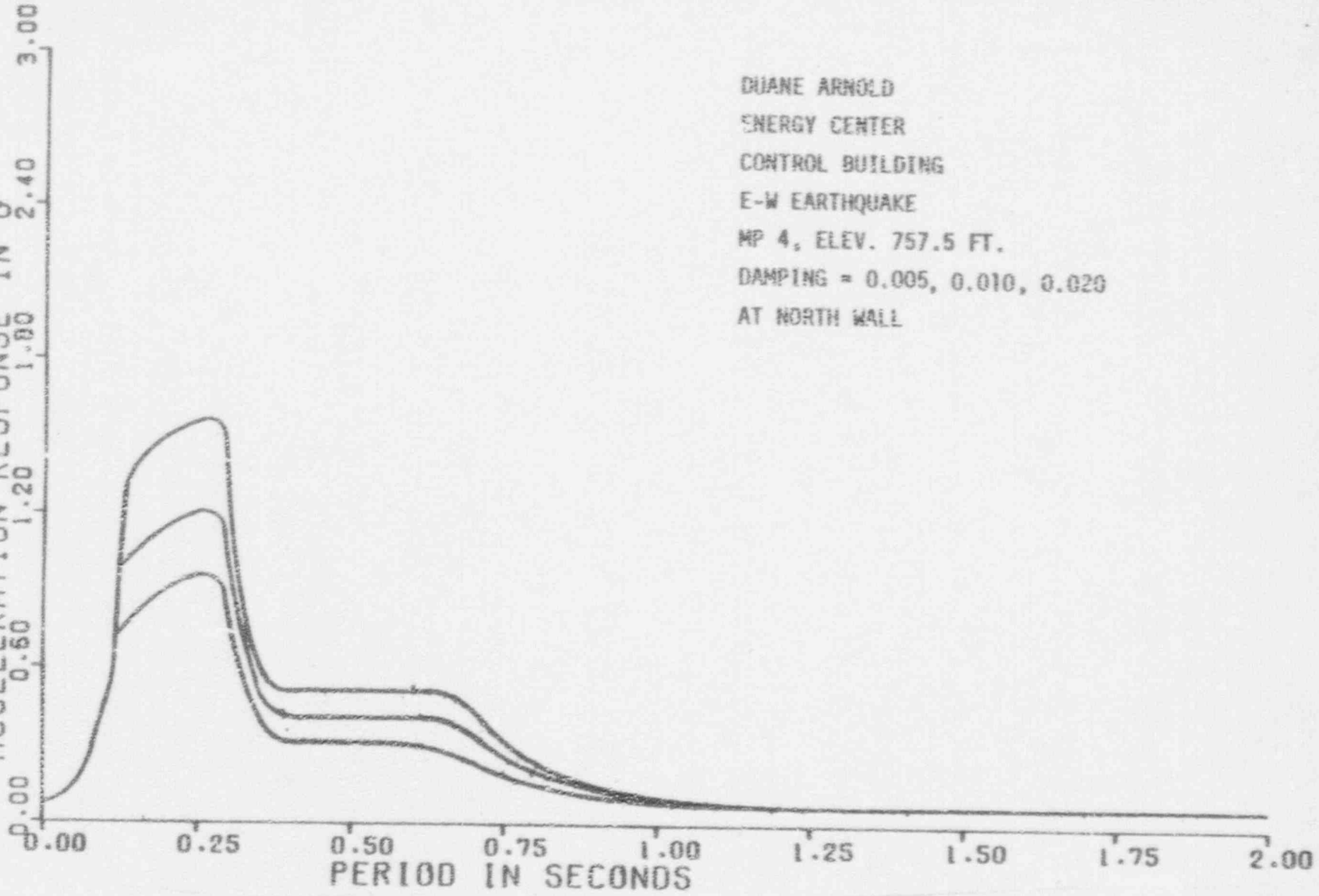
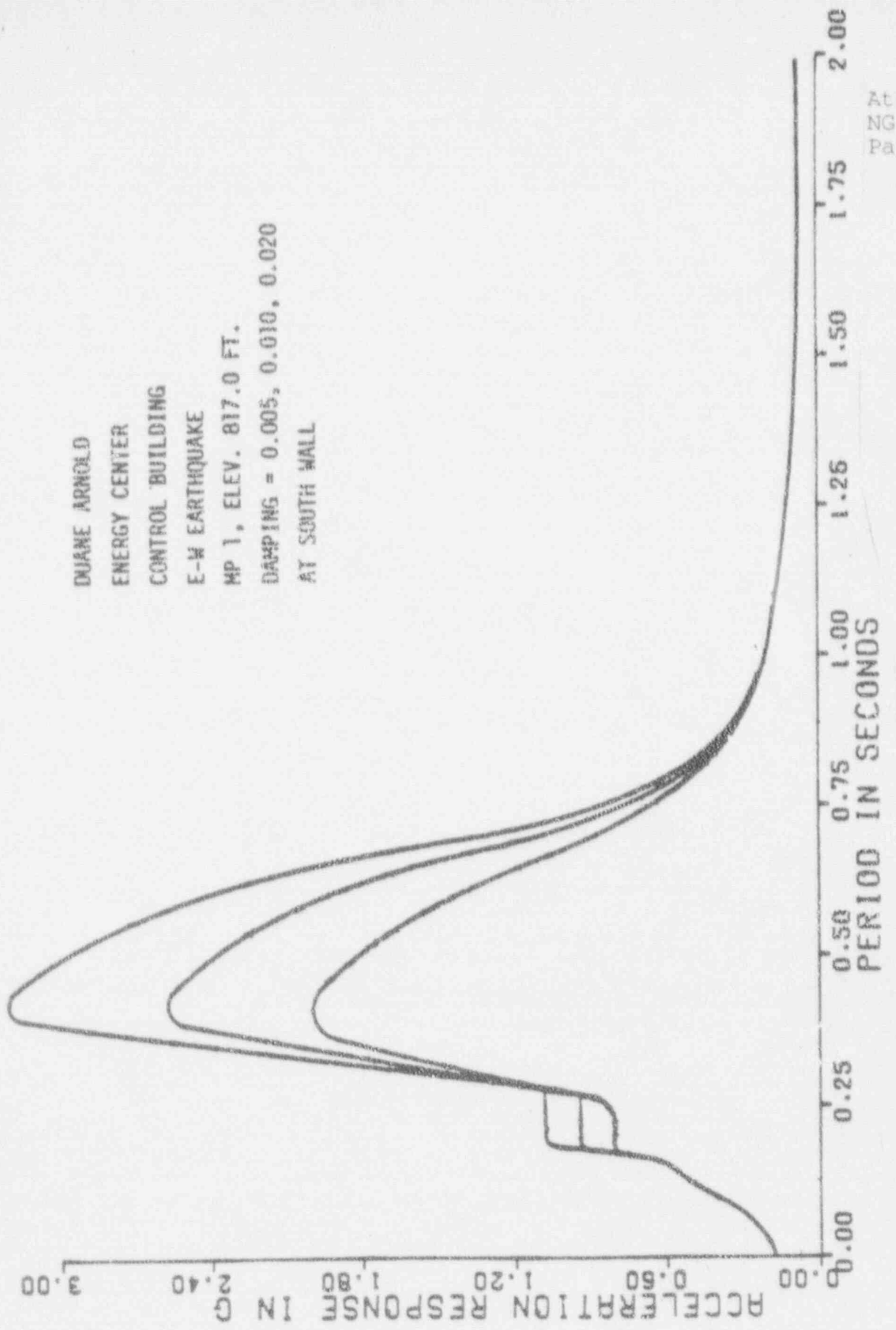


Figure 7.8


DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 1, ELEV. 817.0 FT.
DAMPING = 0.005, 0.010, 0.020
AT SOUTH WALL
ACCELERATION RESPONSE IN G
PERIOD IN SECONDS
0.00
0.50
1.20
1.80
2.40
3.00
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0.50
0.75
1.00
1.26
1.50
1.75
2.00

Figure 7.9

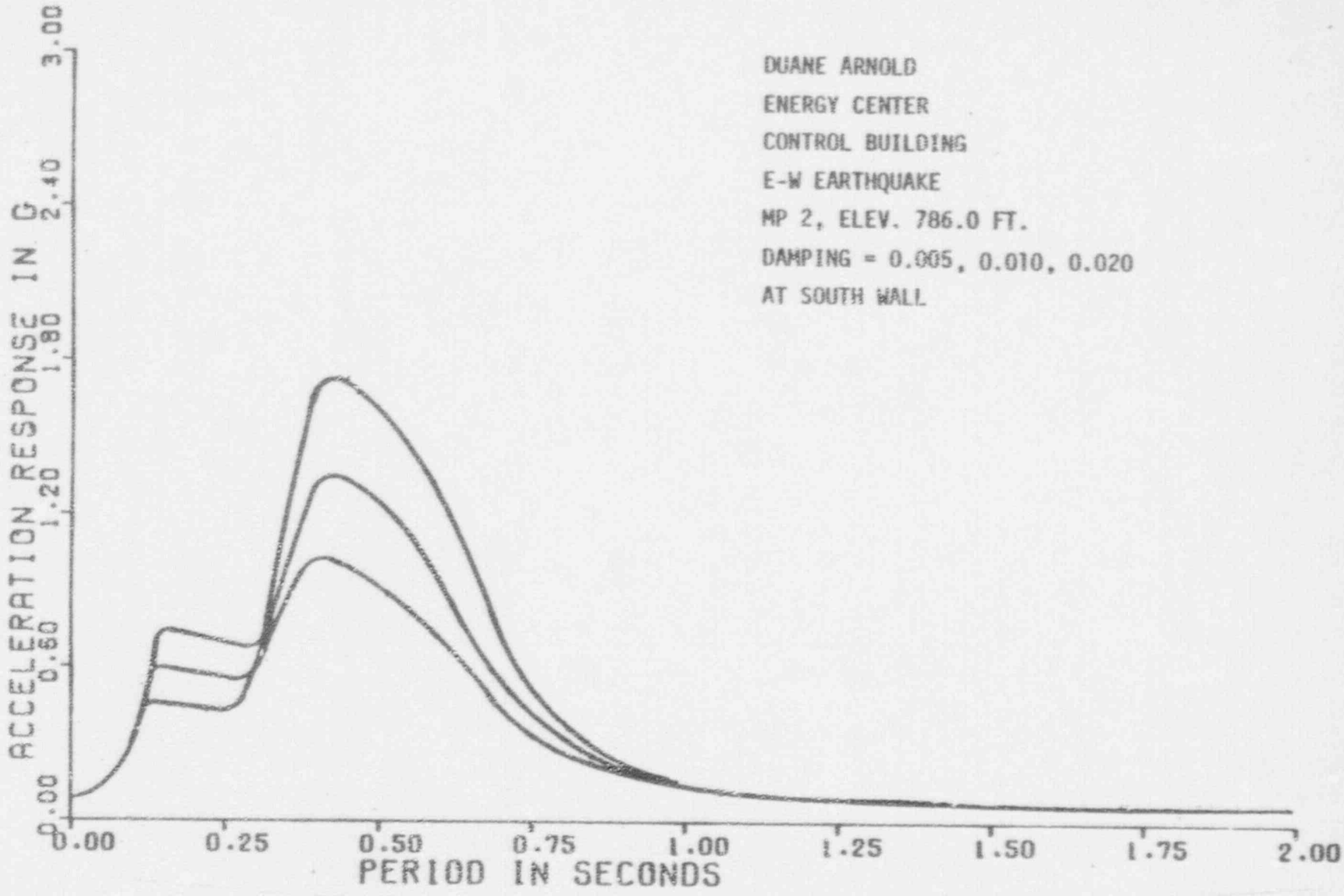
DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 2, ELEV. 786.0 FT.
DAMPING = 0.005, 0.010, 0.020
AT SOUTH WALL
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.10

DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 3, ELEV. 772.5 FT.
DAMPING = 0.005, 0.010, 0.020
AT SOUTH WALL

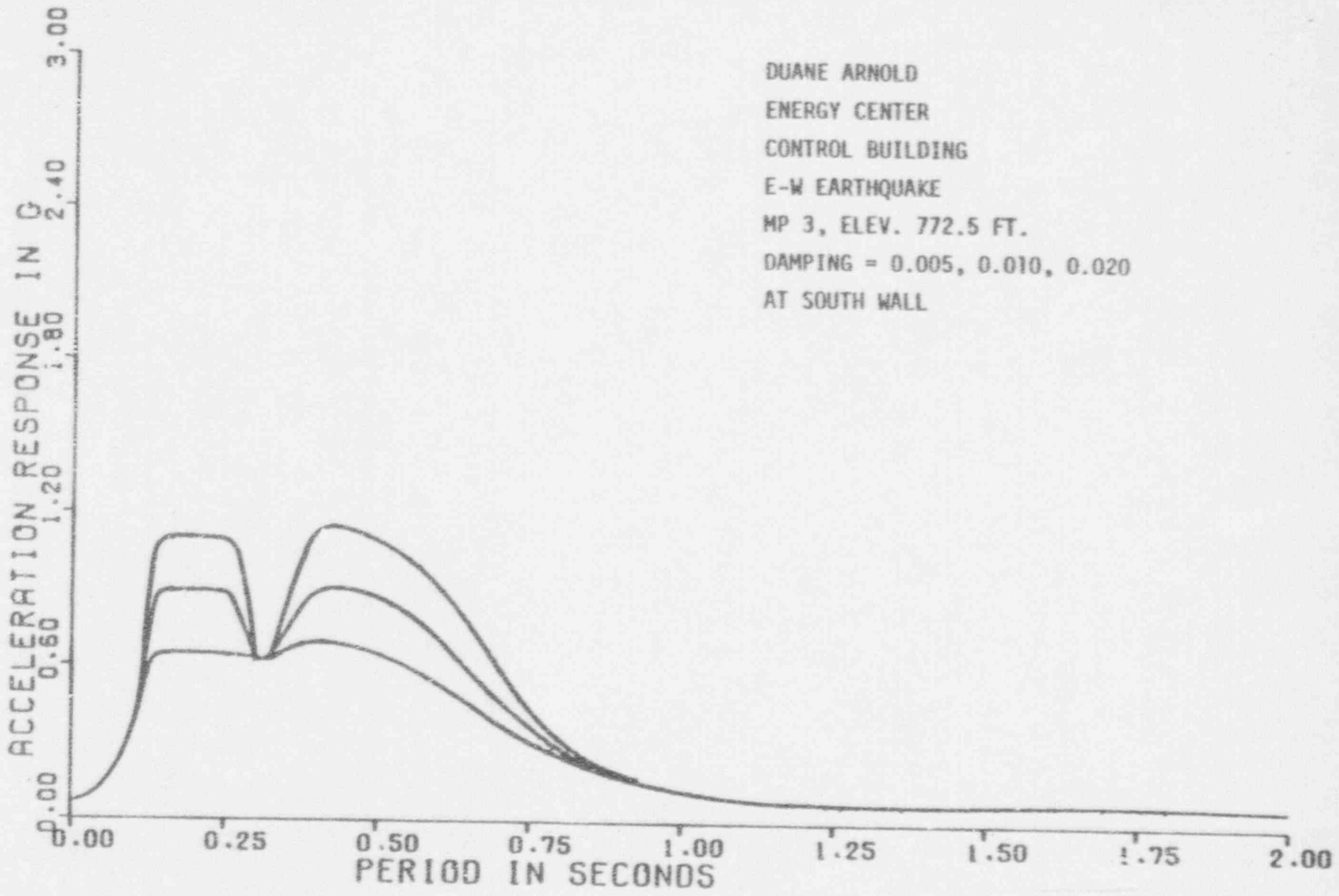

Figure 7.11

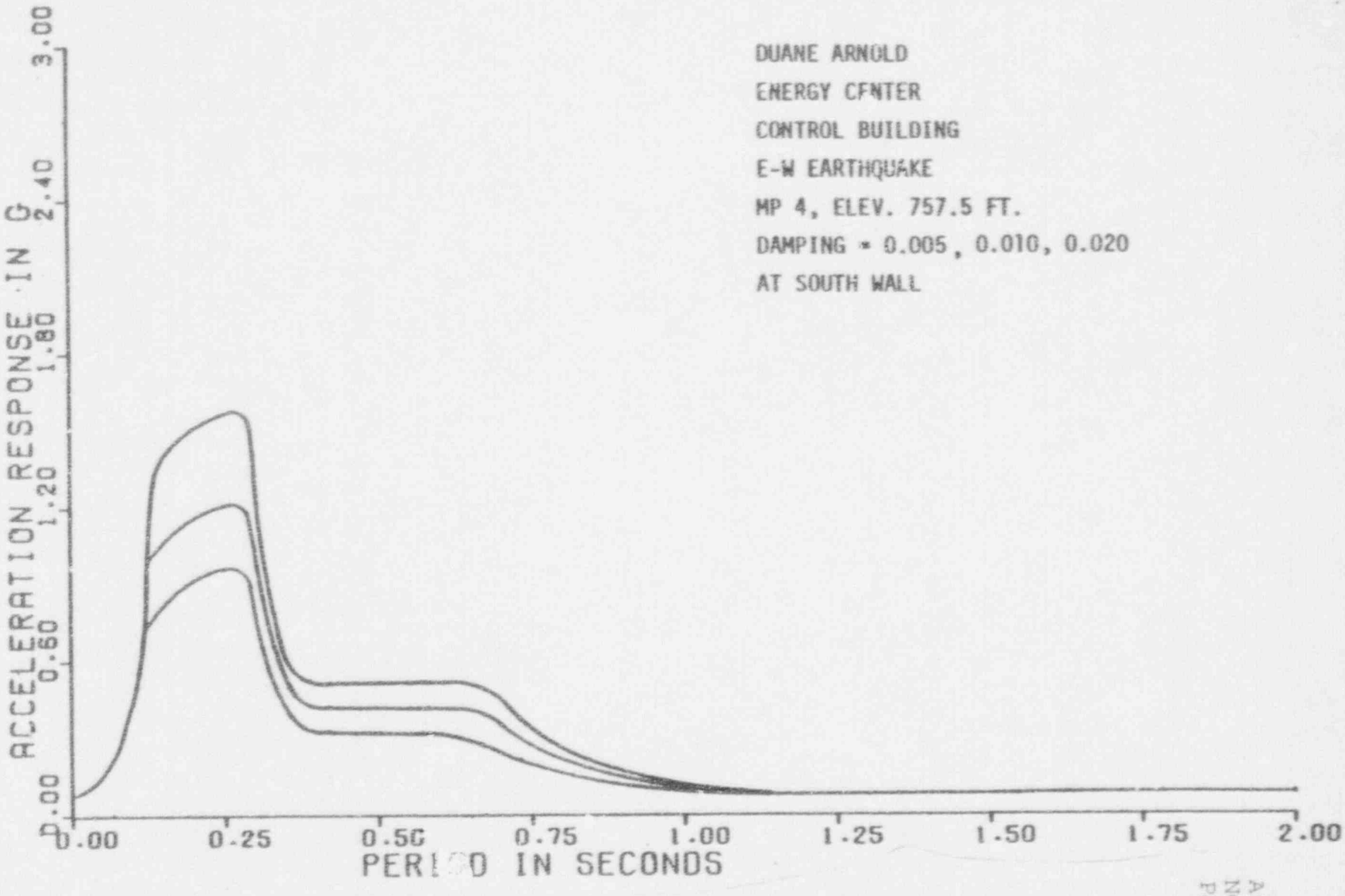
DUANE ARNOLD
ENERGY CENTER
CONTROL BUILDING
E-W EARTHQUAKE
MP 4, ELEV. 757.5 FT.
DAMPING = 0.005, 0.010, 0.020
AT SOUTH WALL
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 7.12

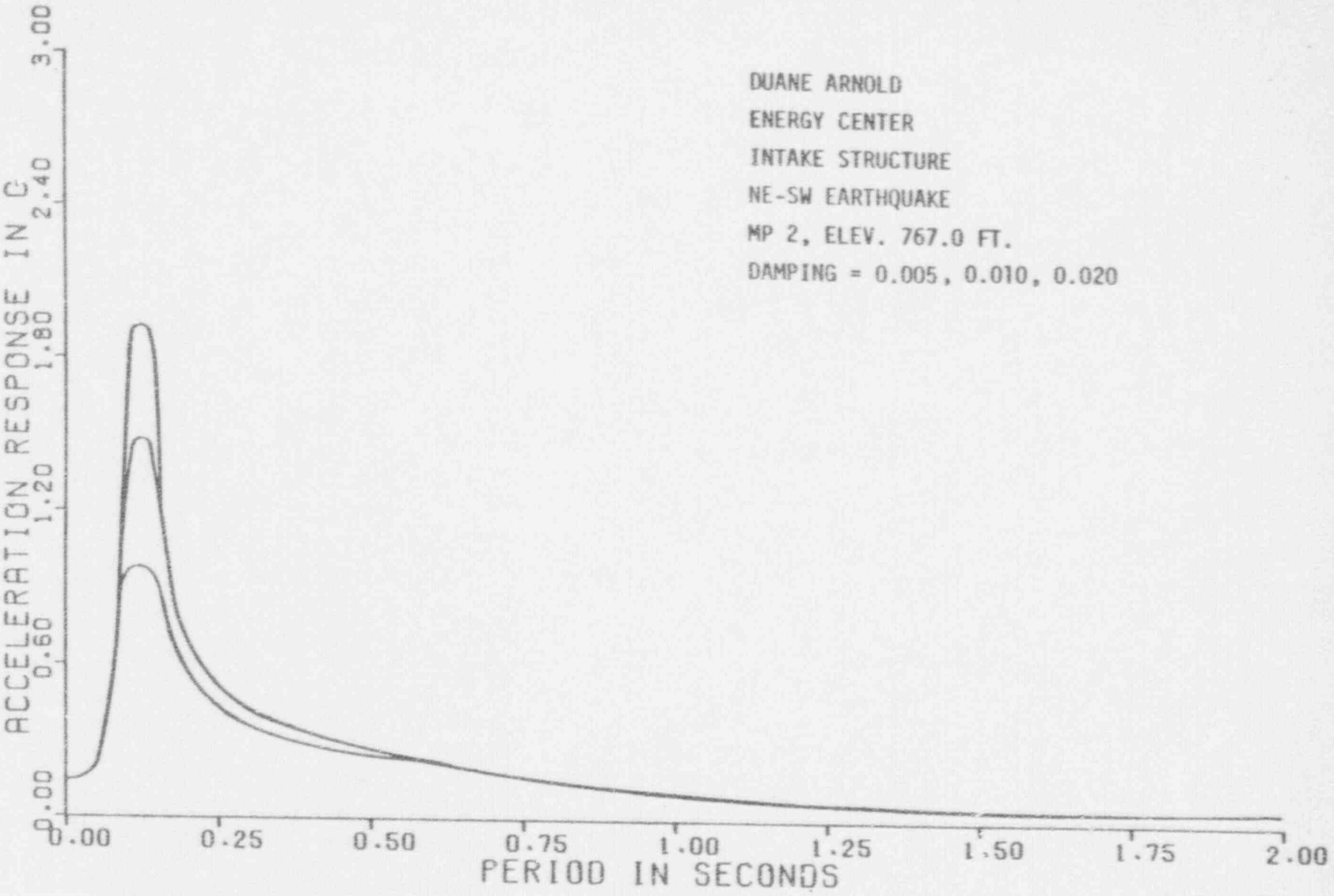
DUANE ARNOLD
ENERGY CENTER
INTAKE STRUCTURE
NE-SW EARTHQUAKE
MP 2, ELEV. 767.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 8.1

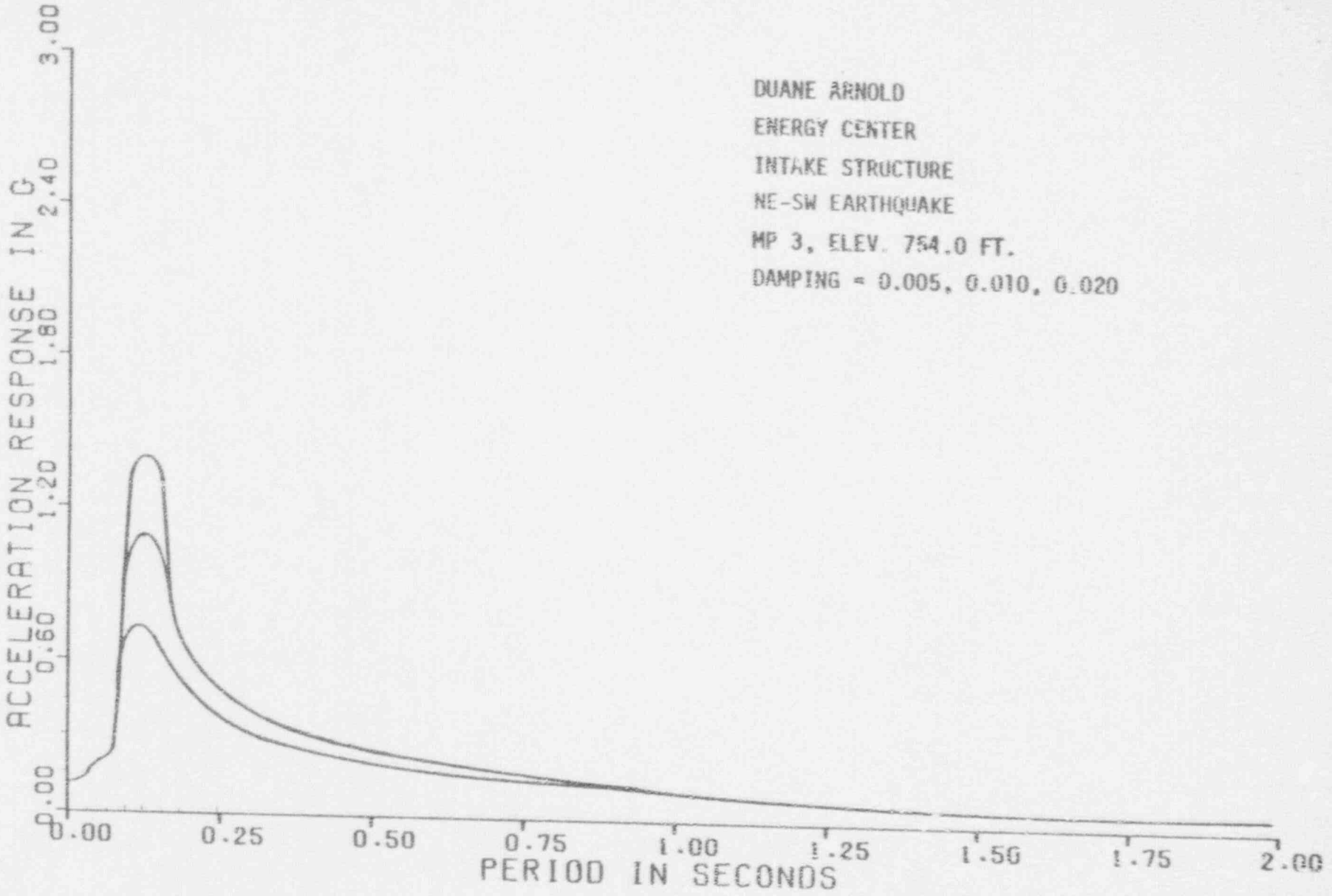
DUANE ARNOLD
ENERGY CENTER
INTAKE STRUCTURE
NE-SW EARTHQUAKE
MP 3, ELEV. 754.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 8.2

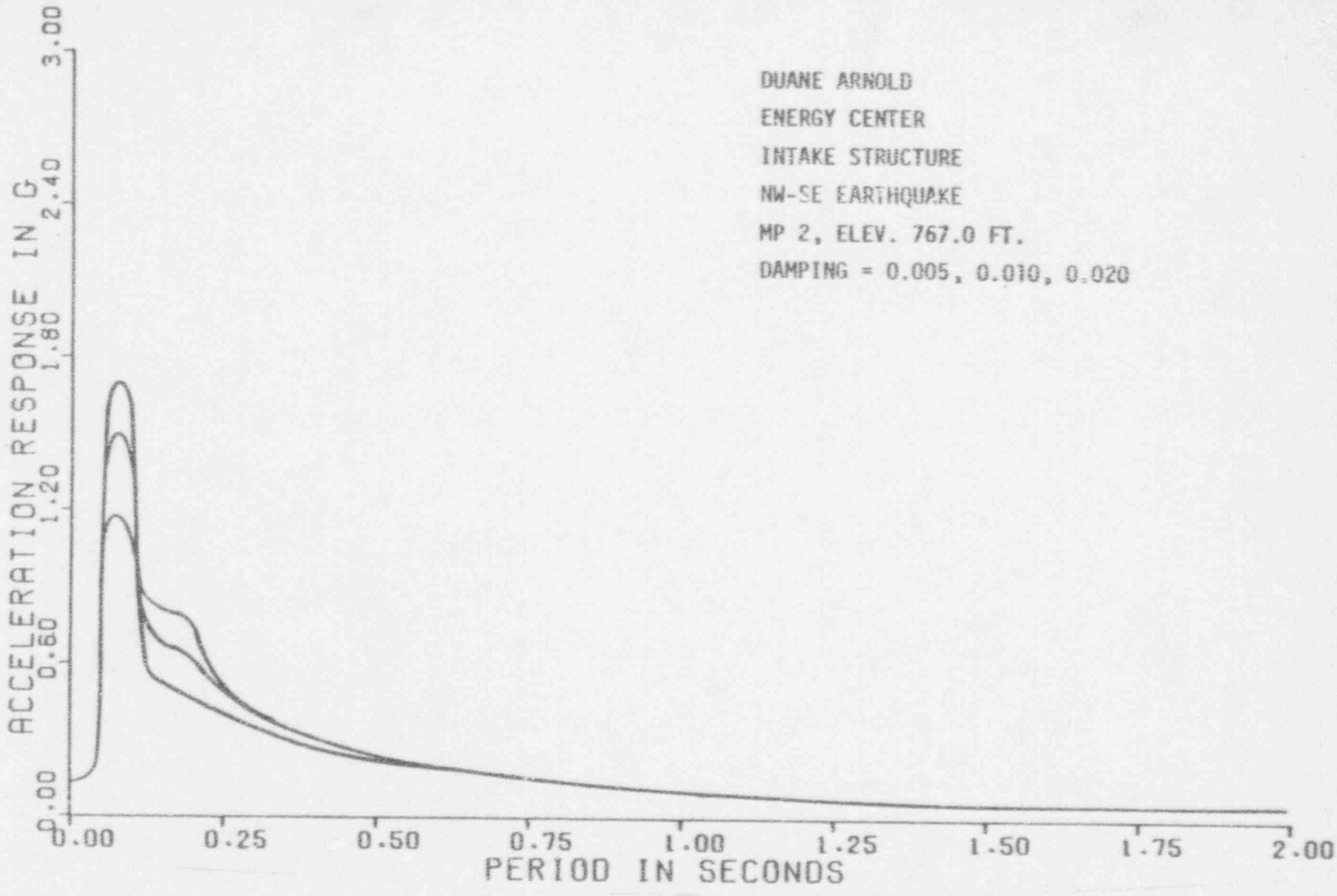
DUANE ARNOLD
ENERGY CENTER
INTAKE STRUCTURE
NW-SE EARTHQUAKE
MP 2, ELEV. 767.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 8.3

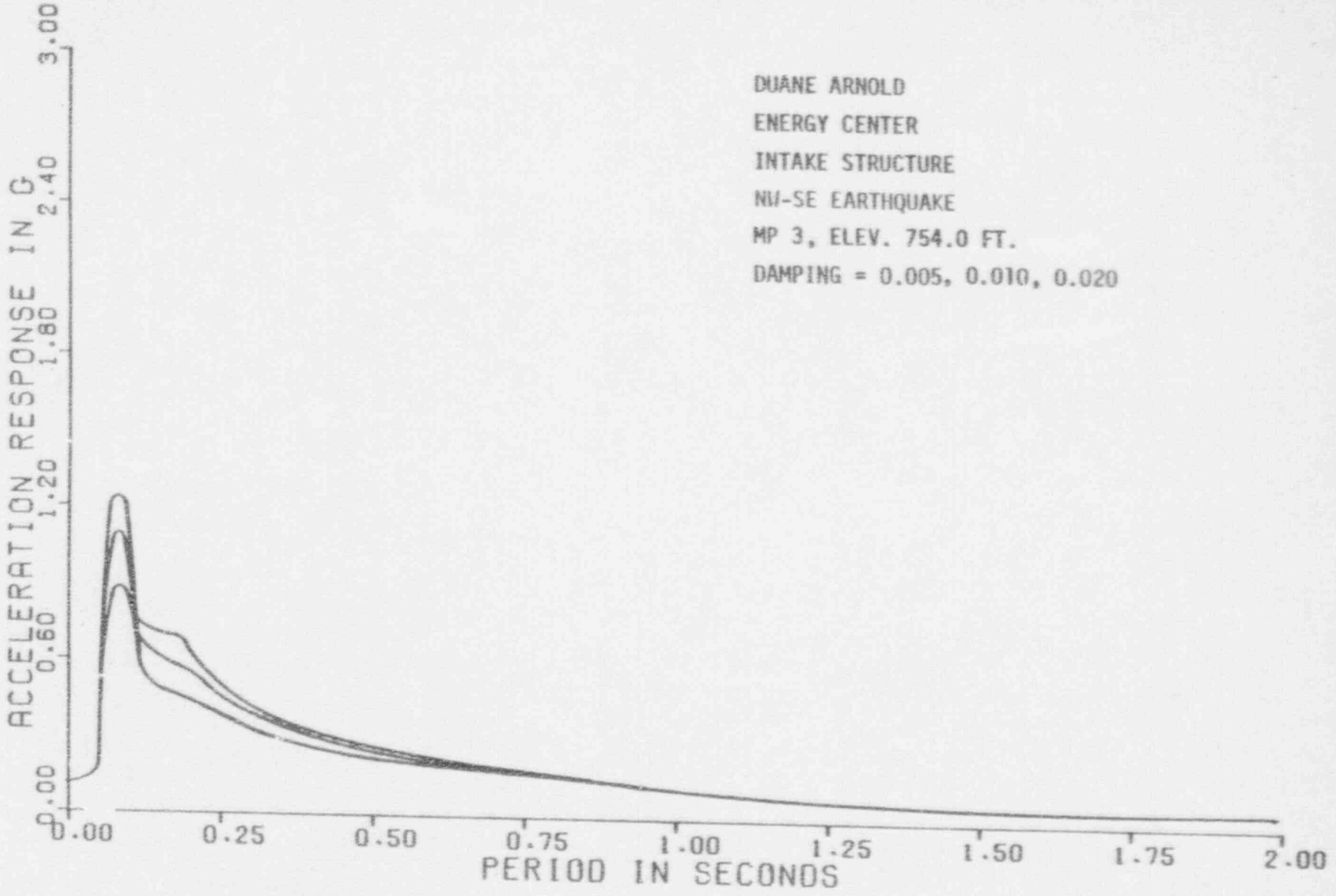

Figure 8.4

Attachment to
NG-92-3961
Page 31

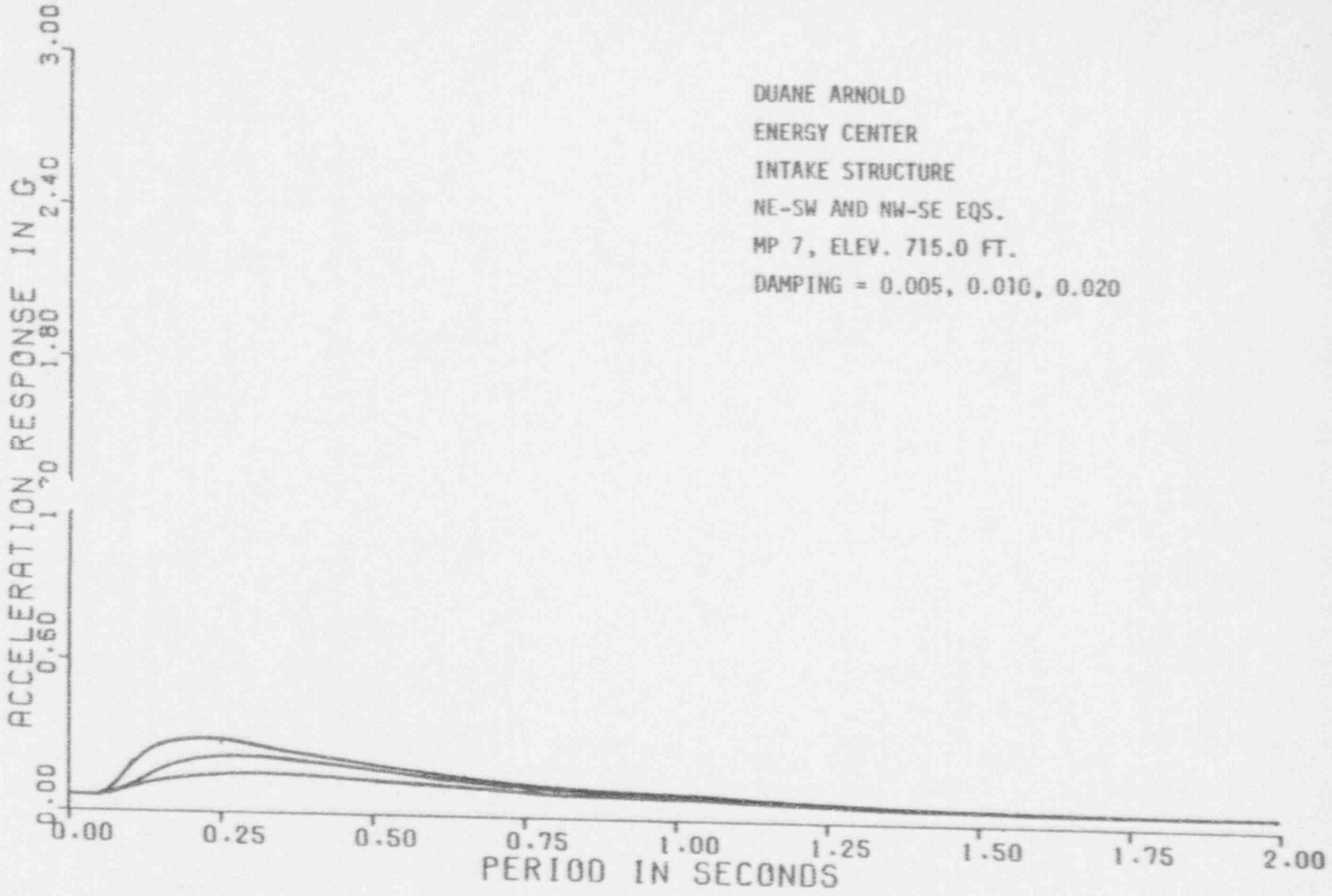
DUANE ARNOLD
ENERGY CENTER
INTAKE STRUCTURE
NE-SW AND NW-SE EQS.
MP 7, ELEV. 715.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 8.5

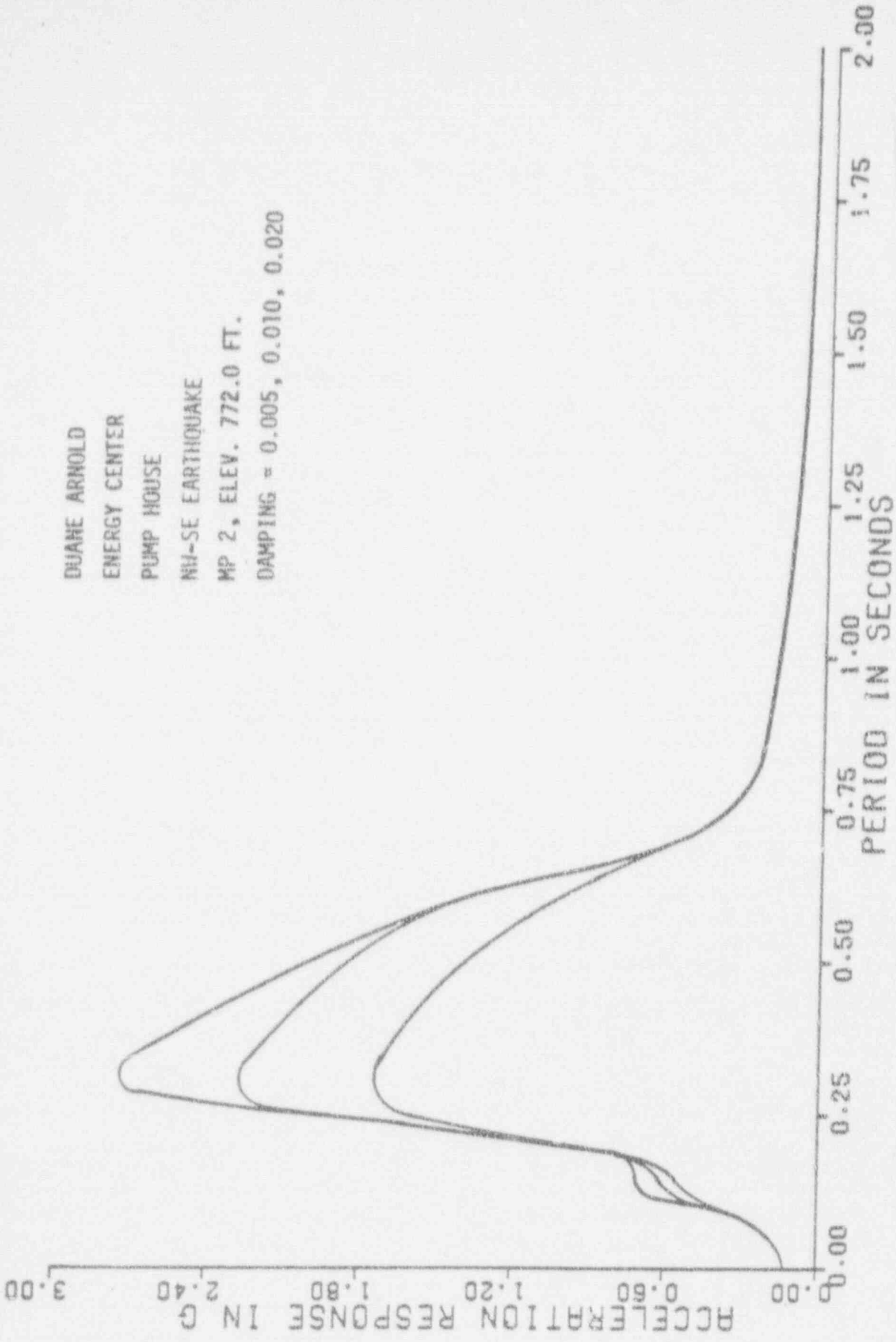
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NW-SE EARTHQUAKE
MP 2, ELEV. 772.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.1

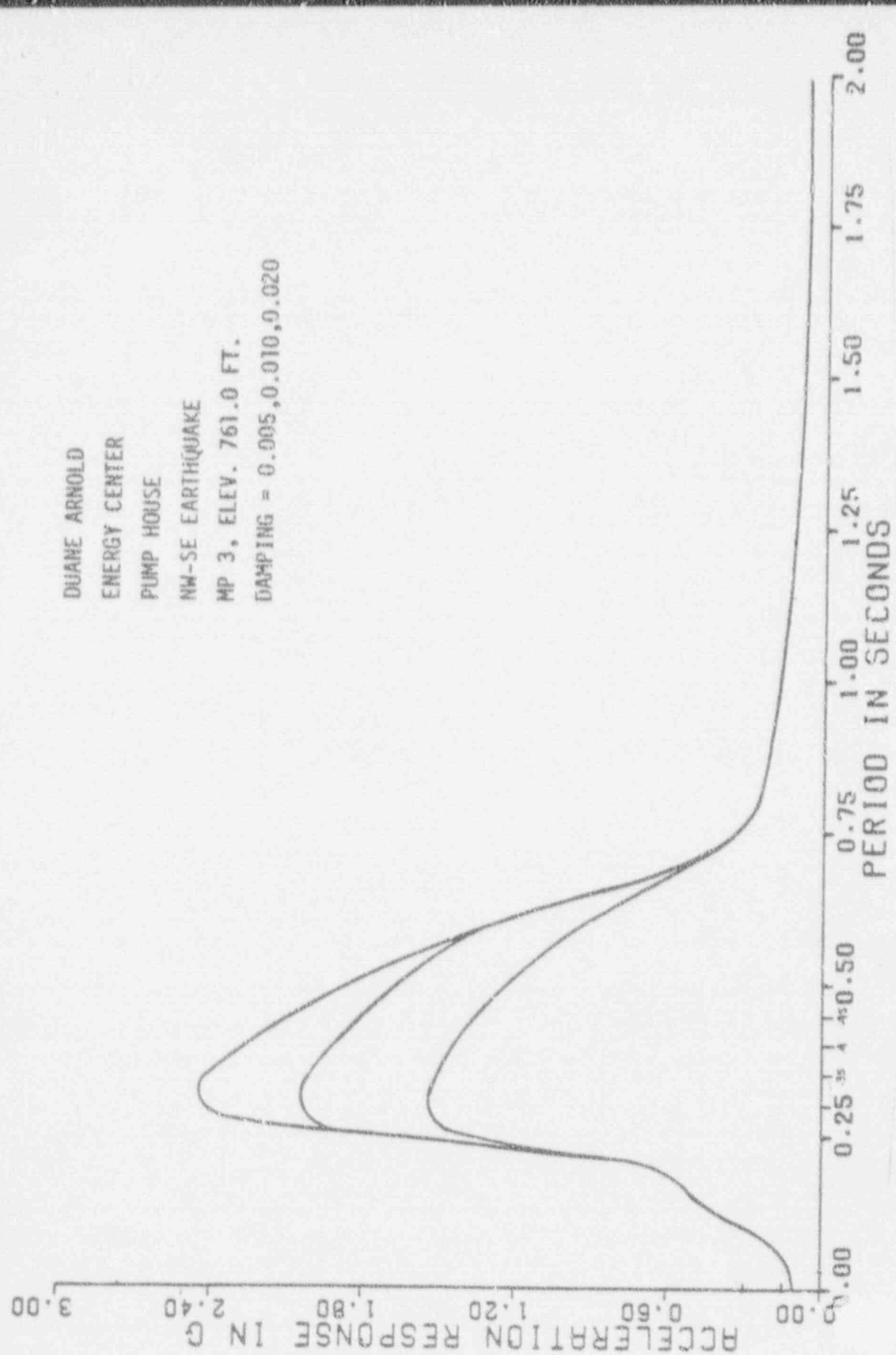
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NW-SE EARTHQUAKE
MP 3, ELEV. 761.0 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.2

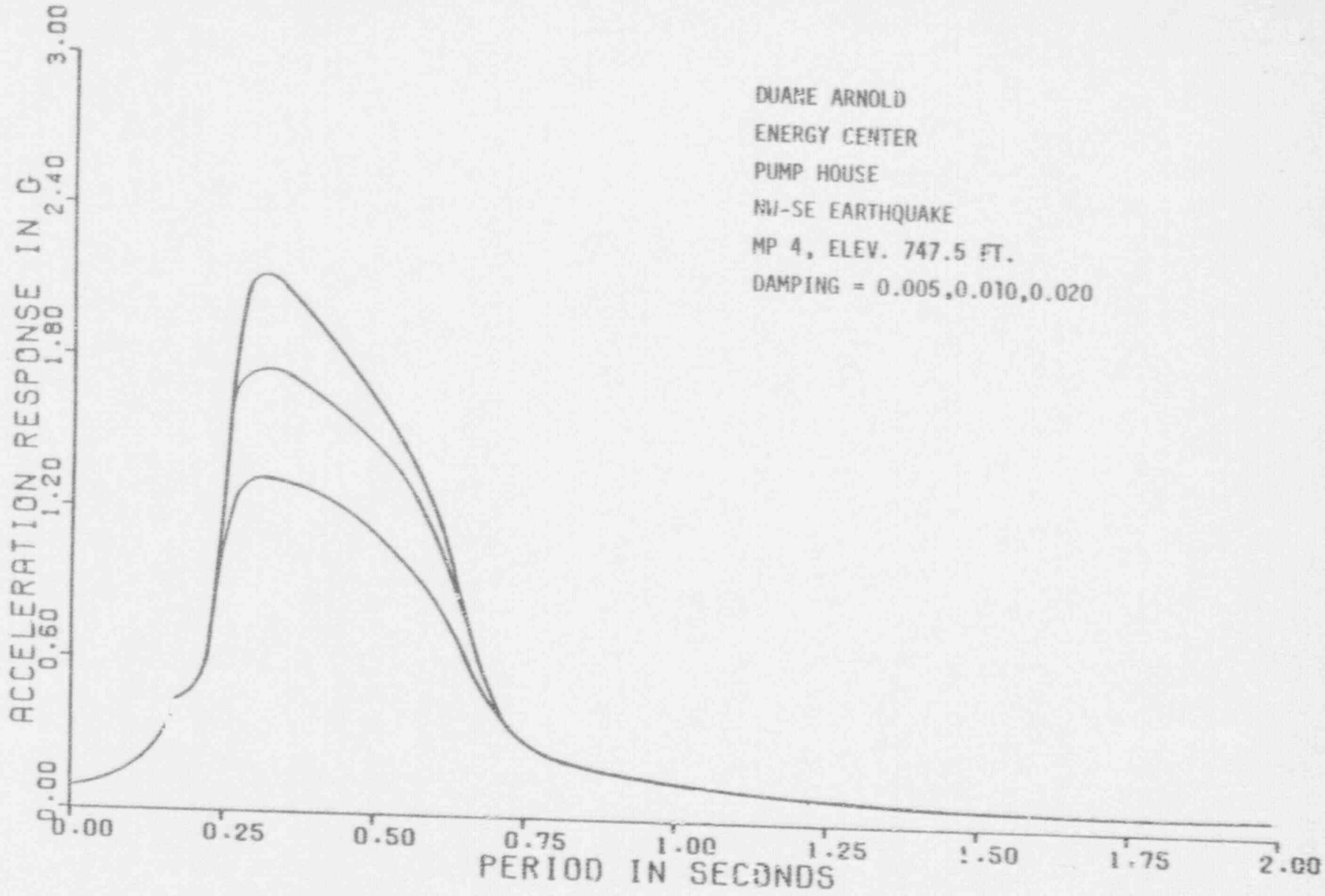
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NW-SE EARTHQUAKE
MP 4, ELEV. 747.5 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.3

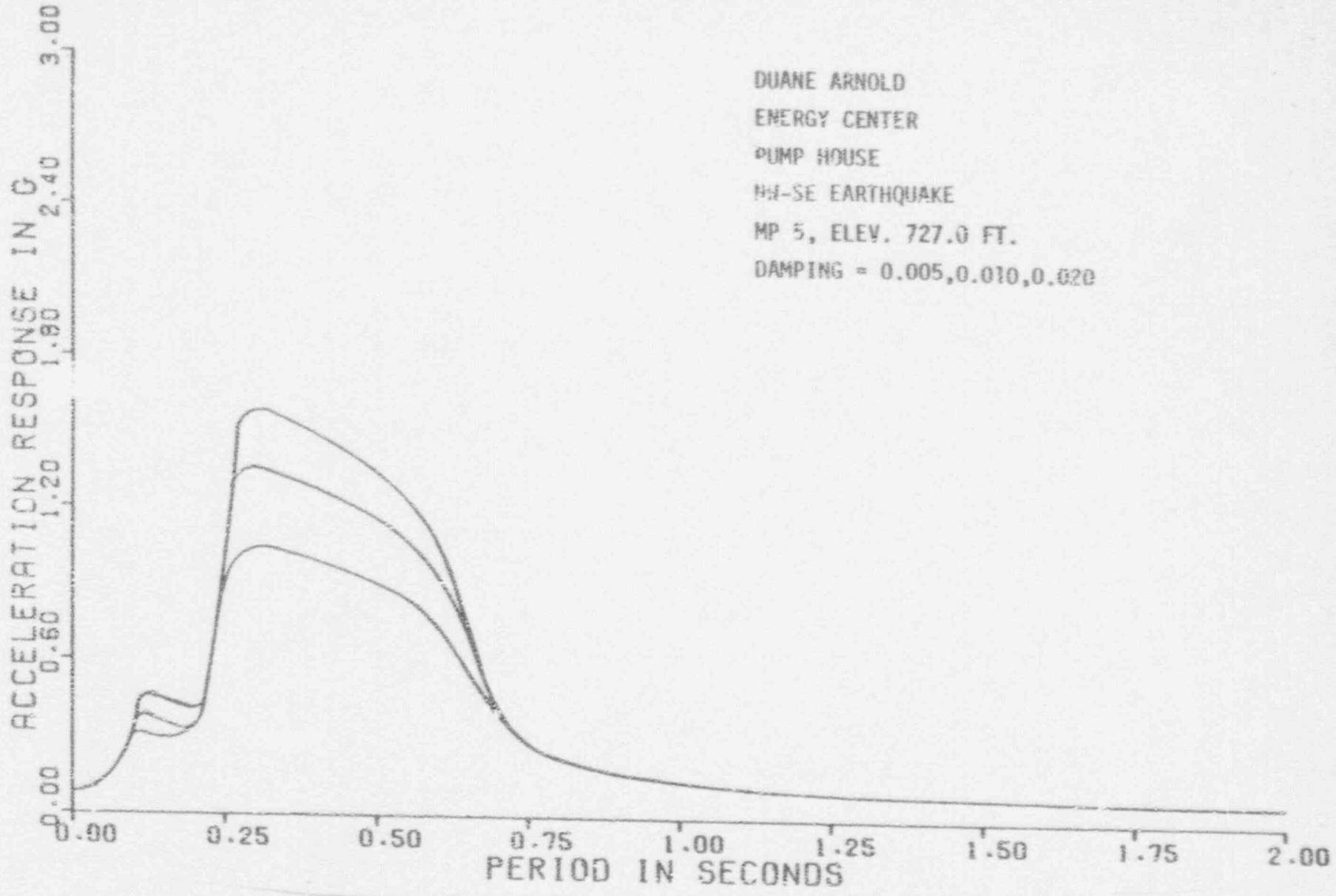
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NW-SE EARTHQUAKE
MP 5, ELEV. 727.0 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.4

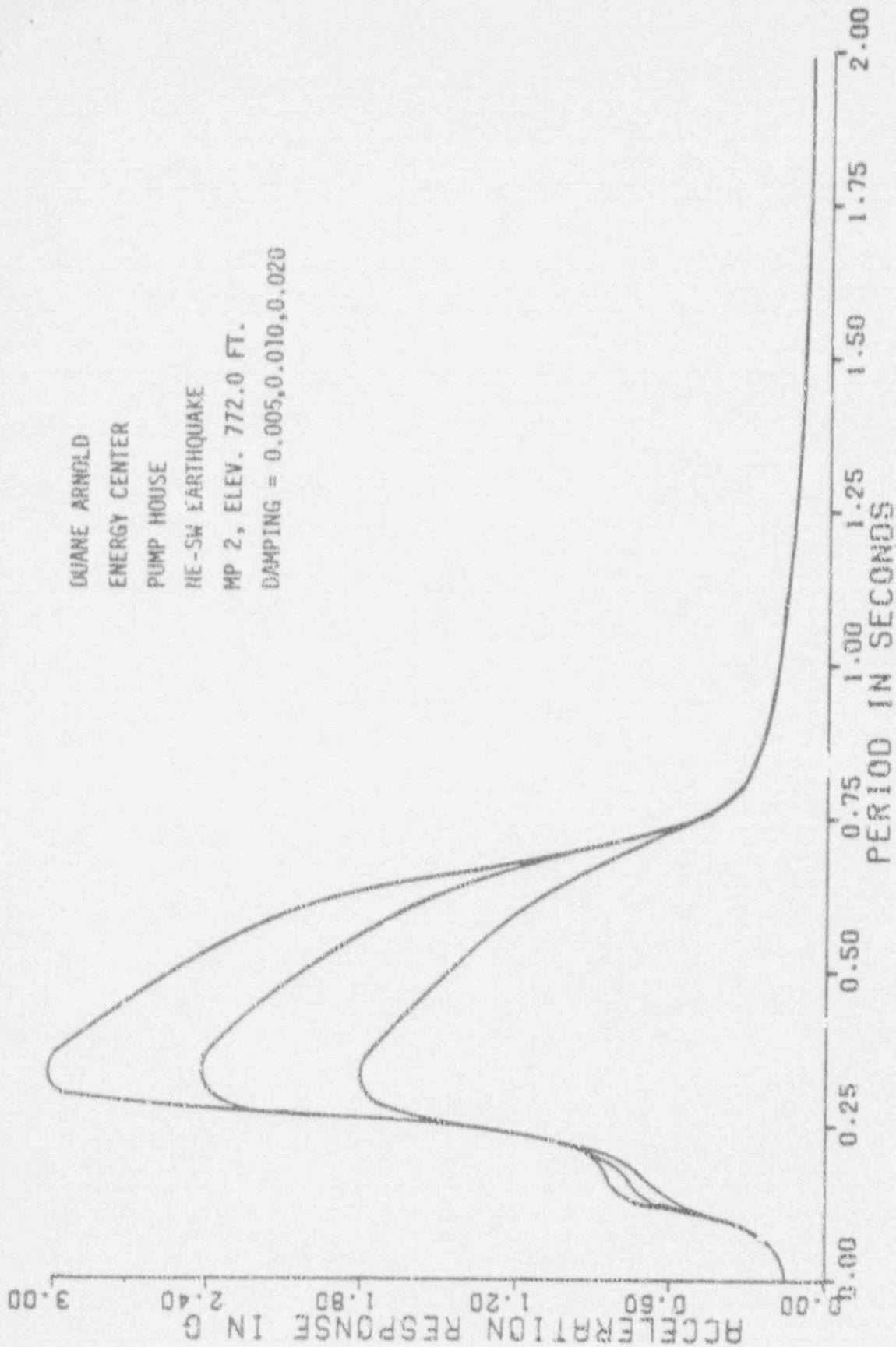
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NE-SW EARTHQUAKE
MP 2, ELEV. 772.0 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.5

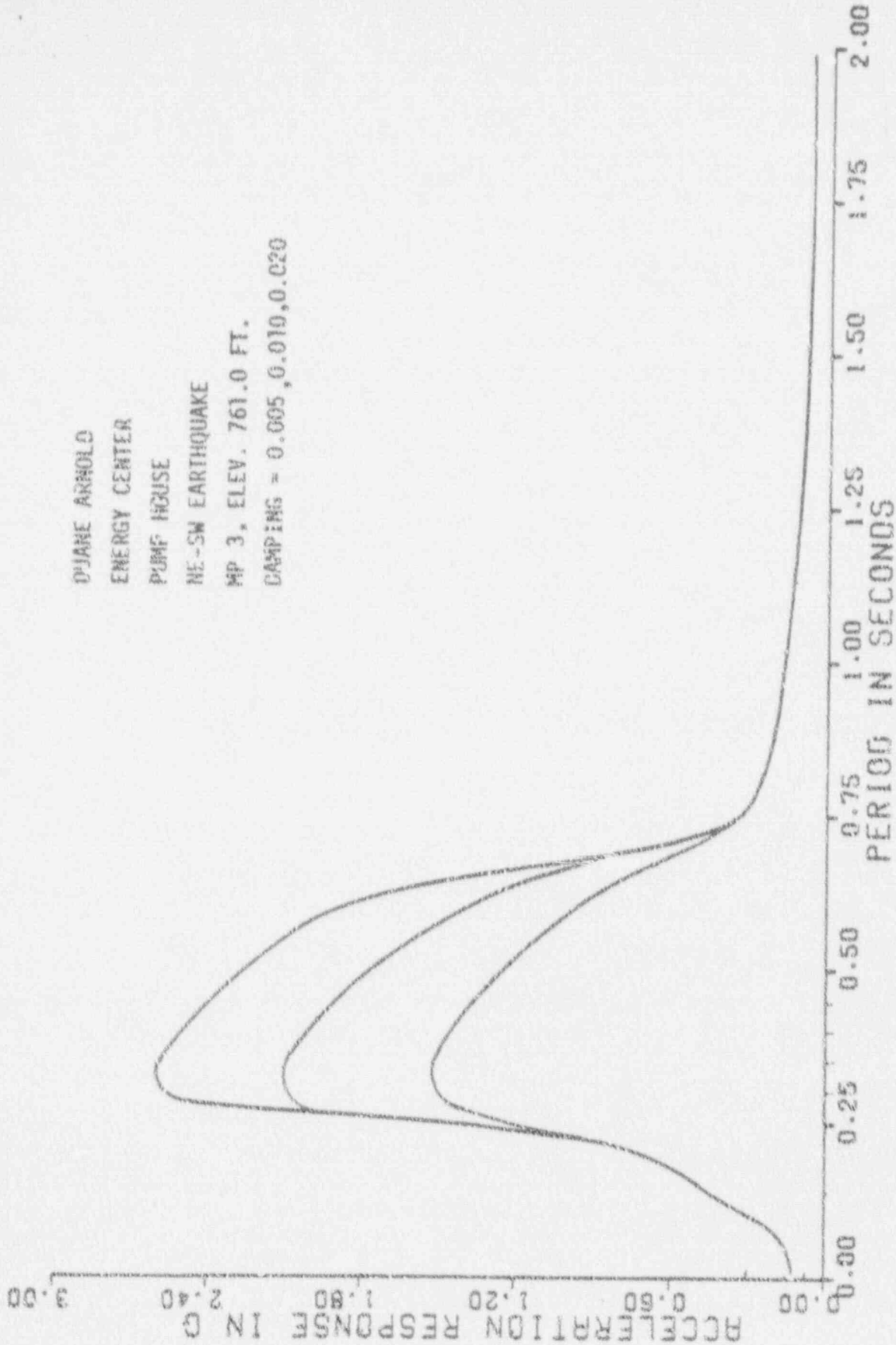
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NE-SW EARTHQUAKE
MP 3, ELEV. 761.0 FT.
CAMPBMS = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.6

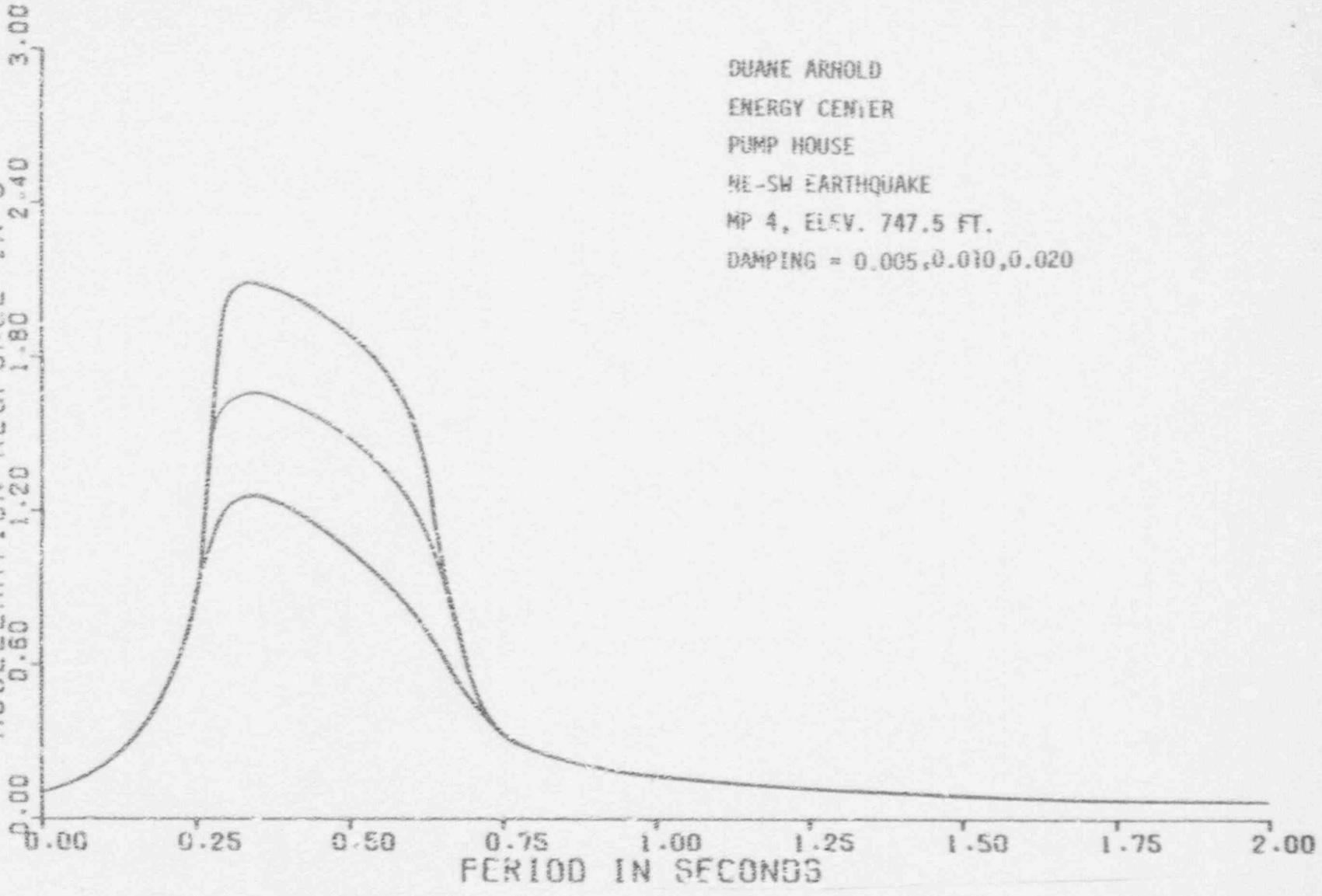
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NE-SW EARTHQUAKE
MP 4, ELEV. 747.5 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.7

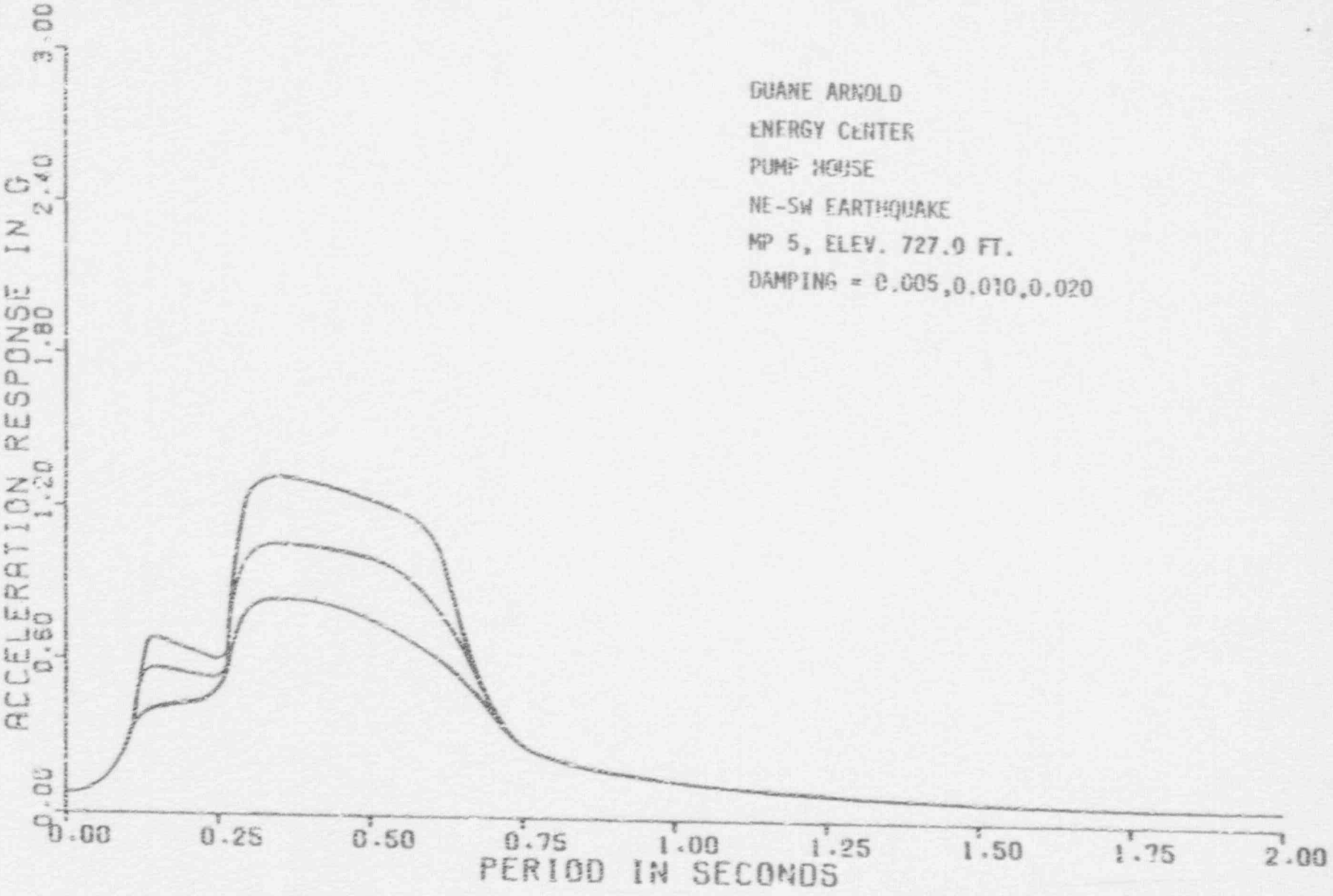
DUANE ARNOLD
ENERGY CENTER
PUMP HOUSE
NE-SW EARTHQUAKE
MP 5, ELEV. 727.0 FT.
DAMPING = 0.005,0.010,0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 9.8

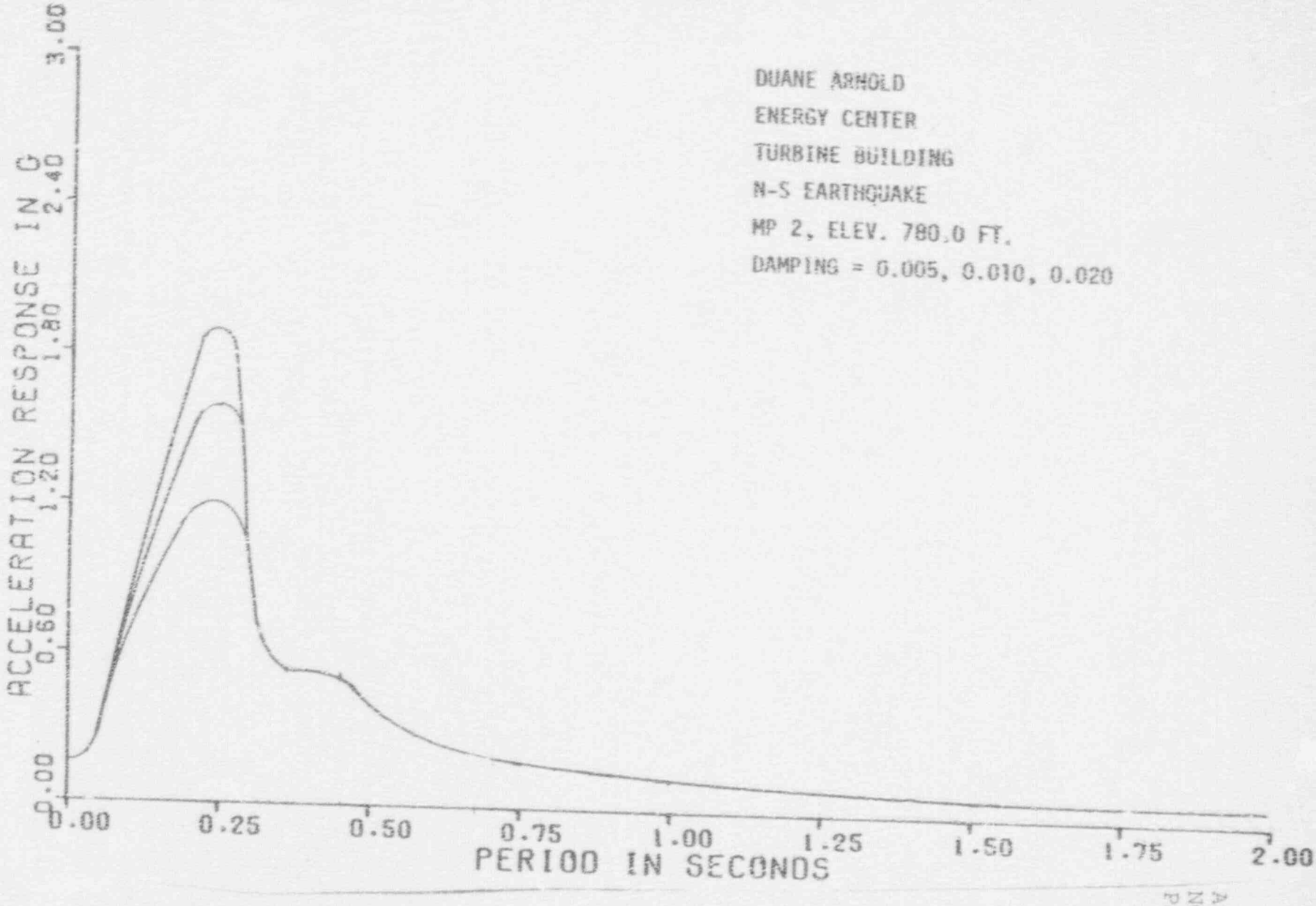
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
N-S EARTHQUAKE
MP 2, ELEV. 780.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.1

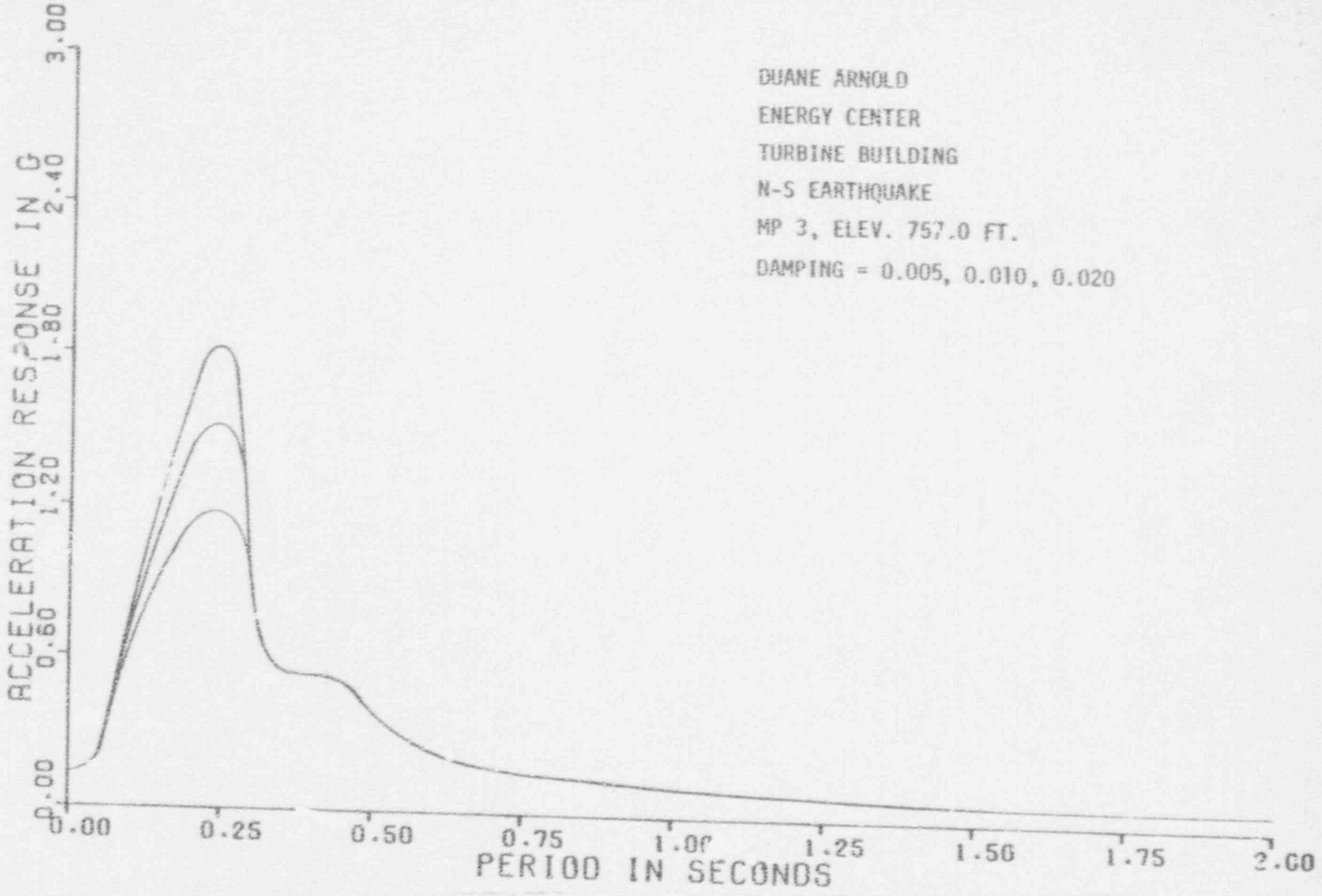
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
N-S EARTHQUAKE
MP 3, ELEV. 757.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.2

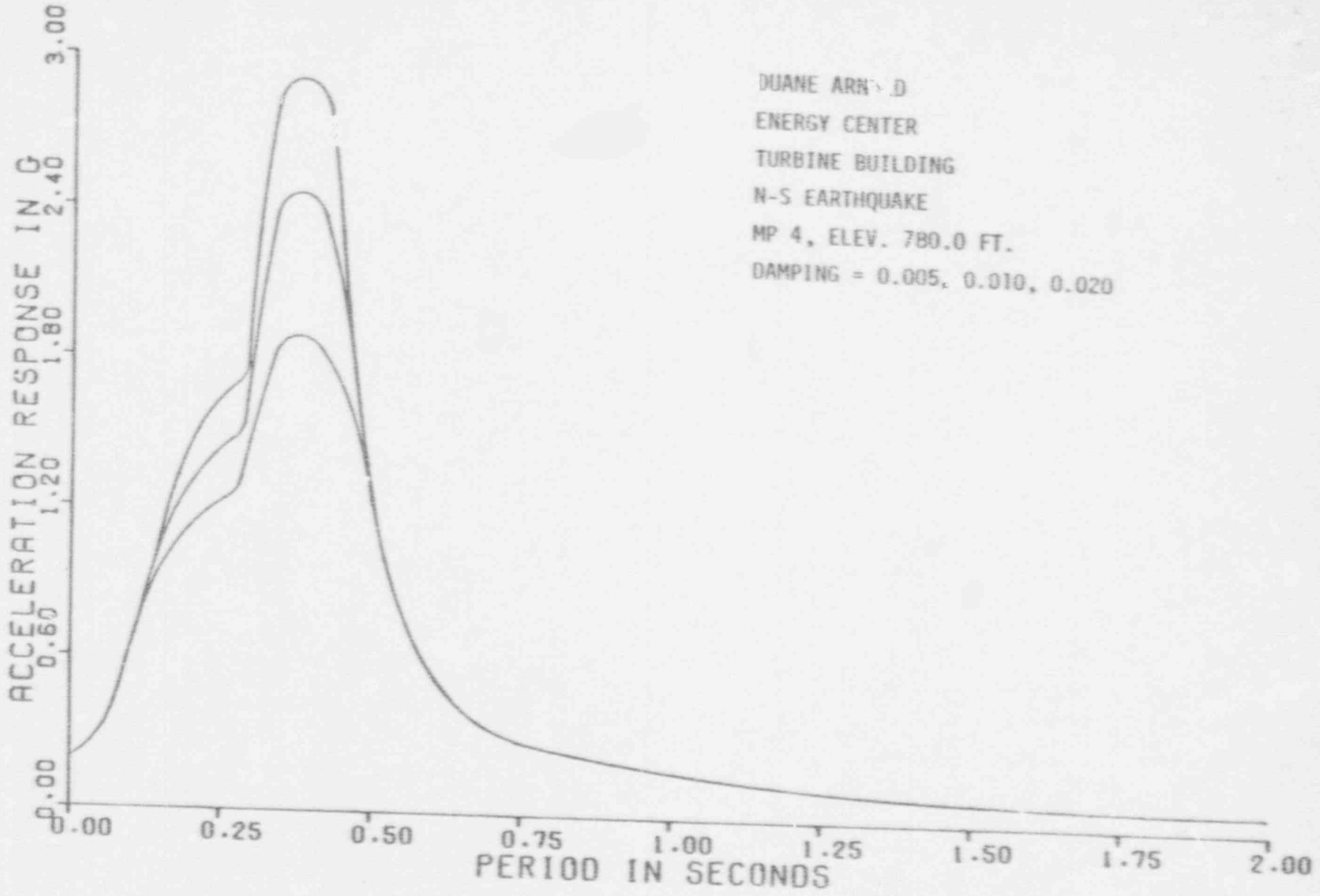
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
N-S EARTHQUAKE
MP 4, ELEV. 780.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.3

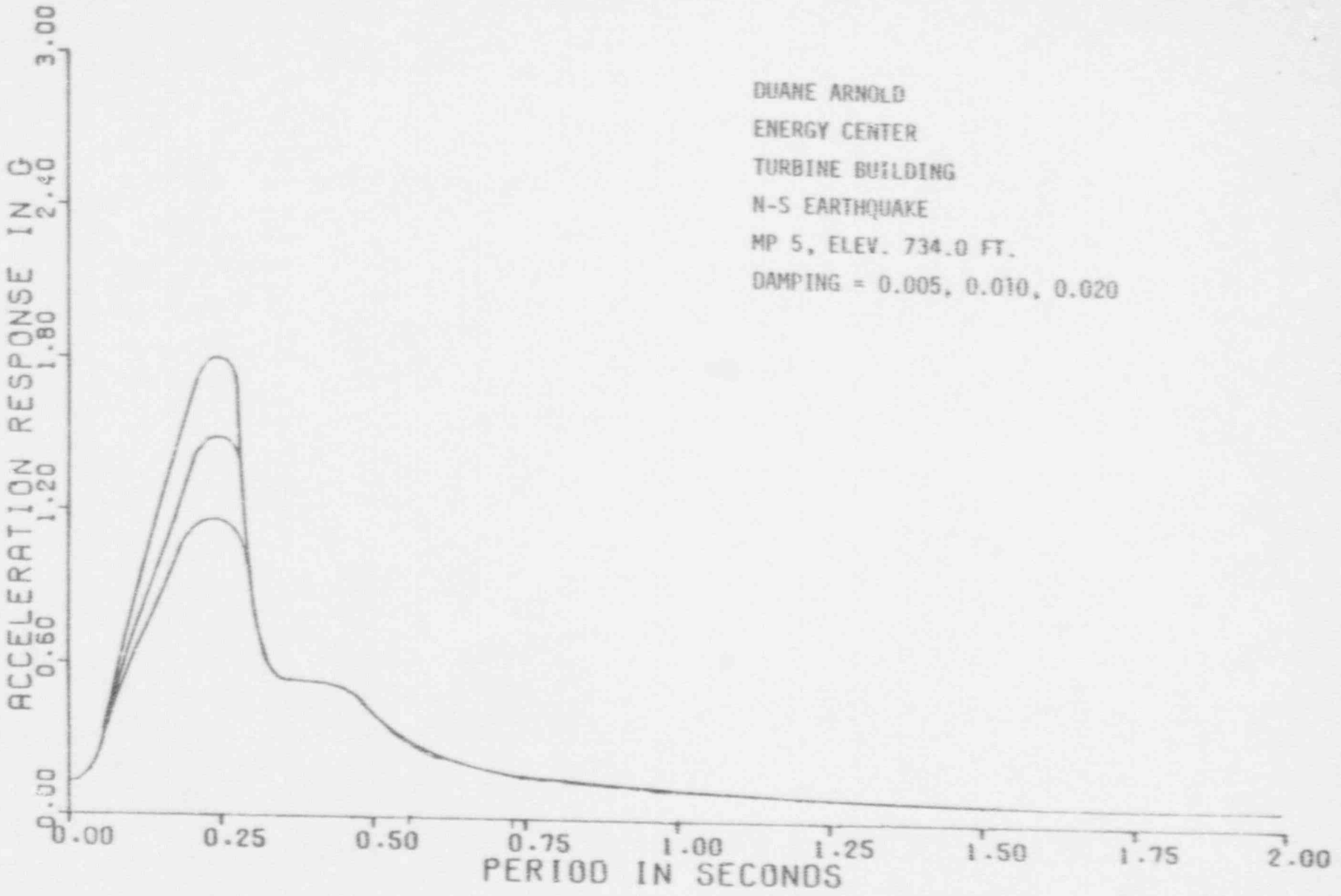
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
N-S EARTHQUAKE
MP 5, ELEV. 734.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.4

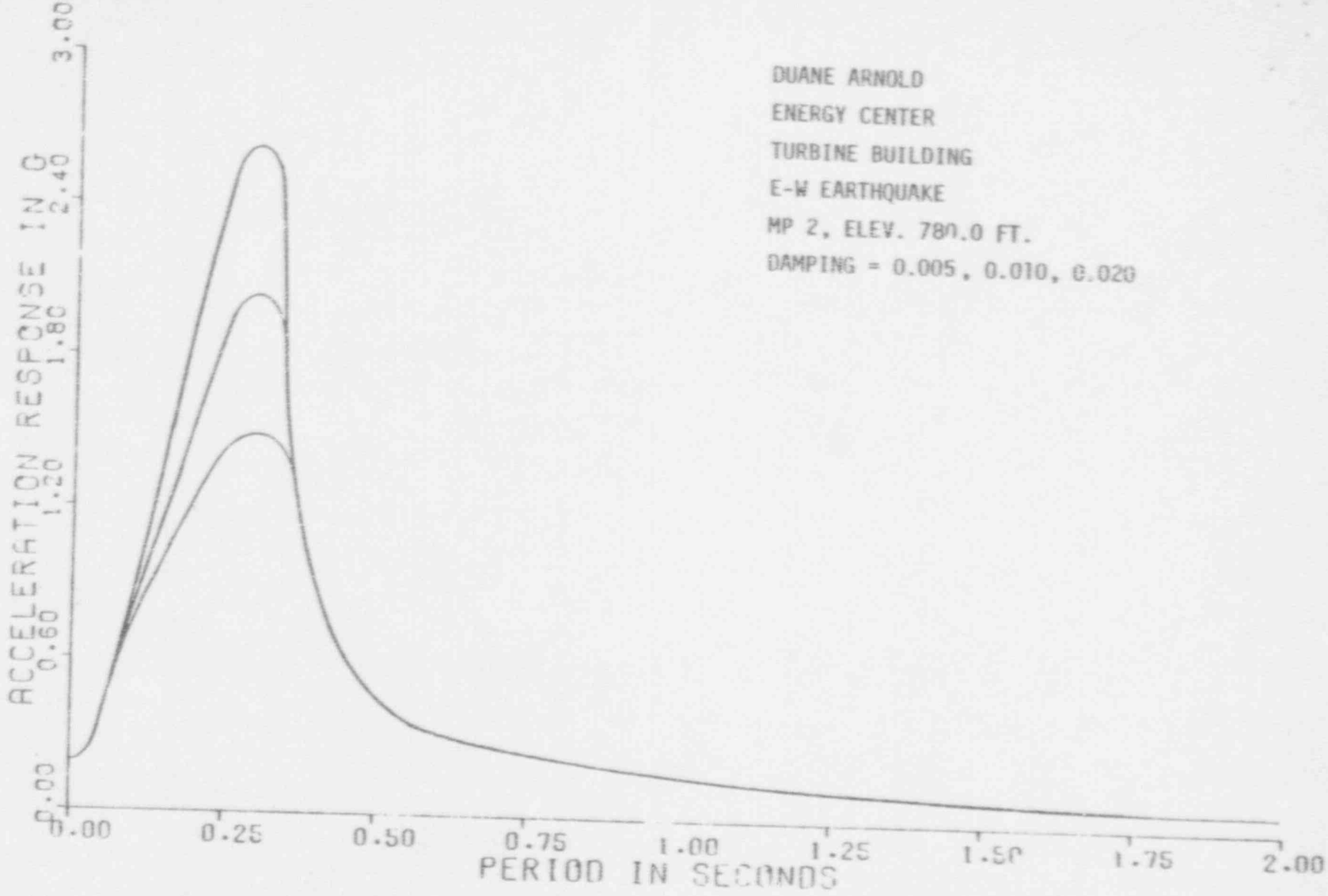
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
E-W EARTHQUAKE
MP 2, ELEV. 780.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.5

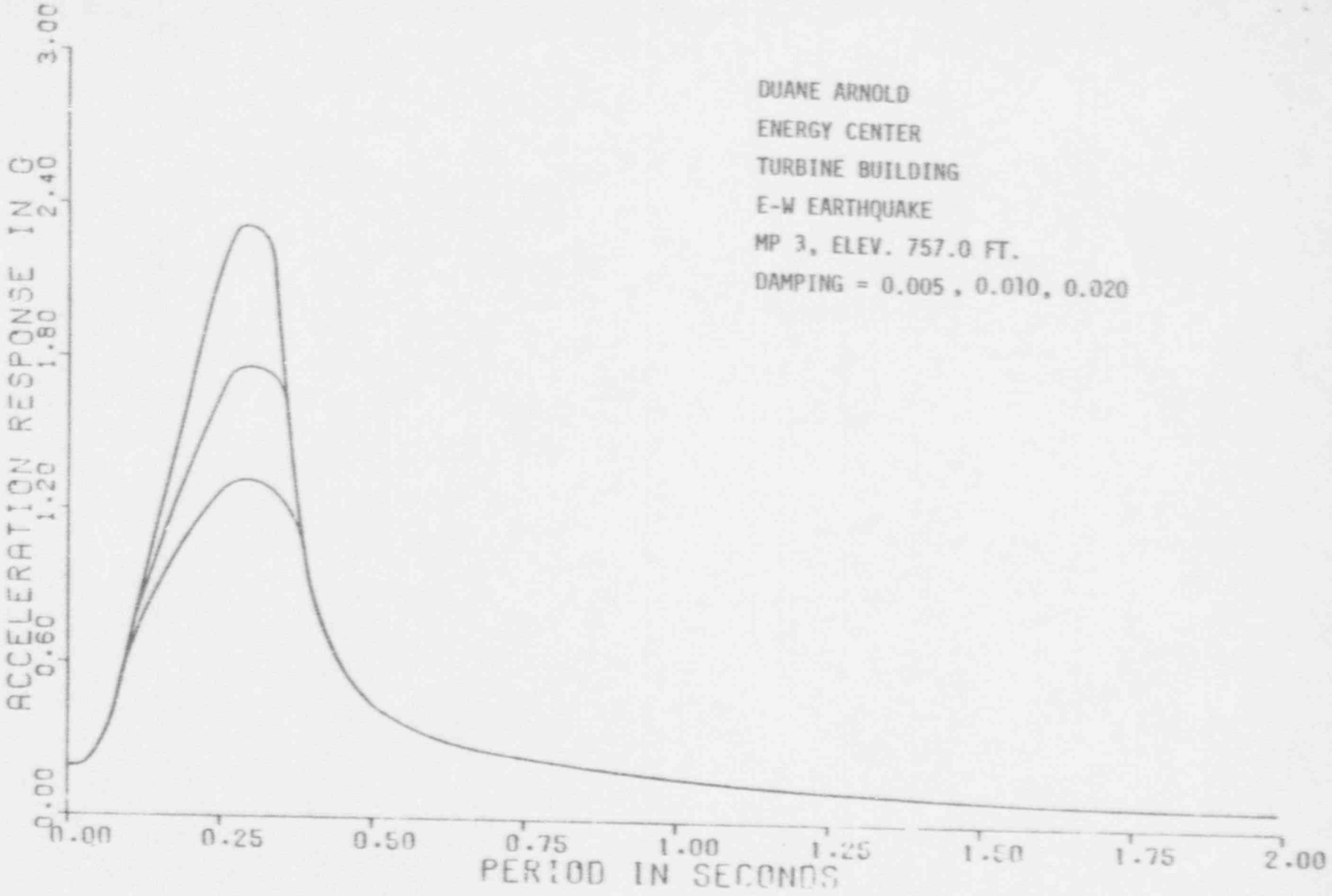
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
E-W EARTHQUAKE
MP 3, ELEV. 757.0 FT.
DAMPING = 0.005 , 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.6

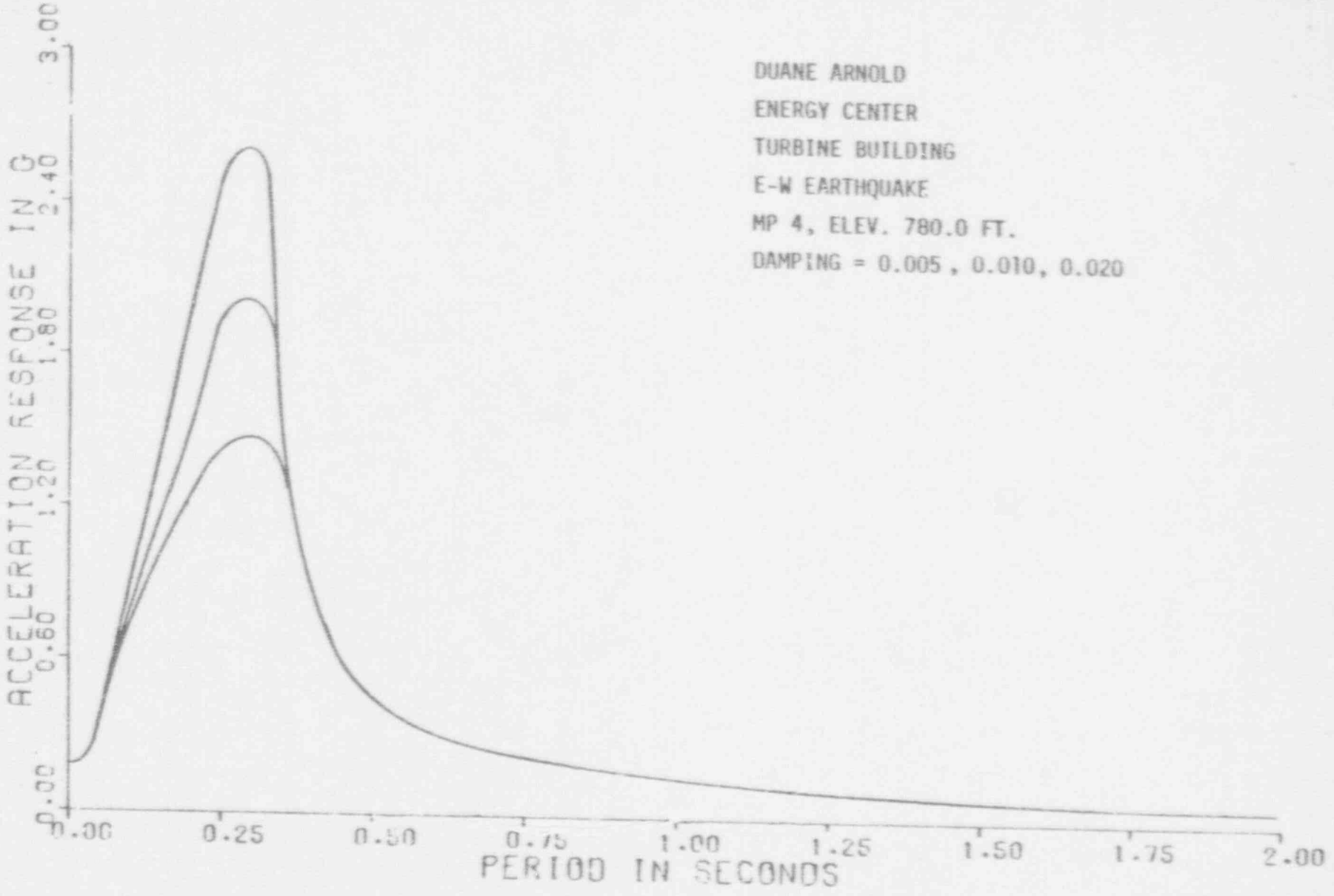
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
E-W EARTHQUAKE
MP 4, ELEV. 780.0 FT.
DAMPING = 0.005 , 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.7

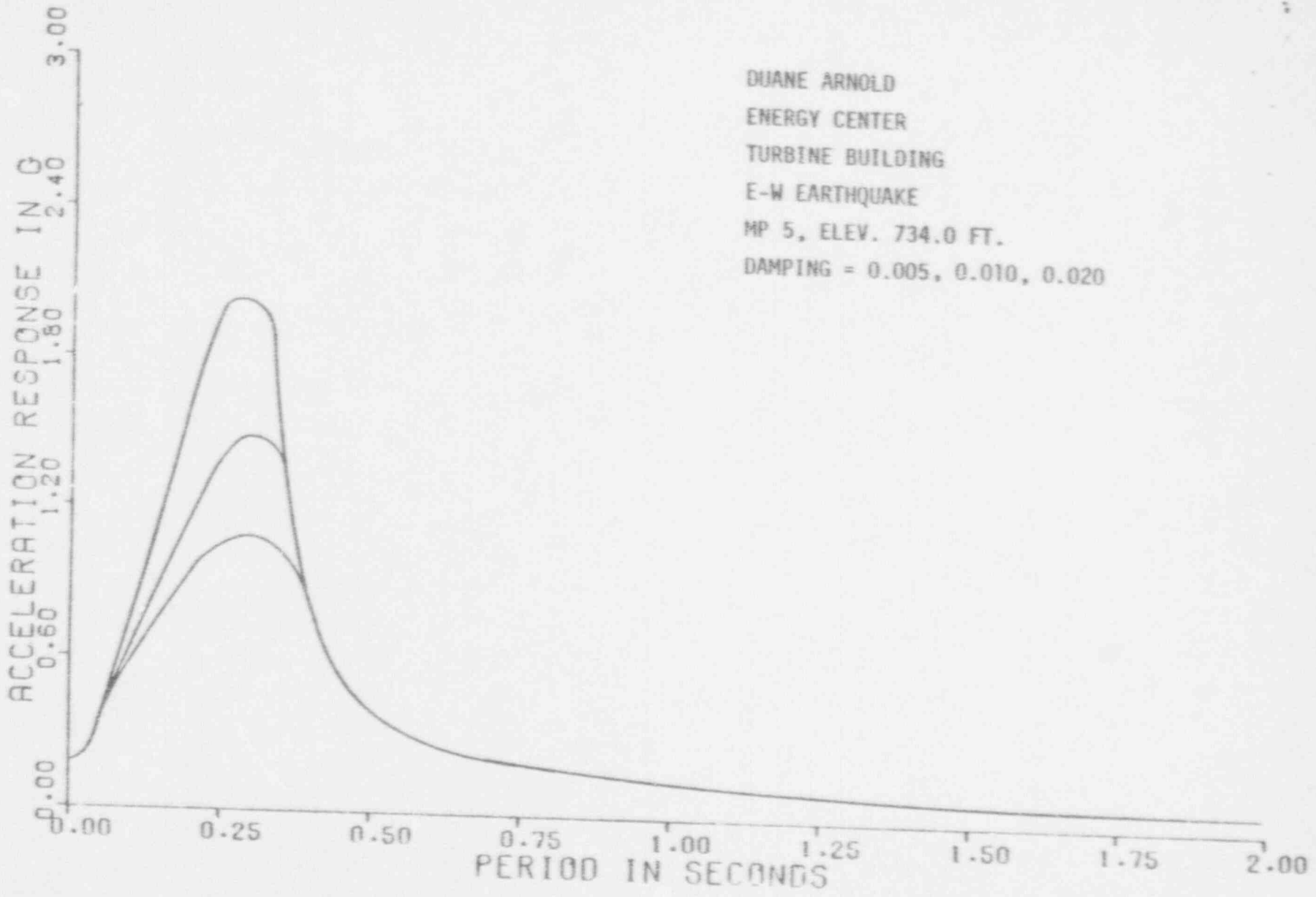
DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
E-W EARTHQUAKE
MP 5, ELEV. 734.0 FT.
DAMPING = 0.005, 0.010, 0.020
ACCELERATION RESPONSE IN G
0.00
0.60
1.20
1.80
2.40
3.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
PERIOD IN SECONDS

Figure 10.8

DUANE ARNOLD
ENERGY CENTER
TURBINE BUILDING
VERTICAL MOTION
ALL ELEVATIONS
DAMPING = 0.005, 0.010, 0.020

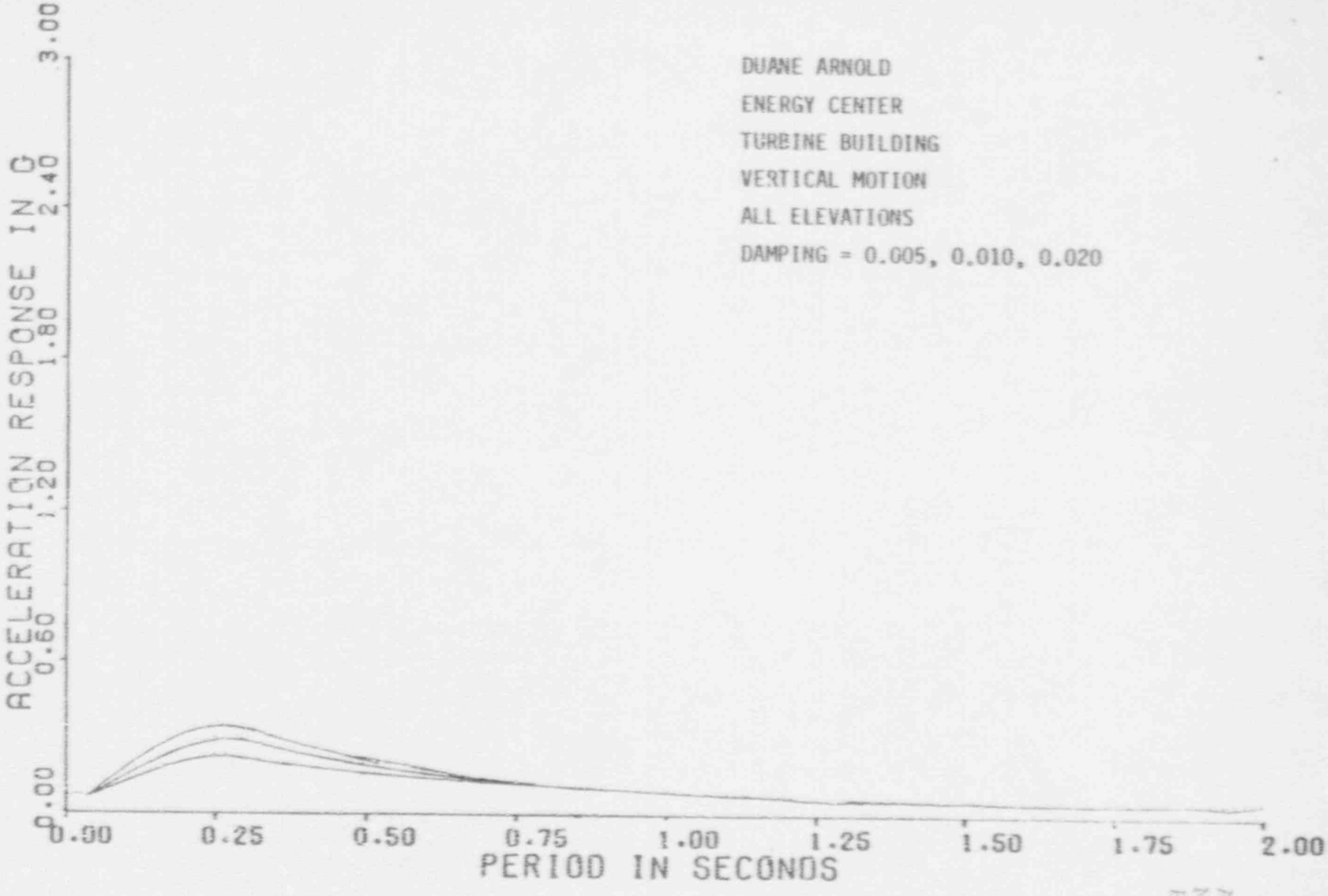

Figure 10.9