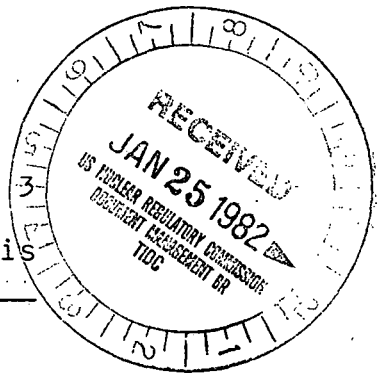
**Commonwealth Edison**
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

January 20, 1982

Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch 5
U.S. Nuclear Regulatory Commission
Washington, DC 20555




Subject: Dresden Station, Units 2 and 3
High Density Spent Fuel
Storage Racks Seismic Analysis
NRC Docket Nos. 50-237/249

Dear Mr. Crutchfield:

On December 1, 1981, Commonwealth Edison (CECo) received a copy of an internal NRC memo (Reference 1)* from Owen Rothberg to Paul O'Connor regarding the report submitted to the NRC on October 2, 1981 (Ref. 16). As will be shown herein, this (Ref. 16) report was of limited scope and not intended to be a complete seismic analysis report.

Following some preliminary discussions, a conference call was held on December 22, 1981, among Paul O'Connor and Owen Rothberg of the NRC, Gunnar Harsted (the NRC consultant), and Tom Rausch and Laird Woldridge of CECo. During this call, CECo was requested, and agreed, to respond in writing to the comments in the above NRC memo, including giving all background information necessary to understand the reasons for our analysis basis or assumptions. Please also refer to the Introduction section of the October 2, 1981 submittal (Ref. 16). As described there, it is our understanding that the present NRC review is to determine the effects of postulated rocking of the racks on the pool floor and walls, and that the NRC has no safety concern with respect to the structural adequacy of the racks. The NRC comments (per Ref. 17) and our responses follow:

1. Comment: Use procedures described in submittal of September 30, 1981 as submittal basis, disregard previous submittals.

   Response: It is our understanding from this comment, that the report of September 30, 1981 (submitted October 2, 1981) was the only basis for the review. However, during the call of December 23, 1981, it was ascertained that the NRC did consider other material, some dating back to 1979.

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*All references in this letter are listed in chronological order in Attachment 1.



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In the remaining responses, we will attempt to tabulate all applicable earlier material.

2. Comment: Use coefficient of friction values of 0.2 and 0.8 as well as 0.5 for analysis cases.

   Response: Values of 0.2 and 0.8 were used in the analyses for the Licensing Report (Ref. 4) as noted in Section 3.4.3.1 of that report. The NRC Safety Evaluation (Ref. 3) stated in Section 3.4.2 that the structural and mechanical analyses were in accordance with accepted criteria. In Section 3.4.1.1, the seismic analyses, time history analyses, and friction coefficients were specifically addressed.

   For the October 2, 1981 report (Ref. 16) the concern was not to completely reanalyze the racks and pool, but to demonstrate that the original analyses were sufficiently conservative, in light of NRC SEP concerns about the seismic analysis methods, and to address rack-to-pool floor impacts. The CECo. approach suggested to the NRC during a conference call on July 23, 1981 (Ref. 15) included use of a median value for the coefficient of friction as being most realistic. The NRC concurred and suggested the commonly used MIT study which indicated a mean value of 0.503. Since the rocking-sliding analysis reported in Reference 16 considered the response of a large number of racks (33 racks) involving even a larger number of leg-floor interfaces, the use of this mean value can be considered as the "best-estimate" value, and no new analysis is deemed necessary.

3. Comment: Use 3 independently generated time histories of pool floor. It is not necessary to develop a floor response spectrum at the pool floor.

   Response: There is no current requirement to use multiple time history analyses. The Dresden Station and, as far as we can determine, all previously licensed free standing fuel racks have been analysed using only one time history. This and other recent NRC requests to use multiple time history analyses apparently originate from NUREG/CR-1161 (Ref. 2), which "recommends changes in the . . . criteria now used in the seismic design of nuclear plants". We are not aware of any actual adoption of these recommendations, nor of any other such requirement. Please refer to the discussion in Page 1-2 of Reference 16, wherein, "the possible sensitivity of the nonlinear response to the change in the input time history and to the change in the friction coefficient" was considered by way of selecting an input ground response spectrum having 54 percent higher

Zero Period Acceleration and much more frequency content than the applicable site-specific response spectrum. Additionally, the effect of peak-broadening of the floor response spectrum, which was used in Reference 16, is similar to the effect of using miltiple time-history and is a commonly used method. In fact, the use of a time-history compatible with a peak-broadened floor response spectrum can account for time-history sensitivity more completely than the use of three arbitrary time-histories. Thus, we maintain that we have used recognized and proven methods compatible with published NRC requirements, and that no additional analysis is necessary to establish the conservatism of the loads for which the rack and the pool structures have been evaluated.

We would also like to point out that the use of multiple time histories for certain analyses is only one of many recommendations in NUREG/CR-1161. Imposing only one recommendation, without considering all of them, could be either ultra-conservative or non-conservative. It certainly does not appear that the NUREG suggested such an approach, but rather suggested an overall revision of requirements. Moreover, the conclusion of NUREG/CR-1161 seems to be that existing analysis methods are overly conservative, and that adoption of its recommendations would reduce conservatism. In support of this conclusion we quote:

a. Section IV. B (page 41)-"The use of time histories for which the response spectra envelop the design respose spectra . . . tends to artifically introduce an added and unnecessary conservatism . . .". This same statement is found in Appendix C, Section 5.1 (page 147).

b. Appendix D (pages 186 and 187)-"This requirement (the present requirement) imposes an additional significant FOC (factor of conservatism) . . ."

c. Appendix D (page 193)-"was proposed to . . . lead to the elimination of conservatism . . ."

d. Appendix D (page 201)- "I do not agree with the recommendation . . ., a single artificial time history with a response spectrum which envelopes a broad base design spectrum is more than sufficient".

The above review of NUREG/CR-1161 is not intended to evaluate the worth of its recommendations, but only to show that the requested analyses may not provide results which are any more valid than those obtained from the

analysis used in the October 2, 1981 submittal (Ref. 16). Thus, it is our position that we have used recognized, long standing, and proven methods, that no other analyses are necessary to demonstrate the suitability of the subject fuel racks, and that the methods we have used are probably more conservative that those recommended in NUREG/CR-1161 and those suggested in Comment No. 3 above.

4. Comment: Revise model to include fuel assemblies so that the time history record will include fuel assembly impact. Therefore a "rattle factor" would be unnecessary. If a "rattle factor" is used, justify the apparently low value of 1.08-1.48.

   Response: A "rattle factor" was not used. As is described in Section 3.2 and Figure 3-1 of the October 2, 1981 submittal (Ref. 16), the analysis model included the fuel and the gap between the fuel and the rack. Therefore, the fuel will impact (rattle) as dictated by the effect of the time history. As is stated, this analysis "assumed that all of the fuel assemblies in a rack will "rattle" in-phase", which is conservative. Since the dynamic response resulting from this analysis was less than that obtained in the earlier analysis (Ref. 4), in which "rattle factors" were used to account for the nonlinear behavior resulting from gap, we do not consider it necessary to justify the value of the "rattle-factors" used, as these no longer formed the design-basis.

5. Comments: Calculate hydrodynamic effects in accordance with classical theory rather than simply by adding mass of external water.

   Response: The effect of hydrodynamic mass was considered using the commonly-used virtual or added mass concept as outlined in the report, "Effective Mass and Damping of Submerged Structures" (Report No. UCRL-52342). This is an NRC-sponsored study report, and the OT position paper (Ref. 1) considers its recommendations on the use of added mass as acceptable. This was earlier discussed with Mr. Herring of the NRC who also concurred with such representation of hydrodynamic mass.

6. Comment: In calculating capacity, do not take credit for shear friction. Use slab formulas from ACI 349.

   Response: The slab capacity based on diagonal shear, as noted in Section 4.2 of the September 30, 1981 submittal is based on ACI 349. The report states "flexure and shear friction capacities are much higher". The report does not actually take credit for these higher capacities. However, since the slab evaluation described in the October 2, 1981,

submittal is based on higher shear loads, and since the slab capacity was found to be adequate even without taking credit for shear-friction, no further evaluation is deemed necessary.

The NRC verbally advised CECo that the question on use of shear friction came from a 1979 transmittal, however the NRC has not provided a specific reference and a search of questions and responses has failed to find any reference to use of shear friction.

7. Comment: Provide data on dimensions and tolerances of fuel assemblies and tubes as well as fabrication tolerances. Justify the tube dimensions and center-to-center spacing for all conditions.

   Response: The structural calculations were based on nominal dimensions. Because of the requirement to meet the overall rack dimensions, any plus or minus cell dimensions would average to near the nominal dimensions and little change in results would occur. The gap between the fuel and/or fuel channel and the cell walls is accounted for in the analytical model. Fuel rack drawings have been provided to the NRC and it is our understanding from the December 22, 1981 call (Ref. 18) that no additional information is needed.

8. Comment: Present all pertinent numerical values of results of design analysis with respect to loads, stresses, deformations and movements for both the racks and the SFP walls and floor.

   Response: The requested data is presented in the Licensing Report (Ref. 4). The October 2, 1981 submittal was of limited scope and did not concern most of the requested analysis results. Furthermore, it would be misleading to combine the October 2, 1981 results with earlier results because of the differences in input and type of analysis. The intent of the October 2, 1981 report was to substantiate the earlier analyses and to address rack-to-pool floor impacts, and was not intended or required to be a complete analysis.

We have attempted to list all material and meetings applying to or leading up to the subject analysis. This list is attached as Attachment 1.

In response to an additional request from Mr. P.W. O'Connor, we are attaching a letter and curves from Quadrex Corp. (formally Nuclear Services Corp.) as Attachment 2.

One signed original and thirty-nine (39) copies of this transmittal are provided for your use.

If you have any questions on the above, please contact this office.

Very truly yours,

Thomas J. Rausch

Thomas J. Rausch
Nuclear Licensing Administrator

Attachments

cc: Region III Inspector - Dresden
Region III Inspector - Quad Cities

mnh/lm

3276N

Attachment 1

Chronological Listing of Relevant Events and Transmittals

| Ref. No. | Date | Item |
|---|---|---|
| 1. | 4/14/78 | "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications" issued to all reactor licensees. Amended 1/18/78. |
| 2. | 5/-/80 | NUREG/CR-1161, "Recommended Revisions to Nuclear Regulatory Commission Seismic Design Criteria". |
| 3. | 6/6/80 | "Safety Evaluation by the Office of Nuclear Reactor Regulation Relating to the Modification of the Spent Fuel Pool, Provisional Operating Licensing No. DPR-19 and Facility Operating License No. DPR-25, Commonwealth Edison Company, Dresden Nuclear Power Station Unit Nos. 2 and 3, Docket Nos. 50-237 and 50-249". |
| 4. | 1/19/81 | Date of Rev. No. 5 (Current) of the "Licensing Report, Dresden Nuclear Power Plant Units 2 and 3, Spent Fuel Rack Modification". Rev. No. 0 was dated December 30, 1977. |
| 5. | 4/29/81 | Conference call (NRC/CECo/NSC). NRC presented concerns regarding tilting and sliding analysis. |
| 6. | 5/5/81 | Date of Affidavit of Anand K. Singh regarding seismic issues at Dresden. |
| 7. | 5/13/81 | NRC request for additional information (4 questions). This request expanded scope of Ref. 5 above. |
| 8. | 6/8/81 | CECo. response to Ref. 7 submitted to NRC (response dated 6/5/81). |

Con't
Attachment 1

## Chronological Listing of Relevant Events and Transmittals

| Ref. No. | Date | Item |
|---|---|---|
| 9. | 6/9/81 | Meeting held between NRC and SEP plant owners group to discuss site specific spectra and methods for use. |
| 10. | 6/12/81 | Letter sent by CECo. to Licensing Board informing Board of NRC concerns and CECo. response. Included an explanation, a "Rack-to-Rack Impact Evaluation," and Ref. 8 above. |
| 11. | 6/19/81 | Conference call (NRC/CECo.). NRC presented 6 additional concerns. |
| 12. | 6/30/81 | Meeting in Bethesda (NRC/CECo./NSC). Discussed CECo. responses to Ref. 11. NRC presented 5 additional concerns. |
| 13. | 7/17/81 | Meeting in Bethesda (NRC/CECo./NSC). NRC expressed concerns with original NRC review of Licensing Report (Ref. 4). The NRC stated that only floor loads were any longer of interest. The NRC consolidated their concerns as noted in Ref. 14 below. CECo. presented drafts of the proposed responses to 7 earlier NRC requests (date not documented). Based on this meeting, the drafts were never finalized or submitted to the NRC, therefore they should not be considered in any formal evaluation. |
| 14. | 7/20/81 | NRC issued notes of meeting of 7/17/81 (Ref. 13), including draft response. |

Con't
Attachment 1

## Chronological Listing of Relevant Events and Transmittals

| Ref. No. | Date | Item |
|---|---|---|
| 15. | 7/23/81 | Conference call (NRC/CECo./NSC). CECo. presented 2 analysis approaches to be used in lieu of the multiple time-history analyses requested by the NRC. The second approach was based on guidelines set forth in the NRC/SEP owners group meeting of Ref. 9 above. Mr. Russel agreed that the approach was per that meeting except for use of a single time-history scaled to 0.2g and broaded per Reg. Guide 1.60, as being more conservative than the plant specific 0.12g spectrum. |
| 16. | 10/2/81 | Report QUAD-1-81-928, "Evaluation of the Effects of Postulated Rocking of Racks on Spent Fuel Pool Structures of Dresden Nuclear Station Units 2 and 3", Rev. No. 0, dated 9/30/81, submitted by CECo. |
| 17. | 11/30/81 | NRC internal memo from O. Rothberg to P.W. O'Connor, "Subject: Dresden SFP-Preliminary Recommendations for Final Submittal from Applicant". |
| 18. | 12/22/81 | Conference call (NRC/CECo.). Discussed memo of Ref. 17. CECo. was requested and agreed to provide a written response. |

Attachment 2

QUADREX CORPORATION
1700 DELL AVENUE
CAMPBELL
CALIFORNIA 95008

408 866-4510
TWX 910-590-2438
TELEX 35-2031

December 24, 1981
CCT-81-12

Mr. J. Laird Woldridge
Commonwealth Edison Company
Station Nuclear Engineering
Room 35 West
One First National Plaza
Chicago, IL 60690

Subject: Response Spectra and Time History Plots, Dresden Station

Dear Mr. Woldridge:

Enclosed are response spectra and acceleration time-history (in g unit) plots for Dresden Station. Plots No. 1 through No. 6 were provided to us by URS/John A. Blume & Associates, San Francisco. Plots No. 7 through No. 10 were generated using the pool floor time-history data (based on El Centro quake ) supplied to us by Sargent & Lundy Engineers, Chicago.

Plot 1 - N-S broadened pool floor response spectrum developed from NRC Reg. Guide 1.60 response time-history and response spectrum generated from synthetic floor time-history of Plot 2.

Plot 2 - synthetic floor time-history (NS)

Plot 3 - similar to Plot 1 in E-W

Plot 4 - synthetic floor time-history (EW)

Plot 5 - broadened pool floor response spectrum developed from site specific response time-history in N-S

Plot 6 - similar to Plot 5 in E-W

Plot 7 - pool floor response spectrum due to time-history of Plot 8 (N-S)

Plot 8 - acceleration time history in N-S based on El Centro quake

Plot 9 - similar to Plot 7 in E-W

Plot 10- similar to Plot 8 in E-W

Time history used in our non-linear analysis (refer to our report No. QUAD-1-81-928 dated 9/30/81) is the one given in Plot 2 above.

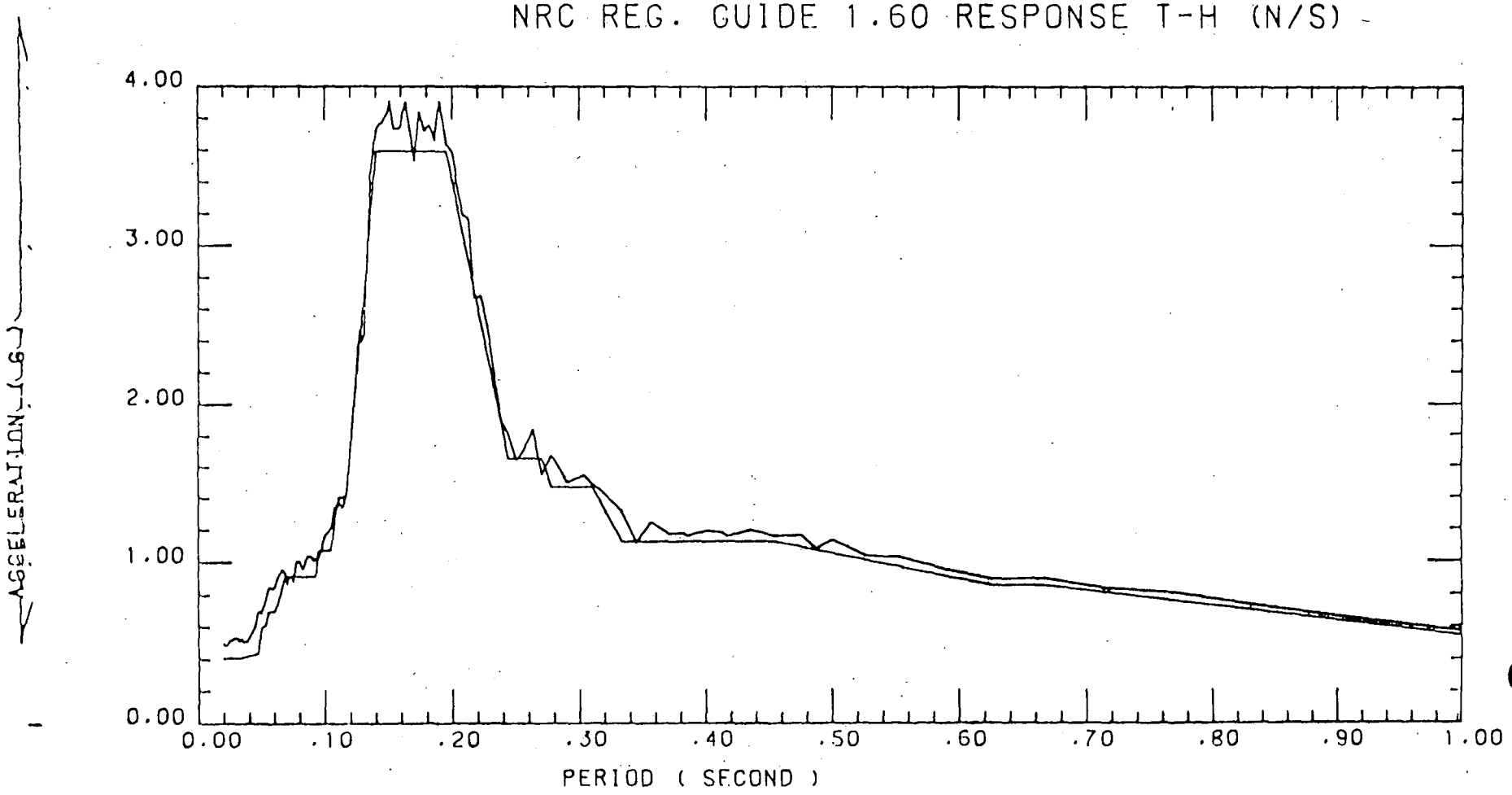
If you have any questions, please call me.

Sincerely,

C. C. Tang
Consultant Engineer

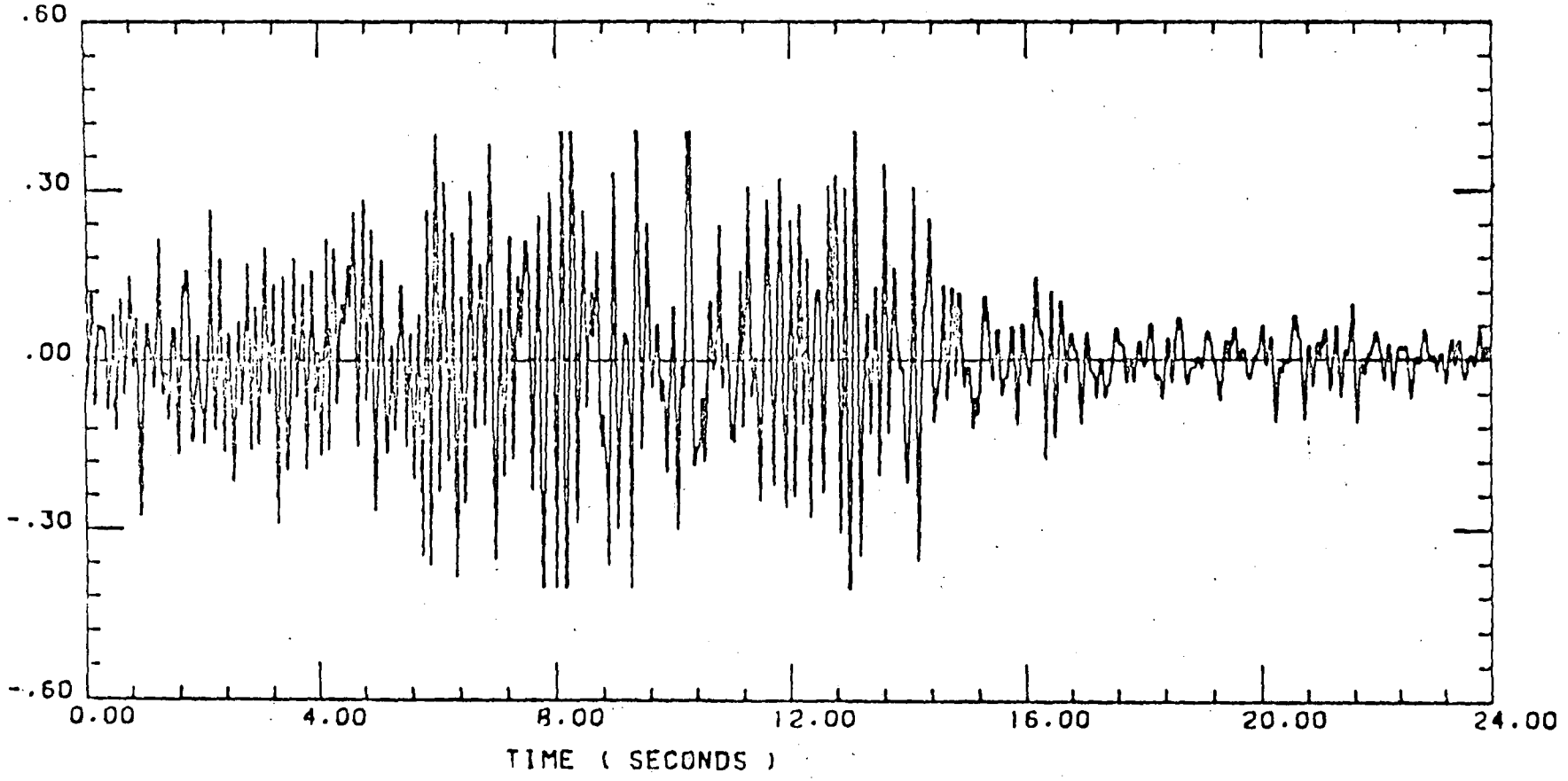
CCT/bd

Enclosures




Plot 1

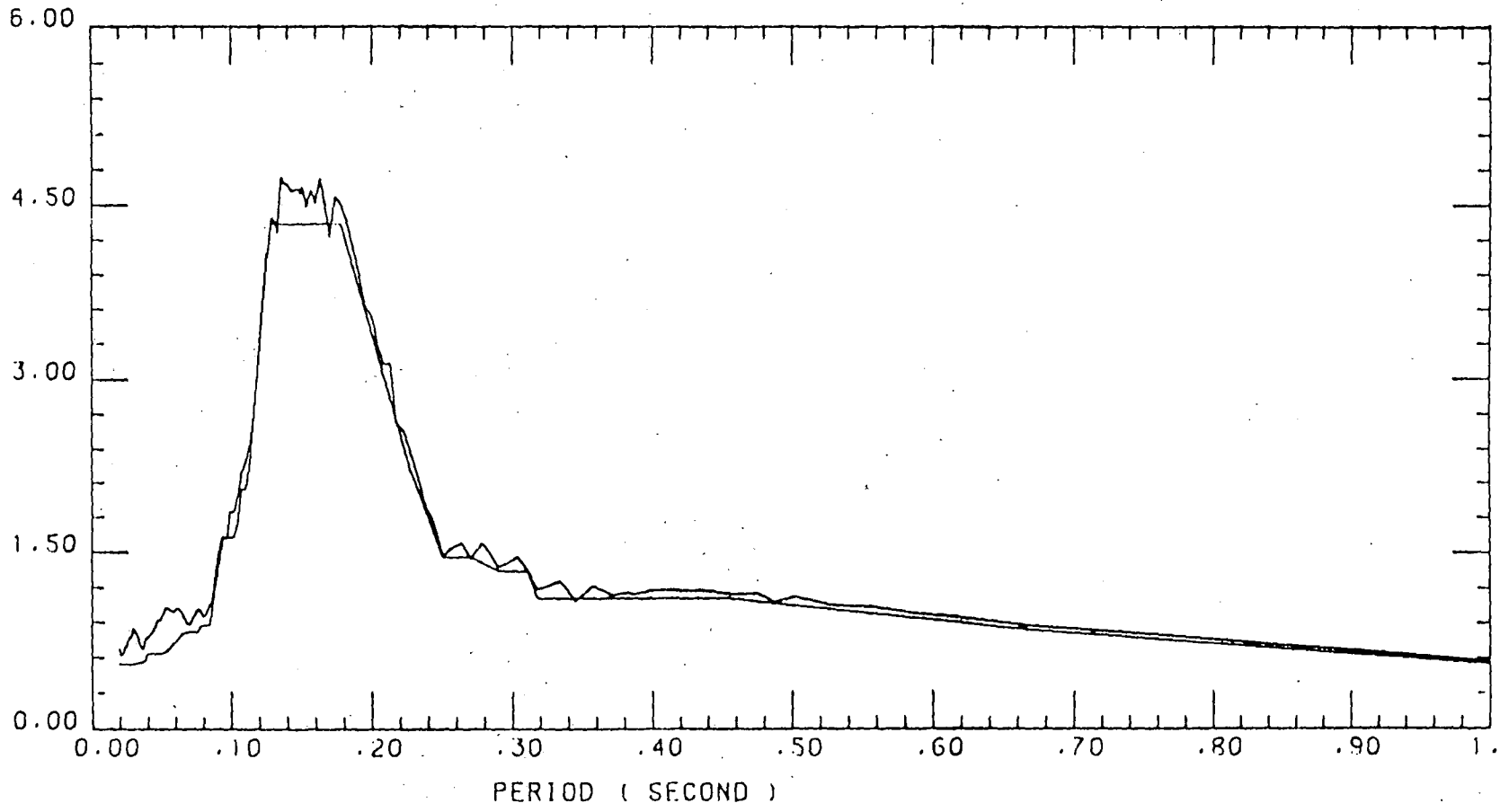
DRESDEN 2 REACTOR-TURBINE BUILDING
NRC REG. GUIDE 1.60 RESPONSE T-H (N/S)




FLOOR TIME HISTORY, ELEV. 570 FT.
ITERATION = 5+5+5, DAMPING= 0.02

Plot 2

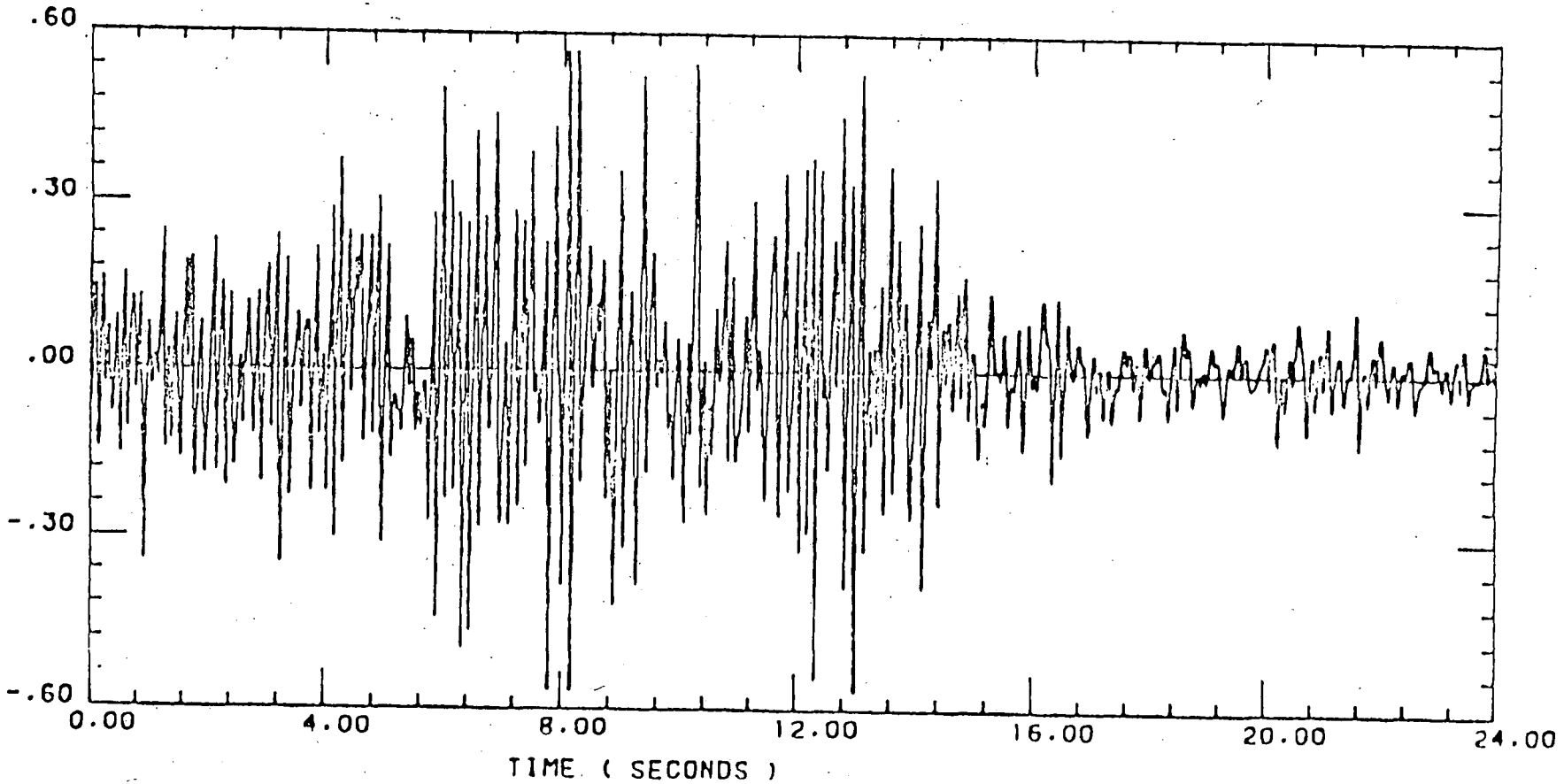
DRESDEN 2 REACTOR-TURBINE BUILDING
NRC REG. GUIDE 1.60 RESPONSE T-H (E/W)




FLOOR RESPONSE SPECTRUM, ELEV. 570 FT.
ITERATION =5+5+5; DAMPING = 0.02

Plot 3

DRESDEN 2 REACTOR-TURBINE BUILDING
NRC REG. GUIDE 1.60 RESPONSE T-H (E/W)



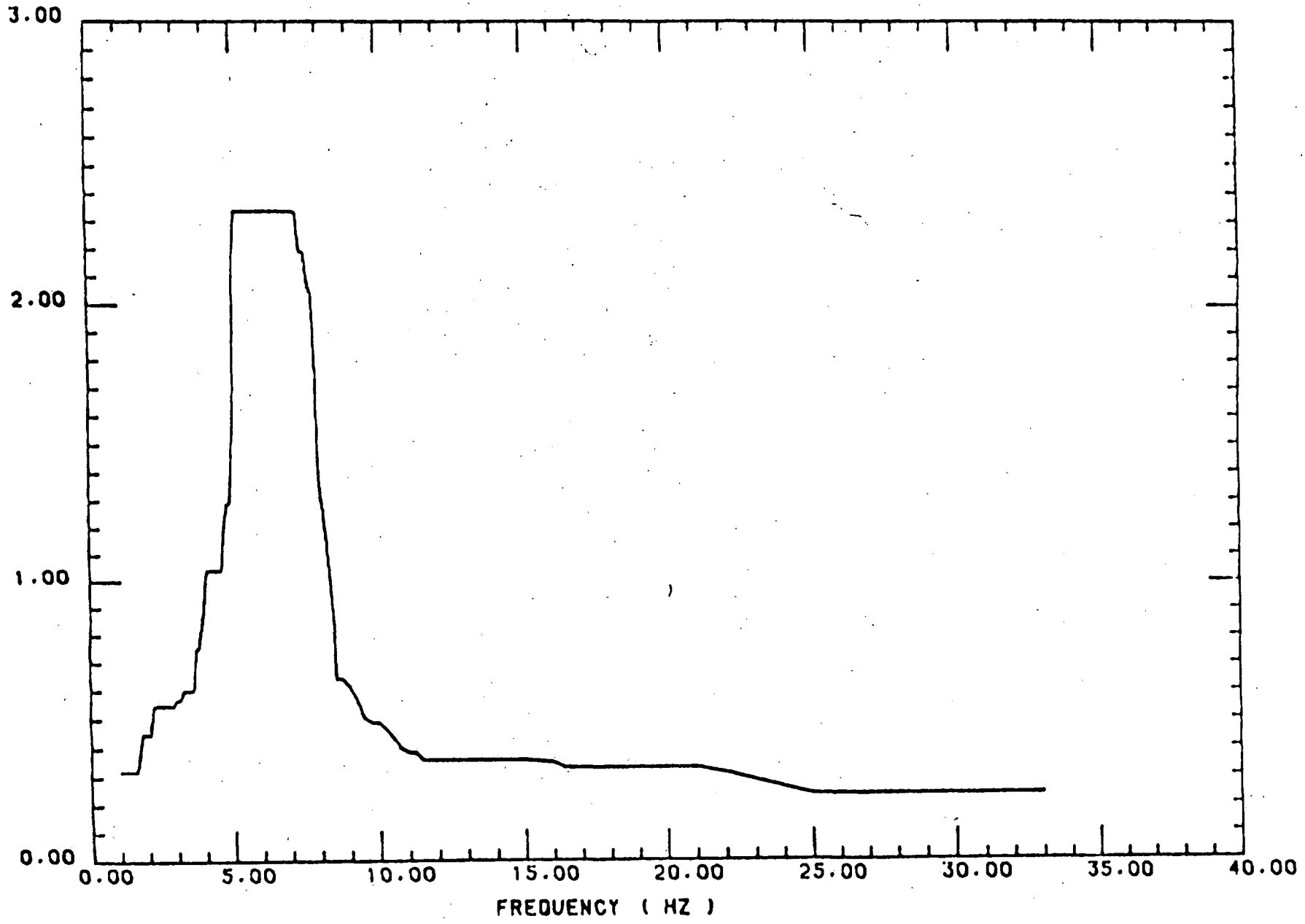

FLOOR TIME HISTORY, ELEV. 570 FT.
ITERATION = 5+5+5, DAMPING= 0.02



URS/Blume

Plot 4

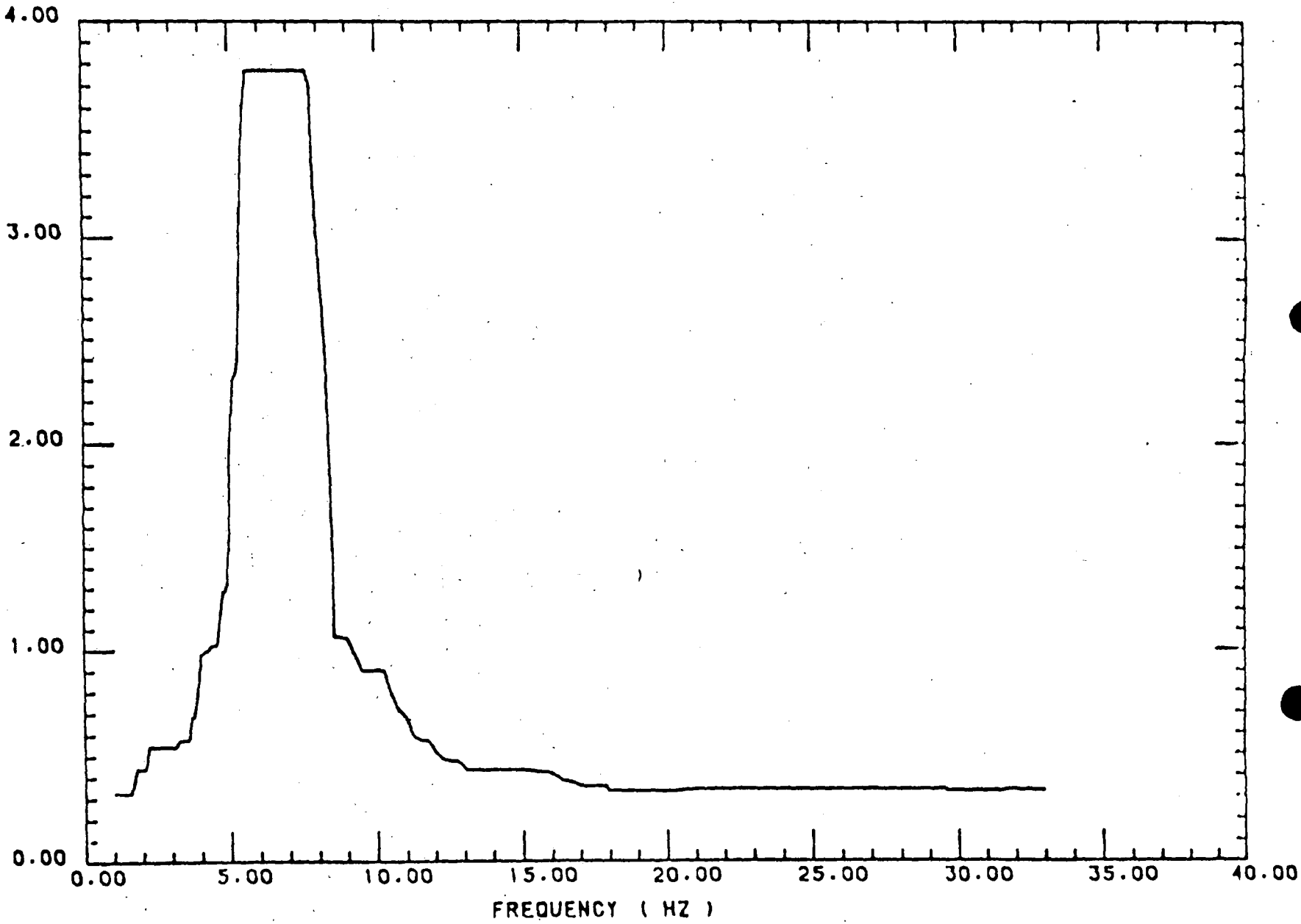
DRESDEN 2 REACTOR-TURBINE BUILDING
FLOOR RESPONSE SPECTRA N/S DIRECTION




BLUME NODE 6, ELEV. 570 FT. DAMP=0.02
SITE SPECIFIC RESPONSE TIME HISTORY

Plot 5

DRESDEN 2 REACTOR-TURBINE BUILDING
FLOOR RESPONSE SPECTRA E/W DIRECTION

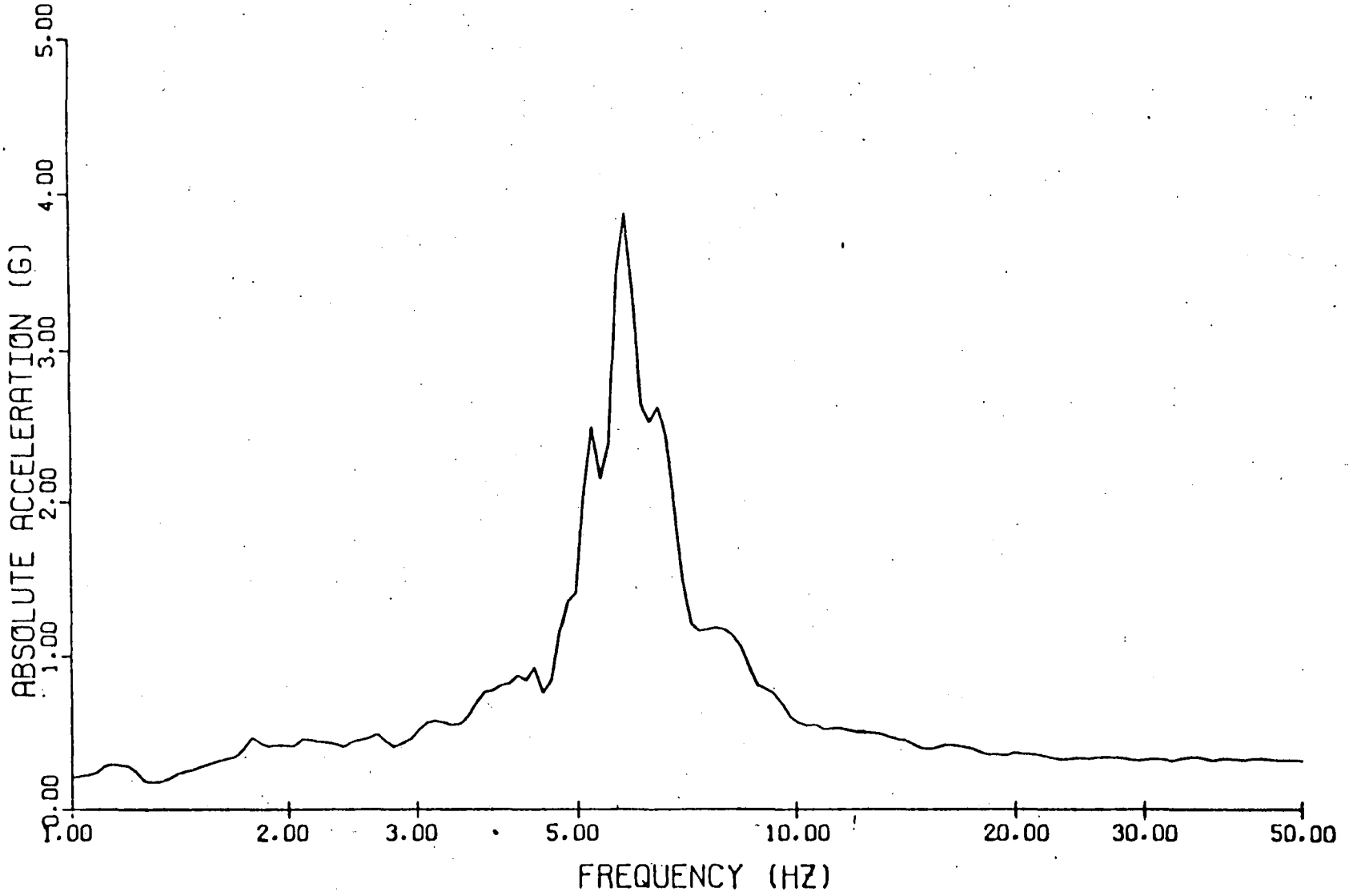



BLUME NODE 6, ELEV. 570 FT. DAMP=0.02
SITE SPECIFIC RESPONSE TIME HISTORY

Plot 6



URS/Blume

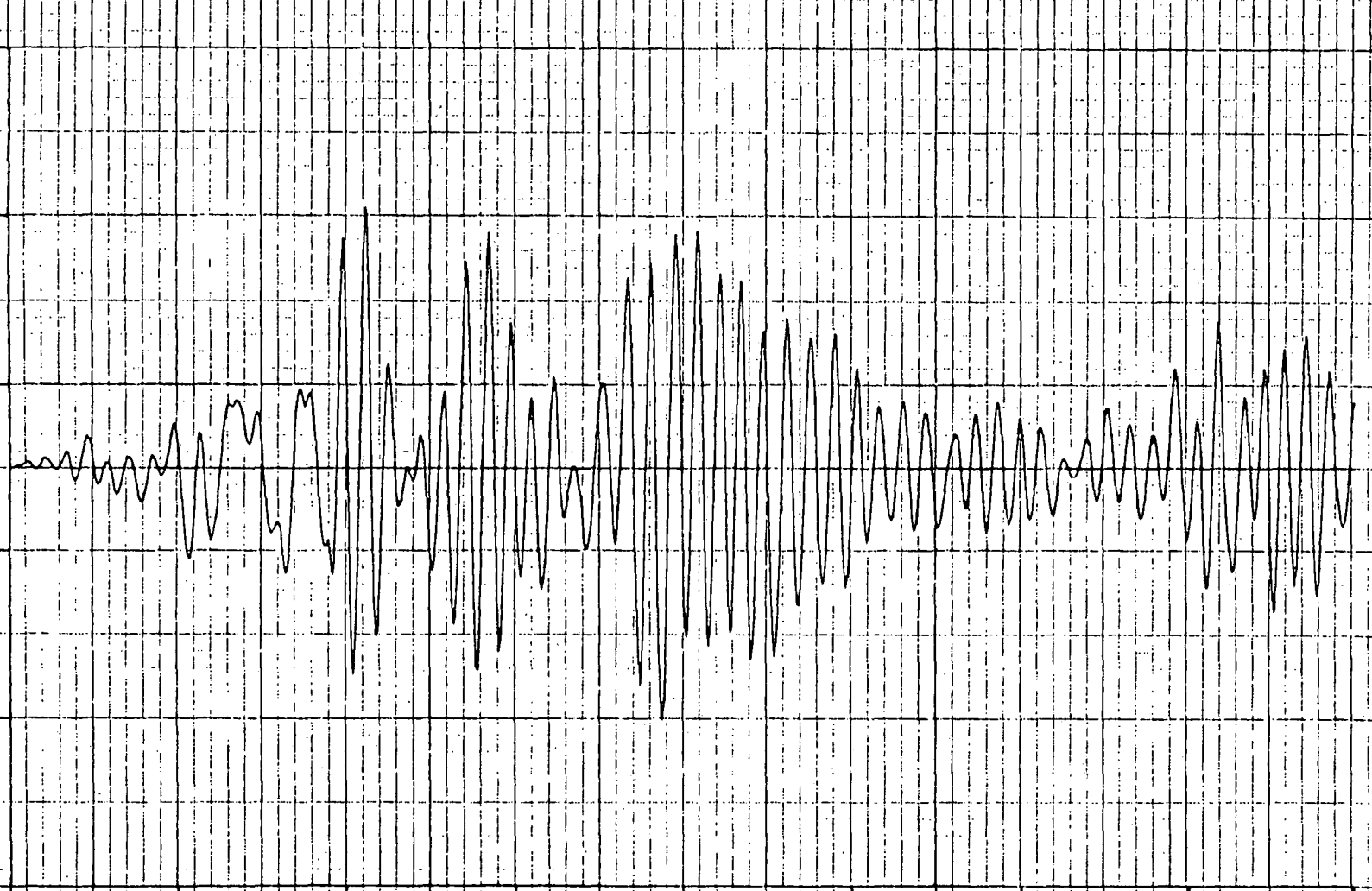



RESPONSE SPECTRUM--TIME HISTORY NO 4 (DRESDEN OBE NS)

(DAMPING = 0.02)

Plot 7

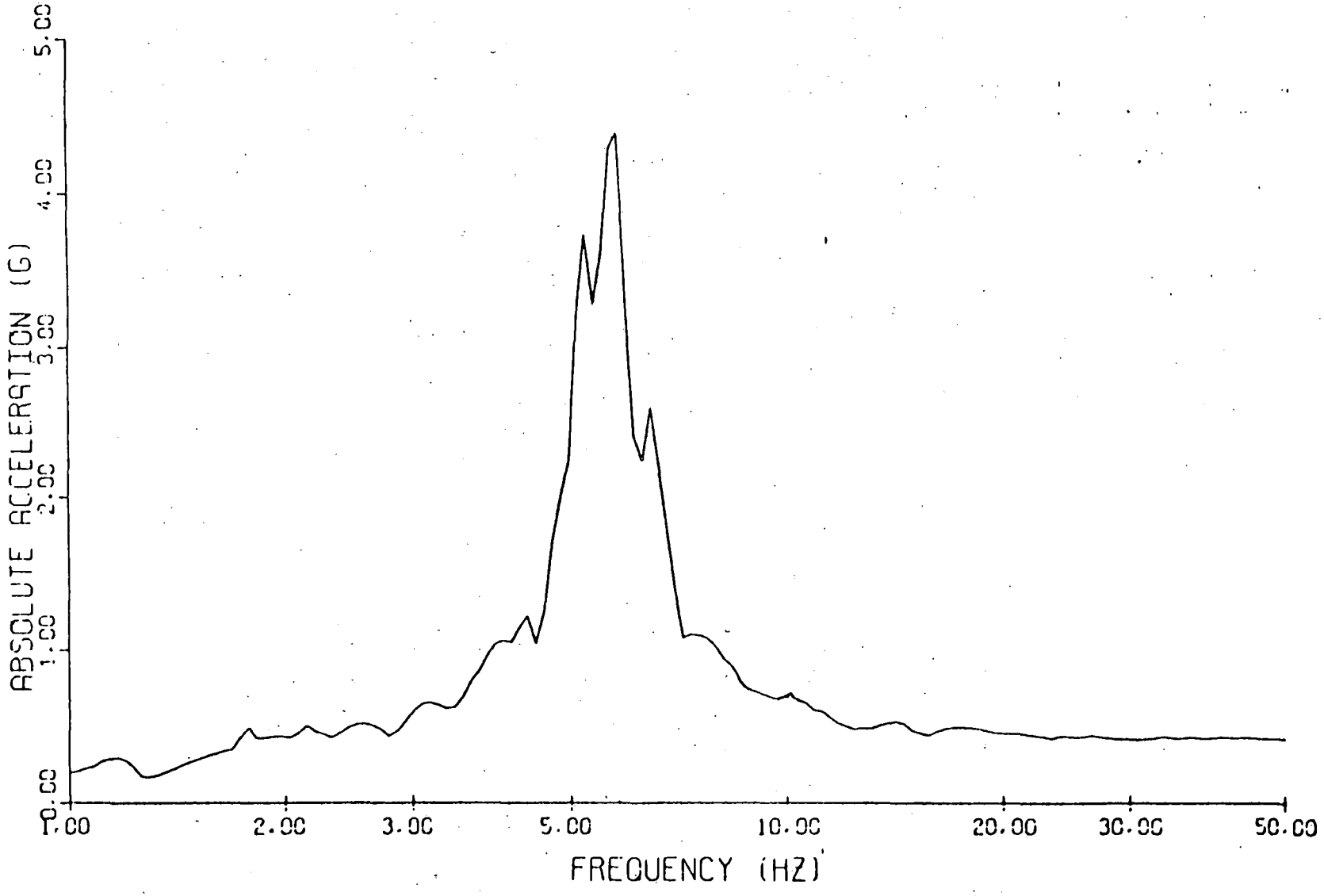
NUCLEAR SERVICES CORPORATION




Q1-2

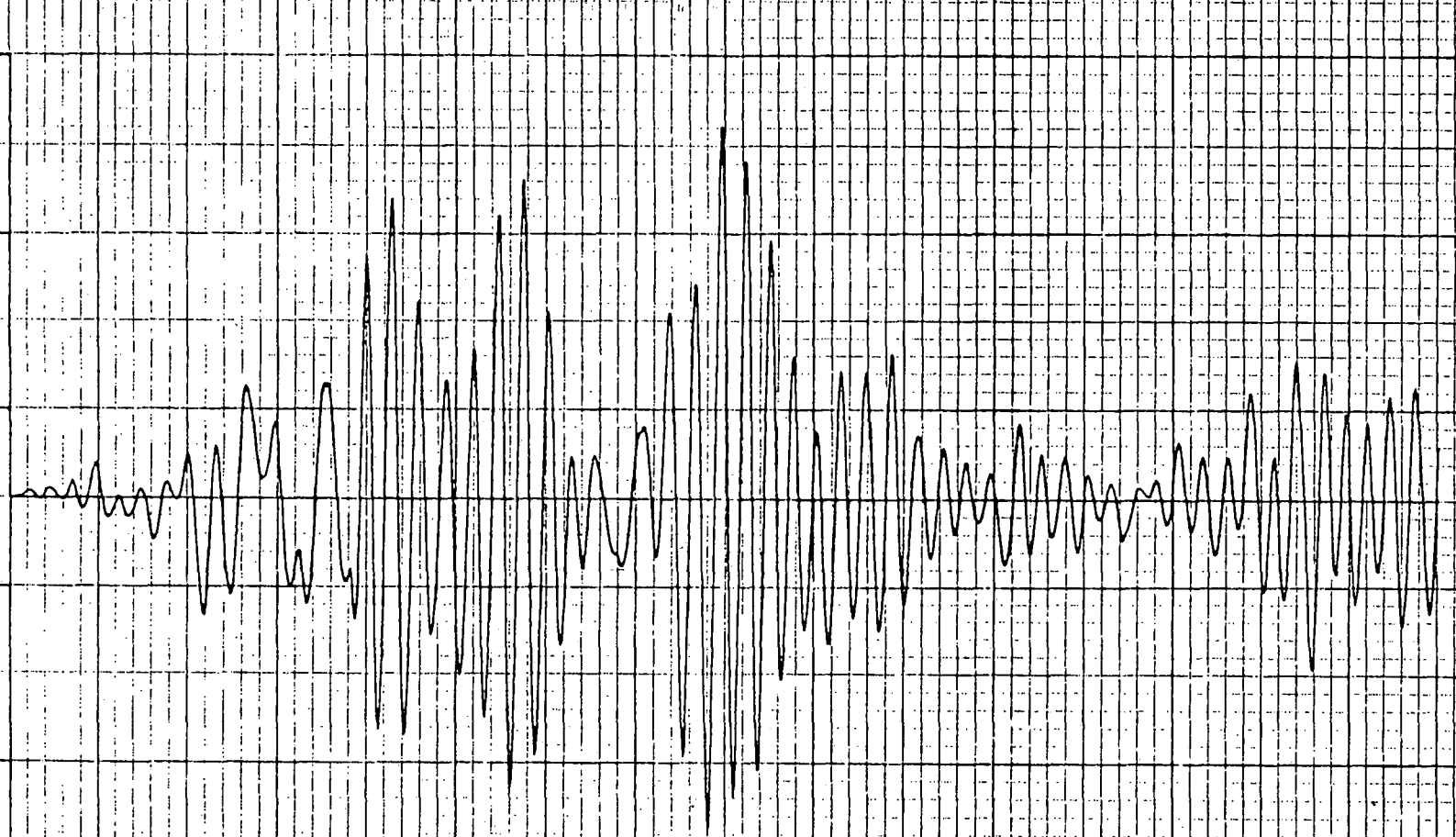
ACCELERATION TIME HISTORY NUMBER 4 (DRESDEN OBE NS)

Plot 8




RESPONSE SPECTRUM--TIME HISTORY NO 7 (DRESDEN OBE EW)
(DAMPING = 0.02)
Plot 9

NUCLEAR SERVICES CORPORATION




21-2

ACCELERATION TIME HISTORY NUMBER 7 (OBE)

Plot 10