UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
DAIRYLAND POWER COOPERATIVE	)	Docket No. 50-409
	)	(FTOL Proceeding)
(LaCrosse Boiling Water Reactor)	)	

AFFIDAVIT OF ROBERT JACKSON, JEFFREY KIMBALL, LEON REITER AND WILLIAM RUSSELL ON SEISMIC ISSUES AT LACROSSE

I, Robert E. Jackson, being duly sworn, state as follows: I am employed as the Branch Chief of the Geosciences Branch of the Division of Engineering, Office of Nuclear Reactor Regulation. A copy of my professional qualifications is attached.

I, Jeffrey K. Kimball, being duly sworn, state as follows: I am employed as a Seismologist/Geophysicist in the Geosciences Branch of the Division of Engineering, Office of Nuclear Reactor Regulation. A copy of my professional qualifications is attached.

I, Leon Reiter, being duly sworn, state as follows: I am employed as the Section Leader of the Seismology Section in the Geosciences Branch of the Division of Engineering, Office of Nuclear Reactor Regulation. A copy of my professional qualifications is attached.

I, William Russell, being duly sworn, state as follows: I am employed as the Branch Chief of the Systematic Evaluation Program Branch of the Division of Licensing, Office of Nuclear Reactor Regulation. A copy of my professional qualifications is attached.

In the November 13, 1981 Atomic Safety and Licensing Board Memorandum concerning the LaCrosse Boiling Water Reactor (Docket No. 50-409 SC, Prov.

Op. Lic. DPR-45) the Board called attention to Staff testimony which might be pertinent in discussing the relationship of the Tyrone SSE to that of the LaCrosse site. The Tyrone SSE was also discussed in the attached January 4, 1980 Staff Memorandum (Attachment 1) from Robert Jackson (Chief, Geosciences Branch) to Olan D. Parr (Chief, Light Water Reactors Branch #3). Both of the above-mentioned references are used to discuss the SSE at Tyrone. In addition, a summary of the overall seismic design adequacy of the LaCrosse site will be reviewed.

The Tyrone site is near the town of Durand in Western Wisconsin. The site is located in what is commonly called the Central Stable Region of the United States. In the Tyrone SER (1975), the Staff considered the intensity VII-VIII Anna, Ohio earthquake of 1937 as the largest earthquake in the Central Stable Region which could not be reasonably associated with known geologic structure. The Staff also discussed the Midcontinent Geophysical Anomaly (both gravity and magnetics) which is located approximately 45 miles northwest of the Tyrone site and assumed that an intensity MMI=VIII could occur on the anomaly, and attenuated the ground motion from this event to the site. In addition, however, it is stated in the SER that the area in which the Tyrone site is located is seismically very quiet. No historical earthquakes had been reported within about 100 miles of the site.

For the standard design of Tyrone the SSE chosen by the Applicant was 0.20g peak acceleration, because this was a SNUPPS (Standardized Nuclear Unit Power Plant System) plant which used 0.20g as the standard design input. However, the applicant has proposed the use of 0.14g for the non-standard portion of the plant. After review, the Staff recommended the use of 0.20g for all safety related features at Tyrone

based on the intensity VII-VIII earthquake as a matter of assuring conservatism. This peak acceleration was to be used with the Regulatory Guide 1.60 response spectra.

Nevertheless, the Staff, both in the past and currently, recognizes that significant variations exist in historic seismicity within the Central Stable Region. Based on the low level of seismicity in the vicinity of the Tyrone site, had the applicant given sufficient supportive bases, the Staff may have considered an intensity lower than MMI=VII-VIII for the design of the plant, but this was not done by the applicant. The Staff reviews applications in comparison to standard review plans and regulatory guides, but it is possible for applicants to obtain Staff approval of variances from Staff review guides if sufficient supporting data is provided.

Specific elements of these considerations are contained in Attachment 1 (Jackson to Parr Memorandum). For example, the conclusion states, "based upon our evaluation of the SER's for the most recent licensing decisions, we conclude that it is not necessary to have the same SSE at the Tyrone and Wolf Creek sites." (The Jackson to Parr memorandum discussed why Wolf Creek and Tyrone had different SSE's). "Applying a current intensity-attenuation relation at both sites, a site intensity of VII is an adequately conservative value for the effects of the maximum earthquake on significant nearby structures. At the Tyrone site the maximum random earthquake was conservatively chosen by the Staff to be intensity VII-VIII but the Staff could have considered a lower intensity based on the low level of seismicity in the vicinity of the site."

During the review for the Midland site (the testimony discussed in the Board Memorandum) the Staff utilized two main techniques to evaluate the SSE. These were the development of a site specific spectra and the use of a relative seismic hazard analysis. Midland, like Tyrone, is located within a region of low seismicity. The SSE response spectra proposed by the applicant and ultimately accepted by the Staff after review of the seismic analyses and information provided by the applicant, was less than a Regulatory Guide 1.60 spectra anchored at 0.20g. The Staff approval of the applicant's lower value was based upon both the site specific spectra work and the seismic hazard analysis. However, if the Midland applicant had not presented sufficient data to support the use of an acceleration value less than 0.20g, the Staff could have imposed the higher value.

It should be noted that the seismic zonation described at the Midland hearing was specifically defined for only the Midland site. Although it was stated that Tyrone fell within the same general region which was described for Midland, (both regions of low seismicity activity) any specific definition for Tyrone would need a comparative seismic hazard analysis undertaken and detailed Staff review of this study. Since the Tyrone site is cancelled, such a study will not be performed. Thus, the Tyrone applicant might have been able to use a lower response spectra, if (1) they were to utilize the same techniques as the Midland applicant and (2) if these techniques were reviewed in detail and approved by the Staff.

The Staff typically reviews sites on a case-by-case basis. While the techniques and possibly some of the results for the Midland site could be applied to the Tyrone site, it would be speculation to apply the evaluation

for one site to another in the absence of specific studies. At the Tyrone site the maximum random earthquake was conservatively chosen by the Staff to be intensity MMI=VII-VIII but the Staff could have considered a lower intensity if the applicant had demonstrated that the site was in a region of significantly lower seismicity than the rest of the Central Stable Region.

Although such a study was not done for Tyrone, site specific studies have been performed by the Staff for the LaCrosse site as part of the Systematic Evaluation Program. The seismic design (vibratory ground motion) input parameters for use in evaluating the overall seismic design adequacy of the LaCrosse site has been determined by the Staff. The Staff position is contained in the June 17, 1981 "Letter to All SEP Owners (Except San Onofre)", Attachment 2. The supporting bases for the Staff determination of the appropriate ground motion response spectra are contained in Attachment 3, Memorandum to D. Crutchfield from Robert Jackson dated June 23, 1980 entitled "Initial Review and Recommendations for site Specific Spectra at SEP Sites" and Attachment 4, Memorandum to William Russell from Robert Jackson dated May 20, 1981 entitled "Final Review and Recommendations for Site Specific Spectra at SEP Sites." These documents constitute the Staff's position as a result of its review of NUREG CR/1582, Seismic Hazard Analysis Volumes 2, 3, 4 and 5. The Staff's position for LaCrosse is contained in figures 10 and 15 of the June 23, 1980, Jackson to Crutchfield Memorandum and is reproduced in Figure 1.

The SEP site specific spectra program is not solely a probabilistic method. It was conceived as a multi-method approach for determining site specific spectra for given sites. It encompassed probabilistic approaches

at predicting peak acceleration, peak velocity and uniform hazard spectra for different return periods, empirical approachs for calculating 50th and 84th percentile spectra at different magnitudes, different site conditions and distance ranges, and comparisons with Regulatory Guide 1.60. The probabilistic approach utilized is basically that suggested by Cornell (1968) which has been modified to formally incorporate expert opinion.

The probabilistic aspect of the SEP methodology, (properly termed a "uniform hazard spectra") is determined to represent the composite risk to a site from a variety of different potential earthquake source zones and relevant background seismicity as determined from a variety of experts. This latter aspect (i.e. solicitation of expert opinion) is the most innovative aspect of the SEP approach and potentially represents a significant improvement over the single expert or single "province" approach utilized under Appendix A to 10 C.F.R. 100. A recurrence model is determined utilizing the historic seismicity. Such probabilistic models assume that earthquake occurrence follows a Poisson process (i.e. that earthquakes occurred randomly in time and space in a given source). The ground motion at the site resulting from the many different earthquakes in different zones is estimated from relationships (such as magnitude-ground motion) that explicitly incorporate the dispersion of the data about such relationships. Finally, integrating the effect of different size earthquakes from different locations in different sources with the recurrence information, the probabilities that given levels of ground motion will not be exceeded in given time periods are calculated. The result of this procedure is the development of a group

of synthesized uniform hazard ground motion response spectra which have certain relative exceedance probabilities related to them.

It was also decided that a minimum spectra be established which no uniform hazard spectra could go below. This minimum is the median (50th percentile) representation of real spectra (similar to what was done for Midland) for a magnitude 5.3 earthquake. The resulting real spectra for the LaCrosse site are displayed in Figure 1. This minimum was found to exceed the "1000 year" spectra for LaCrosse at frequencies greater than 2 to 3 Hz. Our estimate is that although the recommended spectra are labelled "1000 year" spectra the actual return periods associated with these spectra are longer. While we are not sure what the precise return periods would be, we estimated that they ("1000 year" spectra) have return periods of the order of 1,000 or 10,000 years. Figure 2 shows the LaCrosse spectra (combined Uniform Hazard Spectra and median spectra from real time histories) along with a Regulatory Guide 1.60 spectra anchored at 0.12g.

The SEP program was developed over a number of years with Commission awareness and approval. Throughout the development of this program, an attempt has been made to describe in as realistic a manner as possible, the actual design basis events. The Staff has relied more heavily on an overall safety assessment rather than on specific single event parameter description. For example, the uniform hazard spectra is used in assessing the seismic capability of structures, systems and components. Although we are not aware of any specific case in which the Commission has approved use of probabilistic technique alone to establish an SSE, that is not what has been done for LaCrosse as discussed above. The Staff's approach in

SEP is to evaluate the actual design of a facility using current licensing criteria as specified in Regulations, Regualtory Guides, the Standard Review Plan and other documents. An existing plant design which meets or is equivalent to these criteria is acceptable and the results of the Staff review are documented. If however, the design does not meet or is not equivalent to current licensing criteria, the difference is evaluated on a realistic or best estimate basis to determine if backfitting is necessary. Early in the SEP it was known that some old plants might not meet current licensing criteria with respect to their seismic design and that the seismic review of these plants would be the most resource intensive and lengthy SEP topic reviews.

A two part approach for the SEP seismic review was developed. The review of the seismic hazard was pursued in parallel with the review of the capacity of structures, systems and components to resist seismic shaking. The review of seismic capacity was performed by the Staff on five plants using conservative seismic input (i.e. Regulatory Guide 1.60 spectra). The Staff believed that the recommended SEP spectra would be enveloped by the more conservative Regulatory Guide 1.60 spectra. This permitted parallel rather than series review of the overall seismic adequacy of these plants. For five other plants, including LaCrosse, the Staff directed a reanalysis of the facility using either the preliminary spectra from the SEP approach or a spectra proposed by the licensee. For LaCrosse, the licensee utilized a Regulatory Guide 1.60 spectra at 0.12g peak ground acceleration. Other utilities have chosen different approaches to their reanalysis program.

The Staff issued a safety evaluation report (Attachment 5) for LaCrosse, which provided our basis for continued operation during the seismic reanalysis and upgrading required as a part of SEP. It should be noted that the Staff's seismic review of LaCrosse was the origin of the identification of the liquefaction concern for soils at the LaCrosse site.

In summary, the higher acceleration value of 0.20g used for the Tyrone plant was selected by Staff as a conservative licensing approach for new plants, but if the Tyrone applicant had provided sufficient documentation, the Staff might have accepted a lower acceleration value. The SEP seismic hazard review is also a conservative approach but utilizes different methodologies. No analysis of the difference between the tectonic provinces of the Tyrone and LaCrosse sites has been performed, so that an explanation of these variations cannot be provided.

It is the conclusion of the Staff, based on the methodologies used in the SEP seismic review that the SSE of 0.12g used to anchor a Regulatory Guide 1.60 design spectra which was used for evaluation of the liquefaction potential for the LaCrosse site, is an adequate and conservative description of the size of the SSE for the LaCrosse site.

I hereby attest that the foregoing affidavit is true and correct to the best of my knowledge.

Robert E. Jackson

Jeffrey K. Kimball

Leon Reiter

William Russell

Subscribed and sworn to before me
this day of January, 1982

Notary Public

My Commission expires: July 1, 1982

ROBERT E. JACKSON, JR., PH.D.
GEOSCIENCES BRANCH
Division of Engineering
U. S. NUCLEAR REGULATORY COMMISSION

My name is Robert E. Jackson. I presently reside at 6609 Carleton Court Laurel, Maryland 20810 and am employed as Branch Chief, Geosciences Branch, Division of Engineering, Office of Nuclear Reactor Regulation, Washington, D. C. 20555.

PROFESSIONAL QUALIFICATIONS

I received a B. S. degree in Geology from the University of Rhode Island, and a Ph.D. degree in Geology from the University of North Carolina with a specialty in structural geology - rock mechanics.

I have been employed by NRC since August 1974 in the areas of Structural Geology and Fault Geology as applied to the evaluation of the suitability of nuclear power plant sites. My area of expertise includes structural geology of igneous, metamorphic and sedimentary rocks, rock mechanics, teconophysics, petrology, and fault identification and behavior. I am experienced in field analysis.

From 1973 to 1974 I was employed by Martin Marietta Laboratories in Baltimore, Maryland as a research scientist. My work for this corporate research and development laboratory consisted of a variety of problem-solving programs in rock mechanics relating to quarrying and blasting. I also contributed to programs in rapid tunneling and excavation technology. I also was involved in evaluating and developing new technologies for the crushed stone quarrying industry. I directed a program of investigation of sliding friction as it relates to earthquake source mechanicsms and frictional behavior of fault zones. While at Martin Marietta Laboratories, I was an author or co-author of 12 professional papers in these various fields.

From 1969 to 1973, I was a research assistant and teaching assistant at the University of North Carolina. My activity as a research assistant was in the development of a triaxial rock mechanics laboratory. One project I conducted in this lab was a study of experimental rock dilatancy as an earthquake mechanism. My dissertation was a study of sliding friction in foliated rocks and fault mylonites, including the behavior of fault gouge. Teaching experience consisted of teaching undergraduate and advanced structural geology laboraqtries as well as teaching field mapping. I have presented papers at national meetings of professional societies to which I belong, including the American Geophysical Union, Geological Society of America, and the International Society for Rock Mechanics.

From September 1978 to May 1979, I served as Leader, Geology and Seismology Section, Geosciences Branch. Since May, 1979 I have been Chief, Geosciences Branch. In this capacity I am responsible for managing staff review of the geological, seismologic, and geotechnical engineering aspects of nuclear facilities for which applications for licenses have been made. Since joining the Nuclear Regulatory Commission staff, I have participated in the licensing activity for approximately thirty sites.

LEON REITER
LEADER, SEISMOLOGY SECTION
GEOSCIENCES BRANCH
DIVISION OF ENGINEERING
U. S. NUCLEAR REGULATORY COMMISSION

My name is Leon Reiter. I presently reside at 1960 Dundee Road, Rockville, Maryland 20850 and am employed as a Seismologist, Geosciences Branch, Division of Site Safety and Environmental Analysis, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

PROFESSIONAL QUALIFICATIONS

I received a Bachelor of Arts degree in Geology from Brooklyn College in 1958, a Master of Science degree in Geology (Geophysics from the University of Michigan in 1968, a Master of Arts degree in Mathematics from the University of Michigan in 1970 and a Ph.D. in Geology (Geophysics) from the University of Michigan in 1971. In the year following receipt of my Ph.D. I was a National Science Foundation Post-Doctoral Fellow at the Institute of Geophysics and Planetary Geophysics in La Jolla, California. From 1972 to 1976 I was an Assistant Professor of Geophysics at the University of Oklahoma. During the summer of 1975 I was a visiting scientist of the U. S. Geological Survey National Center for Earthquake Research in Menlo Park, California. I joined the NRC in August, 1976 as a Seismologist and since August 1979 I have been Leader of the Seismology Section in the Geosciences Branch of the Division of Engineering.

My research during my academic career has included the areas of crustal exploration, seismic wave attenuation, midcontinent seismicity and tectonics, earthquake prediction and the application of seismic techniques to engineering problems. At NRC I have been actively involved in review of sites for nuclear facilities in all parts of the United States and in several foreign countries. I have also taken a lead responsibility for studies in the fields of strong motion seismology, near-field groundmotion, and probabilistic risk assessments.

I am a member of the American Geophysical Union, the Seismological Society of America, the Society of Exploration Geophysicists and the Earthquake Engineering Research Institute. I have served as a member of the Plate Interiors Working Group of the U. S. Geodynamics Committee, the Interagency Committee on Seismic Safety in Construction and the Panel on National Regional and Local Seismograph Networks of the National Research Council-National Academy of Sciences. I have authored or co-authored papers published in the Bulletin of the Seismological Society of America, the Journal of the Acoustical Society of America, the Proceedings of the American Society of Mechanical Engineers and National Science Foundation Conference Proceedings.

JEFFREY K. KIMBALL
GEOSCIENCES BRANCH, P-314
DIVISION OF ENGINEERING
U. S. NUCLEAR REAGULATORY COMMISSION
WASHINGTON, D.C. 20555

Ny nameis Jeffrey K. Kimball. I am employed as a Seismologist/Geophysicist reviewer, Geosciences Branch, Division of Engineering, Office of Nuclear Reactor Regulation.

I received a B.S. degree in Oceanography from the University of Michigan in 1977 and a M.S. degree in Geology from the University of Michigan in 1979, with a specialty in seismology and geophysics.

I have been employed by NRC since May 1980 as a Seismologist/Geophysicist reviewer as applied to the evaluation of applications for construction and operation of nuclear facilities, and to determine the thoroughness of this information for defining the seismic hazard for which facilities must be designed. Since joining the Nuclear Regulatory Commission staff, I have participated in the licensing activity for approximately ten sites.

From 1977 to 1980, I was a research assistant and teaching assistant at the University of Michigan. My activity as a research assistant included seismic data compilation studies for the U. S. Geological Survey and data analysis and operation of a nine station seismic network. My M.S. thesis work involved a study on surface wave dispersion of the Atlantic Ocean Basins and has been presented at national meetings of professional societies and published in a professional journal. Teaching assistant experience consisted of helping teach both introductory and advanced geology field courses in Wyoming for two summers and an introductory geology laboratory class at the University of Michigan.

I am a member of the American Geophysical Union and the Seismological Society of America, and have co-authored 7 publications including abstracts of presentations to professional societies and NUREG documents.

WILLIAM T. RUSSELL
SYSTEMATIC EVALUATION PROGRAM BRANCH
DIVISION OF LICENSING
OFFICE OF NUCLEAR REACTOR REGULATION
U.S. NUCLEAR REGULATORY COMMISSION

My name is William T. Russell. I presently reside at 103 South Cherry Grove Avenue, Annapolis, Maryland, 21401 and am employed as Branch Chief, Systematic Evaluation Program Branch, Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

PROFESSIONAL QUALIFICATIONS

I received a B.S. degree with majors in Mathematics and Systems Engineering from the U.S. Naval Academy and a M.S. degree in Nuclear Engineering from Catholic University.

I have been employed by NRC since September 1976 as an Operating Reactor Project Manager, as Group Leader of the Standard Technical Specification Group, as Chief of the Technical Support Branch and since September 1980 as Chief, Systematic Evaluation Program Branch. I was the overall Task Leader for NRC's review of seismic design deficiencies which involved the shutdown of five plants in March 1979.

From May 1975 to August 1976, I was employed as a Group Manager by ARINC Research Corporation, Annapolis, Maryland. My work involved the supervision and management of seven engineers working in the areas of advanced ship design, operation and support. During this period I served as a consultant to Propulsion Dynamics, Inc. in Annapolis, Maryland in the areas of nuclear submarine propulsion system controls.

From June 1967 to May 1975, I served in the U.S. Navy as a nuclear trained submarine officer. I qualified for supervision, operation and maintenance of four different Naval Reactors and qualified as Engineer Officer. I served as a member of the Joint Test Group responsible for reactor refueling, startup and testing of the USS Alexander Hamilton SSBN-617. As Staff Training Officer at the D1G Reactor Prototype in West Milton, New York, I was responsible for all aspects of the operating staff's training and qualification including the qualification of all instructors.

In my current position as Chief, Systematic Evaluation Program Branch, I am responsible for direction, supervision and coordination of the overall NRC effort associated with the safety review for the systematic evaluation of operating reactors.

ATTACHMENT 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

January 4, 1980

MEMORANDUM FOR: Olan D. Parr, Chief
Light Water Reactors Branch No. 3, DPM

FROM: Robert E. Jackson, Chief
Geosciences Branch, DSS

SUBJECT: STAFF RESPONSE TO WILLIAM H. WARD'S LETTER ON SEISMIC ISSUES AT WOLF CREEK

Enclosed is the Staff response to William H. Ward's petition to the Commissioners requesting at least a partial suspension of the construction permit for the Wolf Creek Generating Station. This Staff response is an expanded background for the seismic issue mentioned in footnote 6 of the July 12, 1979 Director's Decision under 10 CFR 2.206. This Director's Decision by Victor Stello, Jr., IE, denied Mr. Ward's petition. It stated that the seismic issues contained in Mr. Ward's letter were previously considered by the Staff and do not alter the Safe Shutdown Earthquake at the Wolf Creek site. Based upon the enclosed evaluation of Mr. Ward's concerns and recent Staff licensing decisions, we conclude that the 0.12g Safe Shutdown Earthquake is adequately conservative and therefore recommend that Mr. Ward's request for at least a partial suspension of the construction permit for Wolf Creek be denied. Dr. Phyllis Sobel, Geophysicist, prepared this evaluation. She was assisted by Leon Reiter, Section Leader.

Original Signed by
R. E. Jackson

Robert E. Jackson, Chief
Geosciences Branch
Division of Systems Safety

Enclosure:
As stated

cc: w/enclosures
J. Knight
S. Varga
R. Jackson
L. Reiter
R. McMullen
P. Sobel
M. Licitra
J. Harbour
J. Lieberman
S. Burns
R. Rothman
H. Lefevre
R. Muller
D. Vassallo
H. Thornbury, IE
W. Reinmuth, IE
M. Schumacher, IE

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STAFF RESPONSE TO WILLIAM H. WARD'S LETTER ON
SEISMIC ISSUES AT WOLF CREEK

On June 29, 1979, William H. Ward, Attorney for the Mid-America Coalition for Energy Alternatives, wrote the NRC Commissioners to advise them of several seismic issues affecting the Wolf Creek site and to request at least a partial suspension of the construction permit (Attachment). It is the purpose of this Staff response to address Mr. Ward's concerns.

Concern 1. A report by the Kansas State Geological Survey (KSGS), NUREG/CR-0294, concludes that the 1867 Manhattan earthquake was at least intensity VII-VIII (MM). Mr. Ward states that this earthquake was used as the basis for the Safe Shutdown Earthquake (SSE) and that the SSE was based on the assumption that the 1867 Manhattan earthquake could occur on the Nemaha Ridge at its closest approach to the Wolf Creek site, 50 miles. In light of the new information developed by the KSGS, the .12g horizontal acceleration SSE does not now appear to be conservative to Mr. Ward.

Response. The Staff has reviewed the report by KSGS and still finds the 1867 Manhattan earthquake to be intensity VII (MM). The assignment of intensity VII-VIII is based upon an 1877 report of liquefaction on a farm on the floodplain of the Kansas River. That observation was assigned intensity VIII and placed close to the epicenter by the Kansas Geological Survey. Liquefaction is very dependent upon local site conditions and may occur in isoseismal areas that may otherwise be associated with intensities less than VIII. The staff agrees with the standard references, such as Earthquake History of the United States (1973), which list this earthquake as an intensity VII (MM).

In the Safety Evaluation Report (SER) for the Wolf Creek site, the Staff chose a Safe Shutdown Earthquake (SSE) of intensity VII (MM). This intensity was based on:

1. The maximum earthquake that could occur in the Nemaha Uplift at its closest approach to the Wolf Creek site.
2. The maximum random earthquake in the region (for example, the 1956 Catoosa, Oklahoma earthquake).

The Staff's analysis did not involve the direct use of the 1867 Manhattan earthquake since a larger earthquake (intensity greater than VIII and less than X) was assumed to occur on the Nemaha Uplift. This larger earthquake was already assumed to occur at the closest approach of the Humboldt Fault to the Wolf Creek site. Therefore, the results of the Staff's analysis (an SSE of intensity VII) are not modified by the KSGS results.

Concern 2. The size of the appropriate Wolf Creek SSE can be determined by reference to the SER for another of the SNUPPS units, Tyrone. Both Tyrone and Wolf Creek are located in the Central Stable Region Tectonic Province. The Tyrone SSE is 0.2g horizontal acceleration.

Response. The Staff's assessment of the SSE at both Wolf Creek and Tyrone considered both the maximum random earthquake and the maximum earthquake that could occur on a nearby structure. The staff has evaluated the SSE at Wolf Creek and Tyrone in light of more recent licensing decisions. As a result of this evaluation we see no evidence that the SSE at Wolf Creek is unconservative or that it is inconsistent with recent licensing decisions.

1. Random earthquake at Tyrone.

The Tyrone site is near the town of Durand in western Wisconsin. The site is in the Central Stable Region Tectonic Province. In the Tyrone SER (1975), the Staff considered the intensity VII-VIII Anna, Ohio earthquake of 1937 as the largest earthquake in the Central Stable Region which could not be reasonably associated with known geologic structure. Using the Trifunac-Brady (1975) empirical relation between intensity and ground acceleration, the mean vibratory ground acceleration corresponding to MM intensity VII-VIII is 0.2g. This evaluation of the largest random earthquake near the Tyrone site is conservative and similar to recent licensing decisions made for other sites in the Central Stable Region. The Staff, however, recognizes significant variations in the historic seismicity among subregions of this large structural tectonic province. Based on the low level of seismicity in the vicinity of the Tyrone site and had the licensee given sufficient supportive bases, the Staff may have considered an intensity lower than VII-VIII (MM) more appropriate for the random earthquake.

2. Maximum earthquake on the Midcontinent Geophysical Anomaly and its effects at the Tyrone site.

For the purpose of establishing the SSE at the Tyrone site, the Staff evaluated the effects of the maximum earthquake associated with the Midcontinent Geophysical Anomaly (MGA) on the Tyrone site (SER, 1975). The Staff assumed that an intensity VIII earthquake could occur on structures associated with the MGA. In the SER the Staff assumed that at its closest approach to the site, i.e. 45 miles, the intensity at the site due to attenuation would be reduced to intensity VII-VIII. Using current intensity-attenuation relationships for the Central Stable Region (Gupta and Nuttli, 1976) attenuation of the effects of the intensity VIII event at the closest point on the MGA to the Tyrone site, i.e. 45 miles, results in a site intensity less than VII. Using the Trifunac - Brady (1975) empirical relation between intensity and ground acceleration, the mean

vibratory ground acceleration corresponding to MM intensity VII is 0.12g.

3. Random earthquake at Wolf Creek.

The Wolf Creek site lies in southeast Kansas in the Central Stable Region Tectonic Province. In the Wolf Creek SER, the Staff considered the maximum random earthquake to be intensity VII (MM). This position was reiterated in a more recent Staff decision in the same region-the Black Fox site in eastern Oklahoma (SER, 1977). The Staff recognized the low level of seismicity in the vicinity of the Black Fox site and considered the maximum random earthquake to be intensity VII.

4. Maximum earthquake on the Nemaha Uplift and its effects at the Wolf Creek site.

For the purpose of establishing the SSE at the Wolf Creek site, the Staff evaluated the effects of the maximum earthquake associated with the Nemaha Uplift (NU) on the Wolf Creek site (SER, 1975). The Staff assumed that intensities greater than VIII and less than X could occur on the Nemaha Uplift. In a more recent Staff decision for the Black Fox site (SER, 1977), the Staff found that an earthquake of intensity VIII was a more reasonable maximum event on the NU, based on similarity with other structures in the Central Stable Region which have associated seismicity. (This Staff decision was supported by the Black Fox Licensing Board Decision "Partial Initial Decision Authorizing Limited Work Authorization,' LBP-78-26, 8 NRC 102, 111 ('978), Aff'd ALAB - 573, Slip Op. at 40 (Dec. 7, 1979)). Using current intensity-attenuation relationships for the Central Stable Region (Gupta and Nuttli, 1976), attenuation of the effects of the intensity VIII event at the closest point on the NU to the Wolf Creek site, i.e. 50 miles, results in a site intensity less than VII.

Conclusion

Therefore, based upon our evaluation of the SER's for the most recent licensing decisions, we conclude that it is not necessary to have the same SSE at the Tyrone and Wolf Creek sites. Applying a current intensity-attenuation relation at both sites, a site intensity of VII is an adequately conservative value for the effects of the maximum earthquake on significant nearby structures. At the Tyrone site the maximum random earthquake was conservatively chosen to be intensity VII-VIII but the Staff could have considered a lower intensity based on the low level of seismicity in the vicinity of the site. At the Wolf Creek site credit was given for the lower level of seismicity in the vicinity of the site and the maximum random earthquake was considered to be intensity VII.

Analysis of NRC Sponsored Research Programs Affecting the Wolf Creek Site

The KSGS report mentioned in Ward's letter is part of a cooperative geologic, seismic, and geophysical research program by several state geological surveys that is seeking to define the structural setting and tectonic history of the Nemaha Uplift and the Midcontinent Geophysical Anomaly in order to provide the bases for a more realistic appraisal of the earthquake risks in the siting of nuclear facilities in the North American Mid-Continent. This information is used as a basis for continuing research and as input to the evaluation of seismic risk in the region within and around the Nemaha Uplift. The research effort thus far has increased our current data base and our understanding of earthquake phenomena in the vicinity of the Nemaha Uplift; however, this information has not indicated a need to modify any previous licensing decisions.

As part of this cooperative research program, the NRC is funding a five year detailed study of the sources of seismicity in the Nemaha Uplift area. The results of work completed in Phase I is currently being reviewed. Therefore, it is too early to assess the impact on nuclear power plant licensing. The total impact of the five year study cannot be assessed until the overall program is completed and synthesized with seismic monitoring data. The preliminary results are being considered in the development of a tectonic province or seismic zoning map of the eastern U. S.

ATTACHMENT 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

June 17, 1981

LS05-81-06-068

LETTER TO ALL SEP OWNERS
(EXCEPT SAN ONOFRE)

Gentlemen:

SUBJECT: SITE SPECIFIC GROUND RESPONSE SPECTRA FOR SEP PLANTS LOCATED IN THE EASTERN UNITED STATES

Reference: Letter to SEP Group II Plant (Big Rock Point, Dresden 1, Haddam Neck, La Crosse, Yankee Rowe) Licensees from D.G. Eisenhut, NRC dated August 4, 1980

Our letter dated August 4, 1980 (reference) issued the prelimiary version of site specific ground response spectra for the eastern United States SEP plants. Recently, these spectra have been finalized by the staff. Enclosure 1 includes the recommended ground response spectra (5% damping) for the eastern SEP sites. The bases of our final decision regarding the spectra and the digitized spectral acceleration values (5% damping) for these spectra are documented in Enclosure 2.

The site specific spectra (SSS) included in Enclosure 1 establish the ground motion acceleration values to be input into the structural reevaluation analyses to determine the resultant seismic loads. The geology reviews for Palisades, Ginna and Dresden 2 have been completed by the staff. The results of the review did not identify any geologic features that would affect the site specific spectra for those facilities. Based on our review to date for the remainder of the SEP facilities located in the eastern United States, we do not expect the SSS to be changed due to local geologic considerations.

Sincerely,

Dennis M. Crutchfield

Dennis M. Crutchfield, Chief
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Enclosure:
As stated

cc w/enclosure:
See next page

8106246234

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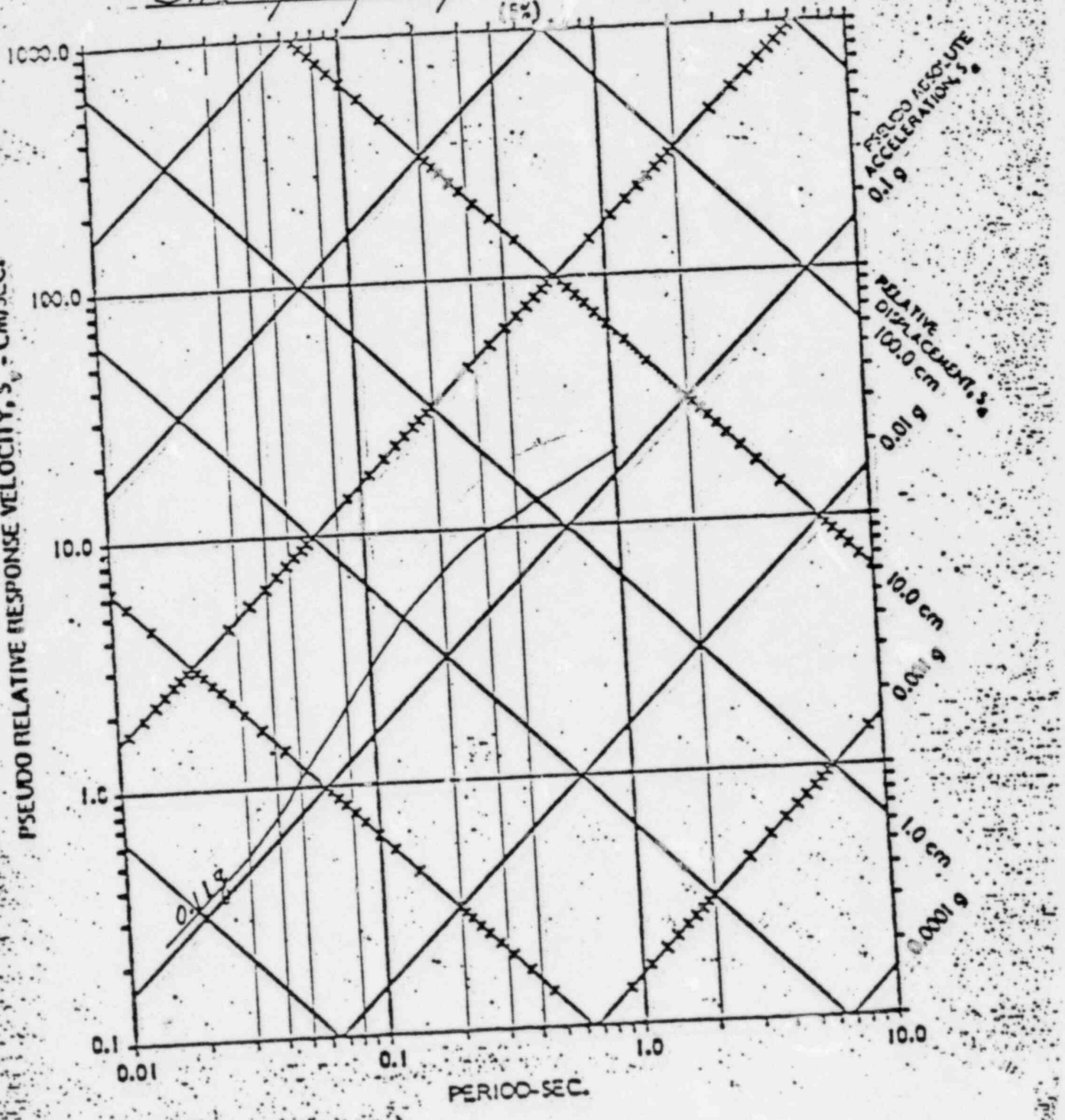
Attachment 1

Site Specific Spectrum

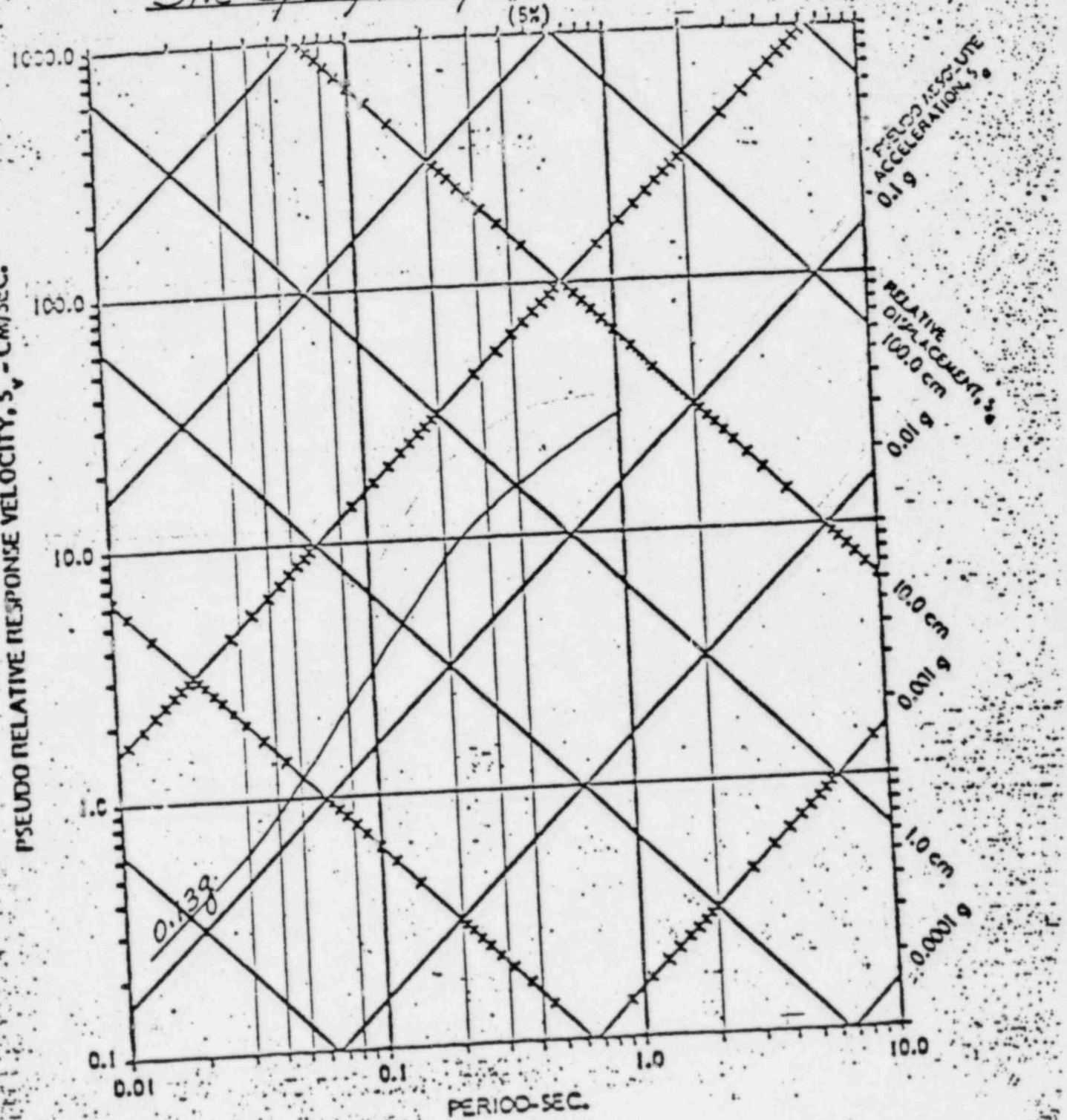


Big Rock Point Site

(5% Damping)

Attachment 1

Site Specific Spectrum

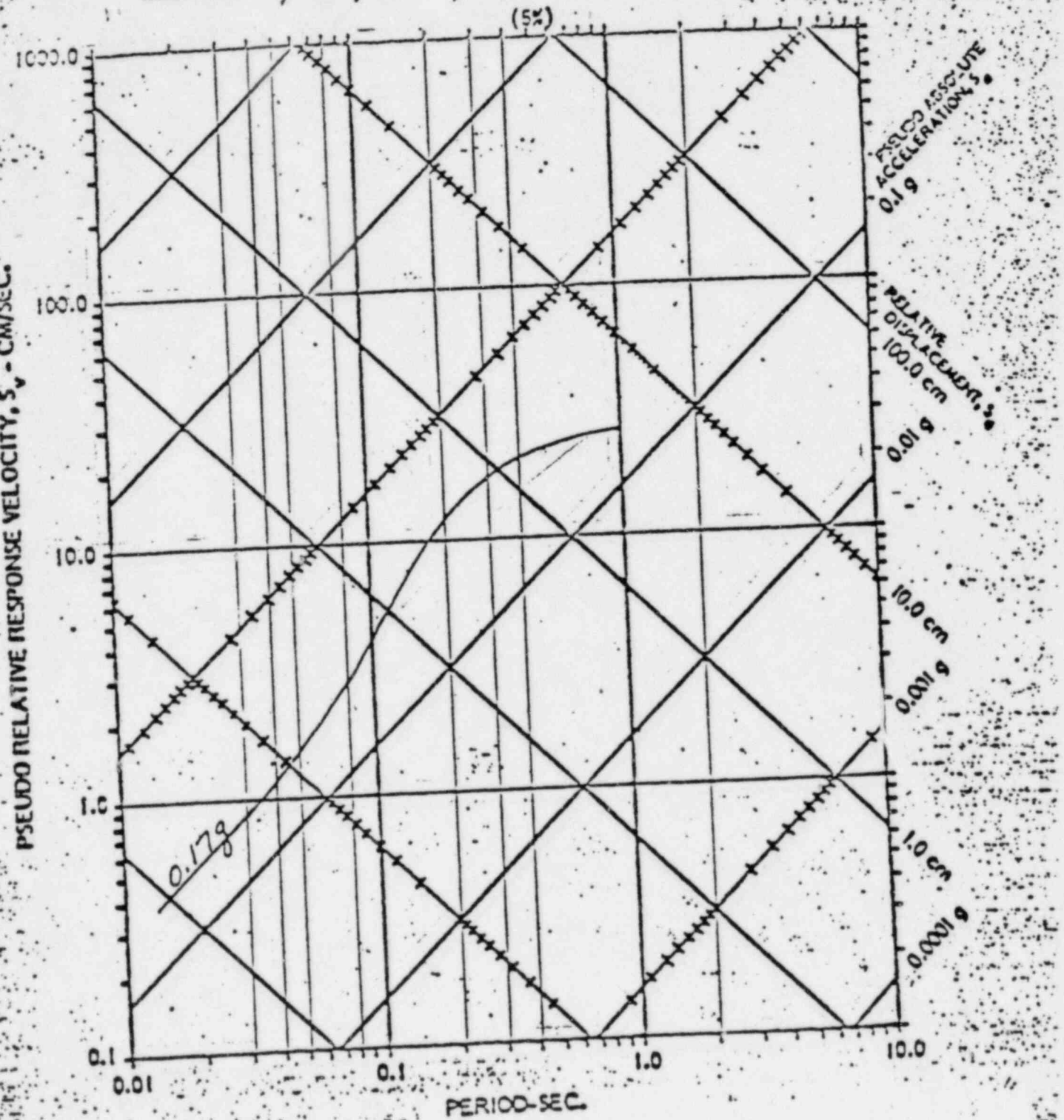


Dresden Site

(5% Damping)

Attachment 1

Site Specific Spectrum

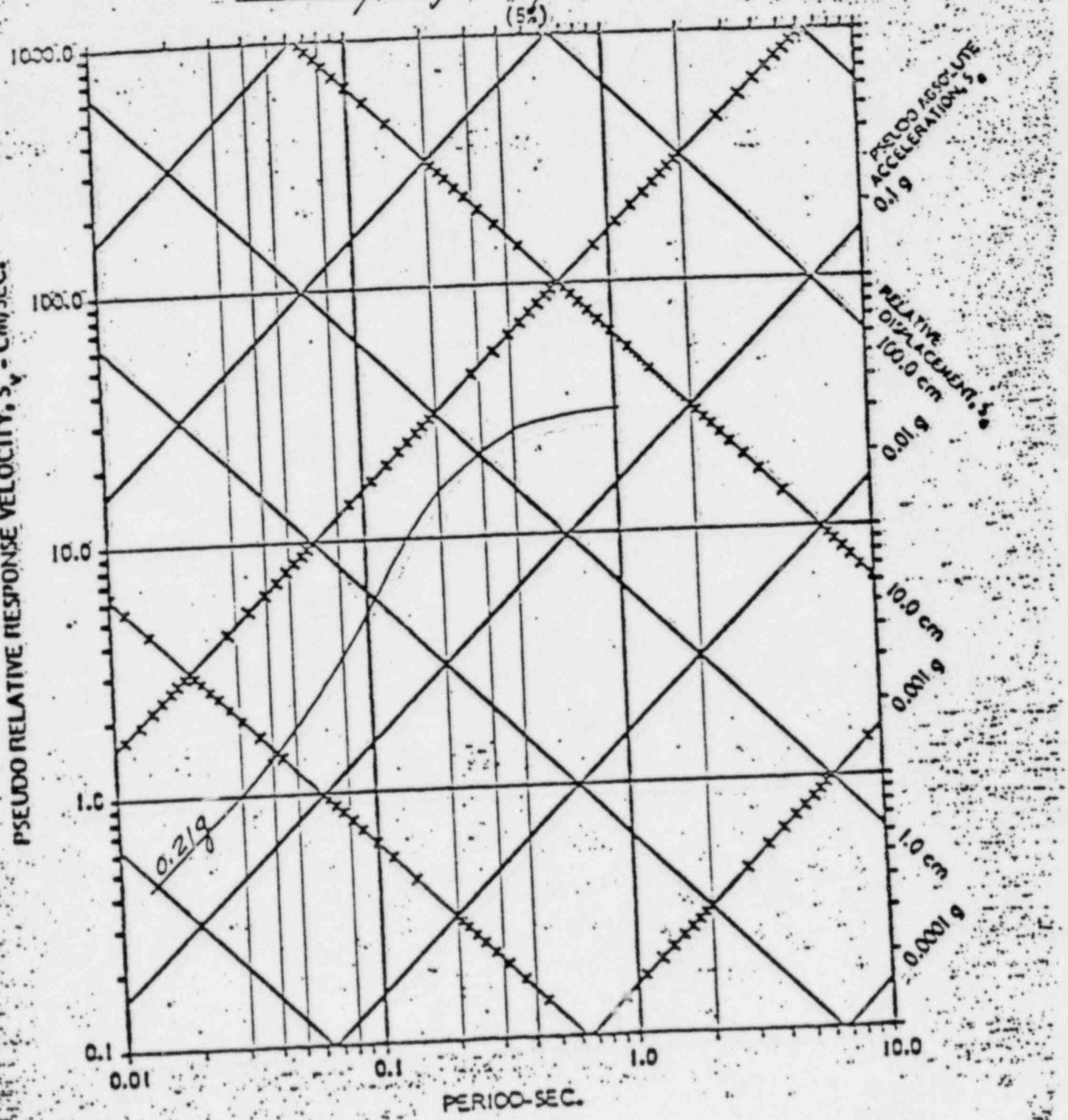


Ginna - Site

(5% Damping)

Attachment 1

Site Specific Spectrum

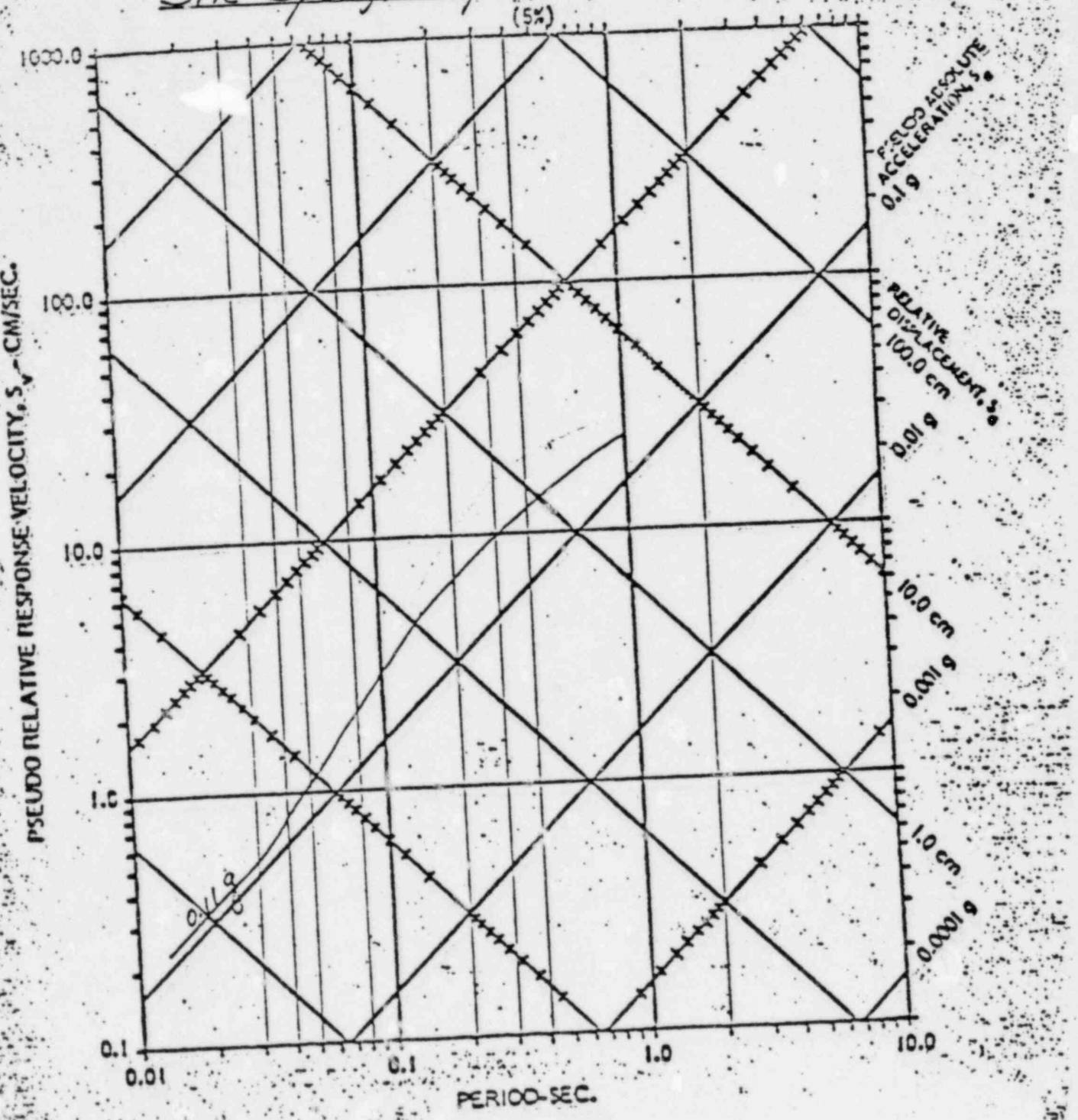


Haddam Neck Site

(5% Damping)

Attachment 1

Site Specific Spectrum

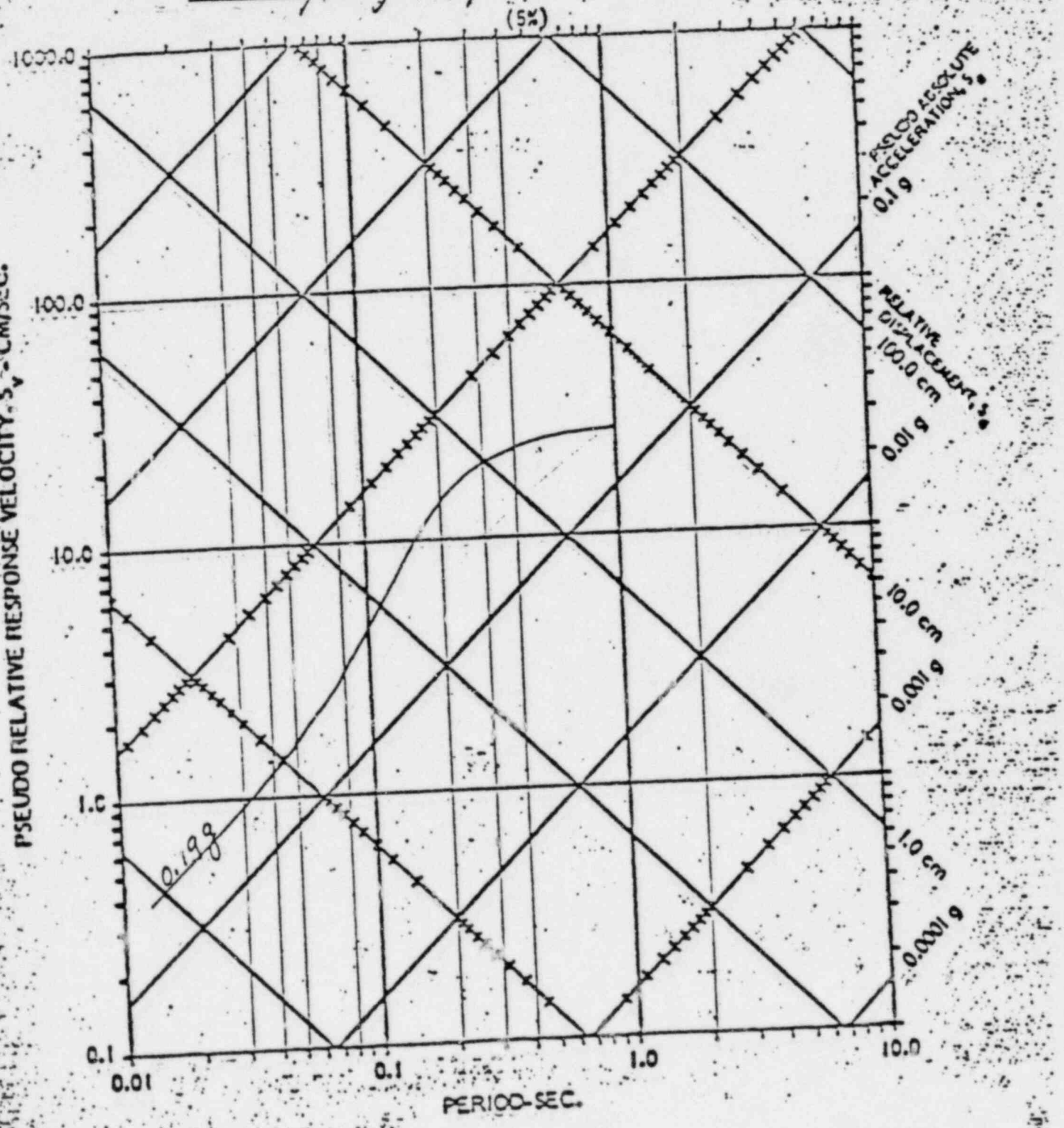


La Crosse Site

(5% Damping)

Attachment 1

Site Specific Spectrum

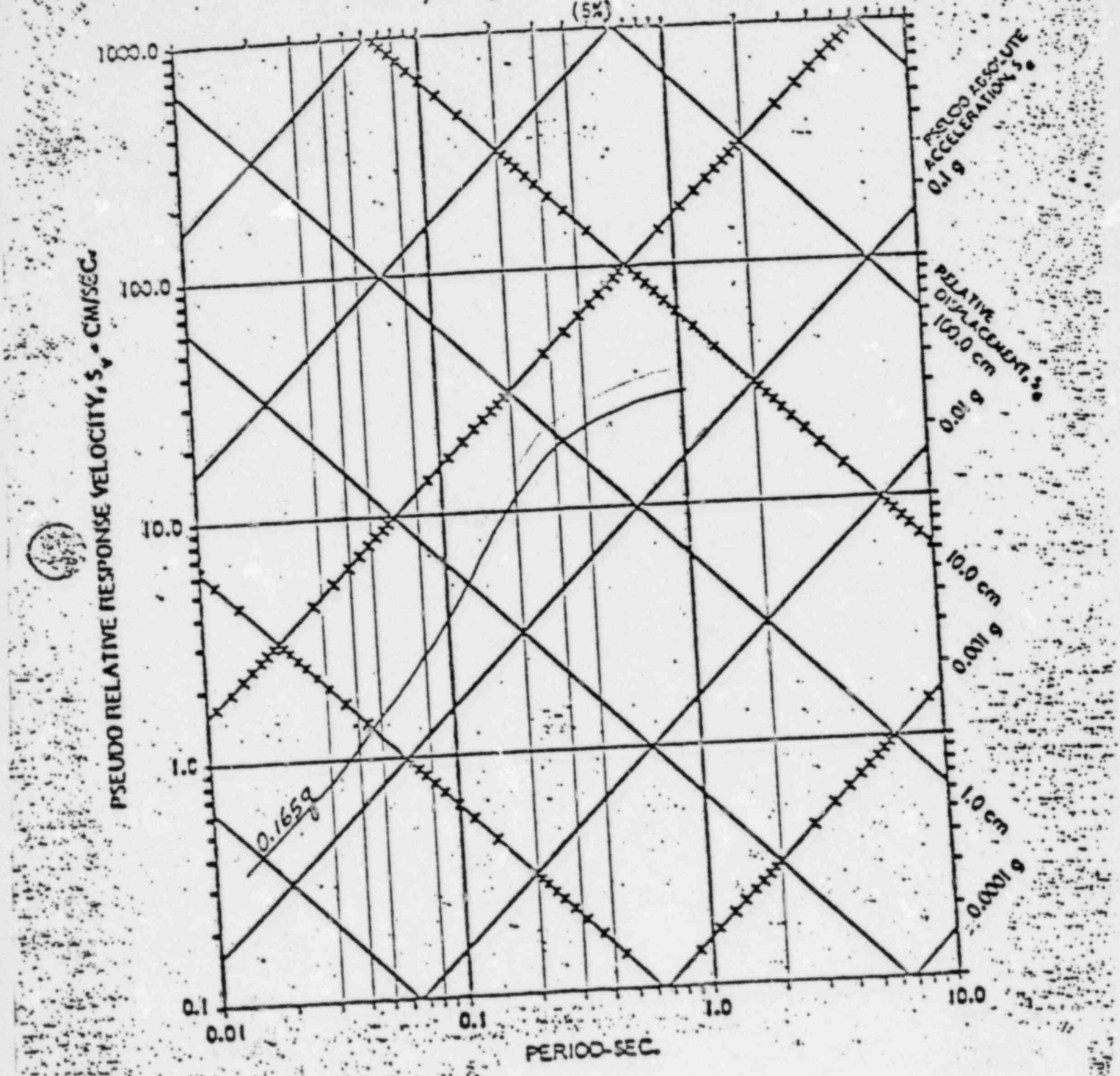


Millstone 1 Site

(5% Damping)

Attachment 1

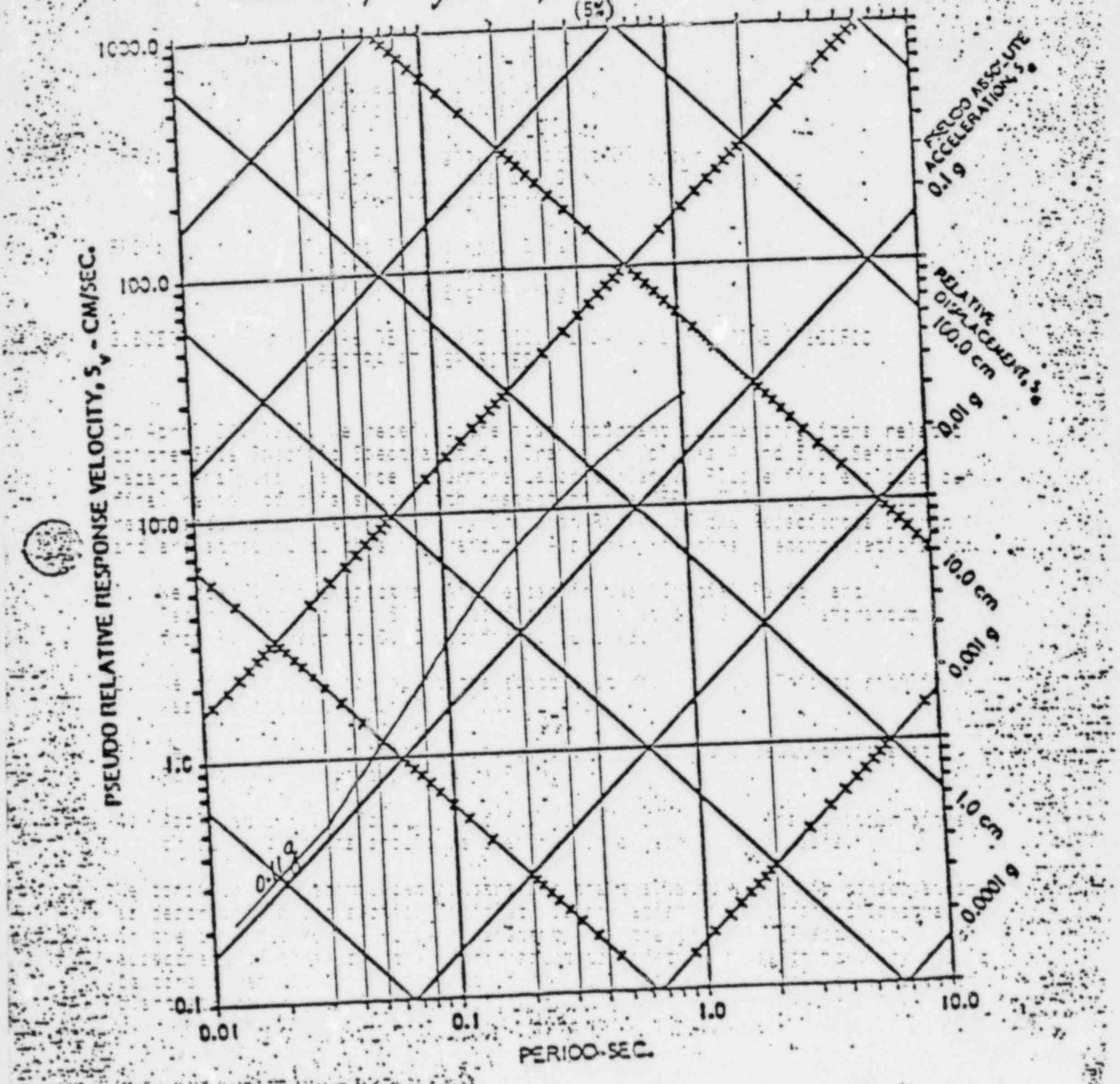
Site Specific Spectrum



Oyster Creek Site
(5% Damping)

Attachment 1

Site Specific Spectrum

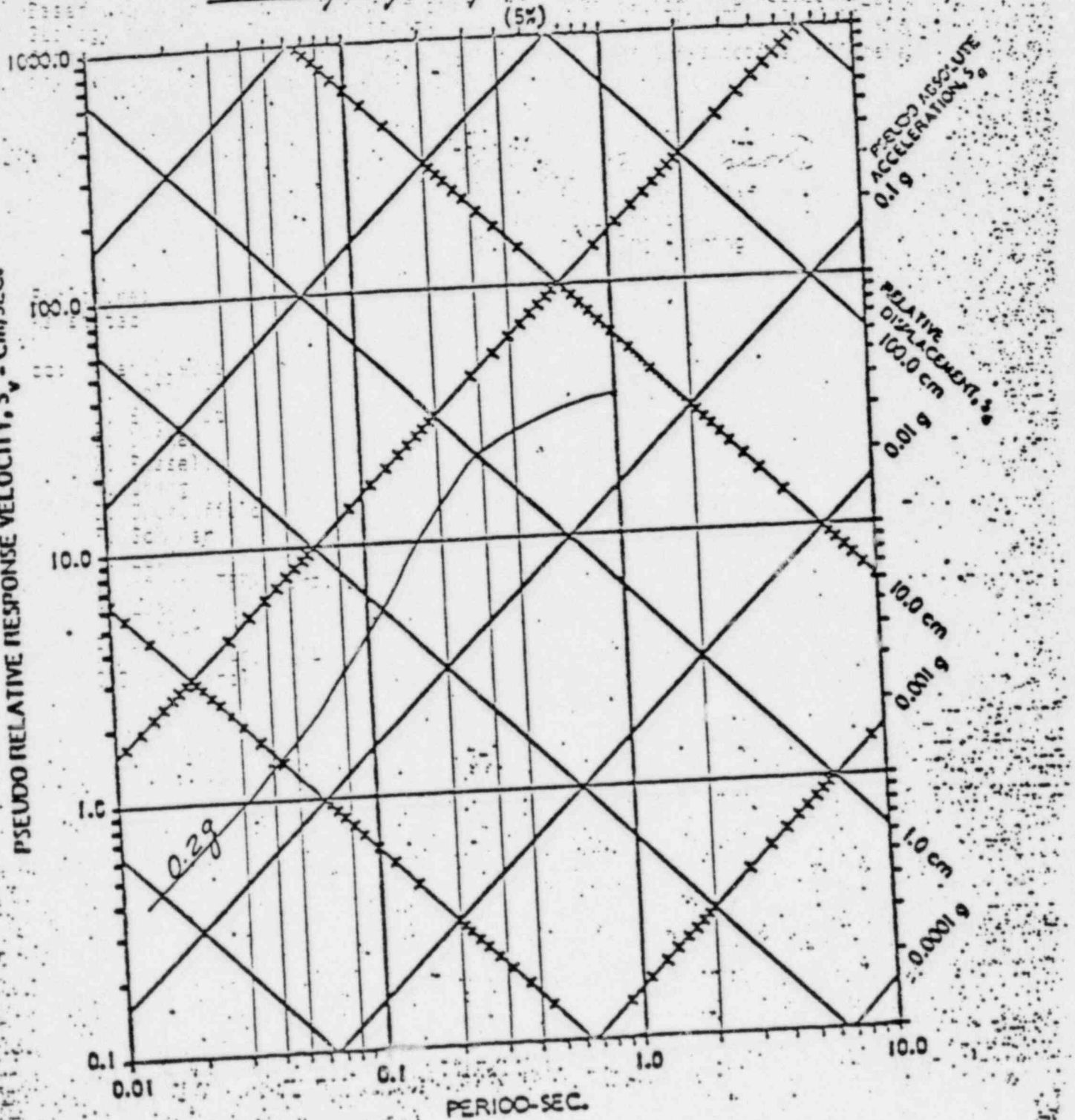


Palisades Site

(5% Damping)

Attachment 1

Site Specific Spectrum



Yankee Rowe Site

(5% Damping)