ATTACHMENT A

SQUG

RKH

File No. A3.6
SQUG

August 21, 1992

James G. Partlow
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: SQUG Response to Generic Letter 87-02, Supplement 1 and Supplemental Safety Evaluation Report No. 2 on the SQUG GIP

Dear Mr. Partlow:

The Seismic Qualification Utility Group acknowledges receipt of Supplement 1 to Generic Letter 87-02 and Supplemental Safety Evaluation Report No. 2 ("SSER-2") on our Generic Implementation Procedure (GIP) For Seismic Verification of Nuclear Plant Equipment, Revision 2, corrected 2/14/92. We appreciate the Staff's extensive effort and cooperation, without which this generic resolution of Unresolved Safety Issue A-46 would not have been possible.

SQUG has advised its member utilities that a plant-specific response to SSER-2 is required by September 21, 1992, and has encouraged them to adopt the commitments and guidelines in the GIP as supplemented by the explanations, clarifications and interpretations in SSER-2 and this letter with minimal exceptions.

Although SQUG accepts SSER-2 as marking completion of the evaluation of the GIP, Revision 2, and the starting point for the plant-specific A-46 resolution process, we would like to state our understanding of some of the Staff's positions in the SSER.

First, SQUG understands the Staff position that the GIP is not currently recognized as constituting an equipment seismic qualification methodology. In that NRC regulations do not require "seismic qualification," however, the Staff was able to conclude that implementation of the GIP satisfies NRC regulations relevant to equipment seismic adequacy. SQUG interprets SSER-2 as recognizing that, for A-46 plants, the GIP methodology is an acceptable engineering method to insure that required safety functions are maintained during and after a Safe Shutdown Earthquake, consistent with 10 C.F.R. Part 100.

Second, we understand that the scope of the Staff's evaluation of the adequacy of selected licensees' in-structure response spectra ("ISRS") is limited to the A-46 program. SQUG acknowledges that, in light of discussions with the Staff, any evaluations of the adequacy of the ISRS will be confined to the context of USI A-46. If evaluations of plant ISRS result in the Staff rejecting the spectra for A-46 program purposes, or if Staff actions significantly increase the cost of a licensee's A-46 program, SQUG expects the Staff to comply with pertinent backfit requirements of 10 C.F.R. § 50.109.

Third, with regard to the scheduling considerations for licensees submitting ISRS information to the Staff under SSER-2, Section II.4.2.3, we understand numbered paragraphs (1) and (2) to mean that a licensee should await written Staff approval prior to commencing implementation. If the Staff does not respond by accepting, questioning, or rejecting the spectra within sixty days, the Staff is deemed to have accepted the licensee's spectra and the licensee may proceed with implementation. If a rejection or question is received from the Staff, the licensee will provide additional information to the Staff to resolve the problem. If the Staff takes no action on this new information within sixty days, the Staff is deemed to have accepted the licensee's resolution and the licensee may proceed with implementation. When the Staff is deemed to have accepted a licensee position by inaction for sixty days, as noted above, any subsequent Staff action to reject the licensee's position will be considered a changed staff position requiring 10 C.F.R. § 50.109 considerations.

Fourth, with regard to the Staff's position on operator training as discussed in SSER-2, Section II.3, "Evaluation and Conclusion," numbered paragraph 2 and the statement that "[t]he compatibility of these procedures with the USI A-46 safe shutdown equipment list should be verified . . . and the results included in the operator training program," SQUG understands that appropriate changes to operator training will be made only if licensees find that changes to the plant operating procedures are necessary to achieve compatibility with the Safe Shutdown Equipment List. Training will be modified only to the extent needed to familiarize operators with these procedure changes.

Fifth, SQUG notes that SSER-2, Section II.4.4.9, was modified by the Staff, and differs considerably from the March 13, 1992, draft version of SSER-2, which was the subject of discussion between SQUG and the Staff. Specifically, the final version of SSER-2 suggests that licensees consider concrete crushing strain, determination of the overturning axis, and the applicability of the rigid base plate assumption when using the ANCHOR and EBAC codes. Concrete crushing has been shown by extensive experience data to not be a concern for A-46 equipment. The only plausible situation for actual concrete crushing might be for unconfined concrete pedestals and footings. For those situations, SQUG will agree to consider concrete crushing.

When using the EBAC code, it is understood that the overturning axis location should be evaluated in the field by Seismic Capability Engineers. These types of evaluations are covered in the SQUG training program and are within the capability of their engineering

judgement; therefore SQUG believes that these considerations are adequately covered in the GIP.

With regard to the ANCHOR code, SSER-2 incorrectly states that a rigid base plate assumption is used in the analysis. In fact, ANCHOR uses ultimate strength design principles to establish the location of the neutral axis and to determine the capacity of the anchorage; the flexibility of the equipment and its base plate do not have any influence on the anchorage capacity values calculated using this method.

Sixth, with regard to exchanging GIP-implementation information among the SQUG member utilities, SQUG commits to facilitate a transfer of knowledge regarding major problems identified, and lessons learned, in the USI A-46 plant walkdowns and third-party reviews. This transfer will consist of periodic written communications to all member utilities and, as needed, periodic workshops.

As a final note, SQUG has identified a process for long-term maintenance of the GIP for applications beyond the A-46 resolution. The procedure for updating the GIP in accordance with SSER-2 is attached.

Sincerely,

Neil P. Smith

Neil P. Smith, Chairman
Seismic Qualification
Utility Group

Enclosure

cc: P. Sears, NRC
J. Richardson, NRC
J. Norberg, NRC (6 copies)
B. D. Liaw, NRC
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J. Conran, NRC
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SQUG Member Utilities

Attachment to
SQUG Letter Dated
August 21, 1992

PROCEDURE FOR REVISING THE GIP

INTRODUCTION

The purpose of this procedure is to provide a framework for reviewing and evaluating new information and data on seismic ruggedness of equipment, and for implementing necessary changes to the criteria and guidelines contained in the Generic Implementation Procedures (GIP) for Seismic Verification of Nuclear Plant Equipment.

Changes to the GIP are anticipated for several reasons. First, since the GIP is based on experience data from past earthquakes and testing, it is possible that new areas of concern or vulnerability may become evident from new earthquakes and tests. Also, it is likely that new information could be used to expand the coverage of the GIP and possibly refine or eliminate certain restrictions. Changes to the GIP are also anticipated from practical experience gained while applying the criteria and guidelines during implementation of the USI A-46 program. These type of changes would include clarifications and corrections of typographical errors. It is also planned that the GIP will be revised to reflect NRC positions contained in the SSER #2 which are different than the current version.

PROCEDURE

The main elements of this procedure for revising the GIP are summarized below. This approach is similar to that used by SQUG/EPRI to develop the GIP. Specifically, a SQUG/EPRI oversight panel will supervise the review and evaluation of available information and data which becomes available, an independent peer review panel will review and comment on substantive GIP changes, and the NRC Staff will review and approve GIP changes before use by the utilities. The details of each of these activities are described below.

1. SQUG/EPRI Oversight and Supervision. SQUG/EPRI will provide the oversight and supervision of the overall process of selecting, reviewing, and evaluating available information on seismic ruggedness of equipment covered by the GIP and, based on this new information, developing changes to the GIP when they are considered necessary. The SQUG Steering Group will exercise this responsibility for SQUG/EPRI during the A-46 implementation. Contractors, under the direction of the Steering Group, may be used to perform most of the work described in item 2 below.

2. Review and Evaluation of New Information. Several sources of information will be used to obtain new information which may be of use in revising the GIP. These sources will include additional experience gained from earthquakes investigated by EPRI, shake table and other relevant test data furnished by utilities and vendors, lessons learned by SQUG utilities during implementation of USI A-46, and other publicly available sources (e.g., LERs, I&E Bulletins, etc.). Incidences of seismic damage will be evaluated to the extent necessary to determine whether changes to the GIP are necessary. New information may also be used to expand the coverage of the GIP and to revise, add or eliminate certain restrictions. Based on these evaluations, proposed revisions to the GIP will be developed for review and approval by the SQUG Steering Group.

3. Peer Review Panel: Substantive changes to the technical requirements of the GIP and the reference material supporting these changes will be sent to the Peer Review Panel and the NRC Staff. The Peer Review Panel will review the reference material and the proposed GIP revision. The conclusions and recommendations from the Peer Review Panel will be communicated to both SQUG/EPRI and the NRC. This may be by written comments and/or by oral presentations at meetings. The Peer Review Panel will be composed of seismic experts selected by mutual agreement between SQUG/EPRI and the NRC. Additional individuals may also be selected, on an as-needed basis, to provide specific expertise during review of certain topics.

4. Finalization of GIP Changes. SQUG/EPRI will consider the recommendations from the Peer Review Panel and will develop a final draft of the GIP changes. These will be submitted to the full SQUG membership for review and comment. After the membership comments have been considered and incorporated into the GIP, a final version of the GIP revision will be prepared for submittal to the NRC (see item 5 below).

5. NRC Review and Approval. The NRC Staff will review and either approve or reject changes to the GIP submitted by SQUG/EPRI. All GIP changes shall be regarded as accepted by the Staff upon receipt of a letter to this effect from the Staff, or if the Staff does not reject the changes or request additional information in writing within sixty days, the Staff is deemed to have accepted the GIP changes and the A-46 licensees may proceed with implementation. If a rejection or request for information is received from the Staff, SQUG/EPRI may provide additional information to the Staff to resolve the problem. If the Staff takes no action on this new information within sixty days, the Staff is deemed to have accepted SQUG/EPRI's resolution and the A-46 licensees may proceed with implementation of the change. When the Staff is deemed to have accepted a GIP change by inaction for sixty days as noted above, any subsequent Staff action to reject the GIP change will be considered a change in staff position requiring 10 C.F.R. § 50.109 considerations.

TYPES OF GIP CHANGES AND REVIEWS

There are several types of changes to the GIP which are expected. The level of review given to these changes is different depending on the nature of the changes. The types of changes which might be made to the GIP along with the reviews to be performed, are described below and summarized in Table 1. All revisions will be identified by marginal notation or other means (e.g., strike-outs, highlighting, etc.).

1. Typographical Changes. These include revisions to correct typographical errors, and omissions and other minor changes which do not affect the meaning or intent of the GIP, e.g., incorrect spelling, format changes, inconsistent nomenclature, errors in copying text or data from reference reports, etc. These types of changes will not be reviewed by the Peer Review Panel but will be sent directly to the NRC for review and approval.

2. Editorial Changes. Editorial changes include clarifications of ambiguous criteria and guidelines as well as additions to the GIP which explain generally understood, but not explicitly stated aspects of the program. These types of changes will not be reviewed by the peer review panel before sending them to the NRC for review and approval.

3. NRC Positions and Changes to Licensing Requirements. The NRC staff has taken some positions in the SSER #2 which (1) are in conflict with the GIP, (2) expand, clarify, or emphasize topics already in the GIP, or (3) add new features or elements not in the GIP. In addition, the Staff may also choose to take positions on certain topics during implementation of USI A-46. These staff positions and any changes to licensing criteria may be incorporated into the GIP to simplify utility implementation of the USI A-46 program. A peer review of these changes is not necessary; however these types of GIP changes will be submitted for NRC review and approval.

4. Additional Restrictions. New information may become available which shows that existing GIP criteria and guidelines may be unconservative. For example, new test or experience data might show the need for additional or more restrictive caveats on a class of equipment. These types of GIP changes will receive a peer review before being sent to the NRC for formal review and approval, and will receive expedited processing.

5. Other Technical Changes and Additions. New information or experience may become available which shows that certain technical criteria and guidelines in the GIP are overly conservative or unnecessary and therefore may be removed or modified. Likewise, new information may show that the scope of the GIP can be extended in certain areas. These types of changes would receive a peer review before being sent to the NRC for review and approval.

Table 1

Types of GIP Changes and Reviews to be Performed

Type of GIP Change	SQUG/EPRI Review and Approval	Peer Review and Comment	NRC Review and Approval
1. Typographical	x		x
2. Editorial	x		x
3. NRC Positions and Licensing Requirements	x		x
4. Additional Restrictions	x	x	x
5. Other Technical Changes and Additions	x	x	x

LICENSING CONSIDERATIONS

A revision to the GIP will not apply retroactively to licensees committed to an earlier revision unless the licensees specifically commit to the new revision. The NRC Staff may require licensees to adopt certain safety-significant changes in a revision of the GIP, if warranted under appropriate NRC regulatory controls, e.g., 10 C.F.R. § 50.109.

Unless the Staff requires licensees to adopt a change in a GIP revision as discussed above, licensees have the option of committing to the new revision (following appropriate in-house procedures and using the Staff letter or the Staff's lack of response to the new revision within sixty days, as justification for the general acceptability of the change). If the commitment results in a modification of the licensing bases, licensees will be required to follow the provisions of 10 C.F.R. § 50.59, where appropriate.

This procedure for revising the GIP does not apply to plant-specific exceptions to the GIP which individual licensees may implement for internal use. Unless the change is adopted by SQUG under this procedure, it is considered to be a modification of a plant commitment, not a change to the GIP.

ATTACHMENT B

DEVELOPMENT OF
IN-STRUCTURE RESPONSE SPECTRA
FOR POINT BEACH NUCLEAR PLANT

MATHEMATICAL MODEL

For the design of Seismic Class 1 structures a five step seismic analysis was performed. The five steps are 1)formulation of a mathematical model, 2)determination of natural frequencies and mode shapes, 3)selection of appropriate damping values, 4)description of the appropriate input earthquake, and 5)determination of the structural response to the earthquake.

Point Beach is made up of the following Seismic Class 1 structures:

1. Containment Structure and Internals
2. Auxiliary Building Central Part
3. Auxiliary Building North and South Wings
4. Control Building
5. Pipeway #1
6. Pipeways #2 & #3
7. Pipeway #4
8. Fuel Oil Pump House
9. Service Water Pump House
10. Spent Fuel Pool
11. Drumming Station

Safe shutdown equipment is located in structures 1 through 9 listed above. The structural response was determined for structures 1 through 8 listed above. The Service Water Pump House was considered a low-rise, rigid structure, therefore, the design used the Housner horizontal peak ground acceleration as the design input acceleration.

The mathematical model of the structures were constructed in terms of lumped masses and stiffness coefficients. At appropriate locations within the buildings, points were chosen to lump the weights of the structure. Between these locations properties were calculated for moments of inertia, cross sectional areas, effective shear areas and lengths of interior and exterior walls. Figures B.2 through B.5 show the models generated for the Containment Structure and Internals, the Auxiliary Building Central part, and the Control Building which are the structures where the majority of the safe shutdown equipment is located. The mathematical models for the other structures of concern are similar to these. The properties of the model were utilized in an IBM computer program, STRESS, along

with unit loads to obtain the flexibility coefficients of the building at the mass locations.

BUILDING NATURAL FREQUENCIES AND DAMPING VALUES

The natural frequencies and mode shapes of the structures were obtained by a Bechtel computer program, CE617. This program utilized the flexibility coefficients and lumped weights of the model. The flexibility coefficients were formulated into a matrix and inverted to form a stiffness matrix. The program then used the technique of diagonalization by successive rotations to obtain the natural frequencies and mode shapes. The mode shapes and natural frequencies were determined for the structures in both the north-south and east-west directions.

In the original design of Point Beach, Bechtel determined that the first and second modes were the predominant modes of vibration. Table B.1 provides the natural frequency associated with the first and second modes for the Seismic Class 1 structures of concern.

Damping values for the structural system were selected based upon evaluation of the materials and mode shapes. Both first and second modes indicated activity mainly due to the elasticity of the underlying soil. The first mode showed the soil to be contributing to a translating effect and only a little rocking of the building. The second mode indicated translation, but the amount of rocking is considerably larger. For both modes, flexure of the structure is considered negligible. Due to this strong effect from the soil elasticity and the relatively small flexibility of the structure, no proportional combining of damping values was necessary. The values of the damping coefficients used in the analysis are presented and compared to REGULATORY GUIDE 1.61, Rev. 0, "Damping Values for Seismic Design of Nuclear Power Plants" values in Table B.2

BUILDING RESPONSE

In determining the response of the building to the earthquake, the response spectrum technique was utilized. For this technique, the earthquake was described by a Housner spectrum response curve scaled to 0.06g for the operating basis earthquake (OBE) and 0.12g for the hypothetical or safe shutdown earthquake (SSE). From the curves, acceleration levels were determined as associated with the natural frequency and damping value of each mode. The standard spectrum response technique used these values to determine inertial forces, shears, moments and displacements per mode. These results were then combined on the basis of the square root of the sum of the squares (SRSS) to obtain the structural response. The structures were analyzed for earthquake

motion in both the north-south and east-west directions acting non-concurrently. The process was accomplished by a Bechtel computer program CE 641, "Earthquake Spectrum Response Analysis of Structures."

SOIL STRUCTURE INTERACTION

The type of soil/structure interaction used for Point Beach was based on a rigid foundation mat situated on an elastic half-space (the ground). In this representation, the soil properties were modelled using soil springs as shown in Figures B.3 through B.5. For buildings other than the Containment, the vertical spring constant is given by the formula:

$$K = \frac{E \times B \times \beta_0}{1 - \mu^2}$$

and the horizontal spring constant by the formula:

$$K = E \times \beta_x \sqrt{B \times L}$$

where B, L = foundation plan dimensions and B is the dimension perpendicular to the direction of analysis.

E = dynamic modulus of elasticity of the soil.

μ = Poission's ratio of the soil.

β_0, β_x = constants.

The rocking stiffness of the structures is accounted for by placing two vertical springs at the edges of the foundation. For the containment, which is supported on piles, spring constants were developed for the piles using the properties of the piles. Table B.3 provides a breakdown of the soil spring constants used.

EQUIPMENT IN-STRUCTURE RESPONSE SPECTRA

Horizontal response spectra curves for equipment inside the buildings were generated by the time history technique of seismic analysis. The sample earthquake utilized is that recorded at Olympia, Washington, N80E, April 13, 1949. The in-structure response spectra (ISRS) curves were generated by applying the Olympia earthquake acceleration time history, normalized to 0.06g horizontal peak ground acceleration, at the base of each building model. Time histories were then developed for each elevation (lumped mass node) in the building model. These time histories

were then applied at each elevation of the applicable structure to a single degree of freedom system, for which values for damping and natural frequency were varied. The ISRS were generated with respect to the OBE value of 0.06g. The acceleration values of the curve are increased by a factor of 2.0 for seismic analyses of equipment with respect to the SSE. At the high frequency end of the curves, the acceleration levels converge to the value of the peak acceleration of the time history at the location inside the building. The response spectra curves were smoothed to eliminate the erratic response of the earthquake's random behavior, and the peaks of the response spectra curves were widened to account for inaccuracies in values of the properties for the building, soils and calculation. The results of the structural analysis showed that the structure response was very similar in both north-south and east-west directions. Therefore, horizontal ISRS were generated for one horizontal direction and considered applicable for seismic analysis in either the north-south and east-west direction.

The original design basis ISRS were generated by Bechtel for the initial plant design. Table B.4 provides a breakdown of the original ISRS developed for Seismic Class 1 structures at PBNP.

During the review of masonry walls for NRC IE Bulletin No. 80-11, additional ISRS were developed for the Auxiliary Building and the Control Building for other damping values. These spectra, scaled to the 0.12g SSE, were generated at 1%, 2%, 4%, 5% and 7% damping by Computech Engineering Services Inc. Wisconsin Electric's resolution of the IE Bulletin No. 80-11, which utilized the ISRS developed by Computech, was reviewed and approved by the NRC in NRC Safety Evaluation Report (SER) dated May 11, 1982.

At a later date, additional ISRS curves at higher damping values were generated for other Seismic Class 1 structures. Spectra for the Containment Structure, Containment Internals, and Pipeways were developed at 1%, 2%, 4%, 5%, and 7% damping, scaled to the 0.06g OBE. The curves were developed by Impell Corporation using their computer code, FLORA. FLORA used random vibration theory to generate response spectra directly from the original design 0.5% damped response spectra developed by Bechtel. Table B.4 also provides a breakdown of the follow-on in-structure response spectra developed for Point Beach.

To facilitate the use of the ISRS for Point Beach, the ISRS developed by Computech and Impell, were consolidated into a single format by Sargent & Lundy Corporation. The curves were peak broadened by ± 15% and the Computech ISRS curves were scaled down to the 0.06g OBE. Figures B.6 through B.8 provide sample 5% damped horizontal ISRS for the Containment Internals, the Auxiliary Building Central Part, and the Control Building. Table B.5 provides peak horizontal in-structure acceleration values at important equipment locations for the SSE.

REFERENCES:

1. Bechtel Corporation, Civil Engineering Department, Power and Industrial Division, "Seismic Analysis Report, Point Beach Nuclear Plant Units 1 & 2, Reactor Building with Concrete Internals", March 1970.

2. Bechtel Corporation, Civil Engineering Department, Power and Industrial Division, "Seismic Analysis Report, Point Beach Nuclear Plant Units 1 & 2", June 6, 1969.

3. Computech Engineering Services (CES) Inc., Point Beach Project No. 541, Point Beach Nuclear Plant Control Building and Auxiliary Building In-Structure Response Spectra.

4. Impell Corporation, "Floor Response Spectra Generation for Higher Damping Values", WEPCo P.O. C443378-5, Impell Job No. 0870-009-1453, Revision 0, May 1988.

5. John A. Blume and Associates, Engineers, "Proposed Nuclear Power Station Recommended Earthquake Criteria", May 1966.

6. Sargent & Lundy, "Response Spectrum Curves for Point Beach Plant, Revision 0", Project No. 8992-01, August 3, 1992.

TABLE B.1

STRUCTURE DYNAMIC MODELING
MODE SHAPES AND NATURAL FREQUENCIES

STRUCTURE	MODE SHAPE	NATURAL FREQUENCY (Hz)
Containment Structure	1	1.6
and Internals	2	4.1
Auxiliary Building	1	1.9
Central Part	2	9.3
Auxiliary Building	1	1.9
North & South Wings	2	6.1
Control Building	1	2.5
	2	6.4
Pipeway #1	1	6.6
	2	20.2
Pipeways #2 & #3	1	3.0
	2	6.9
Pipeway #4	1	5.4
	2	18.3
Fuel Oil Pump House	1	4.5
	2	7.4

TABLE B.2

PBNP STRUCTURAL DESIGN
DAMPING COEFFICIENTS

	Hypothetical Earthquake (SSE)	
	PBNP	RG 1.61
Welded Steel Plate Assemblies	2%	4%
Welded Steel Framed Structures	2%	4%
Bolted Steel Framed Structures	5%	7%
Interior Concrete Equipment Supports	2%	
Reinforced Concrete Structures on Soil	7.5%	7%
Prestressed Concrete Containment Structure on Piles	5%	5%
Vital Piping Systems <12 in. diameter	.5%	2%

TABLE B.3

SOIL STRUCTURE INTERACTION
SOIL STRUCTURE SPRING CONSTANTS

SPRING CONSTANT
($x\ 10^5$ kips/ft)

	SPRING ORIENTATION			
	VERTICAL		HORIZONTAL	
	NORTH-SOUTH	EAST-WEST	NORTH-SOUTH	EAST-WEST
Containment Structure and Internals	5.25	5.25	3.33	3.33
Auxiliary Building Central Part	1.32	0.87	1.57	1.54
Auxiliary Building North & South Wings	[1]	1.06	[1]	1.25
Control Building	1.04	0.85	1.39	1.36
Pipeway #1	0.28	0.46	0.51	0.51
Pipeways #2 & #3	[2]0.34		[2]0.54	
Pipeway #4	0.32	0.58	0.57	0.58
Fuel Oil Pump House	0.16	0.23	0.27 0.24	0.28 (@ 5' El.) 0.24 (@ 10' El.)

Notes: 1. Bechtel calculations provide E-W spring constant only
2. Longitude of Pipeway 2 is NE-SW, Longitude of Pipeway 3 is NW-SE. Spring constant is for analysis in the transverse direction

TABLE B.4

DEVELOPMENT OF IN-STRUCTURE RESPONSE SPECTRA
FOR SEISMIC CLASS 1 STRUCTURES AND EQUIPMENT AT PBNP

STRUCTURE	ELEVATION (feet)	DAMPING VALUES (percent, %)		
		Bechtel	Computech	Impell
Containment Structure	6.5	.5, 1, 2		1, 2, 4, 5, 7
	15			
	45			
	75			
	105			
Containment Internals	17	.5, 1, 2		1, 2, 4, 5, 7
	29			(for 29', 56' & 76' only)
	46			
	56			
	66			
	76			
	96			
Auxiliary Building Central Part	8	.5	.5, 1, 2, 4, 5, 7	
	26			
	44.3			
	62.75			
Auxiliary Building North & South Wings	8	.5	.5, 1, 2, 4, 5, 7	
	26			
	48			
Control Building	8	.5	.5, 1, 2, 4, 5, 7	
	26			
	44			
	60			
	74			

TABLE B.4 (continued)

DEVELOPMENT OF IN-STRUCTURE RESPONSE SPECTRA
FOR SEISMIC CLASS 1 STRUCTURES AND EQUIPMENT AT PBNP

STRUCTURE	ELEVATION (feet)	DAMPING VALUES (percent, %)		
		Bechtel	Computech	Impell
Pipeway #1	6.5 14.95 23.5	.5		1, 2, 4, 5, 7
Pipeways #2 & #3	6.5 14.75 26 36 47	.5		1, 2, 4, 5, 7
Pipeway #4	6.5 15 26	.5		1, 2, 4, 5, 7
Fuel Oil Pump House	5 25.42 35.33	.5		

FIGURE B.1

OLYMPIA, WA. N80E, APRIL 13, 1949 vs HOUSNER GROUND RESPONSE SPECTRA

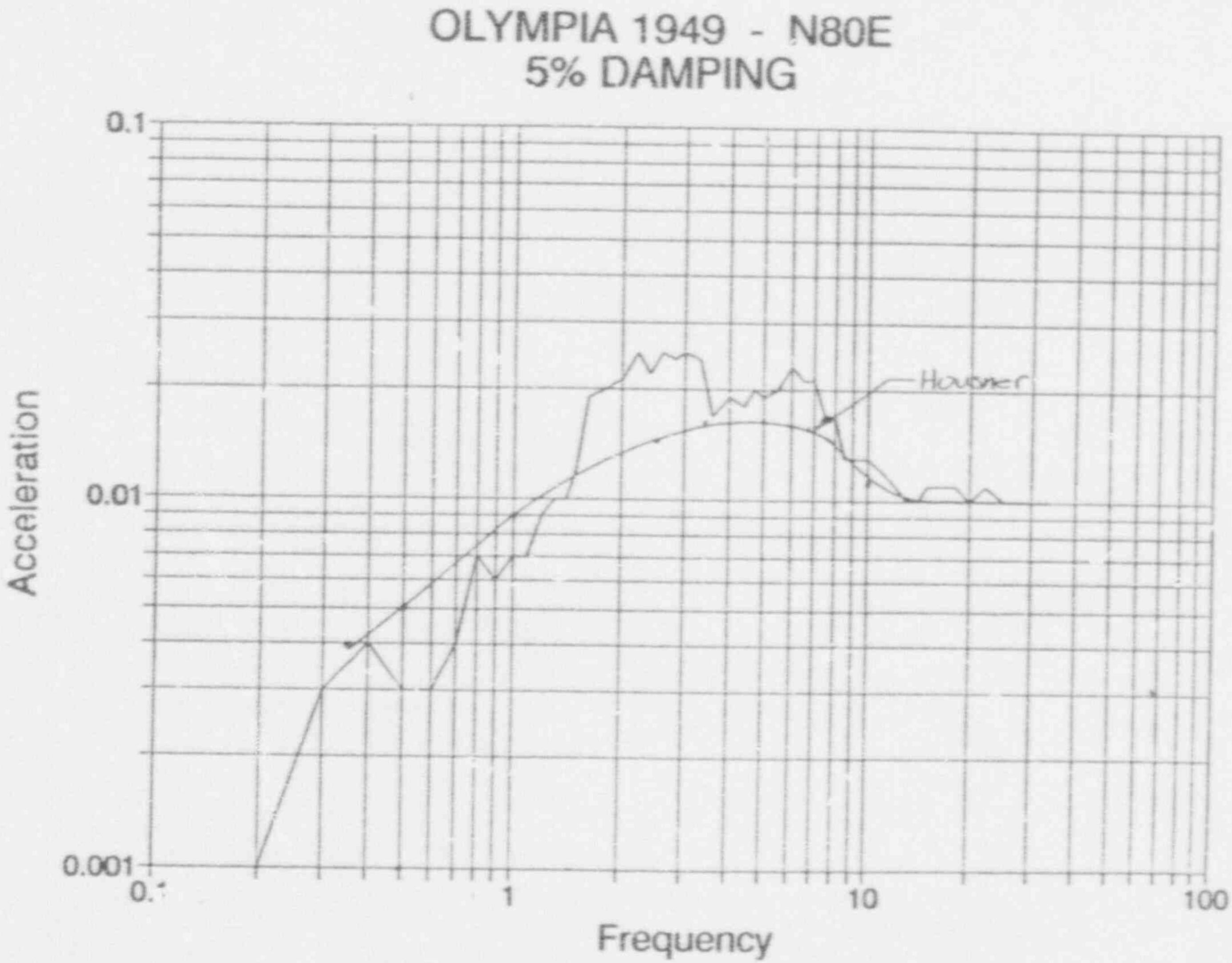


TABLE B.5

PEAK SPECTRAL ACCELERATION VALUES
AT IMPORTANT FLOOR LOCATIONS FOR
SAFE SHUTDOWN EQUIPMENT AT PBNP
0.12g SSE (HORIZONTAL), 5.0% DAMPING

STRUCTURE	ELEVATION (feet)	MAXIMUM SPECTRAL ACCELERATION (g's)
Containment Structure	45	.84
	75	.98
	105	1.26
Containment Internals	29	.82
	56	.88
	76	1.02
Auxiliary Building Central Part	8	.70
	26	.96
	44.3	.98
	62.75	1.18
Auxiliary Building North & South Wings	8	.64
	26	.80
	48	.94
Control Building	8	.92
	26	1.32
	44	1.64
	60	1.92
	74	2.0

FIGURE B.1

OLYMPIA, WA, N80E, APRIL 13, 1949 vs HOUSNER GROUND RESPONSE SPECTRA

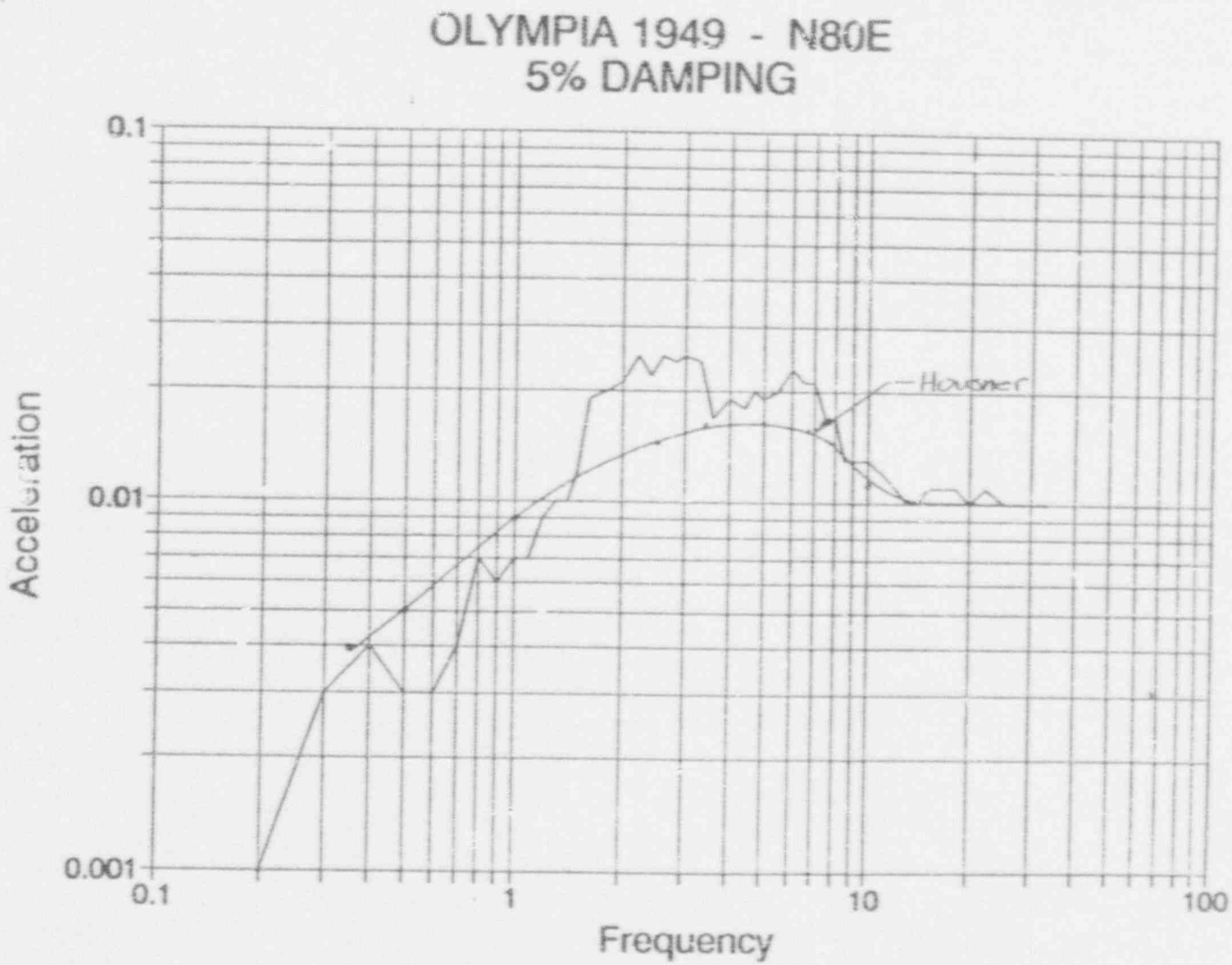


FIGURE B.2

PBNP - CONTAINMENT STRUCTURE AND INTERNALS SEISMIC MODEL

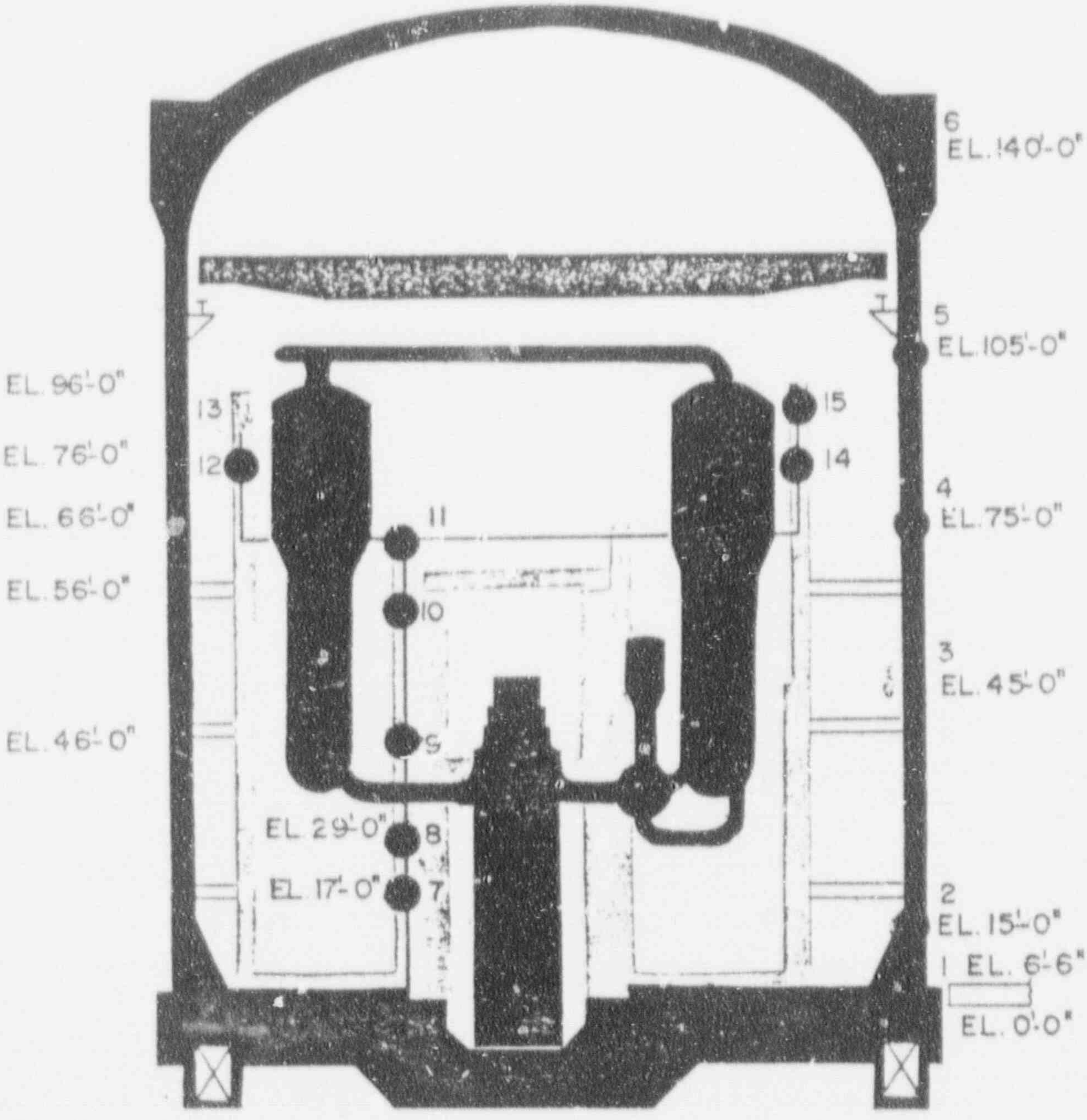


FIGURE B.3

PBNP - CONTAINMENT STRUCTURE AND INTERNALS MATHEMATICAL MODEL

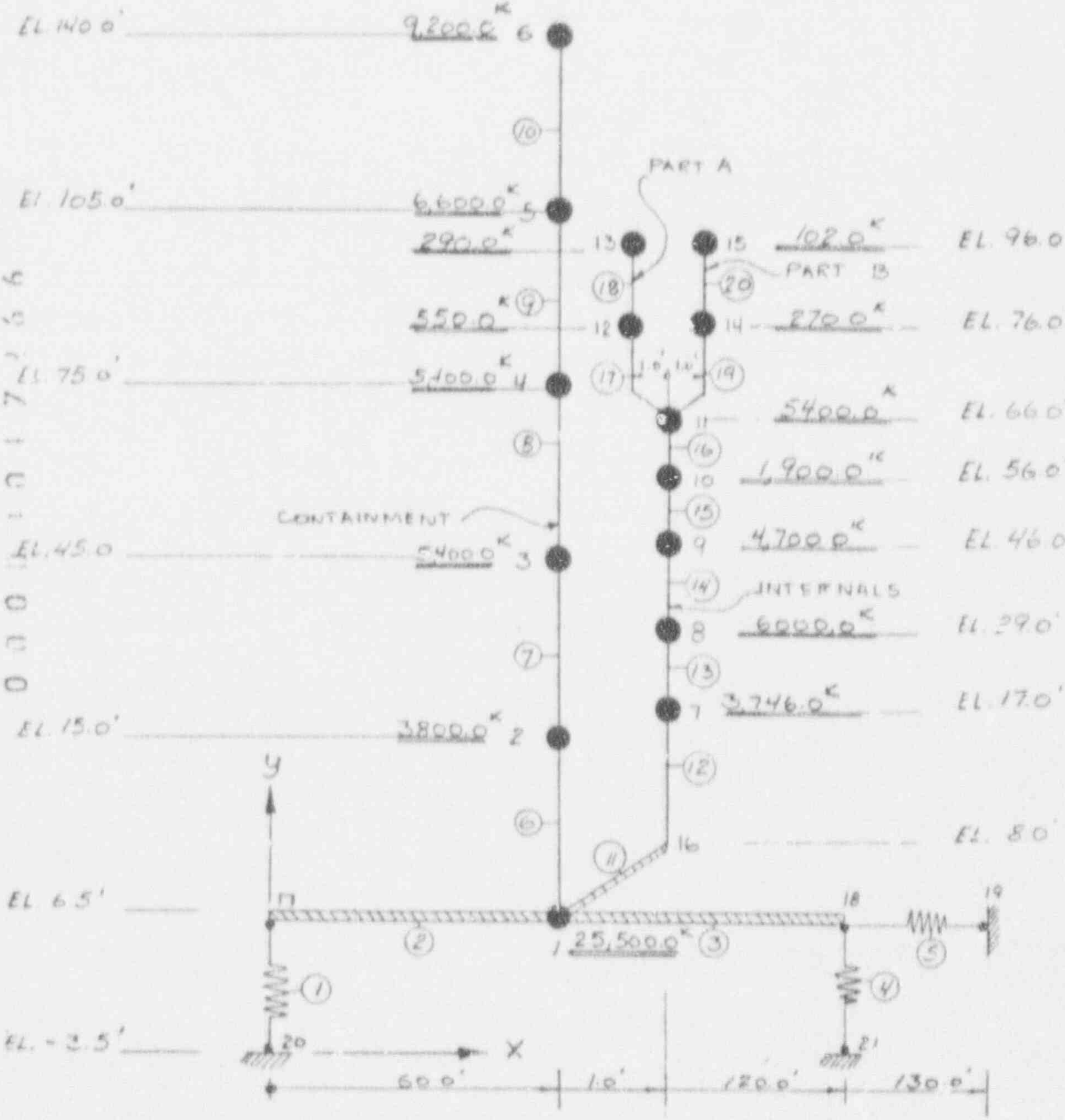


FIGURE B.4

<u>PBNP - AUXILIARY BUILDING CENTRAL PART SEISMIC MODEL</u>

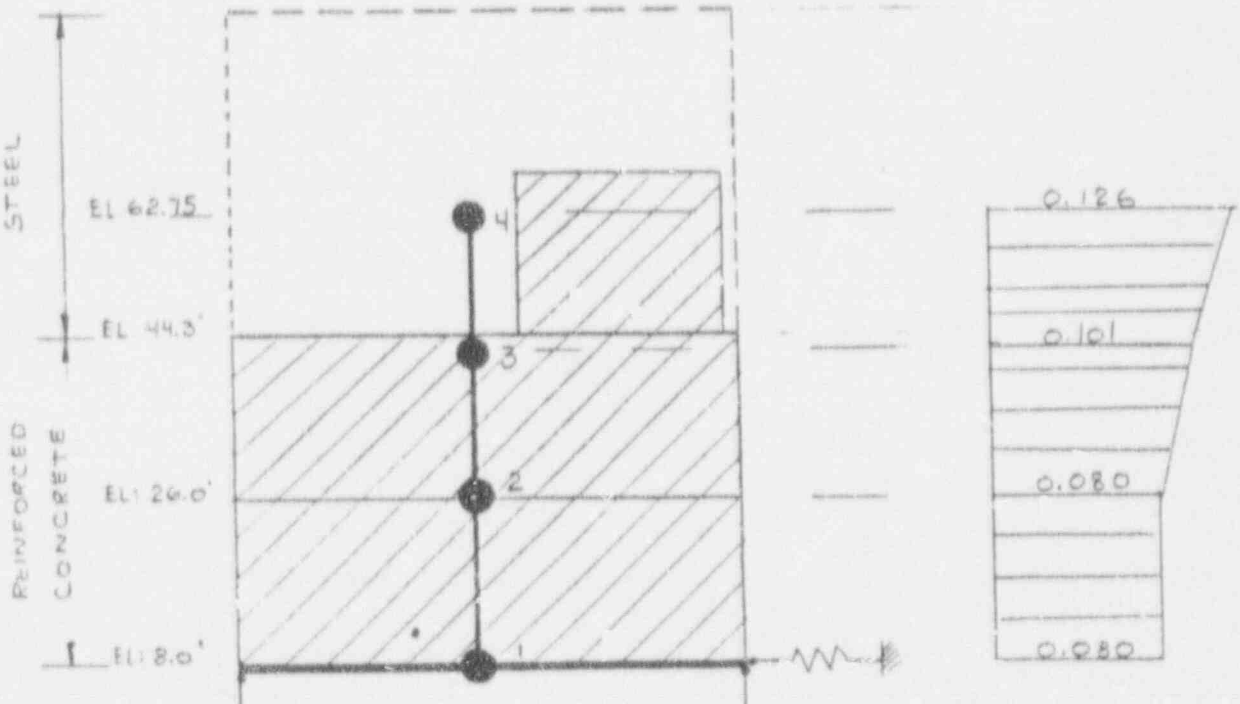


FIG. 1

FIG 2
AC ELERATIO N (G's)
AT EACH ELEVATION

FIGURE B.5

PBNP - CONTROL BUILDING SEISMIC MODEL

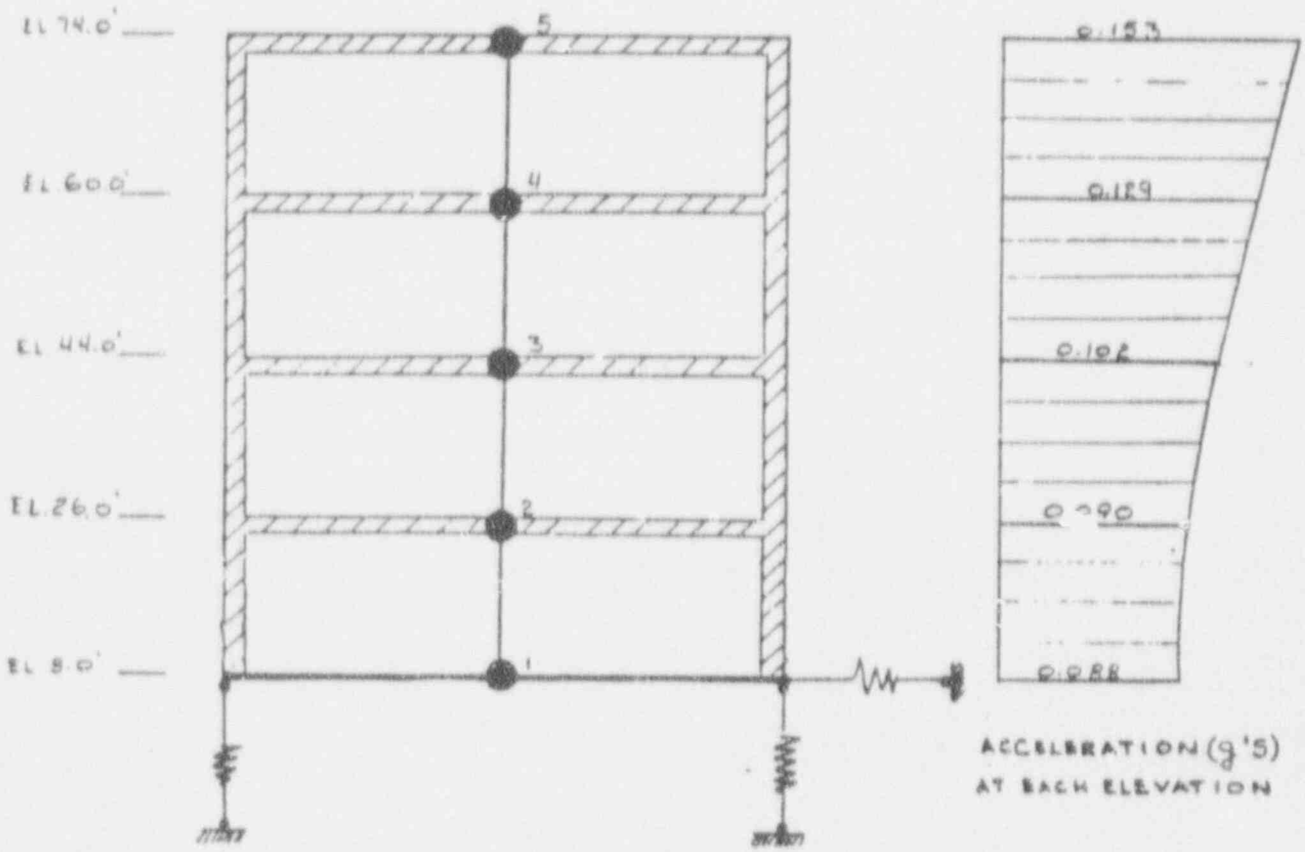
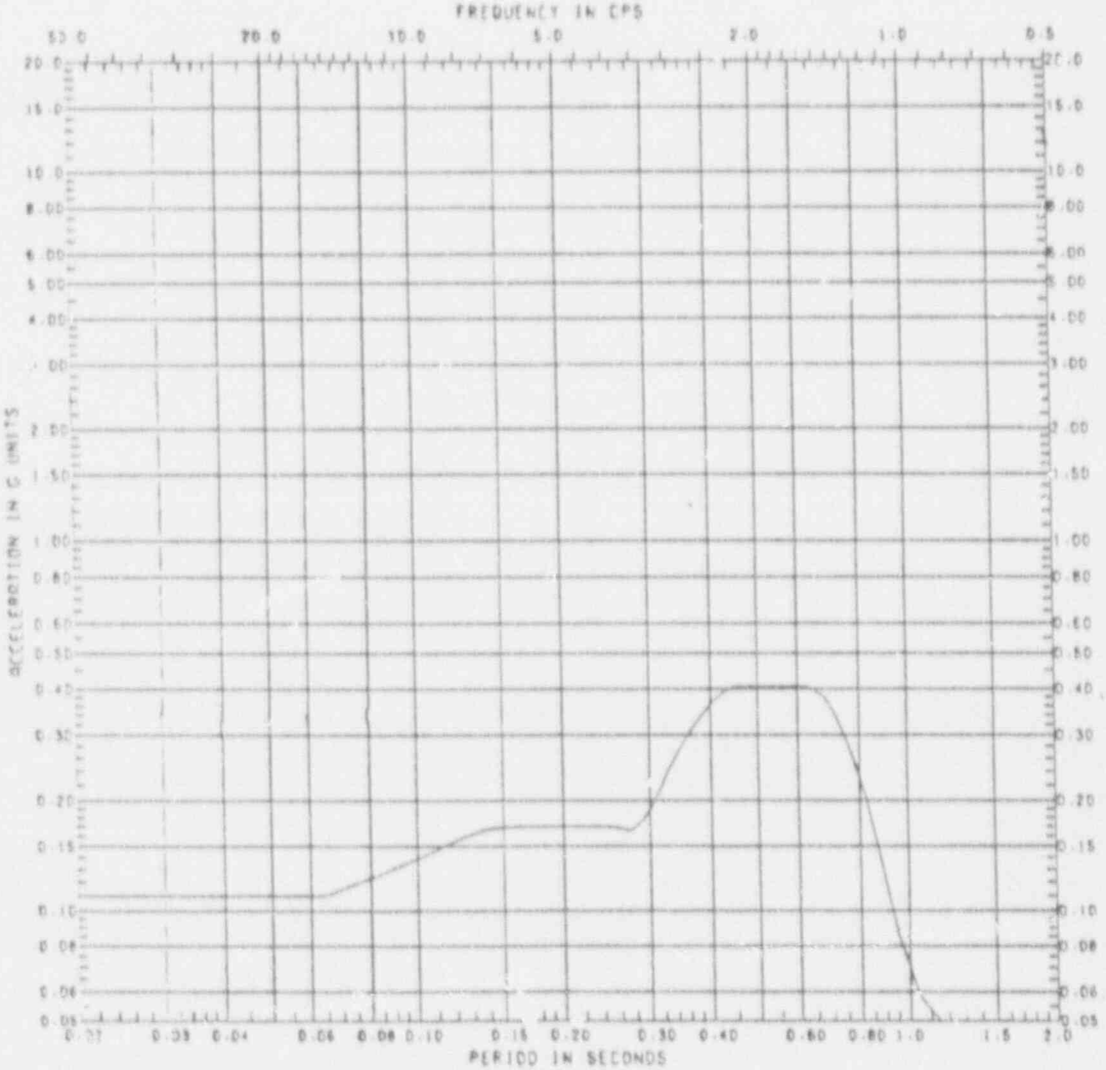


FIGURE B.6

PBNP - CONTAINMENT INTERNALS ISRS
ELEVATION 29', 0.06g OBE (HORIZONTAL), 5.0% DAMPING

08 JAN 92
SYC108

PEAKS WIDENED BY 15% ON EACH SIDE
DAMPING 0.050

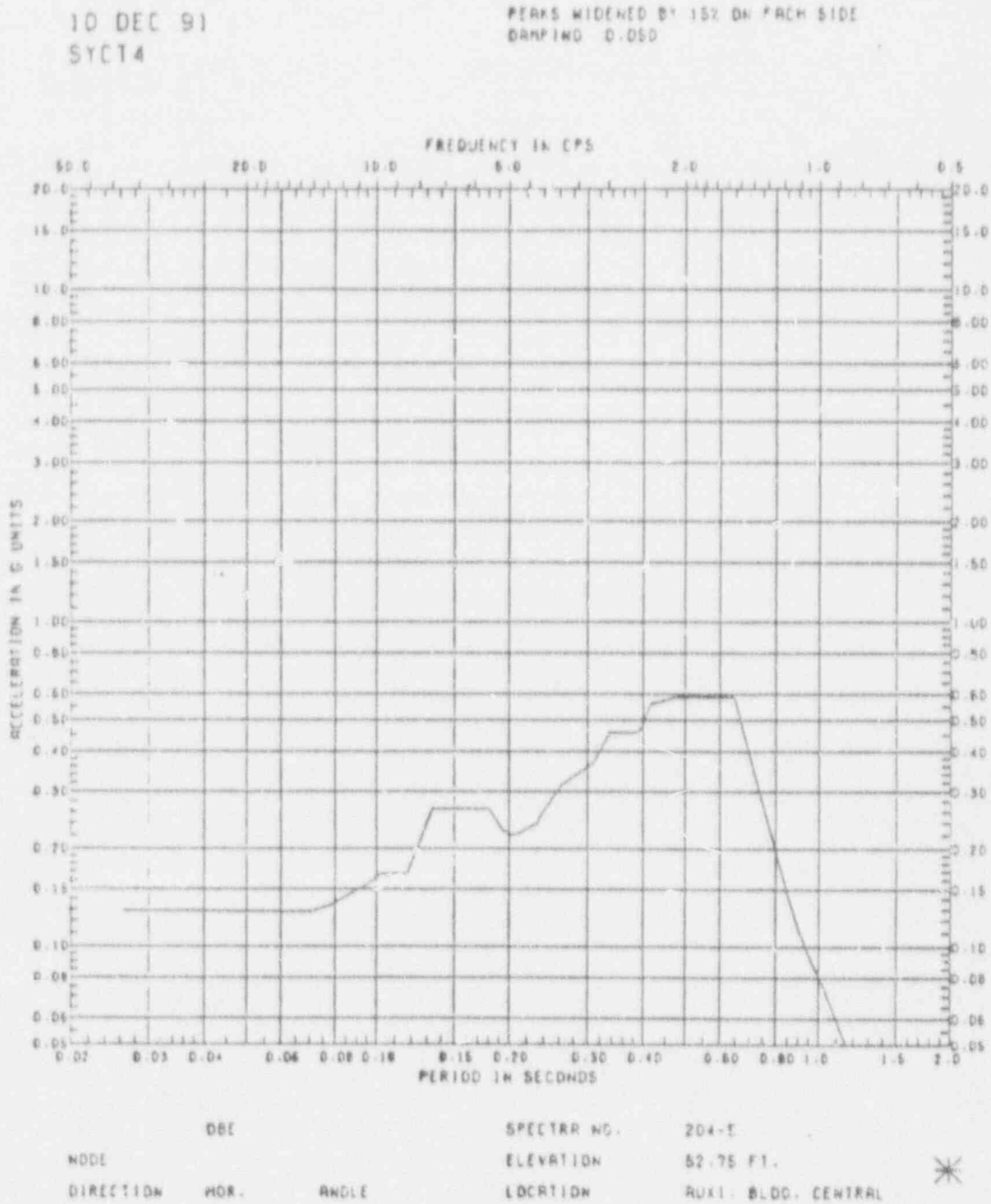


	OBE		SPECTRA NO.	108-5
NODE			ELEVATION	29.00 FT.
DIRECTION	HOR.	ANGLE	LOCATION	CONTAINMENT INTERNAL

Note - Multiply OBE spectral acceleration by a factor of 2 for SSE analysis.

FIGURE B.7

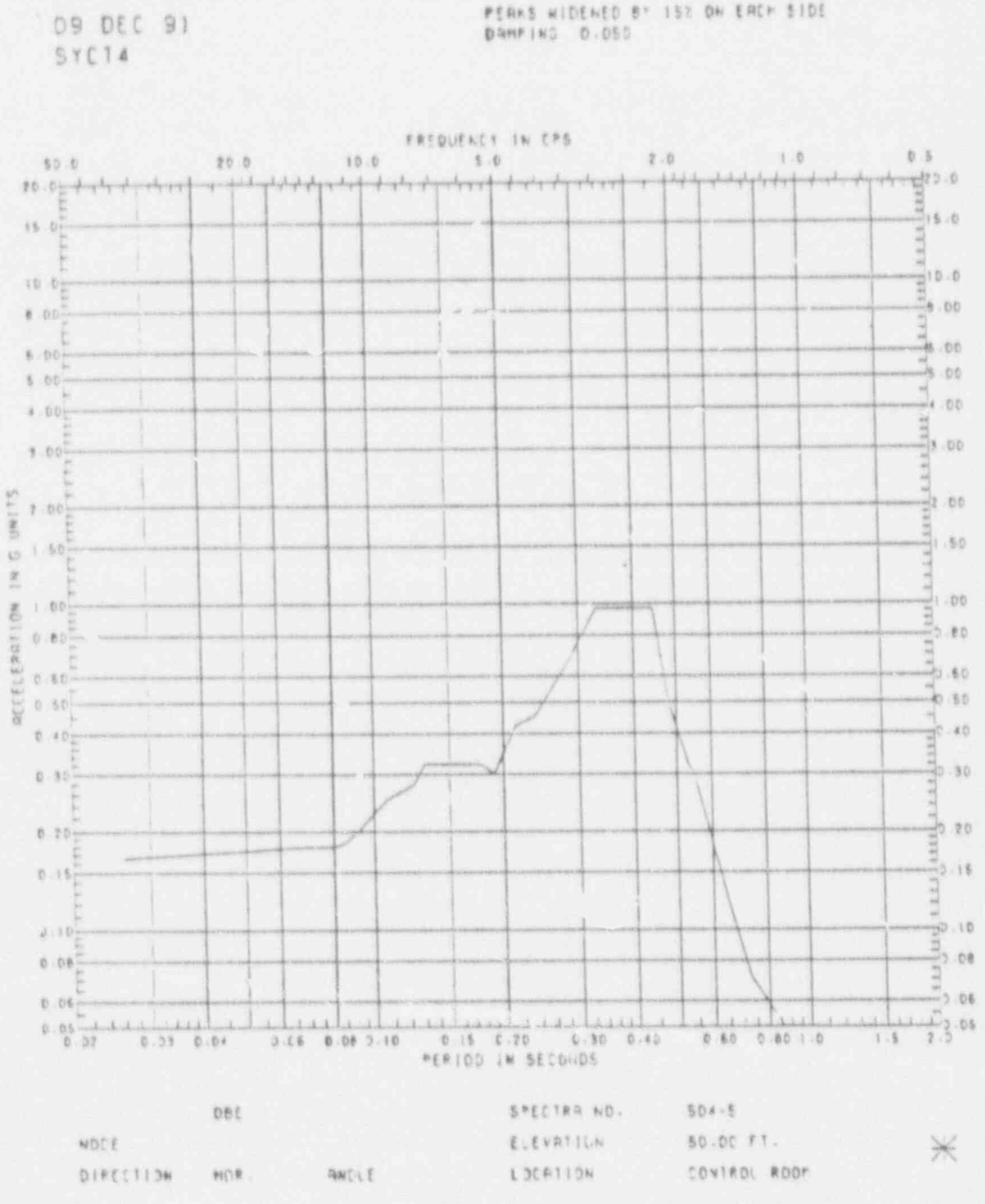
PBNP - AUXILIARY BUILDING CENTRAL PART ISRS
ELEVATION 62.75', 0.06g OBE (HORIZONTAL), 5.0% DAMPING



Note - Multiply OBE spectral acceleration by a factor of 2 for SSE analysis.

FIGURE B.8

PBNP - CONTROL BUILDING ISRS
ELEVATION 60', 0.06g OBE (HORIZONTAL), 5.0% DAMPING



Note - Multiply OBE spectral acceleration by a factor of 2 for SSE analysis.