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Joseph M. Farley Nuclear Plant
Verification of Seismic Adequacy of Mechanical and
Electrical Equipment in Operating Reactors
Unresolved Safety Issue (USI) A-46, Generic Letter 87-02 RAI Response

Ladies and Gentlemen:

This letter is in response to the Request for Additional Information (RAI) dated August 29, 1996, concerning our submittal dated May 18, 1995, titled "Unresolved Safety Issue (USI) A-46, Generic Letter 87-02 Response." The enclosure provides the Southern Nuclear Operating Company (SNC) response to the RAI questions.

In our May 18, 1995 submittal we stated our intention to revise the licensing basis for both Units 1 and 2 to allow application of earthquake experience data as an acceptable alternative for documenting the seismic adequacy of appropriate mechanical and electrical equipment. We strongly believe that since the original seismic licensing basis and design for both Units 1 and 2 is IEEE 344-1971, and the Units are basically identical, with only minor variations existing with regard to seismic design requirements, that if the GIP-2 methodology is acceptable for Unit 1 for new and replacement equipment then it also should be acceptable for Unit 2. However, we do recognize the NRC staff position that Unit 2 is not considered a USI A-46 plant. SNC will therefore not apply the GIP-2 methodology at this time to Unit 2 for new and replacement equipment. SNC will continue to pursue NRC approval of application of the GIP methodology on an industry basis for plants in a similar position as FNP Unit 2. Upon resolution of open issues with the NRC, SNC will revise the FNP FSAR as appropriate.

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If you have any questions, please advise.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Dave Morey

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Enclosure:
A-46 Request for Additional Information

cc: Mr. S. D. Ebneter, Region II Administrator
Mr. J. I. Zimmerman, NRR Project Manager
Mr. T. M. Ross, Plant Sr. Resident Inspector

ENCLOSURE

Farley Nuclear Plant - Unit 1

USI A-46 Request for Additional Information

Enclosure
Farley Nuclear Plant - Unit 1
USI A-46 Request for Additional Information

1. **Question:**

For the plant structures containing equipment in the USI A-46 scope:

a. Identify structures that have licensing-basis floor response spectra (5 percent critical damping) for elevations lower than 40 feet above the effective grade, whose amplitude is greater than 1.5 times the GIP-2 Bounding Spectrum.

b. Provide the response spectra designated according to height above the effective grade identified in Item 1.a above and a comparison to 1.5 times the Bounding Spectrum.

c. With respect to the comparison of equipment seismic capacity to seismic demand, indicate which method (Method A or Method B in Table 4-1 of GIP-2) was used to address the seismic adequacy of equipment installed on those floors identified in Item 1.a above.

Response:

This question is related to the use of 1.5 times the plant SSE ground response spectra as a realistic estimate of seismic demand under certain limited conditions as specified in the GIP. It is our understanding that the NRC Staff and representatives of the Seismic Qualification Utility Group (SQUG) are jointly seeking generic resolution of this issue. It is Southern Nuclear Company's (SNC) position that the GIP has been approved by the NRC Staff in Supplemental Safety Evaluation Report No. 2 dated May 22, 1992, (Reference 1) as an acceptable method of demonstrating the seismic adequacy of equipment within its scope. This new methodology differs from that contained in the existing plant licensing basis in substantial and fundamental respects. Accordingly, it is impossible to meaningfully compare isolated aspects of the two methodologies including their relative conservatisms. Any such comparison must be made at the program level to evaluate compliance with appropriate NRC regulations concerning seismic adequacy.

The following information is provided with the understanding that a generic resolution to the application of method A of Table 4-1 of reference 2 is being pursued by SQUG and the NRC staff.

Enclosure

a. The following structures have licensing-basis SSE floor response spectra (5 percent critical damping) for elevations lower than 40 feet above the effective grade, where the amplitude is greater than 1.5 times the GIP-2 Bounding Spectrum:

Auxiliary Building (effective grade is EL. 155')

Mass Point	Elevation	Direction
3	121'	N-S
4	139'	N-S and E-W
5	155'	N-S and E-W
6	175'	N-S and E-W
7	175'	N-S and E-W

Containment Internal Structure (effective grade is EL. 130')

Mass Point	Elevation	Direction
4	140'	N-S
5	149'	N-S
6	155'	N-S and E-W

Containment Shell (effective grade is EL. 155')

Mass Point	Elevation	Direction
12	193'	N-S and E-W

b. Attachment 1 provides plots of the licensing-basis SSE floor response spectra identified in item "a" above compared to 1.5 times the Bounding Spectrum.

c. Method A of Table 4-1 of reference 2 was typically used to address the seismic adequacy of equipment installed at elevations identified in item "a" above for the auxiliary building and the containment internal structure following the guidance of references 1 and 2. No SSEL equipment is located on the containment shell at EL. 193'. Columns 10 and 11 of the Screening Evaluation Data Sheets found in Attachment G of reference 3, identify the capacity spectrum and demand spectrum respectively that were used to compare equipment seismic capacity to demand for each item of equipment on the SSEL.

2. **Question:**

In Table 1 of Appendix C and Table 2 of Appendix D, one of the relay evaluation status codes is "WALK," which indicates that equipment is seismically adequate based on walkdown using Seismic Capacity Bounding Spectra. Provide a list of relays resolved by this method and describe specific details of how each relay was evaluated to be seismically adequate.

Response:

Items identified with a status code of "WALK" are actually breakers located in MCCs and switchgear. As stated in reference 4, breakers are not considered to be relays in the scope of A-46 because they have not shown a vulnerability to chatter. These breakers are included in the database for tracking purposes only. The status code indicates that the MCC or switchgear housing the breaker has been screened as part of the seismic capability walkdown. Relays, contactors, auxiliary contacts, and any other contact devices that control or effect the operation of these breakers have been evaluated for contact chatter per reference 4. The list of breakers identified with this status code is included as Attachment 2.

3. **Question:**

In your relay evaluation report, you have identified six relays as outliers. Were there any other "bad actor" relays installed in the plant safe shutdown path and identified during the relay evaluation? Describe the resolution for seismic adequacy of these relays.

Response:

In addition to the relays identified in section 3 of reference 3, GE PVD relays were also identified in the safe shutdown path. Shake table testing meeting the requirements of IEEE 344-75, demonstrated that these relays are acceptable for use at Farley Nuclear Plant (FNP).

4. **Question:**

Provide information concerning equipment that does not meet the specific wording of a caveat and was not identified as an outlier. Provide the following information in a tabular form for each of these equipment:

a. Equipment description
b. Caveat Number in the GIP-2
c. Description of deviation from the GIP-2 caveat
d. Justification for resolution

Response:

See Attachment 3.

5. **Question:**

Appendix K contains few cases of outliers where potential bolt bending concerns were resolved by analysis. Provide the detailed analyses with sketches or drawings for the following three cases:

a. LC Transformer in Diesel Generator Building (Equipment ID Q1R11B503-A)

b. MCC 1K in Service Water Intake (EQ ID Q1R17B504-A)

c. 125-V-dC Service Water Building Battery No. I (EQ ID QSR42B523A-A)

Response:

The following describes the analyses performed to resolve outliers related to bolt bending for the three cases identified in question 5:

a. <u>LC Transformer in Diesel Generator Building (Equipment ID: Q1R11B503-A):</u>

The largest gap for this transformer was found to be only 0.35". In the attached Figure 1, Sketch 5-A shows the gap condition. This outlier was resolved by referring to an enveloping evaluation made on an identical transformer (Q2R11B504-A) where a gap of one inch was found. The seismic demand and gap size for Q2R11B504-A enveloped that of Q1R11B503-A. Evaluation of the bolt performance followed the procedure for anchors with excessive gaps given in reference 5. Using this procedure, the maximum allowable shear load associated with bolt bending is calculated assuming a) failure of the bolt at the concrete surface and b) failure of the embedded portion of the bolt. Of course, it should be noted that the maximum applied axial load (demand) on the bolt is explicitly considered in the calculation of the allowable shear load. The lesser allowable shear load is then compared to the maximum shear loading or

demand on the bolt to verify that the allowable shear load is greater than the actual shear loading. Next, the shear-tension interaction on the bolt is checked per reference 2 using the maximum applied shear and axial loads, i.e., the maximum demand, and the allowables V_{all} & P_{all} as defined in the GIP. These evaluations showed the anchorage for the transformer to be acceptable.

b. MCC 1K in Service Water Intake (Equipment ID: Q1R17B504-A):

Sketch 5-B of Figure 1 shows the base channel of the MCC at the corner that is shimmed due to the sloping floor surface. If it is conservatively assumed that the ends of the channel legs that are in contact with the shims and the floor surface offer no resistance to shear loads or lateral deflection at the base, then the shear loads would produce bending in the anchor bolts. Using this conservative assumption, the worst gap identified is approximately two inches, which includes the height of the base channel plus the gap height. Evaluation of the bolt performance followed the procedure for anchors with excessive gaps given in reference 5. A discussion of these evaluation procedures is provided in response 5a above. These evaluations showed the anchorage for the MCC to be acceptable.

c. 125-V-dc Service Water Building Battery No. 1 (Equipment ID: QSR42B523A-A):

Sketch 5-C of Figure 1 shows the largest gap found for this battery rack which is only about 0.4". This battery rack is a low height, two tier battery rack with 16 - 1/2" diameter Phillips Red Head anchors approximately 5-1/2" long. The maximum shear load on a bolt is only about 50 lb. and the maximum tensile load is less than 10 lb. due to the low aspect ratio of these racks. The extremely low resulting bending moment, and very low stresses/loads in the bolts, was the basis for determining that the anchorage is adequate.

The evaluations described above, as well as EPRI Report TR-103960 (reference 5), are available for review at the SNC offices in Birmingham, AL.

6. **Question:**

Referring to Section 4.2.2, provide a detailed discussion of the methodology and assumptions used for the generation of the new in-structure response spectra (IRS) for equipment located in the diesel generator building and the service water intake structure and the new ground response spectra (GRS) at elevation 155 feet. Indicate if the new methodology and the assumptions adopted comply fully with those of the FNP Unit 1 FSAR.

Response:

The development of the new IRS for the diesel generator building (DGB) and service water intake structure (SWIS) follows the guidance given in the current Standard Review Plan (NUREG-0800, Rev. 2, 9/89) using the Farley SSE spectral shape and horizontal peak ground acceleration (pga) of 0.1g.

New In-Structure Response Spectra Generation Per Standard Review Plan (SRP):

The substructure approach of performing soil-structure interaction (SSI) analysis of structures was applied to the DGB and SWIS at FNP. This approach separates the SSI problem into a series of simpler problems, solves each independently, and superposes the results. The elements of the substructure approach are:

- Specifying the free field ground motion and defining the soil profile.
- Calculating the foundation impedances and wave scattering functions.
- Modeling the structure. The structural models were based on the Farley original building models.
- Performing the SSI analysis, i.e., combining the previous steps to calculate the response of the coupled soil-structure system.

This substructure procedure is implemented in the CLASSI family of computer programs, and is identified in the SRP as an acceptable method. There are however, specific recommendations in the SRP for performing SSI analysis, the key aspects of which are summarized in the following paragraphs. In addition to the SRP, guidance on major aspects of SSI analysis in ASCE 4-86 were followed.

The substructure procedure is linear elastic. Nonlinear soil material behavior can be considered in an equivalent linear fashion. The soil model does include the layering characteristics of the site as well as the "primary nonlinearities" associated with the seismic induced strain. Low strain soil properties as a function of depth were derived from detailed site investigation reports as defined in the FSAR, and degraded soil properties compatible with the seismic induced strain level were computed using the computer program SHAKE. Uncertainty in the determination of soil properties are bounded by varying the low strain shear moduli within the range of 0.5 times to 2.0 times the best-estimate values.

Per the SRP, the control point should be specified either on the free surface at grade or, in the case of poor top soil, on an imaginary outcrop of a competent layer. In the original FSAR analysis of caisson supported structures at Farley, the SSE was applied at the lower bearing end of the caisson. For the current analysis, the control point was specified on a hypothetical outcrop, the Compact Overburden layer that exists at 24.5 feet below grade at the main plant area. At the outlying service water intake area, the soil profile differs from the main plant area. There, the control point was specified on an imaginary outcrop of the Lisbon formation 85 feet below grade. The frequency content of the control motion was defined by the Farley SSE.

For embedded structures, the SRP recognizes the wave scattering phenomenon, but limits reduction in foundation input motion to 60% of the control motion at grade. Also, increased foundation rocking due to wave scattering effects should be included. The full effects of radiation damping in the soil may be utilized provided soil layering effects and frequency dependency of the foundation impedances are incorporated in the analysis. If side soil is accounted for in the impedance calculation, the potential for reduced lateral support should be considered. ASCE 4-86 suggests debonding the top 20 feet of soil, or half the embedment, whichever is less. This consideration was applied to the embedded SWIS foundation.

To bound the uncertainty in determining soil properties, three sets of high strain soil properties consistent with the SSE excitation level were developed. These three soil profiles were then used to develop SSI parameters. Three analyses were then performed using the lower bound, best estimate, and upper bound SSI parameters. Structural properties remained unchanged for all three analyses. The IRS from the three analyses were then enveloped and peak broadened by $\pm$10% to yield the "conservative design" SRP spectra.

<u>Site Response and Development of New Ground Response Spectra at Elevation 155' Feet:</u>

The substructure approach to SSI is a linear elastic method. However, the force-deformation, as well as hysteretic damping characteristics of soil, is a function of strain level, i.e., shear modulus decreases, and damping increases with strain. The nonlinear soil behavior was treated in an equivalent linear manner by the use of soil properties compatible with the effective seismic induced strain in the soil. The computation of strain compatible properties was performed in an iterative linear fashion using the computer program SHAKE. The methodology in SHAKE models the soil as a horizontally layered linear viscoelastic medium. By further assuming vertically incident shear, the problem reduces to a one-dimensional case.

Therefore, a soil column may be used to represent a given site for the purpose of performing one-dimensional wave propagation analysis. The input to SHAKE comprise:

- Low strain soil properties.
- The soil shear modulus versus strain, and damping versus strain relationship. For the cohesionless soil type reported in the FSAR for this site, the mean degradation curves for sand are applicable.
- The horizontal component of ground motion. The ground motion is the horizontal artificial time history matched to the Farley SSE.
- Specification of control point location.

SHAKE performs iterative linear analyses to converge on strain compatible soil properties. The use of strain compatible properties accounts for the primary nonlinearities in the soil under seismic induced strain. These properties are used later in calculating foundation impedances. In addition to defining the strain compatible soil properties, the SHAKE analysis also yields motion at various depths of the soil profile, including motion on top of the soil column. The motions at the plant grade of elevation 155 from the SHAKE analysis were used to define the ground response spectra for the surface mounted tanks located in the plant yard for the IPEEE evaluation.

In the SRP approach, the uncertainty in determining soil properties is bounded by considering three sets of low strain soil properties. The lower bound property set is obtained by factoring the best estimate low strain shear moduli by 0.5. The upper bound shear moduli are taken as twice the best estimate values. Each of these property sets is iterated upon using SHAKE to derive the corresponding high strain values.

The subsurface conditions within the main plant area where the DGB is located, and the outlying service water intake area, are sufficiently different to warrant separate treatment.

Methodology for New IRS and GRS for Tanks in Plant Yard Compared to Farley FSAR:

The development of the new IRS for the DGB and SWIS follows the guidance given in the current Standard Review Plan (NUREG-0800, Rev. 2, 9/89) using the Farley SSE spectral shape and horizontal peak ground acceleration (pga) of 0.1g.

As stated in reference 3, these new IRS are judged to be "conservative design" IRS due to the fact that the SSI analyses, and the calculation of the new IRS, were performed following the latest revision of the SRP; however, for additional conservatism in the A-46 and IPEEE evaluations they were treated as "realistic, median-centered" IRS. The Farley FSAR discussion of the development of the original IRS describes analysis techniques commonly used in the early to mid '70's. The original SSI analyses are based on the theory of a rigid base resting on an elastic half-space using a single soil shear wave velocity. Using this SSI analysis approach, the FSAR limited soil damping to 7 percent. The SSE for these analyses was always placed at the foundation level of the building even though the FSAR does not define the motion at those locations but at the ground surface which is plant grade.

New ground response spectra as described above for the surface mounted tanks in the plant yard was developed specifically to meet SNC commitments as a result of the FNP IPEEE response to NRC GL 88-20 Supplement 4 as documented in SNC letter to the NRC dated September 14, 1992.

7. **Question:**

Referring to Section 4.2.4.4, provide an example of the calculation for determining the seismic capacity of key cable and conduit raceways. Was the weight of cable insulating materials (e.g., thermo-lag material) included in the raceway seismic demand determination? If yes, discuss the manner in which the weight was accounted for in the evaluation, and if not, explain the basis for the weight exclusion.

Response:

The seismic capacity of the cable and conduit raceways evaluated in the SQUG limited analytical review (LAR) was determined by following section 8.3 of reference 2. A generic cable tray weight of 50 lb./ft. was used for the evaluations that enveloped the worst case loading determined by adding the weight of the cables as taken from the FNP raceway loading report, the weight of the tray and cover, and the weight of any fire wrap material. Conduit weights were taken from section 8.3.9 of reference 2 plus the weight of any fire wrap material. The LAR evaluations are available for review at the SNC offices in Birmingham, AL.

8. **Question:**

With respect to Appendices I and J of the summary report, please provide the engineering calculations that support the resolution of the two outliers identified with Drawing Nos. D-172203 and D-177920 listed in Appendix I and the three outliers listed in Appendix J, which are associated with Drawing Nos. D-177930, D-177920, and D-207921.

Response:

Limited Analytical Review (LAR) selection number FNPCS8 (the LAR selection number is a unique number assigned to each LAR sample) from drawing D-172203 in the diesel generator building, is a cantilevered support suspended from the ceiling. The support is anchored with four 3/4" diameter cast-in-place J-bolts. The support was analyzed per section 8.3 of reference 2. The evaluation revealed that the anchorage capacity did not meet the GIP criteria when using the generic cable tray weight of 50 lb./ft. for the lateral load check. Therefore, the analysis was performed again using a lower generic weight that enveloped the actual cable tray weights for this support. The lower generic weight was possible because the trays in the diesel generator building are relatively light with no fire wrap material. The revised analysis was successful in demonstrating the adequacy of the support for A-46. No additional LAR samples were selected since FNPCS8 was still the enveloping support for the diesel generator building.

LAR selection number FNPCS10 from drawing D-177920 at elevation 155' in the auxiliary building, consists of a main tube steel column suspended from the ceiling and braced laterally by horizontal members that are connected to adjacent supports. The top of the main column is welded to a steel beam that is welded to embedded steel plates in the ceiling. The evaluation revealed that the welds to the embedded plates were over stressed due to the dead load moment. This condition was resolved by installing additional support members to provide adequate lateral and vertical bracing to reduce the moment at the embedded plate weld. Following this modification the support meets the GIP criteria.

The outlier listed in Appendix J of reference 3 for drawing D-177930 is LAR selection number FNPCS15 located at elevation 139' in the auxiliary building. This support consists of a single tube steel arm cantilevered from the wall supporting 4 conduits. The support is anchored with two 3/8" diameter expansion anchors. The evaluation revealed that the anchor bolts did not meet the GIP criteria due to dead load moment. This outlier was resolved by evaluating the adjacent supports for the additional load assuming failure of FNPCS15. The adjacent supports, as well as the conduit spans, were found to be acceptable for the additional load. This support was a unique case and was not used as an enveloping case for other supports.

The outlier listed in Appendix J of reference 3 for drawing D-177920 is the same as LAR selection number FNPCS10 which is described above.

The outlier listed in Appendix J of reference 3 for drawing D-207921 is LAR selection number FNPCS11 located at elevation 155' in the auxiliary building. This selection is an embedded steel plate in the ceiling with two supports attached to it. The 8" x 3/4" x 4'-0" plate is anchored to the ceiling with eight 3/4" diameter Nelson studs.

The Q-Decking was cut out around the plate prior to pouring the concrete slab to allow the plate to be installed flush with the ceiling rather than spanning the ribs of the Q-Decking. FNPCS11 was chosen as an enveloping case for other embedded plates in the plant. The evaluation demonstrated that the embedded plate meets the GIP criteria. The cable and conduit raceway evaluations were performed as described in the response to RAI question 7. The evaluations described above are available for review at the SNC offices in Birmingham, AL.

9. **Question:**

Review of Appendix K shows several repeating types of outlier descriptions including: potential interaction from overhead light, adjacent panels and walls or hoist chain; inadequate anchorage and load path or bolt bending concern; and unconnected bays and panels or gaps under panels. Provide representative examples of engineering documentation that support the resolution of the above mentioned outlier categories.

Response:

All of the equipment outliers listed in Appendix K, with the exception of the potential bolt bending concerns which were resolved analytically, were resolved by a plant modification. These modifications were performed using the FNP design change process or a maintenance work order which is used to restore a component to its original design configuration. The following summary describes each outlier resolution in more detail. The evaluations described below are available for review at the SNC offices in Birmingham, AL.

- Potential interaction from overhead light: Fluorescent light fixtures throughout the plant were identified by the seismic review teams (SRTs) for their potential to fall during an earthquake. This outlier was resolved by restraining the fixture with tie wire to prevent falling.

- Panels not bolted together: A number of panels containing essential relays were noted as being vulnerable to potential impact from adjacent panels. This outlier was resolved by bolting the adjacent panels together to prevent impact.

- Other potential interaction concerns: Other potential interaction concerns were identified with nearby items such as the diesel generator building hoist crane, platforms, ladders, etc. These items were all restrained or secured to prevent impact to the SSEL equipment.

- Inadequate anchorage and/or load path: All equipment determined to have inadequate anchorage and/or load path was modified to increase the anchorage capacity of the equipment.

- Potential bolt bending concern: Several equipment items had a gap of greater than 1/4" under the base. This condition violates the GIP caveat which limits the gap to less than 1/4" for bolted anchorages. An analysis of the anchor bolts showed that the bolt bending was less than allowed following the procedures in reference 5. Therefore, the bolts are adequate for A-46.

- Gap under panel: Two equipment items were identified with the outlier description "gap under panel". These are actually the same as the "potential bolt bending concerns" described above. These were also evaluated and shown to be acceptable for bolt bending. Because such a large portion of the panel base was not in contact with the floor, grout was added under the panel to provide even distribution of the panel load on the floor.

10. **Question:**

With respect to Appendix G, some heat exchangers and tanks [e.g., condensate storage tank (Q1P11TOO1) and regenerative heat exchanger (Q1E21H0943) with "NA" designations under Columns 10, 11, 12, and 13] are judged as "OK" under Column 16. Discuss the rationale for their acceptance and provide pertinent documentation.

Response:

The regenerative heat exchanger (Q1E21H002) was evaluated under the equipment class "other" because its design did not fit the "tanks and heat exchanger" equipment class. The heat exchanger consists of three horizontal shells. The 9 5/8" OD x 13'- 4 3/8" long shells are bolted to the wall and connected to each other by 3" OD piping. The Seismic Review Team (SRT) used a combination of engineering judgment and calculations to screen out the heat exchanger. The Screening Evaluation Work Sheet (SEWS) for the "other" equipment class only asks the following 4 questions; 1) Seismic capacity vs. demand, 2) Anchorage, 3) Interaction effects, and 4) Is equipment seismically adequate? These questions were all answered affirmatively on the SEWS. Other items such as "capacity spectrum", "demand spectrum", and "caveats" are not included on the SEWS and are therefore "NA". Column 12, "capacity > demand", could have been designated "Y"; however, it was designated "NA" because it is not supported with the same questions such as "capacity spectrum", "demand spectrum", and "<40'" that are typical for most of the equipment classes.

The condensate storage tank (Q1P11T001) was evaluated under the "tanks and heat exchanger" equipment class. The SEWS for this class do not include questions for items such as capacity spectrum, demand spectrum, and caveats and are therefore "NA". The tank evaluation was based on section 7 of reference 2.

Based on these calculations and the seismic capability walkdown, it was determined that the tank shell capacity exceeds demand and that all other aspects of the tank, anchorage, attached piping, and the foundation are adequate for A-46.

11. **Question:**

Referring to Appendix G, provide a copy of the engineering calculations justifying the acceptability of refueling water storage tank (Q1F16T0501).

Response:

The refueling water storage tank (Q1F16T0501) is a 500,000 gallon flat-bottom vertical water storage tank located at plant grade, elevation 154.5 feet. The tank is 46 feet in diameter and 41 feet in height with a dome roof. The tank is anchored to a four foot thick mat foundation at grade. The original seismic analysis used the Farley OBE and SSE ground response spectra with the horizontal pga of 0.05 g and 0.10 g respectively as the seismic design input motion. For the A-46 and IPEEE evaluation of this tank, a new ground motion at plant grade was calculated. This motion was calculated based on the Farley SSE ground motion being defined at a hypothetical outcrop of the Compact Overburden layer that exists at 24.5 feet below grade. The compact overburden has a low strain shear wave velocity of 2520 fps. A plot of the new ground response spectra at plant grade, elevation 154.5, is provided in Appendix F of reference 3. The development of this new ground response spectra is discussed as part of the response to question 6. As previously stated in the response to question 6, new ground response spectra for the surface mounted tanks in the plant yard was developed specifically to meet SNC commitments as a result of the FNP IPEEE response to NRC GL 88-20 Supplement 4 as documented in SNC letter to the NRC dated September 14, 1992.

The GIP guidelines on vertical tanks (section 7 of reference 2) was initially used to evaluate the refueling water storage tank with the new GRS. This evaluation was successful except for a slight exceedance of less than 5 % when comparing overturning moment capacity to the overturning moment. Tank shell capacity was the limiting condition. The GIP evaluation is considered conservative, e.g., maximum peak spectral acceleration was used by assuming the tank's impulsive mode frequency coincides with the peak spectral acceleration of the new GRS. To provide further assurance of the seismic adequacy of this tank, the refueling water storage tank was also evaluated using the seismic margin methodology following Appendix H, "Flat-Bottom Vertical Fluid Storage Tanks", of reference 6. The seismic capacity was found to exceed the seismic demand of the new ground spectra by a margin of 1.5. Therefore, the resulting high-confidence-of-low-probability-of-failure (HCLPF) value when the Farley SSE GRS is specified at the hypothetical outcrop of the Compact Overburden is 0.15 g.

The margin of 1.5 is also considered sufficiently high to satisfy not only screening out the refueling water storage tank for IPEEE but also for resolution of USI A-46. The tank evaluation described above is available for review at the SNC offices in Birmingham, AL.

12. **Question:**

Referring to Appendix G, discuss the basis for accepting fuel Storage Tank 1B (QIY52T502) with "NA" designations under Columns 10 through 14.

Response:

The fuel storage tank 1B (Q1Y52T502) is a 40,000 gallon buried tank. The SRT performed a review of the tank drawings along with an existing FNP seismic evaluation report in order to screen out the tank. Since this is a buried tank, items such as capacity spectrum, demand spectrum, caveats, and anchorage are "NA".

13. **Question:**

Page 27 of Appendix G lists several service water intake louvers with "NA" designations under Columns 10, 11, and 13. Discuss the method used for determining the seismic capacity of these louvers and the basis for their acceptance as designated in Column 16.

Response:

The service water intake louvers consist of Honeywell D640A Moduflow dampers with Honeywell M445 spring return Modutrol motors. The louvers are mounted in the HVAC duct. The duct is well supported at the location of the louvers to support the additional weight of the louvers on the duct and prevent distortion of the duct and louver. The louver frame is blocked into the ductwork plenum area which will prevent any significant movement. There is also sufficient clearance provided to enable the louvers to operate during a seismic event. These details were judged by the SRT to provide sufficient stability and support for the operation of the louvers.

14. **Question:**

Provide a copy of References 8 and 10 listed on Page R-1.

Response:

Reference 8 contains the soil-structure interaction analysis of the diesel generator building and the service water intake structure, and the development of the ground response spectra at elevation 155 feet for the IPEEE evaluation of surface supported tanks in the plant yard. A detailed discussion of the methodology and assumptions used is provided in the response to question 6. These analyses are available for review at the SNC offices in Birmingham. Reference 10 is the computer code "SHAKE." The methodology and assumptions associated with the SHAKE computer program are also discussed as part of the response to question 6. EQE International, who performed these analyses, can provide additional information about this computer program if required.

15. **Question:**

Referring to the third party audit work reported in Appendix L, provide a copy of each of the four files identified in Mr. John W. Reed's letter to Mr. Keith D. Wooten, dated January 20, 1994.

Response:

The four files described in Mr. Reed's letter are summarized below. These evaluations are available for review at the SNC offices in Birmingham, AL.

Motor operated valve Q1E11MOV8888B-B is located on elevation 121' in the auxiliary building. The valve size is 10" diameter with a Limitorque SB4-150 motor operator. The SRT screened out the valve based on their walkdown and a stress analysis performed by Westinghouse. The stress analysis ensured that the valve was adequate for a 3 g horizontal seismic load applied at the center of gravity of the valve operator.

Diesel generator panel 1B CT JB (Q1R43G510-B) is located on elevation 155' in the diesel generator building. The panel is 15 1/2" x 42" x 30" high and is anchored to the concrete floor by four 3/8" diameter expansion anchors. The SRT screened out the panel based on their walkdown and analysis of the base anchorage.

The diesel generator 1B local control panel (Q1H21E527-B) is located on elevation 155' in the diesel generator building. The panel is 35" x 161" x 90" high and is anchored to the concrete floor by 5/8" diameter cast-in-place J-bolts. An analysis of the panel anchorage demonstrated that it did not meet the GIP criteria. Additional anchorage was installed to increase the capacity

to an acceptable level. The SRT also identified an overhead light fixture that could potentially impact the panel during a seismic event. The light fixture was restrained to prevent it from falling. All other aspects of the panel were found to be acceptable by the SRT during the walkdown.

The 600V load center 1R/2R (Q1R16B508-A) is located on elevation 155' in the diesel generator building. The load center is 60" x 84" x 91" high. The as-found anchorage consisted of minimal welds on only one side of the load center. An analysis of the panel anchorage demonstrated that it did not meet the GIP criteria. Additional anchorage was installed to increase the capacity to an acceptable level. The SRT also identified an overhead light fixture that could potentially impact the load center during a seismic event. The light fixture was restrained to prevent it from falling. All other aspects of the load center were found to be acceptable by the SRT during the walkdown.

References:

1. "Supplement Safety Evaluation Report No. 2 on Seismic Qualification Utility Group's Generic Implementation Procedure, Revision 2, Corrected February 14, 1992 for Implementation of GL 87-02 (USI A-46), Verification of Seismic Adequacy of Equipment in Older Operating Nuclear Plants," NRC, May 22, 1992.

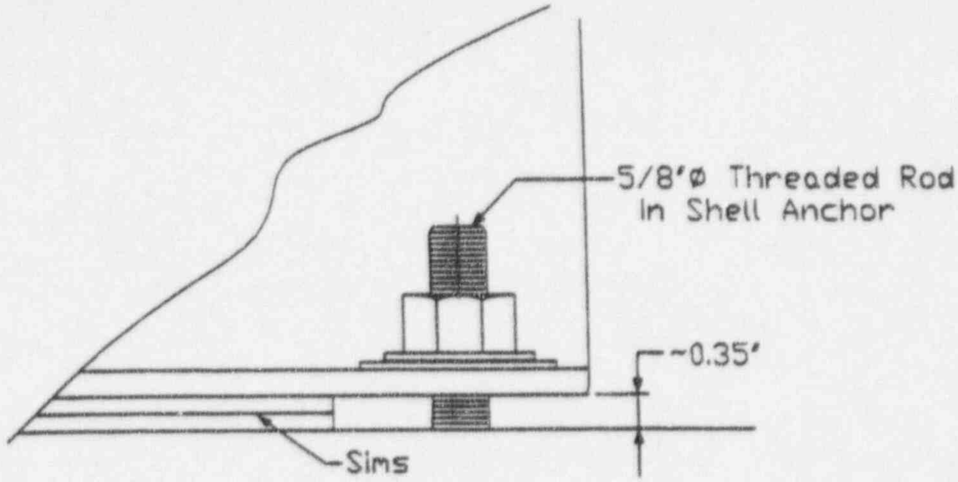
2. "Generic Implementation Procedure for Seismic Verification of Nuclear Plant Equipment," Revision 2, Seismic Qualification Utility Group, February 14, 1992.

3. "Unresolved Safety Issue A-46 Summary Report, Joseph M. Farley Nuclear Plant, Unit 1," Southern Nuclear Operating Company submitted to NRC on May 18, 1995.

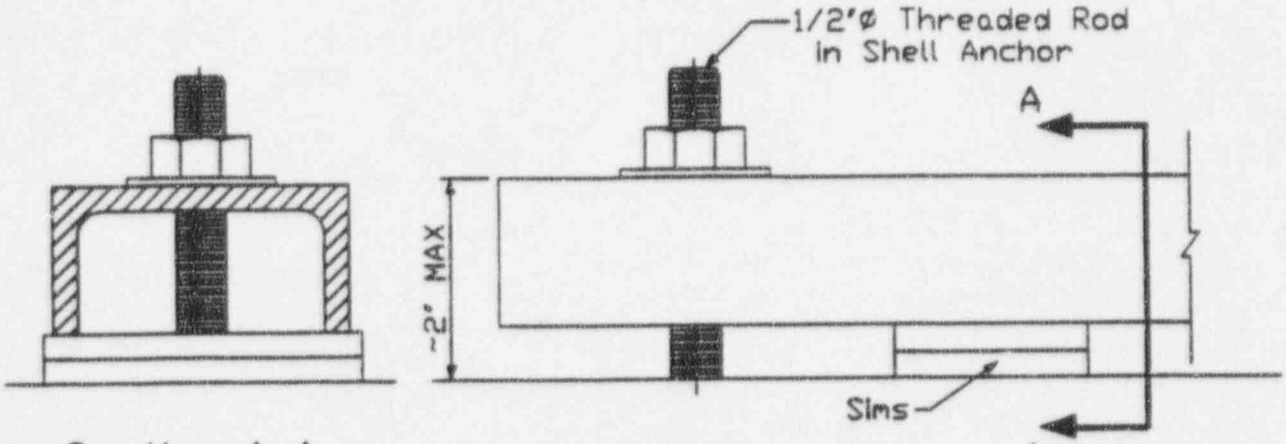
4. "Procedure for Evaluating Nuclear Power Plant Relay Seismic Functionality," Final Report. EPRI NP-7148-SL, Electric Power Research Institute, Palo Alto, CA, December 1990.

5. "Recommended Approaches for Resolving Anchorage Outliers," EPRI TR-103260, Electric Power Research Institute, Palo Alto, CA, June 1994.

6. "A Methodology for Assessment of Nuclear Power Plant Seismic Margin, (Revision 1)", EPRI NP-6041-SL, Electric Power Research Institute, Palo Alto, CA, August 1991.

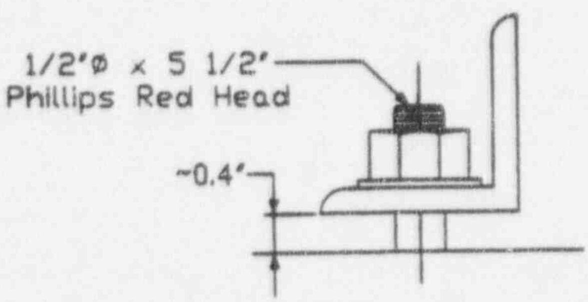


SKETCH 5-A
LC Transformer in Diesel Generator Bldg
Equipment ID Q1R11B503-A
Scale 6'- 1'-0



Section A-A

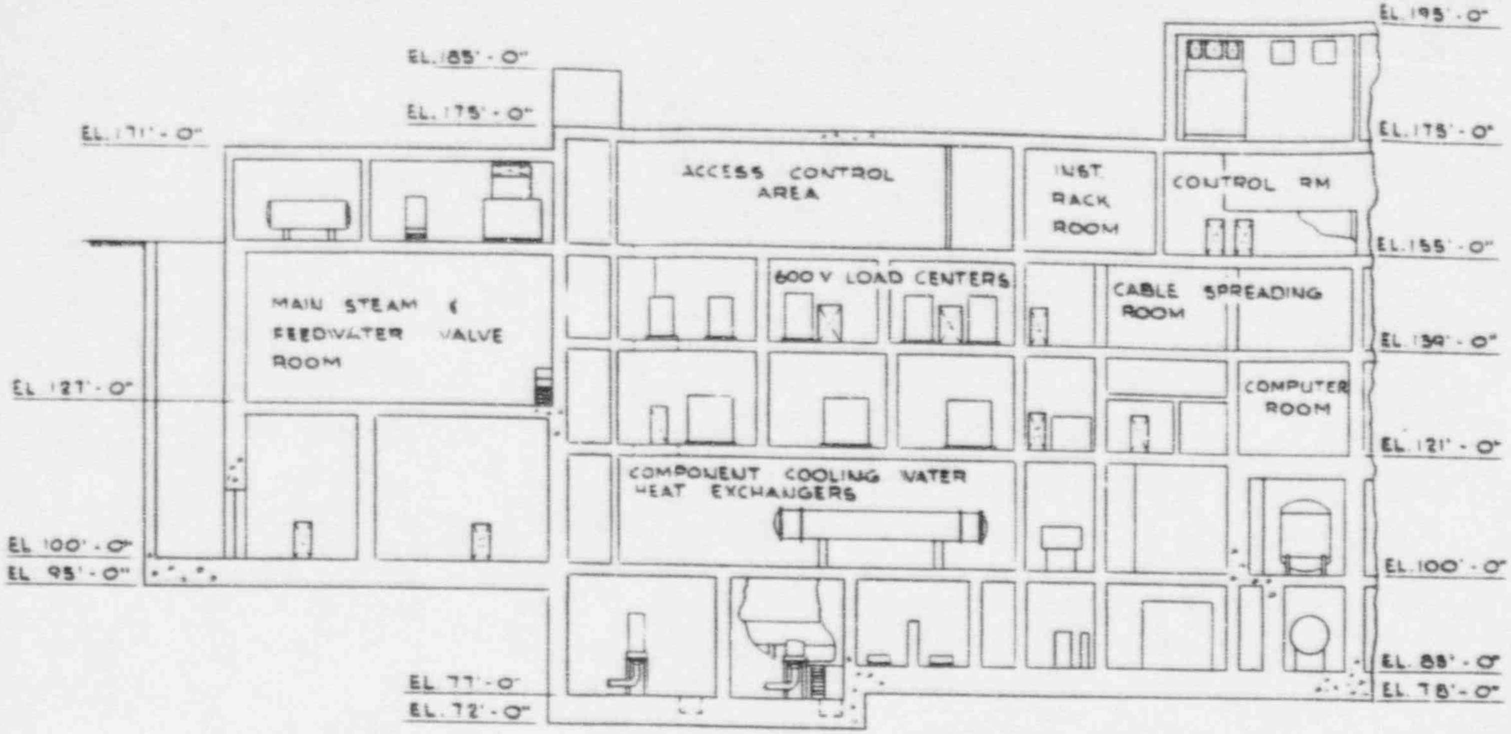
SKETCH 5-B
MCC 1K in Service Water Intake
Equipment ID: Q1R17B504-A
Scale 6'- 1'-0



SKETCH 5-C
125-V-DC Service Water Bldg Battery No. 1
Equipment ID: QSR42B523A-A
Scale 6'- 1'-0

Figure 1

ATTACHMENT 1



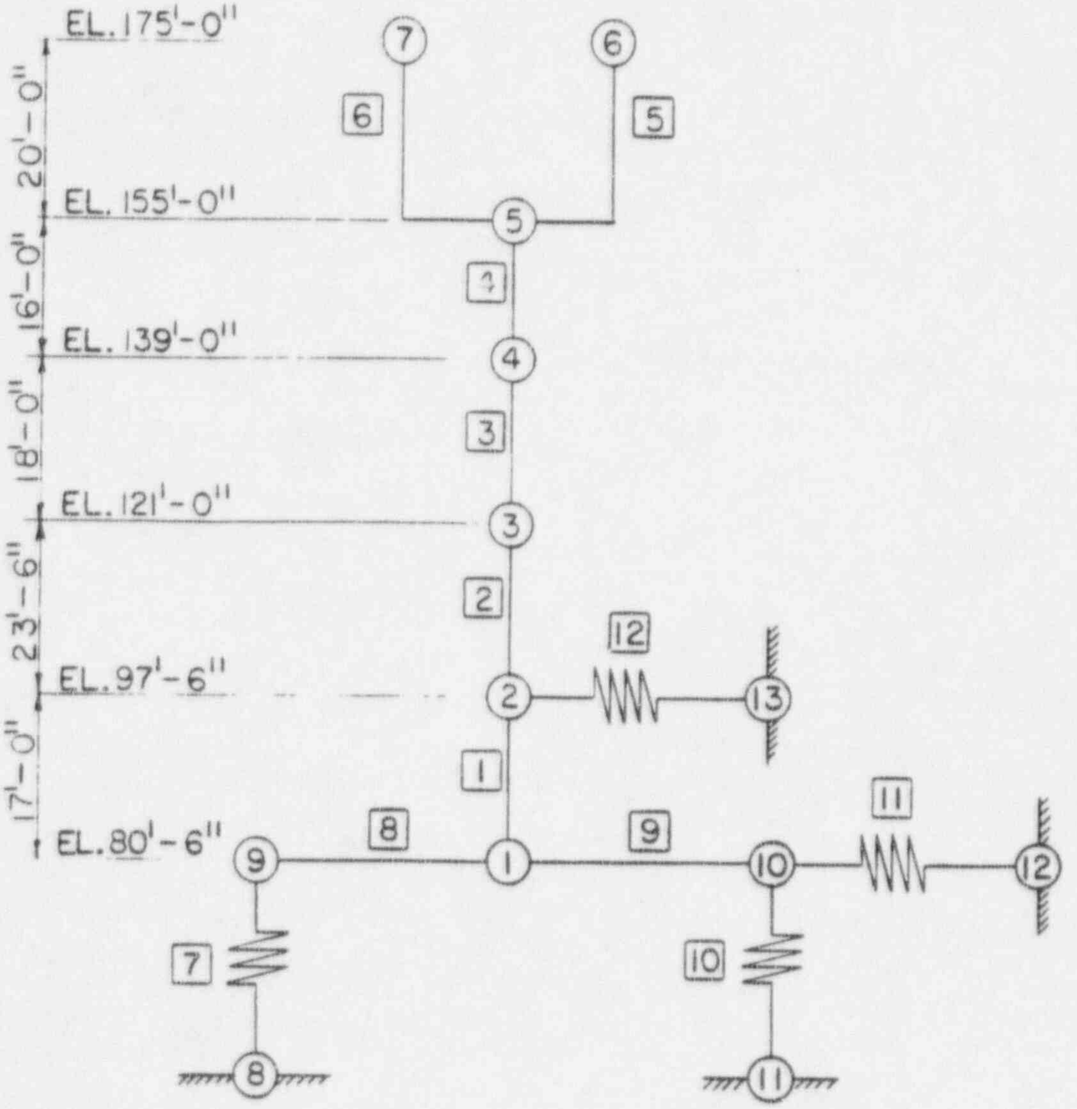
SECTION — LOOKING WEST

Alabama Power

JOSEPH M. FARLEY
NUCLEAR PLANT
UNIT 1 AND UNIT 2

AUXILIARY BUILDING
MATHEMATICAL MODEL

FIGURE 3.7-23



NORTH-SOUTH, EAST-WEST AND VERTICAL DIRECTION

Alabama Power

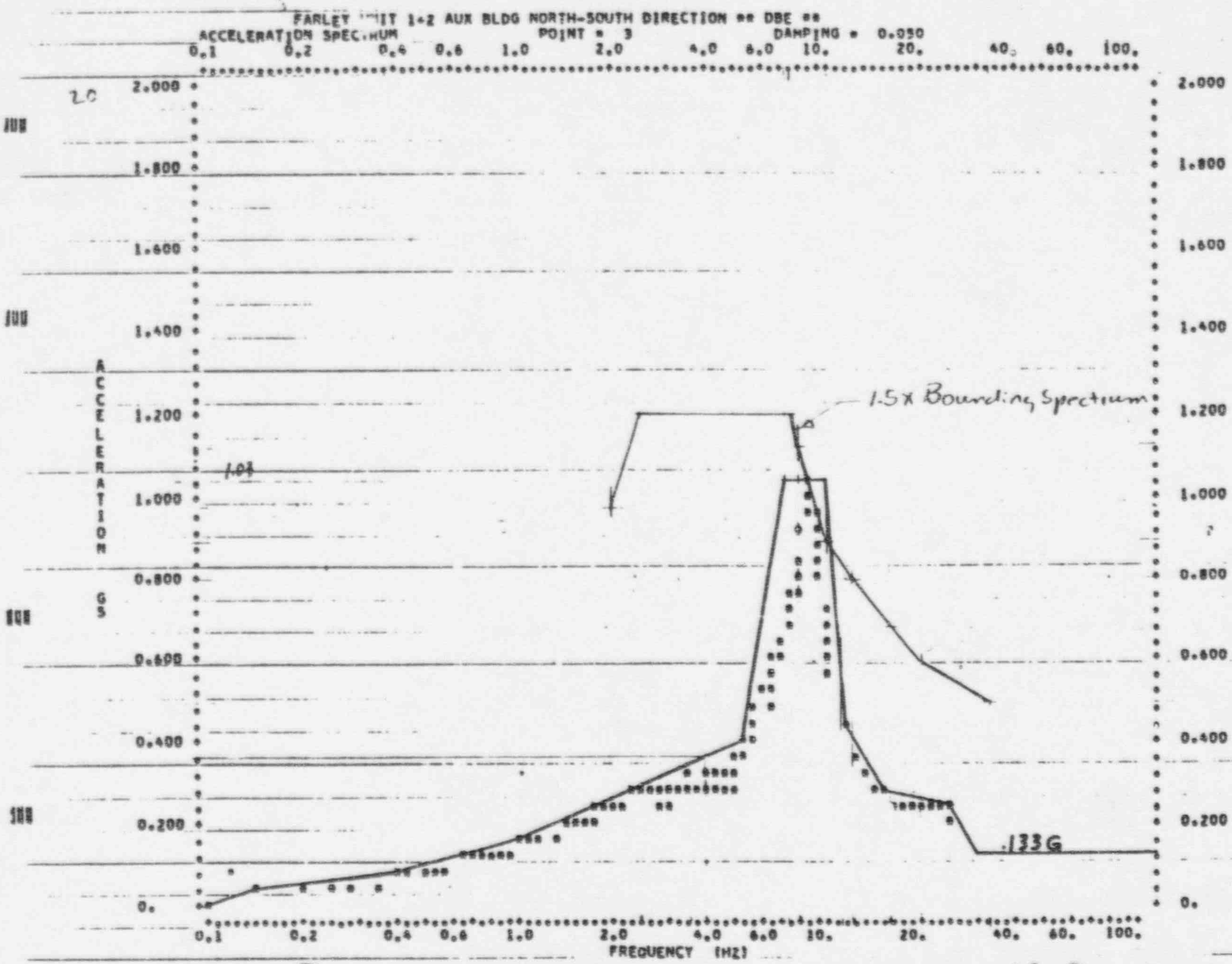
JOSEPH M. FARLEY
NUCLEAR PLANT
UNIT 1 AND UNIT 2

AUXILIARY BUILDING
MATHEMATICAL MODEL

FIGURE 3.7-24

4440-1

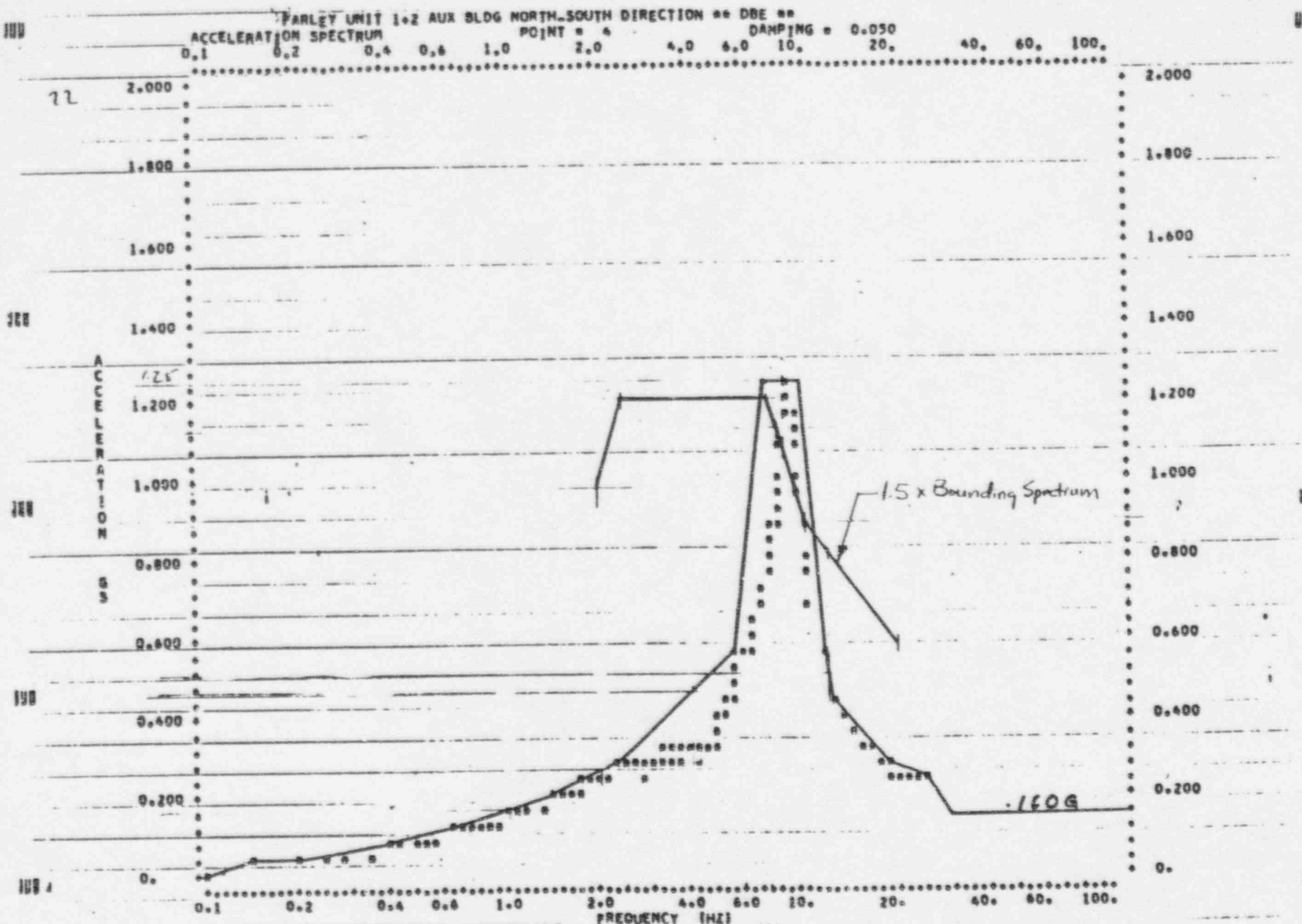
Aux Bldg



MASS POINT 3 ELEV 121' + 0" SSE 5% DAMPING

NORTH - SOUTH DIRECTION

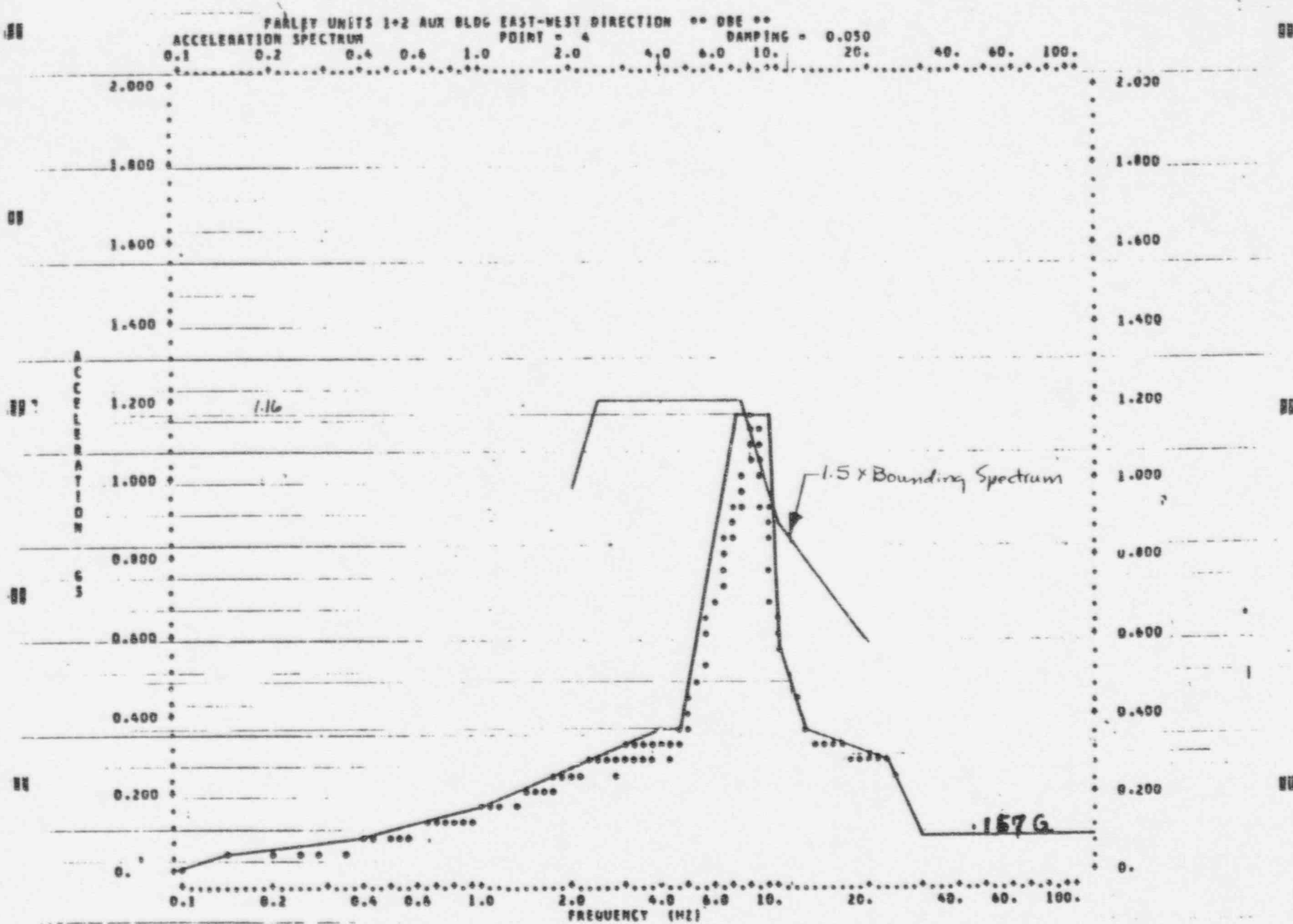
AUX. BLDG



MASS POINT 4   ELEV 139'4 0"   SSE   5% DAMPING
NORTH - SOHTH DIRECTION

4.

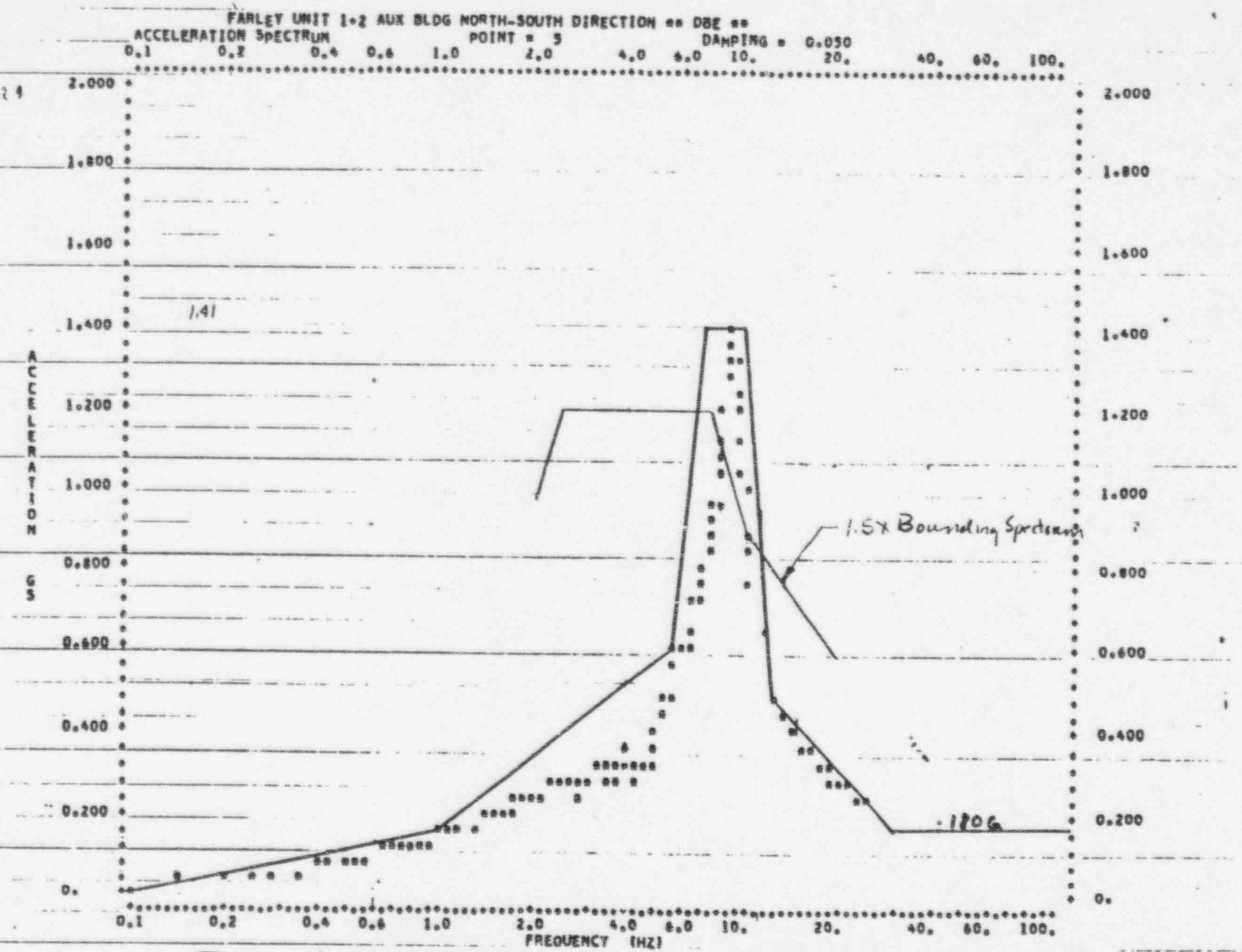
AUX BLDG



MASS POINT 4 ELEV 139'+0" SSE 5% DAMPING

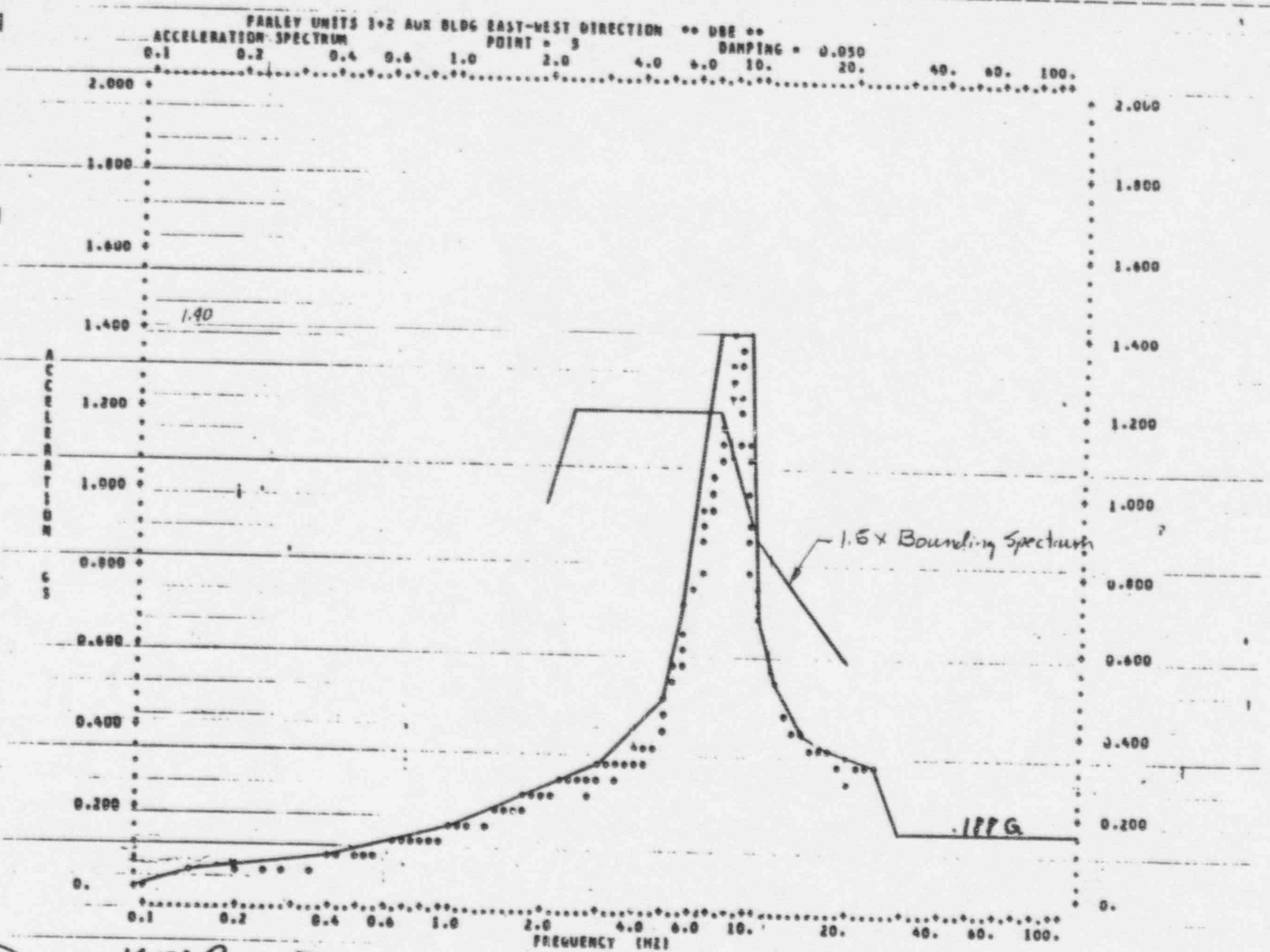
EAST-WEST DIRECTION

Aux Bldg



MASS POINT 5 ELEV 155'-0" SSE 5% DAMPING
NORTH-SOUTH DIRECTION

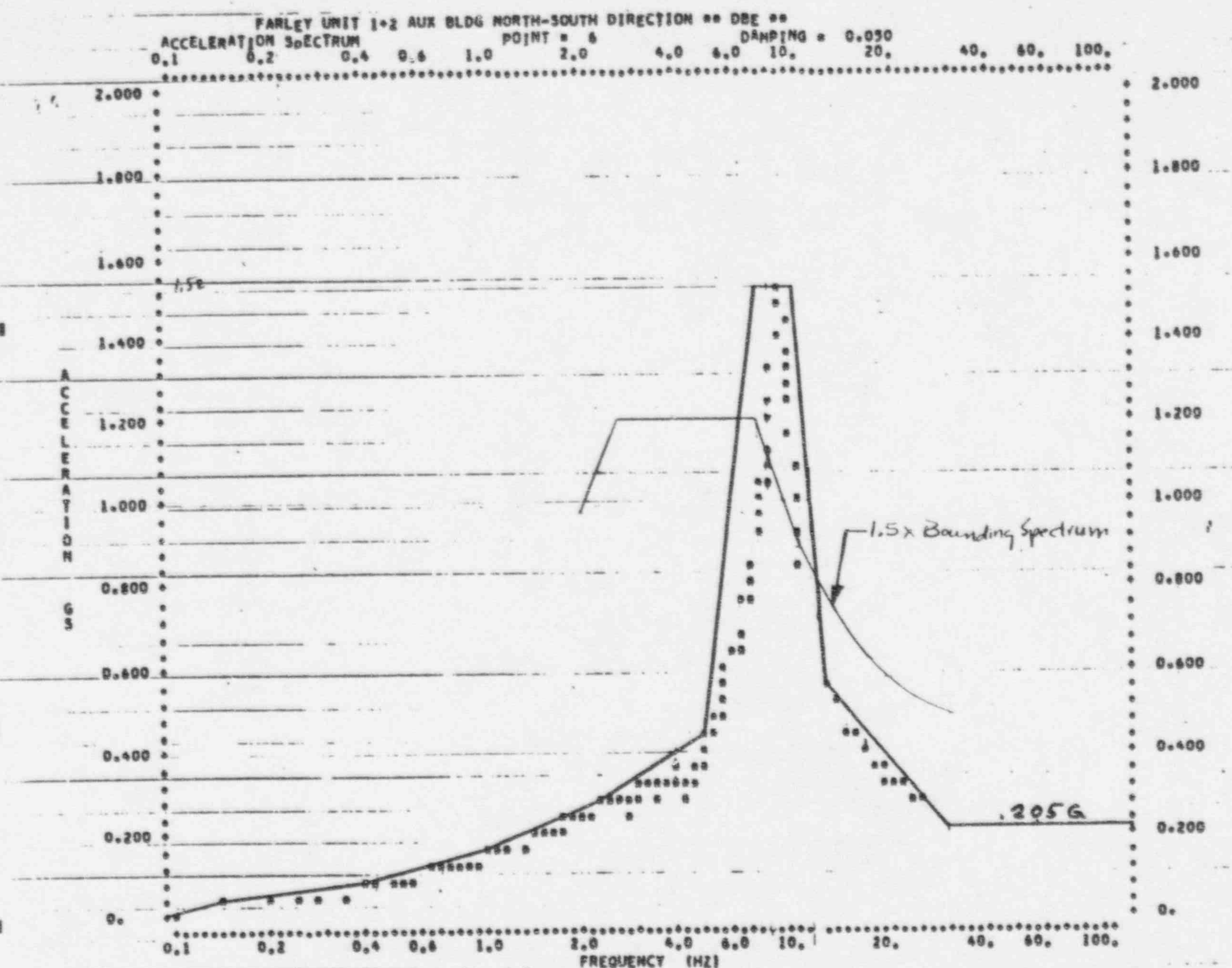
Aux Bldg



Mass Point 5

Elev 155'+0" SSE 5% Damping
East-West Direction

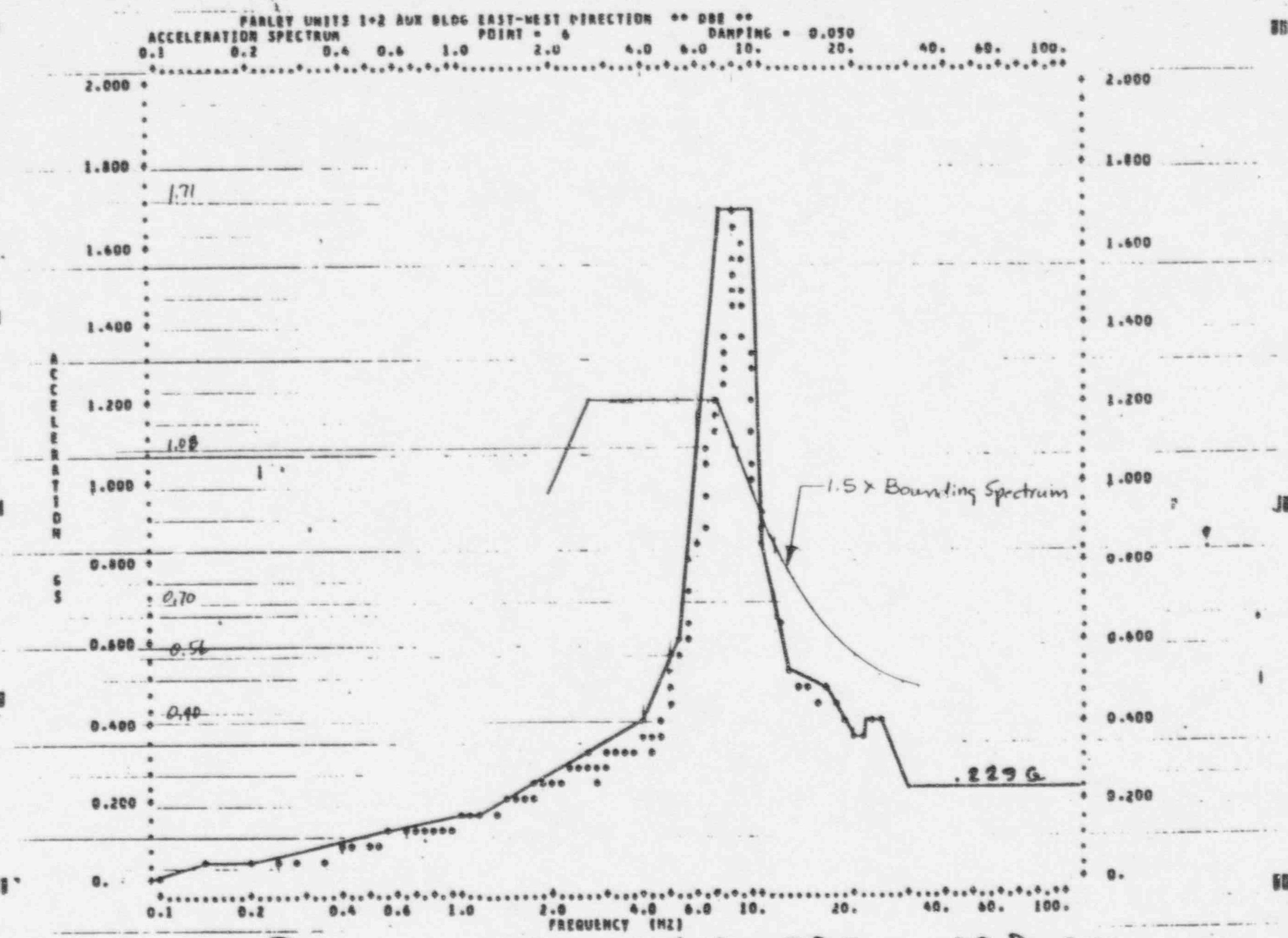
AUX BLDG



MASS POINT 6 ELEV 175'0" SSE 5% DAMPING

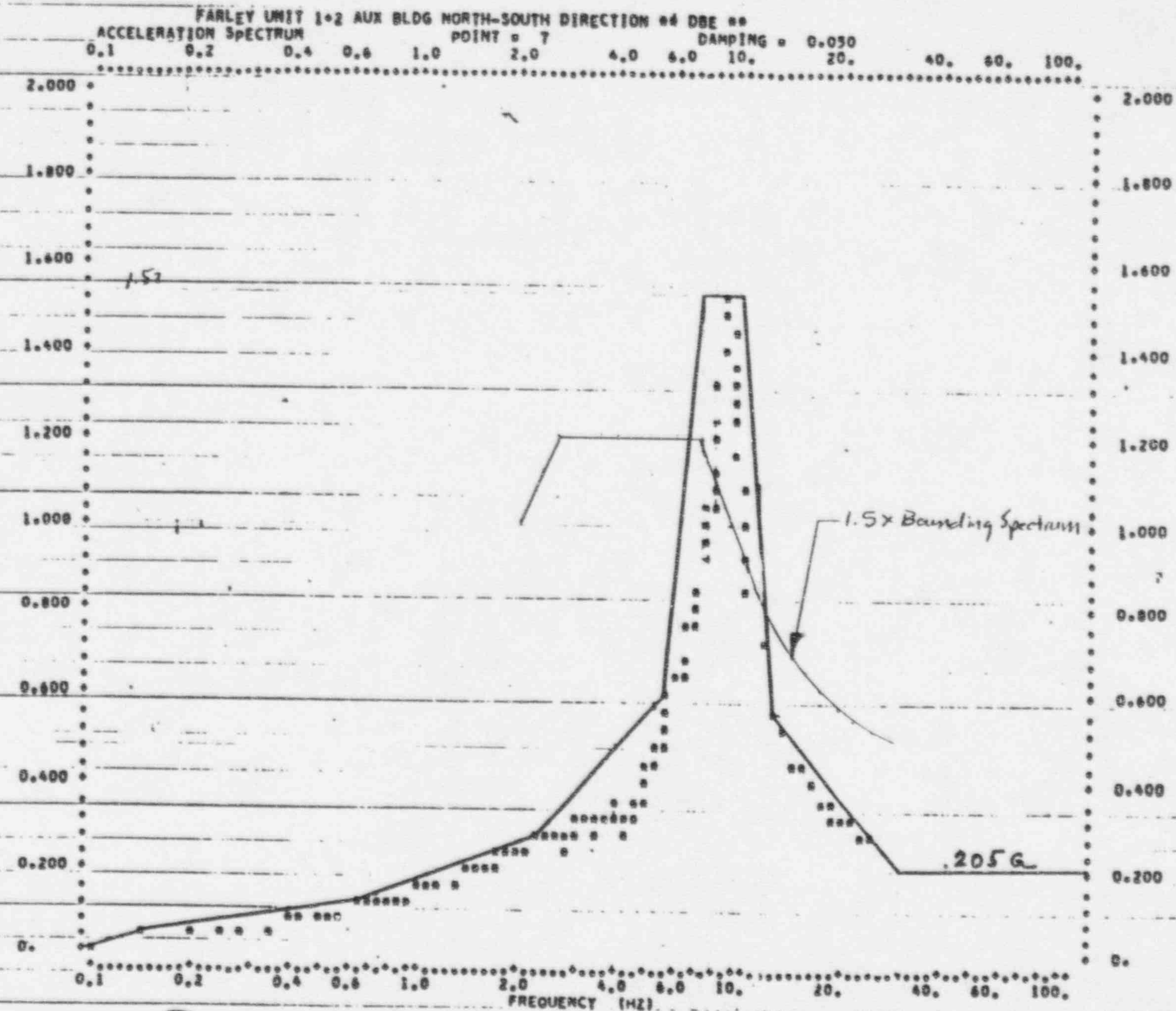
NORTH - SOUTH DIRECTION

AUX BLDG



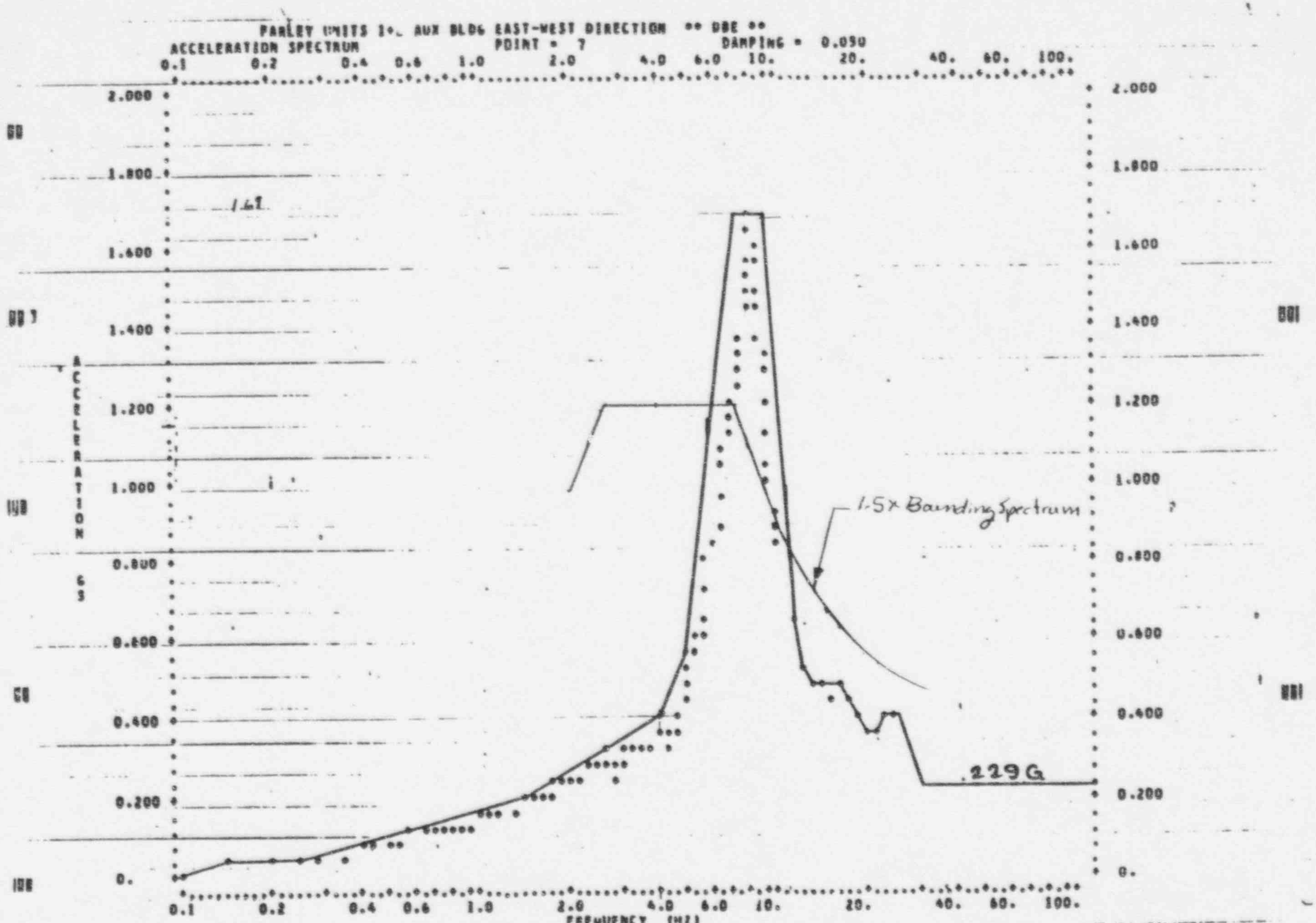
MASS POINT 6 ELE# 175'0" SSE 5% DAMPING
EAST - WEST DIRECTION

AUX BLDG

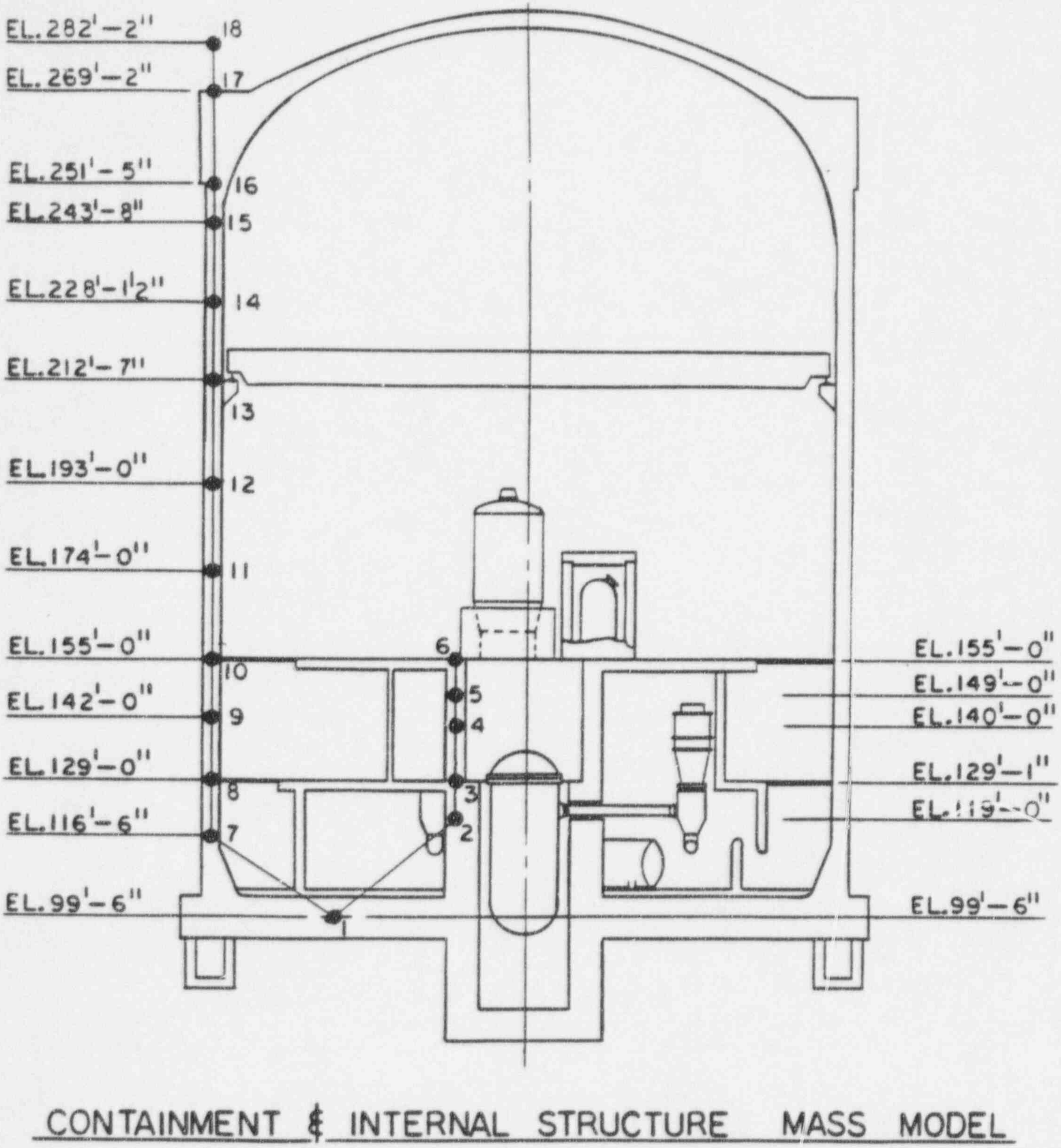


MASS POINT 7 ELEV 175'0" SSE 5% DAMPING
NORTH - SOUTH DIRECTION

AUX BLDG



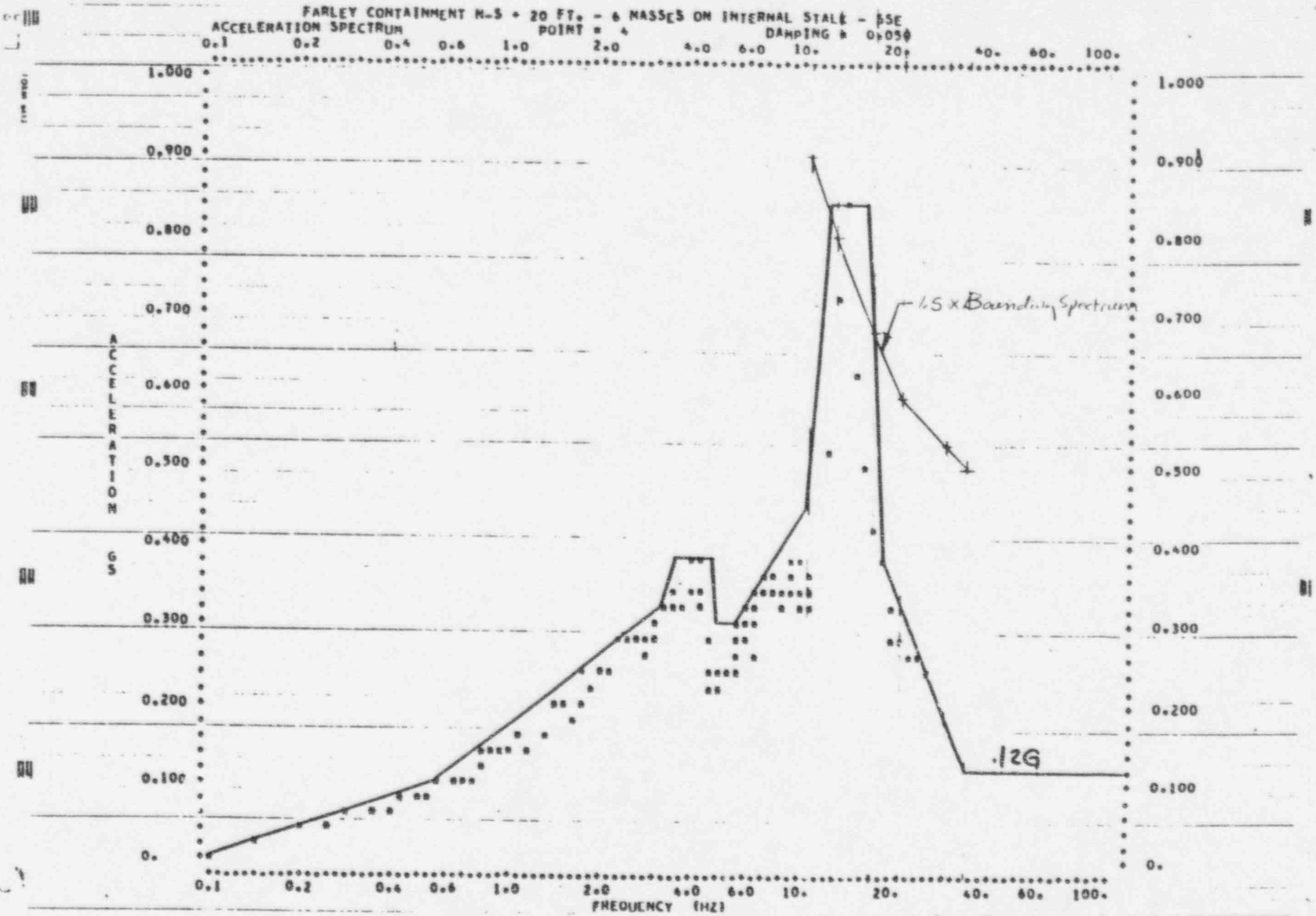
MASS POINT, 7 ELEV 175'0" SSE 5% DAMPING
EAST - WEST DIRECTION



CONTAINMENT & INTERNAL STRUCTURE MASS MODEL

NORTH - SOUTH & EAST - WEST

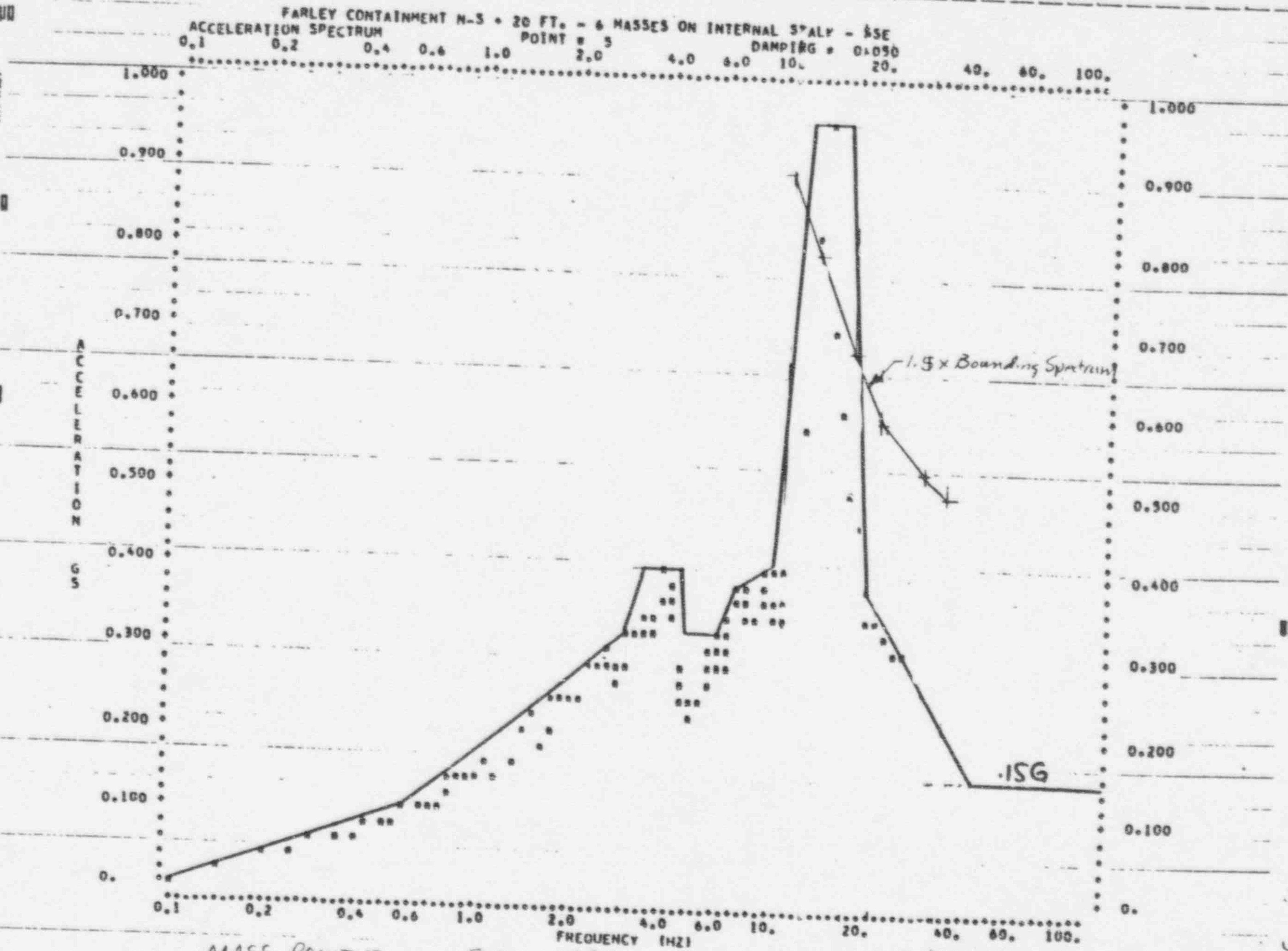
CONTAINMENT & INTERNAL STRUCTURE



MASS POINT 4 ELEV 140' SSE 5% DAMPING

NORTH - SOUTH DIRECTION

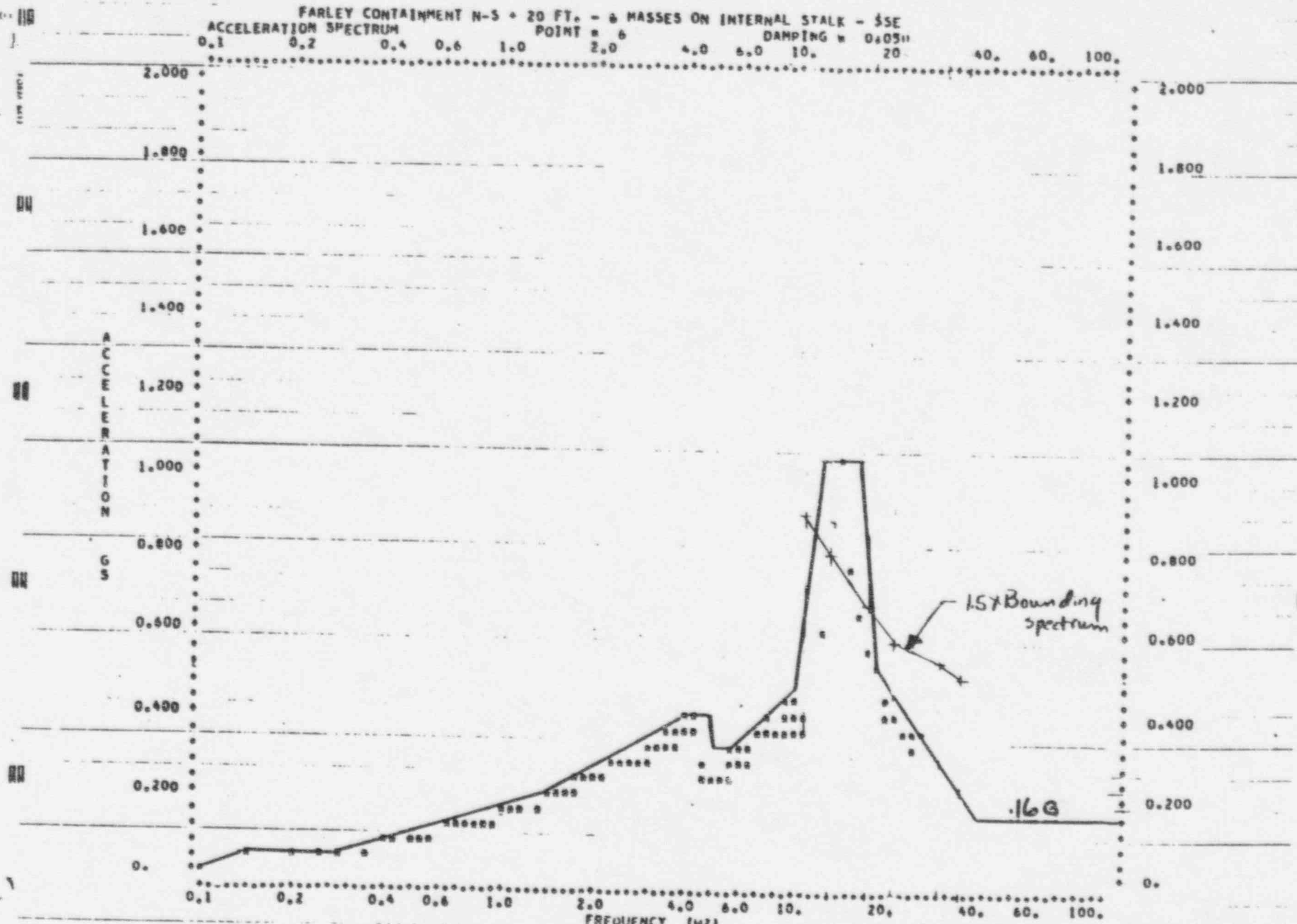
CONTAINMENT & INTERNAL STRUCTURE



MASS POINT 5 ELEV 149' SSE 5% DAMPING

NORTH - SOUTH DIRECTION

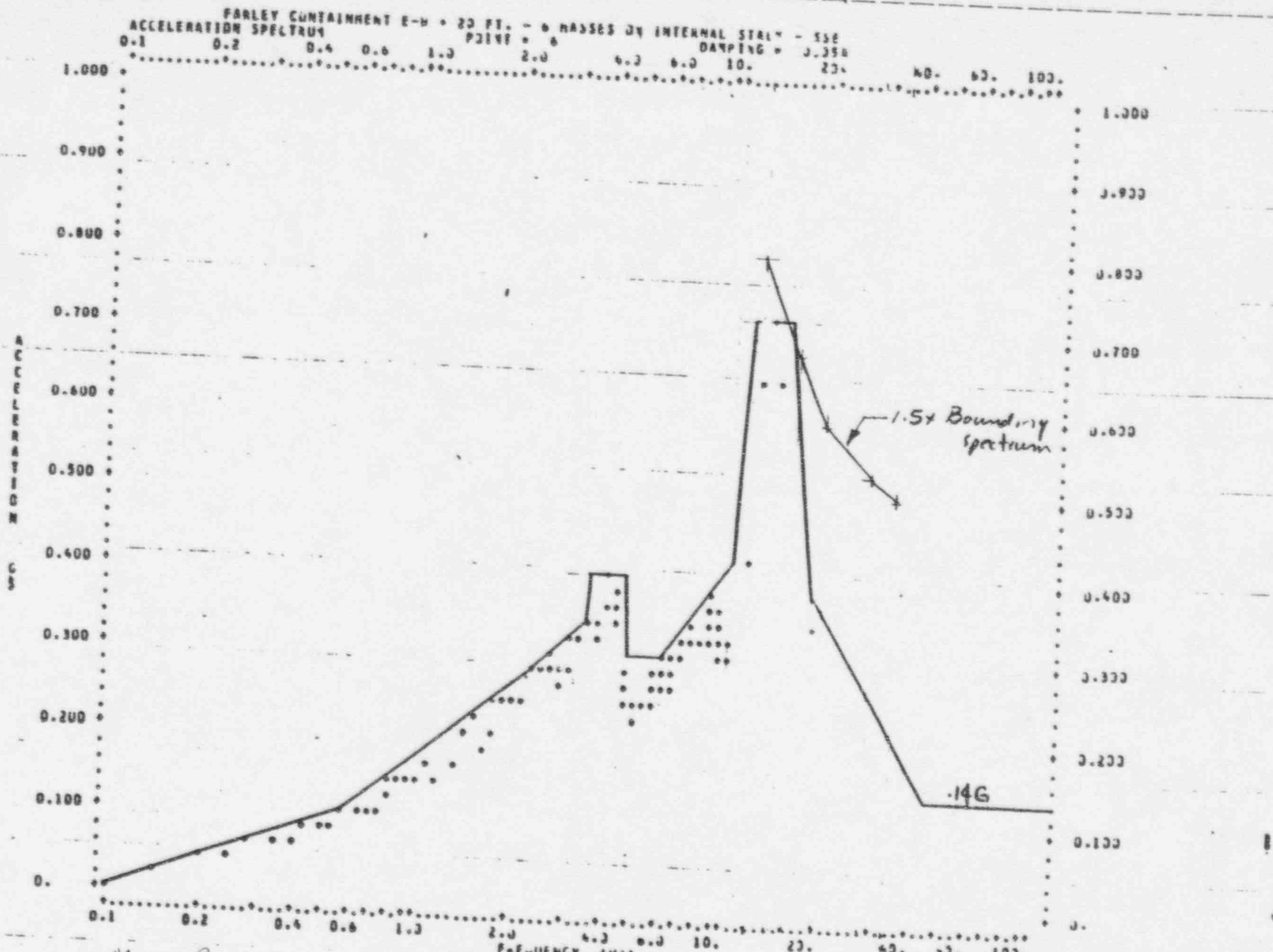
Containment & Internal Structure



MASS POINT 6 ELEV 155' SSE 5% DAMPING

NORTH - SOUTH DIRECTION

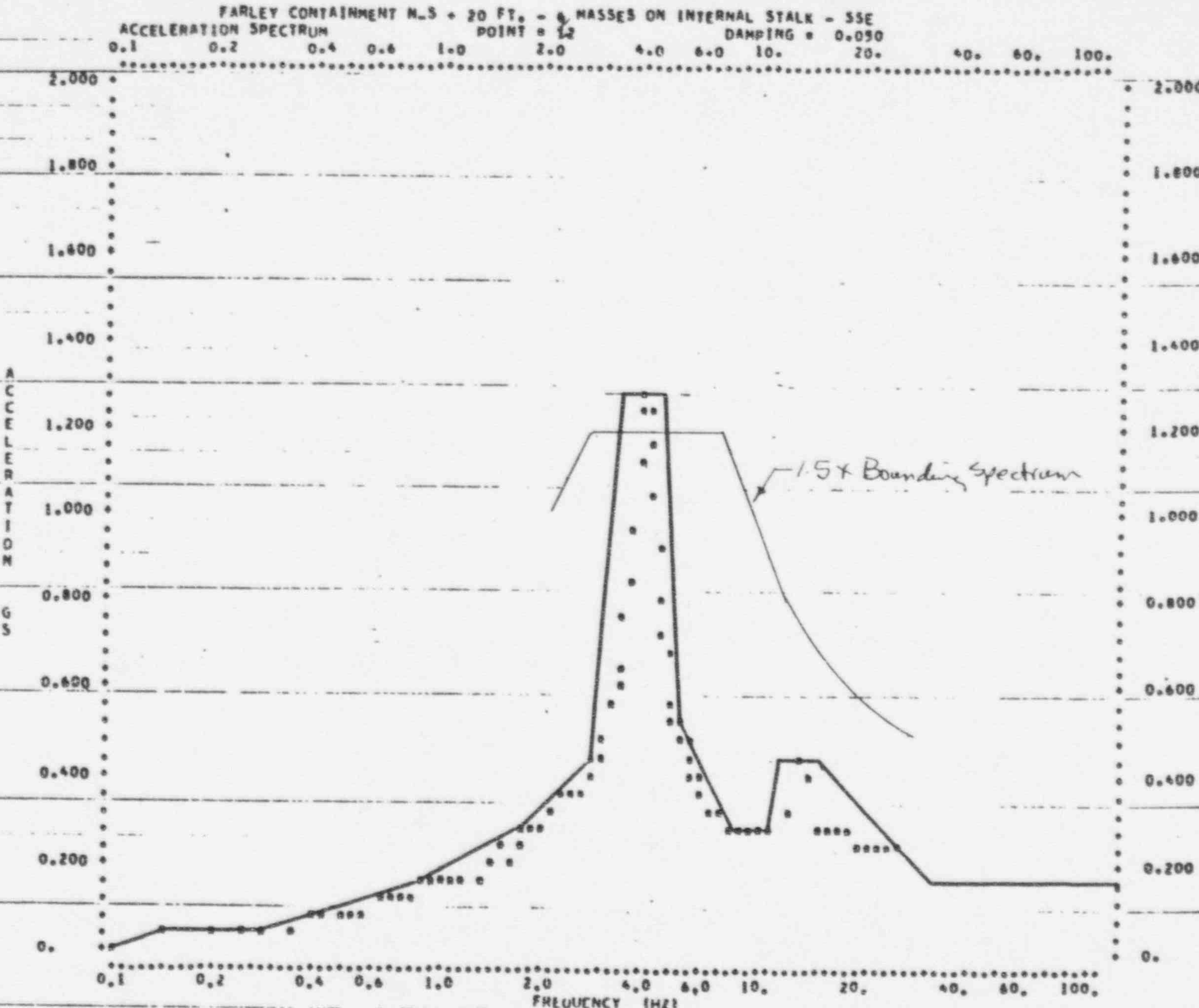
Containment & Internal Structure



Mass Point 6 ELEV 155' SSE 5% DAMPING

EAST-WEST DIRECTION

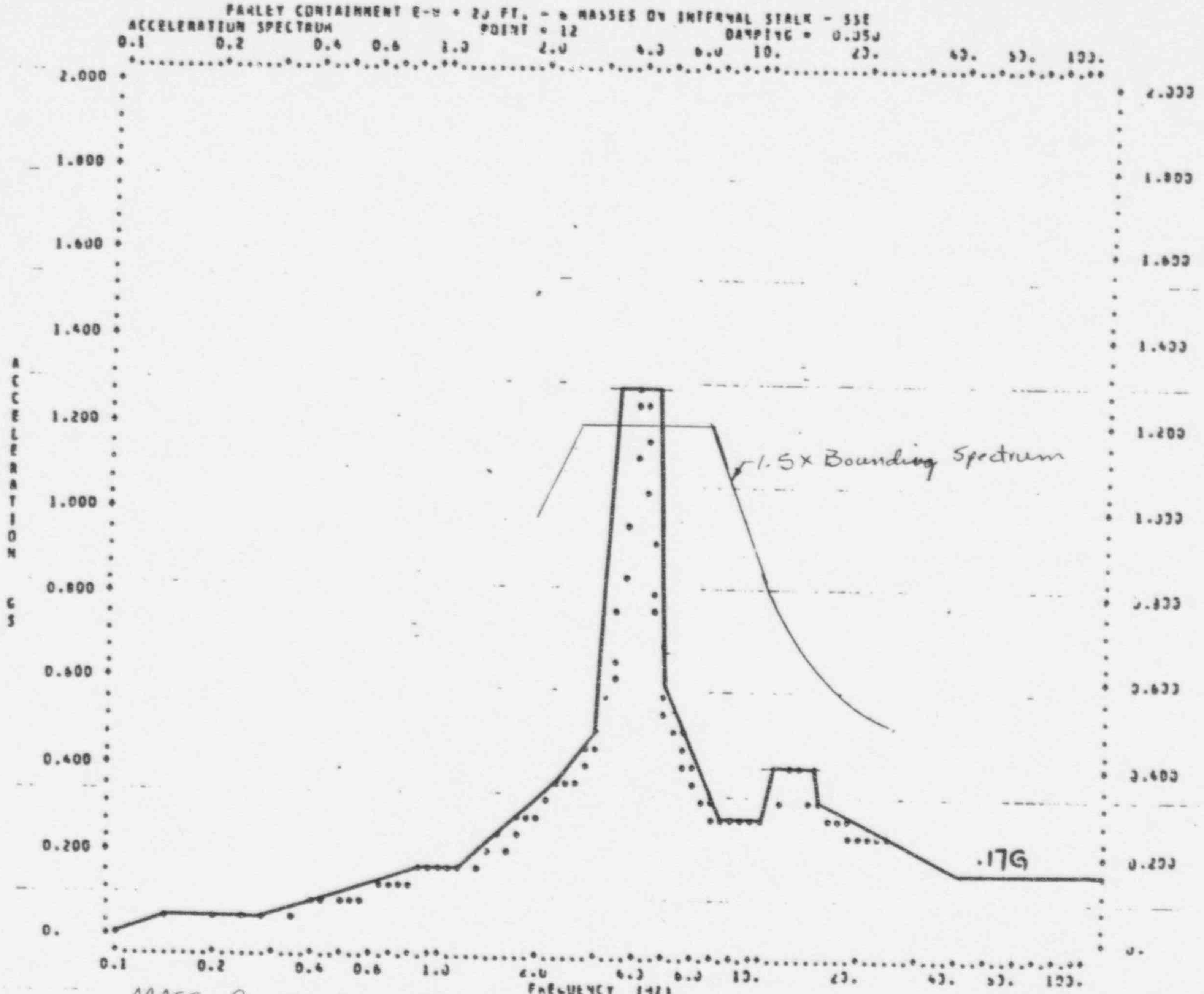
CONTAINMENT & INTERNAL STRUCTURE



MASS POINT 12 ELEV 193' SSE 5% DAMPING

NORTH-SOUTH DIRECTION

CONTAINMENT & INTERNAL STRUCTURE



MASS POINT 12 ELEV 193' SSE 5% DAMPING

EAST-WEST DIRECTION

ATTACHMENT 2

ATTACHMENT 2
FARLEY A-46 RAI RESPONSE - QUESTION 2
Unit 1 Essential Relays With Resolution Method = "WALK"

SSEL COMPONENT	REFERENCE DRAWING	RELAY ID NO.	RELAY VENDOR	RELAY MODEL NO.	RESOLUTION METHOD
PANEL ID NO. Q1C11E004A-AB					
Q1C11E004A-AB	D-177198/2	52/RTA	WESTINGHOUSE	DS416	WALK
Q1C11E004A-AB	D-177198/2	52/RTB	WESTINGHOUSE	DS416	WALK
PANEL ID NO. Q1C11E004B-AB					
Q1C11E004B-AB	D-177198/2	52/BYB	WESTINGHOUSE	DS416	WALK
Q1C11E004B-AB	D-177198/2	52/BYA	WESTINGHOUSE	DS416	WALK
PANEL ID NO. Q1R15A006-A					
Q1P17P001C-A	D-177183	52 DF04	AC	MA-350	WALK
Q1E21P002A-A	D-177180/1	52 DF06	AC	MA-350	WALK
Q1R15A006-A	D-177155	52 DF01	AC	MA-350	WALK
Q1R15A006-A	D-177161	52 DF15	AC	MA-350	WALK
Q1R15A505-A	C-177144	52 DF02	AC	MA-350	WALK
Q1R15A503-A	D-177145	52 DF13	AC	MA-350	WALK
Q1R11B004-A	C-177159	52 DF03	AC	MA-350	WALK
Q1E11P001A-A	D-177193	52 DF09	AC	MA-350	WALK
QSR43A501-A	D-177143	52 DF08	AC	MA-350	WALK
PANEL ID NO. Q1R15A007-B					
Q1E11P001B-B	D-177193	52 DG09	AC	MA-350	WALK
Q1E21P002C-B	D-177180/2	52 DG06	AC	MA-350	WALK
Q1P17P001A-B	D-177184	52 DG04	AC	MA-350	WALK
Q1R15A506-B	C-177144	52 DG02	AC	MA-350	WALK
Q1R11B005-B	C-177159	52 DG03	AC	MA-350	WALK
Q1R15A007-B	D-177168	52 DG01	AC	MA-350	WALK
Q1R15A504-B	D-177167	52 DG13	AC	MA-350	WALK
Q1R43A502-B	D-177142	52 DG08	AC	MA-350	WALK
Q1R15A007-B	D-177169	52 DG15	AC	MA-350	WALK
PANEL ID NO. Q1R15A503-A					
Q1R11B503-A	C-172762	52 DH08	AC	MA-350	WALK
QSR43A503-A	D-172761	52 DH07	AC	MA-350	WALK
Q1R15A503-A	C-172795	52 DH01	AC	MA-350	WALK
PANEL ID NO. Q1R15A504-B					
Q1R15A504-B	D-172763	52 DJ06	AC	MA-350	WALK
Q1R15A504-B	D-172869	52 DJO2	AC	MA-350	WALK
Q1R15A504-B	D-172764	52 DJ01	AC	MA-350	WALK
Q1R15A504-B	D-172764	52 DJ07	AC	MA-350	WALK
PANEL ID NO. Q1R15A505-A					
Q1P16P001B-A	D-172748	52 DK04	AC	MA-350	WALK
Q1R11B504-A	C-172765	52 DK02	AC	MA-350	WALK
Q1P16P001A-A	D-172747	52 DK03	AC	MA-350	WALK
PANEL ID NO. Q1R15A506-B					
Q1P16P001D-B	D-172751	52 DL03	AC	MA-350	WALK
Q1P16P001E-B	D-172752	52 DL04	AC	MA-350	WALK
Q1R11B505-B	C-172766	52 DL02	AC	MA-350	WALK

ATTACHMENT 2
FARLEY A-46 RAI RESPONSE - QUESTION 2
Unit 1 Essential Relays With Resolution Method = "WALK"

SSEL COMPONENT	REFERENCE DRAWING	RELAY ID NO.	RELAY VENDOR	RELAY MODEL NO.	RESOLUTION METHOD
PANEL ID NO. Q1R16B006-A					
Q1R42E001A-A	C-177077	52 ED04	WESTINGHOUSE	DS206	WALK
Q1R16B006-A	D-177064	52 ED08	WESTINGHOUSE	DS416	WALK
Q1R16B006-A	D-177074	52 ED02	WESTINGHOUSE	DS416	WALK
Q1R17B001-A	D-177089/1	52 ED10	WESTINGHOUSE	DS206	WALK
Q1R17B509-A	D-177089/2	52 ED13	WESTINGHOUSE	DS206	WALK
Q1R17B008-A	D-177089/1	52 ED14	WESTINGHOUSE	DS206	WALK
QSR17B006-A	D-177089/1	52 ED05	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R16B007-B					
Q1R42E001B-B	C-177077	52 EE05	WESTINGHOUSE	DS206	WALK
Q1R16B007-B	D-177070	52 EE07	WESTINGHOUSE	DS416	WALK
Q1R17B002-B	D-177089/1	52 EE10	WESTINGHOUSE	DS206	WALK
Q1R16B007-B	D-177074	52 EE02	WESTINGHOUSE	DS416	WALK
Q1R17B009-B	D-177089/1	52 EE15	WESTINGHOUSE	DS206	WALK
Q1R17B510-B	D-177089/1	52 EE14	WESTINGHOUSE	DS206	WALK
QSR17B007-B	D-177089/1	52 EE11	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R16B506-A					
Q1R17B504-A	D-172826/2	52 EK03	WESTINGHOUSE	DS206	WALK
Q1R16B506-A	D-172826/2	52 EK05	WESTINGHOUSE	DS206	WALK
Q1R16B506-A	D-172825/2	52 EK02	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R16B507-B					
Q1R17B505-B	D-172826/2	52 EL09	WESTINGHOUSE	DS206	WALK
Q1R16B507-B	D-172826/2	52 EL05	WESTINGHOUSE	DS206	WALK
Q1R16B507-B	D-172825/2	52 EL02	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R16B508-A					
Q1R17B507-A	C-172832	52 ER03	WESTINGHOUSE	DS206	WALK
Q1R16B508-A	D-172831/2	52 ER02	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R16B509-B					
Q1R16B509-B	D-172831/1	52 ES02	WESTINGHOUSE	DS206	WALK
Q1R17B508-B	C-172832	52 ES03	WESTINGHOUSE	DS206	WALK
PANEL ID NO. Q1R17B001-A					
Q1P18C002A-A	D-177793	52	ITE	HE3	WALK
PANEL ID NO. Q1R17B002-B					
Q1P18C002B-B	D-177793	52	ITE	HE3	WALK
PANEL ID NO. QSR17B006-A					
QSV49K001A-A	D-177270/3	52	ITE	HE3	WALK
PANEL ID NO. QSR17B007-B					
QSV49K001B-B	D-177270/3	52	ITE	HE3	WALK

ATTACHMENT 3

ATTACHMENT 3
FARLEY A-46 RAI RESPONSE - QUESTION 4
Equipment Meeting the Intent of a Caveat Without Meeting the Specific Wording

ID #	Equipment Description	Caveat #	Description of Caveat	Justification for Resolution
N1P18PCV2885A	Pressure Control Valve	4	Valve mounted on 1" dia. pipe or larger	3/4" pipe but valve is very light and judged adequate by SRT
N1P18PCV2885B	Pressure Control Valve	4	Valve mounted on 1" dia. pipe or larger	3/4" pipe but valve is very light and judged adequate by SRT
N1P18PCV2885C	Pressure Control Valve	4	Valve mounted on 1" dia. pipe or larger	3/4" pipe but valve is very light and judged adequate by SRT
Q1E11FCV0602A-A	RHR pump mini flow valve	6	Actuator & yoke not braced independently from pipe	Pipe well supported adjacent to valve. Pipe & valve support are attached to the same wall; therefore, the valve & pipe will move together.
Q1F16T0501	Refueling water storage tank	NA	Shell capacity vs. demand	The tank was evaluated using the Seismic Margin Assessment methodology as described in EPRI NP-6041. The resulting high-confidence-low-probability-of-failure (HCLPF) of 0.15 g pga provides a margin of 1.5 over the SSE pga of 0.10 g. Therefore, the intent of the caveat is met.
Q1H11NGCCM2523A-A	ICCMS processor cabinet train B	2	No computers of programmable controllers	Microprocessor in panel is seismically qualified.
Q1H11NGCCM2523B-B	ICCMS processor cabinet train B	2	No computers of programmable controllers	Microprocessor in panel is seismically qualified.
Q1H11NGR2504I-AB	Radiation monitor panel	3	No strip chart recorders	SRT judged strip chart recorders adequately restrained.
Q1P15HV3103-A	Pressurizer liquid sample line isolation	7	Actuator & yoke not braced independently from pipe	Pipe and valve are supported independently; however, they

ATTACHMENT 3
FARLEY A-46 RAI RESPONSE - QUESTION 4
Equipment Meeting the Intent of a Caveat Without Meeting the Specific Wording

ID #	Equipment Description	Caveat #	Description of Caveat	Justification for Resolution
	valve			will move together since they are both supported from the same point.
		4	Valve mounted on 1" dia. pipe or larger	Valve support will prevent imposing excess stress on the piping.
Q1P15HV3105-B	RHR heat exchanger A sample valve	7	Actuator & yoke not braced independently from pipe	Pipe and valve are supported independently; however, they will move together since they are both supported from the same point.
		4	Valve mounted on 1" dia. pipe or larger	Valve support will prevent imposing excess stress on the piping.
Q1P15HV3106-B	RHR heat exchanger B sample valve	7	Actuator & yoke not braced independently from pipe	Pipe and valve are supported independently; however, they will move together since they are both supported from the same point.
		4	Valve mounted on 1" dia. pipe or larger	Valve support will prevent imposing excess stress on the piping.
Q1P15HV3332-B	Pressurizer sample valve	4	Valve mounted on 1" dia. pipe or larger	Valve support will prevent imposing excess stress on the piping.
		7	Actuator & yoke not braced independently from pipe	Pipe and valve are supported independently; however, they will move together since they are

ATTACHMENT 3
FARLEY A-46 RAI RESPONSE - QUESTION 4
Equipment Meeting the Intent of a Caveat Without Meeting the Specific Wording

ID #	Equipment Description	Caveat #	Description of Caveat	Justification for Resolution
				both supported from the same point.
Q1P15HV3333-B	RCS hot leg sample line is·'ation valve	7 4	Actuator & yoke not braced independently from pipe Valve mounted on 1" dia. pipe or larger	Pipe and valve are supported independently; however, they will move together since they are both supported from the same point. Valve support will prevent imposing excess stress on the piping.
Q1P15HV3765-A	RCS sample valve	7 4	Actuator & yoke not braced independently from pipe Valve mounted on 1" dia. pipe or larger	Pipe and valve are supported independently; however, they will move together since they are both supported from the same point. Valve support will prevent imposing excess stress on the piping.
Q1P16FV3009A-B	CCW heat exchanger service water discharge	7	Actuator & yoke not braced independently from pipe	Tubing to valve components have adequate flexibility, SRT judges that no damaging differential movement will occur.
Q1P16FV3009C-A	CCW heat exchanger service water discharge valve	7	Actuator & yoke not braced independently from pipe	Tubing to valve components have adequate flexibility, SRT judges that no damaging differential movement will occur.
Q1P16P001A-A	Service water pump 1A	2	Casing and impeller shaft not cantilevered more than 20 ft.	Lateral seismic restraint located 38 ft. Below pump. This will

ATTACHMENT 3
FARLEY A-46 RAI RESPONSE - QUESTION 4
Equipment Meeting the Intent of a Caveat Without Meeting the Specific Wording

ID #	Equipment Description	Caveat #	Description of Caveat	Justification for Resolution
			independently from pipe	proximity; therefore, differential displacement between pipe and valve will not occur.
Q1P19HV2228-B	Pressurizer PORV back-up air supply valve	4	Valve mounted on 1" dia. pipe or larger	Lateral support on operator will prevent the valve from imposing excess stress in the 3/4" pipe.
		7	Actuator & yoke not braced independently from pipe	Valve and pipe supports attached to the floor in close proximity; therefore, differential displacement between pipe and valve will not occur.
Q1R36A511B	4.16KV switchgear 1L surge arrestor	Anchorage caveat 6	For bolted anchorages, gap under base less than 1/4"	Bolt bending stress OK per SRT calculation; therefore, the intent of the caveat is met.