Station Support Department

GL 87-02 Supp. 1

PECO ENERGY

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Docket Nos. 50-277
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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Peach Bottom Atomic Power Station, Units 2 and 3
Response to Request for Additional Information on Supplemental Response to Generic Letter 87-02, Supplement 1, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue A-46."

References:

1) Letter from G. J. Beck [PECO Energy Company (formerly Philadelphia Electric Company)] to NRC dated September 18, 1992

2) Letter from J. W. Shea (NRC) to G. J. Beck dated November 17, 1992

3) Letter from G. A. Hunger, Jr. (PECO Energy Company) to NRC dated January 24, 1994

4) Letter from S. Dembek (NRC) to G. A. Hunger, Jr. dated March 29, 1994

Dear Sir:

By letter dated September 18, 1992, (Reference 1) PECO Energy Company (PECO Energy) submitted a response to Generic Letter (GL) 87-02, Supplement 1, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46," for the Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. In the submittal PECO Energy outlined its plan to follow the Seismic Qualification Utility Group's (SQUG) "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," to resolve the seismic verification issues associated with USI A-46.

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The NRC responded to the September 18, 1992, submittal by letter dated November 17, 1992, (Reference 2) stating that the staff had evaluated the response and concluded that the procedures and criteria used to generate the licensing basis in-structure response spectra are adequate for the resolution of USI A-46.

By letter dated January 24, 1994, (Reference 3), PECO Energy supplemented Reference 1 to inform the NRC of its plans to develop and implement realistic, median-centered in-structure response spectra as outlined in the GIP for resolution of USI A-46 for equipment in the Radwaste Building.

The NRC staff performed a preliminary review of the January 24, 1994, letter and by letter dated March 29, 1994, (Reference 4) informed PECO Energy that additional information was needed to complete their review. The NRC requested that the additional information be provided within 30 days from receipt of the March 29, 1994, letter.

Restated below are the NRC staff's questions followed by the PECO Energy response:

Question 1. Provide the details of the suite of earthquake acceleration time histories that will be selected from historical earthquakes or generated artificially, including their characteristics such as duration of strong ground motion.

Response 1. A suite of thirty different acceleration time histories were selected. The following information concerning these time histories is provided.

- Table 1 identifies the characteristics of the historical records which are part of the 30 records used in the time history analyses.

- Table 2 identifies the strong motion characteristics of all the time histories used in the time history analyses.

- Figure 1 is a plot of the 5% damped response spectra of all the 30 time histories and their median at all frequencies.

- Figure 2 is a comparison of the target NUREG/CR-0098 84th percentile spectral shape (anchored to 0.12g) and the median and 84th percentile response spectra obtained from the 30 time histories.

- Figure 3 plots the ratio of the 84th percentile spectral accelerations and the median spectral accelerations of the 30 time histories at all frequency ranges.

Question 2. Describe, in detail, the procedure used to develop the in-structure response spectra.

Response 2. This discussion outlines the methodology for developing in-structure response spectra for use in the USI A-46 program evaluations of equipment in the Seismic Class I portion of the Peach Bottom Radwaste Building. The methods described below comply with guidelines given in section 4.2.4 of the SQUG GIP. Specifically, the GIP (p. 4-17) states that realistic, median-centered in-structure response spectra may be compared to 1.5 times the Bounding Spectrum as a valid comparison of seismic capacity to seismic demand for USI A-46 equipment evaluations.

The proposed method makes use of an existing model of the Radwaste/Turbine Building developed for the Individual Plant Examination of External Events (IPEEE) in-structure spectra generation but incorporates a more elaborate method for generating the in-structure spectra. The A-46 spectra will be generated using a suite of earthquake time history inputs to the structure model, while randomly varying key properties of the structure model. The use of a suite of time histories and variation of structure properties incorporates, in a statistically correct manner, the variability inherent in the input motion as well as the modeling of the structure.

Radwaste/Turbine Building Model

The structural model developed for IPEEE in-structure spectra generation is a full three-dimensional modeling, incorporating horizontal eccentricities between centers of mass and centers of rigidity at each major elevation. The analytical model is shown in Figure 4. The model has realistic concrete properties to account for concrete aging and stiffness reduction due to micro cracking. The median value for structural damping that will be selected for all modes of vibration will be 7% of critical damping.

Input Motions

A suite of at least 30 different earthquake acceleration time histories in 15 pairs will be selected from historical earthquakes or generated artificially. The 5% damping response spectra for all time history components will be generated. The median (50 percentile) response spectrum will be calculated from all the individual time histories and compared with a A-46 GIP recommended ground response spectrum shape, the NUREG/CR-0098 (84 percentile) response spectrum shape with a peak ground acceleration (PGA) of 0.12g.

The earthquake time histories will be scaled and possibly modified until a suitable match is obtained with the target spectrum. A suitable variability in the suite of time histories will be maintained by showing that the resulting response spectra have a coefficient of variation (COV) of about 0.2 to 0.3 over the range of important structure frequencies.

Each horizontal earthquake pair will be used twice. The second use of each earthquake pair will switch the horizontal components, resulting in a total of 30 horizontal time history pairs for use in 30 analyses. For each of the 30 pairs of horizontal earthquake time histories, a vertical time history will be selected randomly from the remaining 28 time histories. This approach avoids the correlation between the vertical and horizontal motions that would result if the same component were reused. The vertical component will be scaled down by an additional factor of 2/3.

Variation of Structure Parameters

Variation in the structural response due to variation in structural damping and frequency will be included in the following manner. A Latin Hypercube simulation will be used to select random variables (model parameter values) to be used in each of the 30 time history analyses. The earthquake time histories are assumed to be equally likely so that the sample size for the simulation will be set equal to 30. Damping ratios and structural frequencies are assumed to be random variables that are log normally distributed with the medians and variabilities shown below. The damping variability implies that a ± one standard deviation is 5% to 10% damping. The variability in the frequency ratio implies that a ± one standard deviation is 0.78 to 1.28 times the median frequency value.

Parameter	Median	Variability (ß)
Structural Damping	0.07	0.35
Structure Frequency Ratio	1.00	0.25

The domain of each model parameter is divided into 32 strata such that each strata is of equal probability. Parameter values within the first and the 32nd strata (that is, the tails of the probability distribution function) are considered to be extreme, unrealistic values. The sampling is then limited to the remaining 30 strata. The Latin Hypercube simulation then randomly selects (from a log normal distribution) a damping and a frequency ratio with a specified median and a variability and combines each value with one of the 30 equally likely time history sets used for analysis.

For each analysis, the modal frequencies will be scaled and the modal damping assigned according to the values selected. A mode superposition time history analysis is then performed for each of the 30 earthquake/model parameter value sets.

Median In-Structure Response Spectra

In-structure response spectra at 5% damping will be generated for each response time history at each model response point and for the two horizontal and the vertical directions. The 30 response spectral will be combined and the median response spectrum for each location and direction will be calculated.

As stated in Reference 3, PECO Energy plans to have the realistic, median-centered in-structure response spectra developed and available for use prior to the Radwaste Building walkdowns. The utilization of this response spectra is not expected to impact the projected completion date of November 20, 1995.

Should the staff require any additional information, please contact us soon as possible, thereby avoiding the possibility of impacts to the completion schedule.

Sincerely,

M. C. Kray for

G. A. Hunger, Jr., Director
Licensing

Attachments: Tables 1, 2; Figures 1, 2, 3, 4

cc: T. T. Martin, Administrator, Region I, USNRC
W. L. Schmidt, USNRC Senior Resident Inspector, PBAPS

Characteristics of 16 Historical Time Histories used in Peach Bottom Radwaste/Turbine Building Analyses

Time History Name	Earthquake Date	Magnitude	Recording Station Distance	Component	Site Conditions
tabas-tr tabas-ln	Tabas, Iran 16-Sep-78	7.4	Tabas 3 km	Tr Ln	Stiff alluvium/rock
gazlieas gazlinor	Gazli, U.S.S.R 17-May-76	6.8	Karakyr Point 3 km	East North	Rock/stiff alluvium
ivdan00e ivdan90w	Imperial Valley, CA 15-Oct-79	6.5	Differential Array 5 km	N00E N90W	Deep alluvium
ivec-40e ivec-50w	Imperial Valley, CA 15-Oct-79	6.5	El Centro No. 4 4 km	S40E S50W	Deep alluvium
pvpp-045 pvpp-135	Coalinga, CA 2-May-83	6.5	Pleasant Valley Pump Station (Switchyard) 10 km	N45E S45E	Stiff alluvium/rock
sflh-21e sflh-69w	San Fernando, CA 9-Feb-71	6.6	Lake Huges No. 12 20 km	N21E N69W	Rock
sfpac-16 sfpac-74	San Fernando, CA 9-Feb-71	6.6	Pacoima Dam 3 km	S16E S74W	Rock
dayhookt dayhookl	Tabas, Iran 16-Sep-78	7.4	Dayhook 17 km	N10E N80W	Rock

Table 1

Characteristics of 30 Time Histories used in
Peach Bottom Radwaste/Turbine Building Analyses

Time-History Name	Time Step (sec)	Total No. of Points	Duration* (sec)	Strong Motion (sec)
tabas-tr	0.01	2900	29	7.89
tabas-ln	0.01	2900	29	7.48
gazlieas	0.00657	2048	13.46	6.15
gazlinor	0.00657	2048	13.46	5.62
ivdan00e	0.01	4096	40.96	5.03
ivdan90w	0.01	4096	40.96	5.5
ivec-40e	0.01	4096	40.96	6.2
ivec-50w	0.01	4096	40.96	5.28
pvpp-045	0.005	4000	20	7.9
pvpp-135	0.005	4000	20	6.6
sflh-21e	0.02	1838	36.76	5
sflh-69w	0.02	1838	36.76	5
sfpac-16	0.02	2092	41.84	6.6
sfpac-74	0.02	2092	41.84	7.38
dayhookt	0.02	2000	40	7.72
dayhookl	0.02	2000	40	7.84
Artificial T/H 1	0.005	4000	20	9.24
Artificial T/H 2	0.005	4000	20	11.22
Artificial T/H 3	0.005	4000	20	9.63
Artificial T/H 4	0.005	4000	20	9.06
Artificial T/H 5	0.005	4000	20	9.57
Artificial T/H 6	0.005	4000	20	10.2
Artificial T/H 7	0.005	4000	20	8.57
Artificial T/H 8	0.005	4000	20	10.02
Artificial T/H 9	0.005	4000	20	9.88
Artificial T/H 10	0.005	4000	20	9.82
Artificial T/H 11	0.005	4000	20	9.39
Artificial T/H 12	0.005	4000	20	9.83
Artificial T/H 13	0.005	4000	20	10.34
Artificial T/H 14	0.005	4000	20	10.52

* The duration used in the structural time-history analyses is 20 seconds or the total duration of the record for records with less than 20 seconds of motion

Table 2

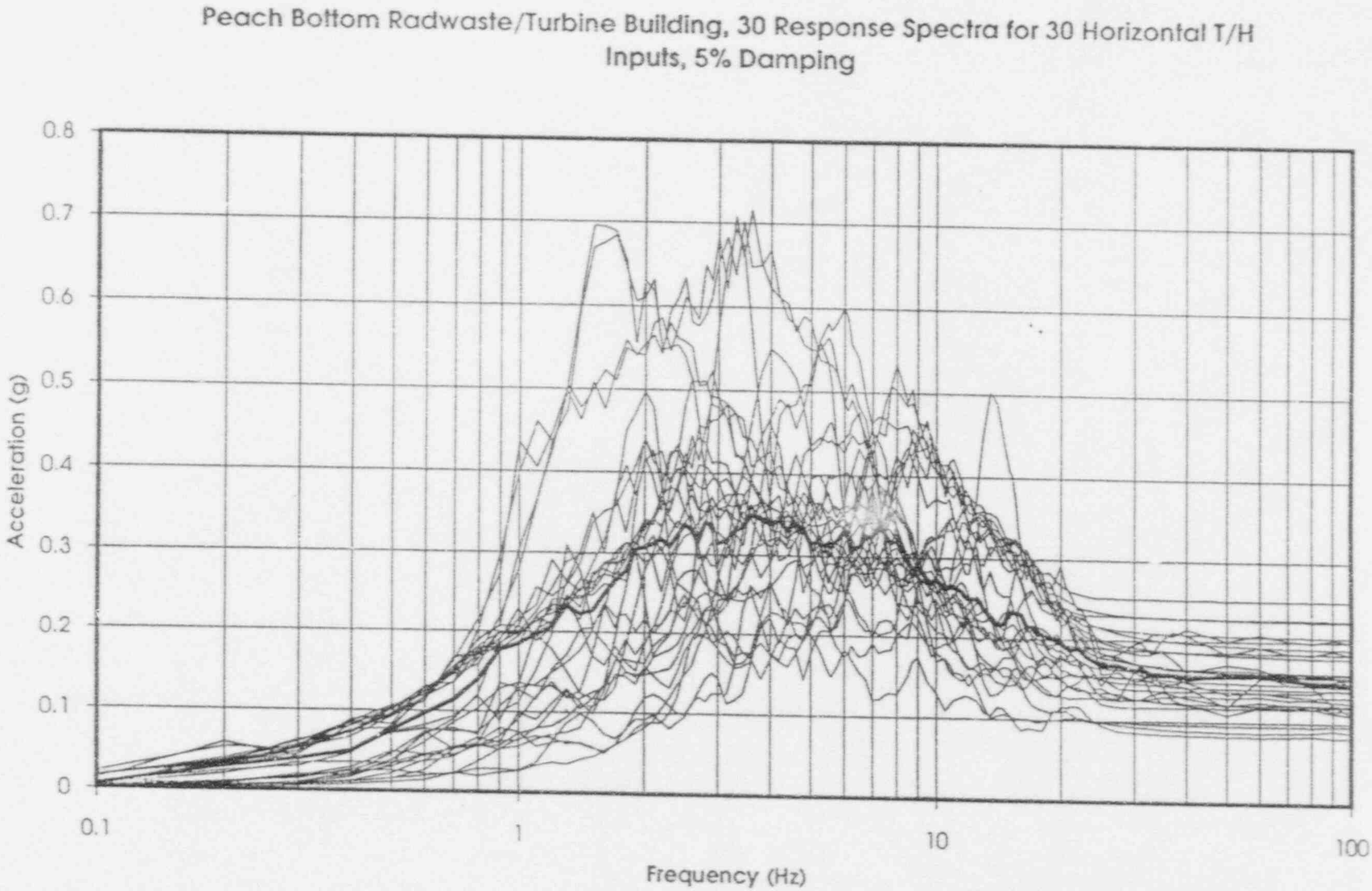
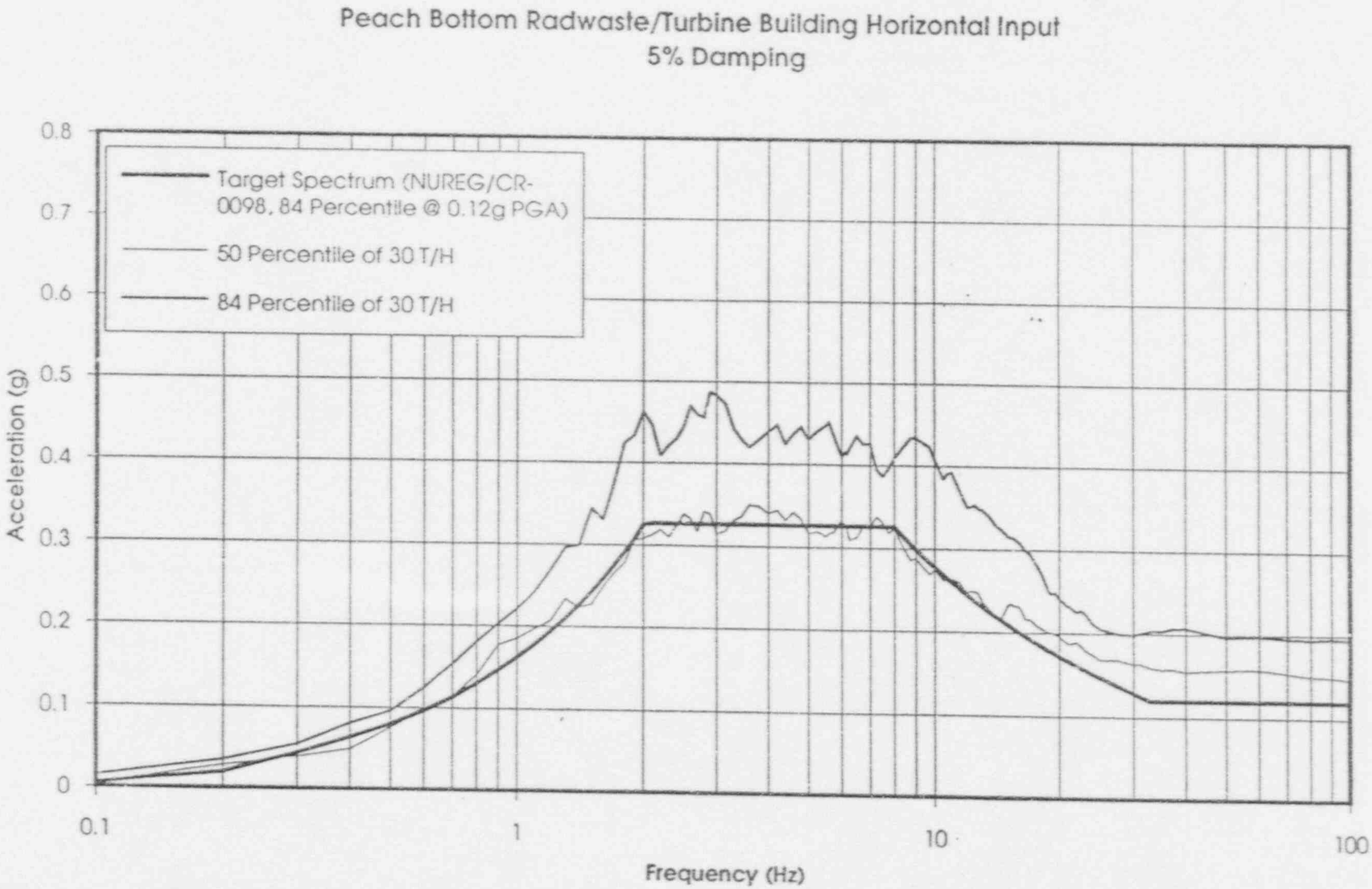

Peach Bottom Radwaste/Turbine Building, 30 Response Spectra for 30 Horizontal T/H Inputs, 5% Damping
Acceleration (g)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.1
1
10
100
Frequency (Hz)

Figure 1



Peach Bottom Radwaste/Turbine Building Horizontal Input
5% Damping
Target Spectrum (NUREG/CR-0098, 84 Percentile @ 0.12g PGA)
50 Percentile of 30 T/H
84 Percentile of 30 T/H
Acceleration (g)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
1
10
100
Frequency (Hz)

Figure 2

Peach Bottom Radwaste/Turbine Building, Ratio of 84th Percentile Spectral Acceleration to 50th Percentile Spectral Acceleration for 30 T/H

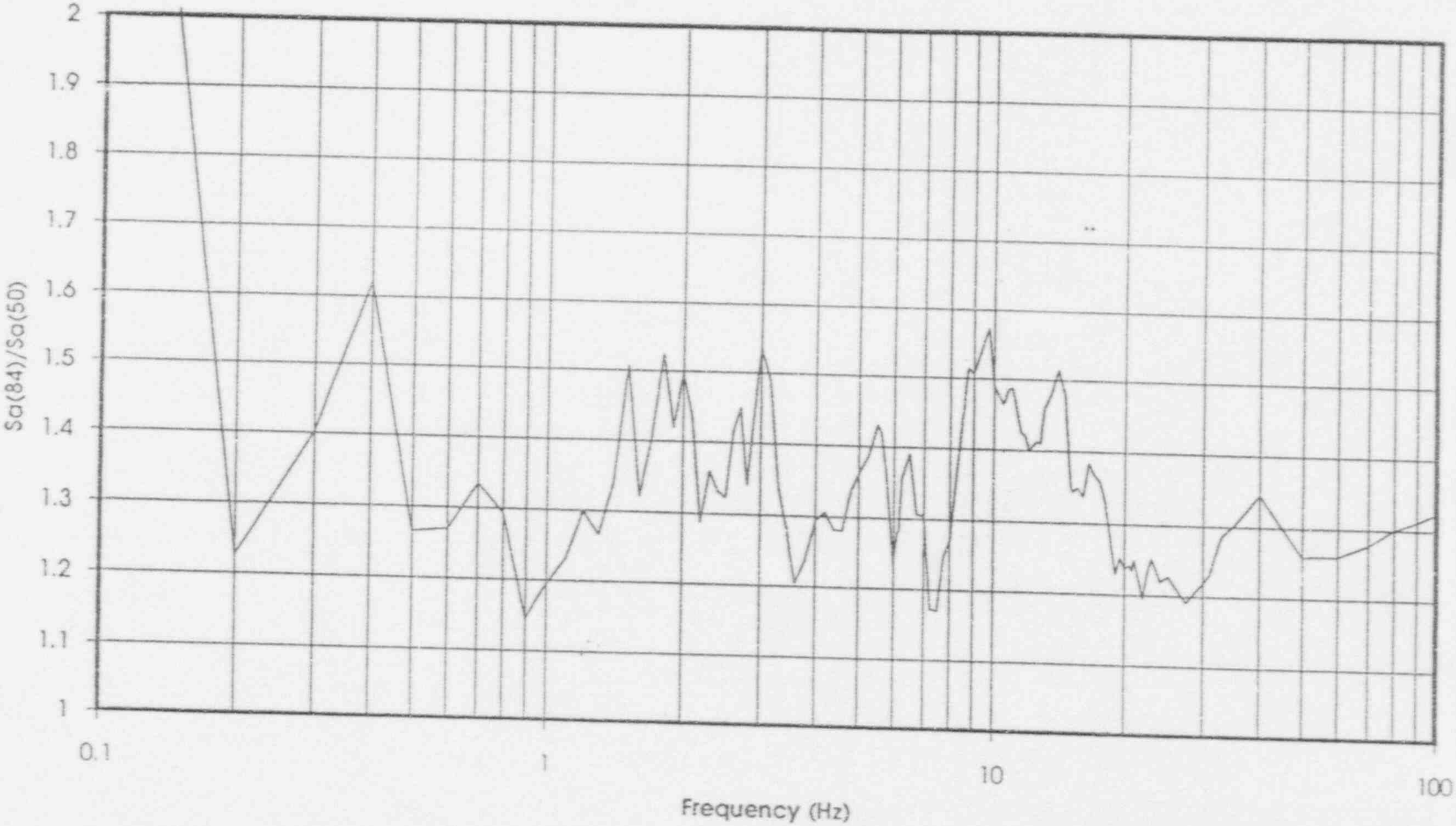


Figure 3

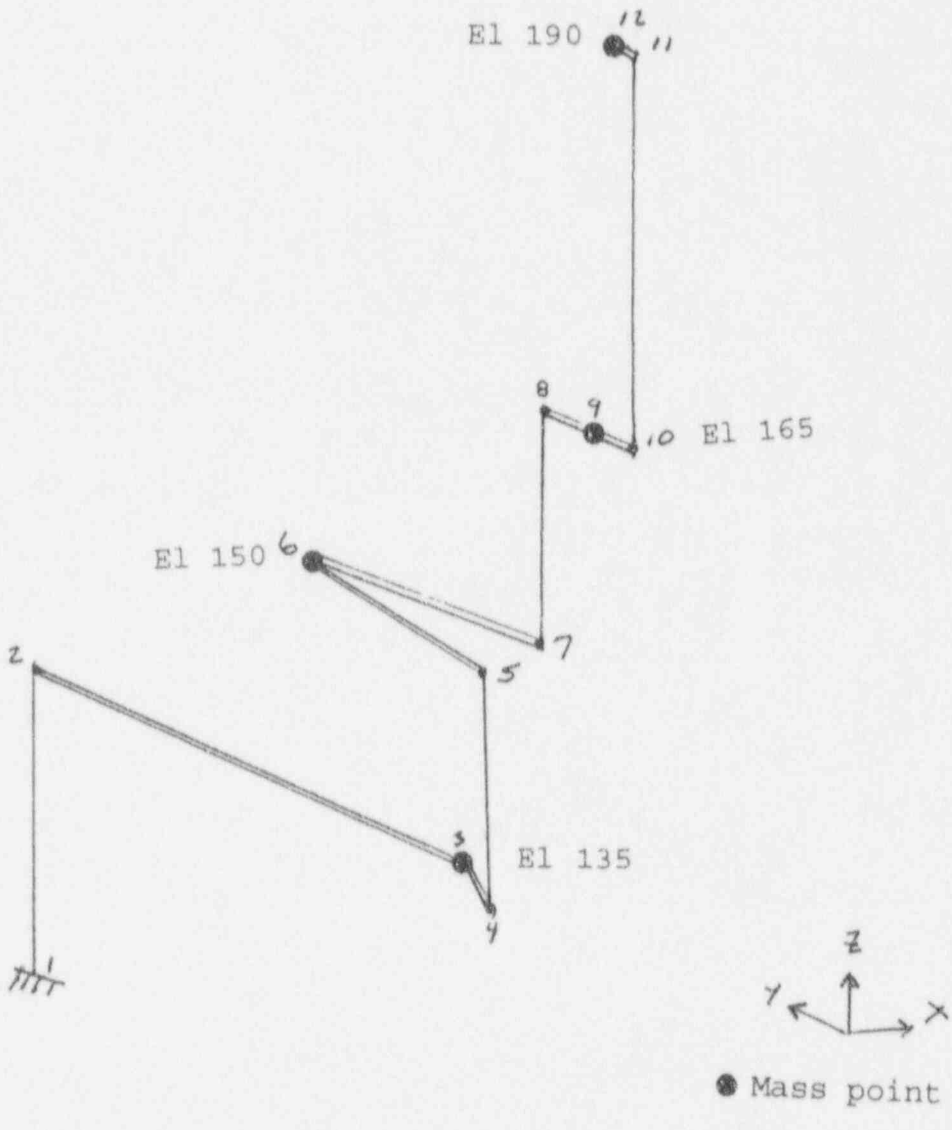


Figure 4 Radwaste Building Analysis Model (Y=West)