PECO NUCLEAR
A Unit of PECO Energy

PECO Energy Company
Nuclear Group Headquarters
965 Chesterbrook Boulevard
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October 19, 1998

Docket Nos. 50-277
50-278

License Nos. DPR-44
DPR-56

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Peach Bottom Atomic Power Station, Units 2 and 3
Response to Request for Additional Information
Regarding Floor Response Spectra for
Replacement Recirculation Piping Systems

References:
(1) Letter from Mohan C. Thadani, U.S. Nuclear Regulatory Commission (USNRC), to Garrett D. Edwards, PECO Energy Company, dated August 6, 1998
(2) Letter from Garrett D. Edwards, PECO Energy Company to USNRC, dated September 22, 1998
(3) Telecon between USNRC (M. Thadani, R. Rothman and Y. Kim) and PECO Energy Company (K. Hudson and J. Phillabaum) on September 28, 1998

Dear Sir:

Your request for Additional Information (RAI) was transmitted by the reference (1) letter. Attachment 1 to this letter provides a restatement of your questions followed by our response as agreed upon in references (2) and (3).

If you have any questions, please contact us.

Very truly yours,

Garrett D. Edwards
Director - Licensing

A001/1

Enclosure: Attachment 1, Attachment 2, Attachment 3

cc: H. J. Miller, Administrator, Region I, USNRC
A. C. McMurtray, USNRC Senior Resident Inspector, PBAPS

Disk located in File Center

ATTACHMENT 1

Docket Nos. 50-277
50-278
License Nos. DPR-44
DPR-56

Response to Request for Additional Information

Peach Bottom Atomic Power Station, Units 2 and 3

Floor Response Spectra for Replacement Recirculation Piping Systems

Question 1:

Reference 1 indicates that a single set of artificial time histories (two horizontal and one vertical components) were developed from the RG 1.60 GRS. Demonstrate the adequacy of the artificial time history including the extent of conformance to the target power spectral density (PSD) function of the artificial time history. Provide the actual and target PSDs.

Response 1:

See the response to item 2 in attachment 2. As can be seen by review of the figures discussed in item 2 of attachment 2, the PSDs from the generated artificial time histories compare favorably to the target PSDs.

Question 2:

Is the developed time history applied directly at the base of the structure (Mass point 41 in Figure E1 of Reference 1)? Indicate whether any deconvolution technique is used to reduce the amplitude of the SSE from the ground surface to the base of the structure.

Response 2:

As stated in Peach Bottom Atomic Power Station, Units 2 and 3 (PBAPS) UFSAR section 5.3.1.3, the reactor building is founded on rock. UFSAR section 2.7.6.3 states that the "drywells are installed on rock pedestals". Therefore, the seismic free-field input motion is directly applied to the foundation level. As stated in UFSAR section 2.5.3.3.2, compression wave velocities for the site range from under 7000 fps to over 16000 fps. See item 1 on page 3 of attachment 2 for additional discussion.

Question 3:

Provide the time history input data applied at the base of the structure in ASCII format on a 3.5 inch diskette.

Response 3:

The data is included as attachment 3 to this response. Reference item 3d of attachment 2 for a description of the data.

Question 4:

You indicate in Reference 1 that the calculated stresses exceeded the ASME Code allowables when a time history, generated using the GESSAR method, was used. Therefore, you regenerated a new time history using the SCOTH method.

a) Explain the difference between the GESSAR and SCOTH methods.

b) Demonstrate the validity of the SCOTH method.

Response 4:

See item 3a, b, and c of attachment 2 for the response to this question.

Question 5:

With respect to the development of the FRS, provide the following:

a) Indicate whether you accounted for any soil-structure interactions.

b) Indicate whether you applied the vertical time history at the base of the structure.

c) It appears that you made one assumption that the structure is rigid; therefore, there is no amplification at higher elevation due to the vertical seismic motion. You assumed that the vertical spectrum applied at the base of the structure is the same as the FRS at any elevation. Based on the structural model provided in Reference 1, the staff does not agree with your assumption. Provide detailed technical justifications for your assumption.

d) What was the structural damping value used?

e) Provide generated time histories for the Mass points (41, 39, 37, 34, 42, 29, 27, 43, 51, 45, 58, 44, 1, 12, 9, 24, 47, 48 and 49) in Figure E1 of Reference 1 in ASCII format on a 3.5 inch diskette and hard copies of their corresponding FRS.

Response 5:

a) See the response to question 2 above.

b) Since the vertical analysis is not a part of the PBAPS Licensing Basis, the associated vertical model was not developed. Therefore, the requested data is not available. Per UFSAR section M.3.2.3.1.7:

"The calculated seismic stresses for the drywell and suppression chamber are extremely low as compared with stresses induced by pressure and temperature. Due to this, the use of equivalent static loads derived from the dynamic analysis was considered satisfactory. Torsional response of the drywell was not considered because of the axisymmetrical configuration of the drywell and torus. The contribution from slight eccentricities is an insignificant part of the seismic stresses which in turn form a very small part of the total stresses. The vertical response amplification was also not considered for the same reason."

Additionally, in general, piping and equipment attached to the main column or wall structural elements may be designed using the ground response spectra as the seismic input for the vertical excitation. This concept is documented by the following excerpts taken from Appendix C, section C.2.2 of PBAPS UFSAR.

"Vertical seismic stresses are not severe because they represent only a fractional increase in the dead load which the structure carries. Since the frequencies of the modes associated with vertical motion are normally large, it is sufficient to design the vertical elements for the maximum vertical ground acceleration without a detailed dynamic analysis of the structure."

"The vertical seismic response can be divided into two categories. The first category is the general building motion involving primarily the column or wall elements and the second category is the local response of various beam and slab elements oriented parallel to the ground.

In general, for a building founded on a rigid foundation the building response will be small compared to the dead load since the building frequencies will be higher than the primary frequencies of the earthquake spectrum."

c) See response to 5.b above.

d) NRC Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," was used in the analysis.

e) As discussed in the teleconference on September 28, 1998, the data requested in question 5.e was to be used to explain the NRC observation that the data in attachments A and C of NEDC-32970 indicates the structural response to the analyzed earthquake decreases as the plant elevation increases. This effect is opposite from normal observations. The reason for this apparent discrepancy is that the figures in attachment A of NEDC-32790 are for response spectra generated using ASME Code Case N-411-1 damping. The figures in attachment C of NEDC-32790 are for response spectra generated using 2%, 3%, and 5% strain energy weighted damping. Therefore, the responses at node 6 (ref. Figure E1 of NEDC-32970) are higher than the responses at node 1 because of the difference in critical damping, even though node 6 is lower in elevation than node 1.

Question 6:

The structural model (Figure E1 of Reference 1) used for the piping analysis is different to the structural model (Figure 1 of Reference 2) used for PECO's shroud repair analysis. In the structural model (Reference 1), some of the horizontal masses are lumped on the vertical stick model, thereby reducing the vertical and eccentricity effects. The structural model for the shroud repair analysis (Reference 2) appears to be more realistic.

Explain the reasons for using the different structural model in the piping analysis, and demonstrate that the model of Reference 1 is as appropriate as the model of Reference 2.

Response 6:

See item 5 of attachment 2 for the response to this question.

NRC References:

1. "Peach Bottom 2 & 3 - Recirculation Piping Reanalysis, Uniform Support Motion, Seismic Response Spectra based on Regulatory Guide 1.60 Free-Field Earthquake and ASME Code Case N-411 Damping," NEDC-32790, DRF B33-00293, Section 15, Class 2, GE Nuclear Energy, October 1997.

2. "Shroud Mechanical Repair Program: Peach Bottom Units 2 & 3 - Seismic Analysis," GENE-771-60-0994, DRF B13-01732, Rev. 2, Class III, GE Nuclear Energy, June 1995.

ATTACHMENT 2

GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

March 15, 1998
DRF-B13-01920-034

cc: T. A. Caine
M. K. Kaul
dkh9810

To: Ken Hudson
PECO Energy

From: Dave Robare
GE Nuclear Energy

SUBJECT: Peach Bottom 2 and 3 - GE Response to NRC Questions Pertaining to the Recirculation Piping System Reanalysis

1. BACKGROUND

The piping seismic input motion utilized in the reanalysis of the Peach Bottom 2 & 3 recirculation piping was generated by subjecting the Peach Bottom 2 & 3 primary structure seismic model to North-South (NS), East-West (EW) and Vertical (V) spectrum consistent synthetic time histories. The OBE and SSE synthetic time history input motion to the primary structure were based on the US NRC Regulatory Guide 1.60 free-field response spectra. The NS, EW and V synthetic time history components are mutually statistically independent.

The first iteration of the recirculation piping reanalysis was based on existing GE Standard Plant Safety Analysis Report (GESSAR) free-field spectrum consistent synthetic time histories corresponding to Regulatory Guide 1.60 in conjunction with Code Case N-411 damping. The GESSAR synthetic time histories were generated based on the Reference 5.4 "SIMQK-01" computer program developed at the Massachusetts Institute of Technology (MIT). However, because several piping responses in the first iteration analysis exceeded ASME Code allowables, the decision was made to regenerate the Regulatory Guide 1.60 spectrum consistent time histories based on the Reference 5.5 "SCOTH" computer program. This decision was made to reduce the conservatism inherent to the synthetic time histories based on "SIMQK-01", Reference 5.4. Typically, there is less margin between the target spectrum and the spectrum generated from the synthetic time histories for time histories based on SCOTH, Reference 5.5. All subsequent piping reanalysis responses based on the SCOTH synthetic time histories were within ASME Code allowables.

2. PURPOSE

Subsequent to reviewing the Peach Bottom 2 & 3 recirculation piping reanalysis, the NRC has requested additional information. The NRC request came in the form of 5 questions. The 5 questions are restated below. The purpose of this letter is to provide responses to Question 2, 3 and 5 as requested by PECO in Reference 5.2 and as farther defined in the Reference 5.3 Task Scoping Document (TSD).

3. NRC QUESTIONS

The NRC staff's request for additional information pertaining to the Peach Bottom 2 & 3 recirculation piping reanalysis is contained in Reference 5.2. The 5 items identified by the staff for which additional information is required are provided below.

Item 1. *Indicate whether or not the RG 1.60 seismic free-field input motion is directly applied at the foundation level without using a deconvolution technique.*

Item 2. *Since PECO used a single time history, it needs to submit a power spectra density (PSD) comparison.*

Item 3. *When PECO used the synthetic time history, which was developed using the GESSAR method, and Code Case N-411 damping, the results exceed the ASME Code allowables. Consequently, PECO regenerated a new synthetic time history using the SCOTH method, and used it for the final piping analysis:*

- *a) Explain the difference between the GESSAR and the SCOTH methods.*
- *b) Submit adequacy and validity of the SCOTH method.*
- *c) Did both the GESSAR and SCOTH response spectra envelop the RG 1.60 spectra? Submit the results.*
- *d) As requested before, submit three (X, Y and Z) components of GESSAR and SCOTH time histories in ASCII code.*

Item 4. *PECO assumed that there is no amplification of the vertical seismic motion. It assumed that the vertical input ground response spectrum at the foundation level is the same as the floor response spectra at any elevations of the pipes. Submit vertical floor response spectra based on actually applying the vertical seismic ground motion.*

Item 5. *The structural model used for developing the floor response spectra is different to the structural model used for the PECO shroud repair. Explain the reasons for using the different structural model. Since the structural model for the shroud repair looks more realistic, PECO needs to demonstrate the adequacy of the structural model used for piping analysis. Submit floor response spectra based on an analysis in which the time histories used for the piping analysis are applied to the structural model used for the shroud repair.*

4. GE RESPONSE

The item by item GE response to the NRC staff request for additional information is provided as follows:

Item 1. The RG 1.60 spectrum consistent synthetic acceleration time histories were applied directly at the foundation level in the Peach Bottom 2 & 3 primary structure seismic models utilized to generate the seismic input motions required for the recirculation piping reanalysis. The deconvolution technique associate with Soil-Structure Interaction (SSI) is not required because the Peach Bottom 2 & 3 site is a soil subgrade "rock" site in which the subgrade shear wave velocity is well above the 3,500 ft/sec threshold below which SSI analyses would be required.

Item 2. The Power Spectral Density (PSD) comparison plots of the horizontal target PSD from Reference 5.8 (see Equation 2 of Appendix A) and the EW and NS components generated from the SCOTH synthetic time histories are provided in Figures 2 & 3 and Figures 5 & 6, respectively of Attachment A. The PSD from the EW synthetic time history is compared to the horizontal target PSD in the log-log plot in Figure 2. The same comparison, except on a linear-log plot, is provided in Figure 3. Similar comparisons are made for the NS components in Figures 5 and 6.

Item 3. Per the Reference 5.3 Task Scoping Document, responses 3c and 3d are to be provided for only the SCOTH synthetic acceleration time histories.

a) The GESSAR method uses SIMQK computer code to generate a synthetic time history. The original version of the computer code was developed at MIT in 1975 and is based on a qualitative correspondence between the power spectral density function and the response spectrum of a time history. The power spectrum is derived from the target response spectrum which is then used to generate a synthetic trial time history. Response spectrum of the thus generated time history is compared with the target response spectrum and the differences between the two are fed back to obtain a modified power spectrum. The recursive process is repeated until an acceptable level of accuracy is achieved.

   Contrary to the frequency domain generation of a synthetic time history in GESSAR, SCOTH used a time domain based method. The principles of calculus of variations are used to establish a relationship between small variations in time history to the resulting small changes in its spectral amplitudes. This relationship takes the form of an integral transformation which is then numerically solved to obtain changes in an existing trial time history from desired changes in its spectrum values. The method is iterative but assures a progressive convergence to the target response spectra as the time history is modified. The theoretical details are given in Reference 1.

b) Both the SIMQK-01 ECP used to generate the synthetic acceleration time histories for the GESSAR and SCOTH are self checking programs. A generated time history, no matter how arrived at, is verified for acceptability by comparing its response spectra with the target response spectra. The validity of these computer codes lies in this self-checking feature.

c) Both the GESSAR and the SCOTH response spectra envelop the RG 1.60 spectra in accordance with the requirements given in Subsection 3.7.1.II.1.b of Reference 5.8. The response spectra generated from the SCOTH synthetic acceleration time histories, based on RG 1.60, are compared to the RG 1.60 horizontal and vertical spectra in Reference 5.6 which has been previously transmitted to PECO. The NS comparison plots at 0.5%, 2.0% and 7.0% oscillator damping are given in Figures D1, D2 and D3, respectively, of Reference 5.6. Corresponding EW comparison plots are given in Figures D7, D8 and D9 and Vertical plots in Figures D13, D14 and D15.

d) The SCOTH generated synthetic acceleration time histories are provided on a 3.5" floppy disk in the following three ASCII files:

EWT:	East West Acceleration Time history
NST:	North-South Acceleration Time History
VTT:	Vertical Acceleration Time history

All acceleration time histories are of 20 seconds duration and are digitized at 0.01 seconds. The format on all three files is 4(F10.3,E10.3) and the time histories are presented in (Time, Acceleration) pairs.

Item 4. Per Reference 5.3, the response to Item 4 is to be provided by PECO!

Item 5. The Peach Bottom 2 & 3 primary structure seismic model use to generate the seismic input motion for the recirculation piping reanalysis is identical to the primary structure "benchmark" seismic model used for the Peach Bottom 2 & 3 shroud repair project, Reference 5.9. The benchmark model does not include the shroud repair hardware or any weld-cracks in the shroud circumferential welds.

For convenience, sketches of the Peach Bottom 2 & 3 primary structure seismic model from both projects are provided in Attachment B. Figure 1 in Attachment B, corresponding to the shroud repair project, was taken from Reference 5.9 and Figure E1 from the recirculation piping reanalysis was taken from Reference 5.6. The depiction of the primary structure seismic model in the two figures is not exactly the same; especially for Node 32 at the top of the reactor building. However, the very same eigenanalysis input geometry was used for both projects. A hard copy of that geometry is provided in Attachment E of Reference 5.6.

5. REFERENCES

5.1 GE Nuclear Energy DRF B13-01920, "1998 Consulting Engineering and Structural Mechanics & Materials Small Job DRF", March 14,1998.

5.2 PECO E-Mail from Hudson, K.A. (Kenneth) to Karina Faynshtein (GE), "FW: Topics for Recirculation Piping Telecon", January 29, 1998 2:17PM.

5.3 GE Nuclear Energy Task Scoping Document, Task No. EP-0069, Rev. 0, "Response to PECO for NRC's Request for Additional Information", February 13,1998.

5.4 GE Engineering Computer Program (ECP), "SIMQK-01 - A Computer Program for Artificial Motion Generation", June 1976. (SIMQK-01 was obtained by GE from the Massachusetts Institute of Technology and was established as Level 2 GE ECP as a result of the Encoded Technology Review held on May 17,1976.)

5.5 Engineering Mechanics Research, Inc., Computer Program SCOTH, "A Spectrum **CO**mpatible **T**ime **H**istory Generation Computer Program", Version 2.30, March 1992.

5.6 GE Nuclear Energy Report NEDC-32790, Class 2, "Peach Bottom 2 & 3 - Recir Piping Reanalysis Uniform Support Motion (Reg. Guide 1.60 Free-Field Motion and ASME Code Case N-411 Damping", October 1997.

5.7 Kaul, Maharaj K., "Spectrum-Consistent Time History Generation," Journal of Engineering Mechanics Division, ASCE, Vol. 104, No. EM4, Aug. 1978.

5.8 U.S. NRC Standard Review Plan (SRP), Section 3.7.1, "Seismic Design Parameters", Rev. 2 - August 1989.

5.9 GE Nuclear Energy Report No. GENE-771-60-0994, Revision 2, "Shroud Mechanical Repair Program - Peach Bottom Units 2 & 3 Seismic Analysis", June 1995.

If there are any questions or if I can be of further help, please call me at (408) 925-5964 or page me on (408) 932-3194.

D. K. Henrie, Principal Engineer
Structural Mechanics and Materials
Seismic & Dynamic Analysis

Verified By:

M. K. Kaul, Principal Engineer
Structural Mechanics and Materials

ATTACHMENT A

Philadelphia Electric Company
Peach Bottom, Units 2 & 3

SCOTH
Reg. Guide 1.60 Free-Field Synthetic Time History
Power Spectrum Function Computation

Power Spectrum Density Function Computation

The power spectrum density function (PSDF) of an acceleration time history x(t) is computed according to the definition set forth in Reference 1 SRP 3.7.1, i.e.,

$$S(\omega) = 2x\,|f(\omega)|^2 / (2\pi T_d) \qquad \text{......(1)}$$

in which

$S(\omega)$ = One-sided Power Spectral Density Function of x(t)

$f(\omega)$ = Fourier Amplitude Spectrum of the time history x(t) defined by the relation

$$f(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-i\omega t}\, dt \qquad \text{......(2)}$$

and

T_d = duration of strong motion of the input earthquake acceleration.

The Fourier amplitude spectrum is calculated over the strong motion duration T_d of the time history x(t).

The strong motion duration T_d is calculated according to the definition (Reference 2)

$$T_d = T_{0.75} - T_{0.05} \qquad \text{......(3)}$$

in which, $T_{0.75}$ and $T_{0.05}$ are the times at which 75% and 5%, respectively, of the cumulative energy reached.

Reference 1 requires that the average PSDF of the horizontal acceleration time history computed according to the procedure described above exceed 80% of the target PSDF (Minimum PSDF in the 0.3 Hz. to 24 Hz. frequency range. The target PSDF is defined below. In the definition, the peak horizontal acceleration is fixed at 1g; the units for power spectrum density function S are $inches^2 / sec^3$ and those for frequency f are in Hertz.

$$S = 650\ (f / 2.5)^{0.2} \qquad 0.3 < f < 2.5$$

$$S = 650\ (2.5 / f)^{1.8} \qquad 2.5 < f < 9.0$$

$$S = 64.8\ (9 / f)^{3} \qquad 9.0 < f < 16. \qquad \text{......(4)}$$

$$S = 11.5\ (16 / f)^{8} \qquad 16. < f < 24$$

East-West Component of Ground Motion

The generated acceleration time history anchored to peak value of 1g is shown in Figure 1. The accumulated energy for the horizontal acceleration history was computed and is presented in Table 1. From Table 1 it is easily concluded that the strong motion duration of the time history is 10.84 seconds. The PSDF of this strong motion duration segment of the acceleration was computed and is shown in Figure 2. Also shown in Figure 2 is the Minimum Target PSDF. The plots of Figure 2 are presented on a different ordinate scale in Figure 3.

Except in a small frequency window of 13.87 - 15.92 Hz, the Minimum Target PSDF is exceeded everywhere. In the 13.87-15.92 Hz. range the PSDF of the generated acceleration time history is, on the average, about 3.5% below the Minimum Target PSDF. In this region the values of both the Minimum Target PSDF and the PSDF of the E-W acceleration time history are very small and contribute very little to the total power in the earthquake motion. A 3.5% average deficiency of power in this region would, therefore, have an insignificant effect on structural response.

However, if the generated acceleration time history is scaled up by a factor of 1.06, the generated acceleration PSDF would exceed the Minimum Target PSDF at all the frequencies. This small increase in the accelerations would lead to no more than 6% increase in the structural stresses and can be accommodated by the safety margin available in the structural components.

North-South Component of Ground Motion

The generated acceleration time history anchored to peak value of 1g is shown in Figure 4. The accumulated energy for the horizontal acceleration history was computed and is presented in Table 2. From Table 1 it is easily concluded that the strong motion duration of the time history is 9.96 seconds. The PSDF of this strong motion duration segment of the acceleration was computed and is shown in Figure 5. Also shown in Figure 4 is the Minimum Target PSDF. The plots of Figure 5 are presented on a different ordinate scale in Figure 6.

As seen from Figures 5 and 6, the Minimum Target PSDF is exceeded everywhere in the frequency range of 0.3 - 24 Hz.

References:

1. U.S. Nuclear Regulatory Commission Standard Review Plan. Section 3.7.1, NUREG-0800, 1989

2. Recommendations for Resolution of Public Comments on USI A-40, "Seismic Design Criteria", Appendix A, BUREG/CR-5347, BNL-NUREG-52191

TABLE 1
EAST-WEST ACCELERATION TIME HISTORY

Normalized Peak Acceleration	= 1g
Duration	= 20 seconds
Discretization Interval	= 0.01 seconds
Maximum Accumulated Energy	= 332,960 in^2 / sec^3
Strong Motion Duration	= 10.84 seconds

Accum. Energy (%)	Time (Sec.)	Accum. Energy (%)	Time (Sec.)
5	2.71	55	10.60
10	3.96	60	11.27
15	4.70	65	12.55
20	5.32	70	12.93
25	6.11	75	13.55
30	7.25	80	14.27
35	8.06	85	14.60
40	9.04	90	15.09
45	9.33	95	16.34
50	9.55	100	20.00

TABLE 2
NORTH-SOUTH ACCELERATION TIME HISTORY

Normalized Peak Acceleration	= 1g
Duration	= 20 seconds
Discretization Interval	= 0.01 seconds
Maximum Accumulated Energy	= 340,400 in^2 / sec^3
Strong Motion Duration	= 9.96 seconds

Accum. Energy (%)	Time (Sec.)	Accum. Energy (%)	Time (Sec.)
5	2.30	55	9.93
10	3.31	60	10.47
15	4.17	65	11.38
20	5.47	70	11.84
25	6.13	75	12.26
30	6.74	80	13.12
35	7.24	85	14.18
40	7.73	90	14.82
45	8.44	95	16.19
50	9.41	100	20.00

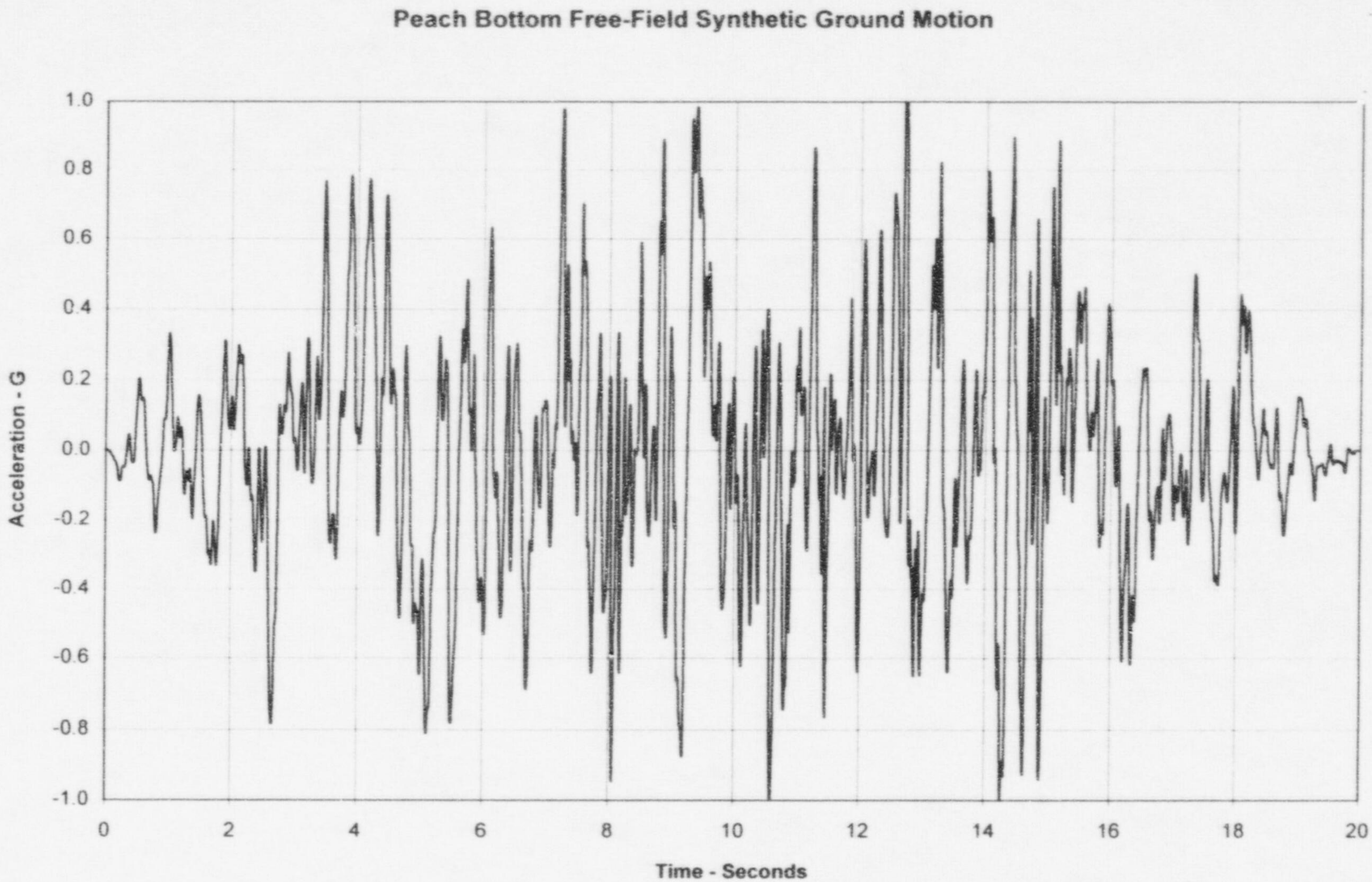

Figure 1 -- E-W Acceleration Time History

Peach Bottom Free-Field Synthetic Ground Motion

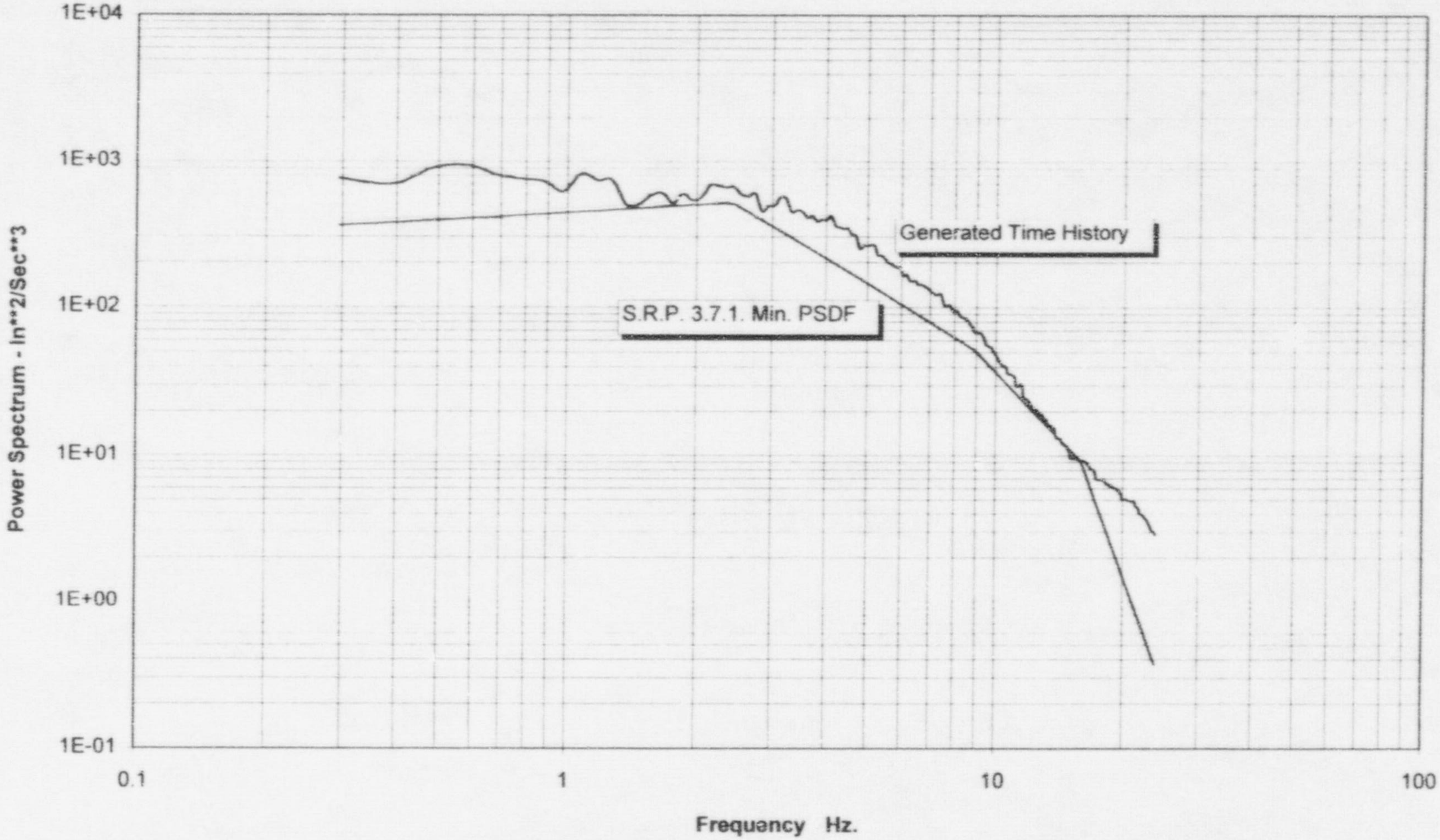

Figure 2 - E-W Acceleration Time History Power Spectrum

Peach Bottom Free-Field Synthetic Ground Motion

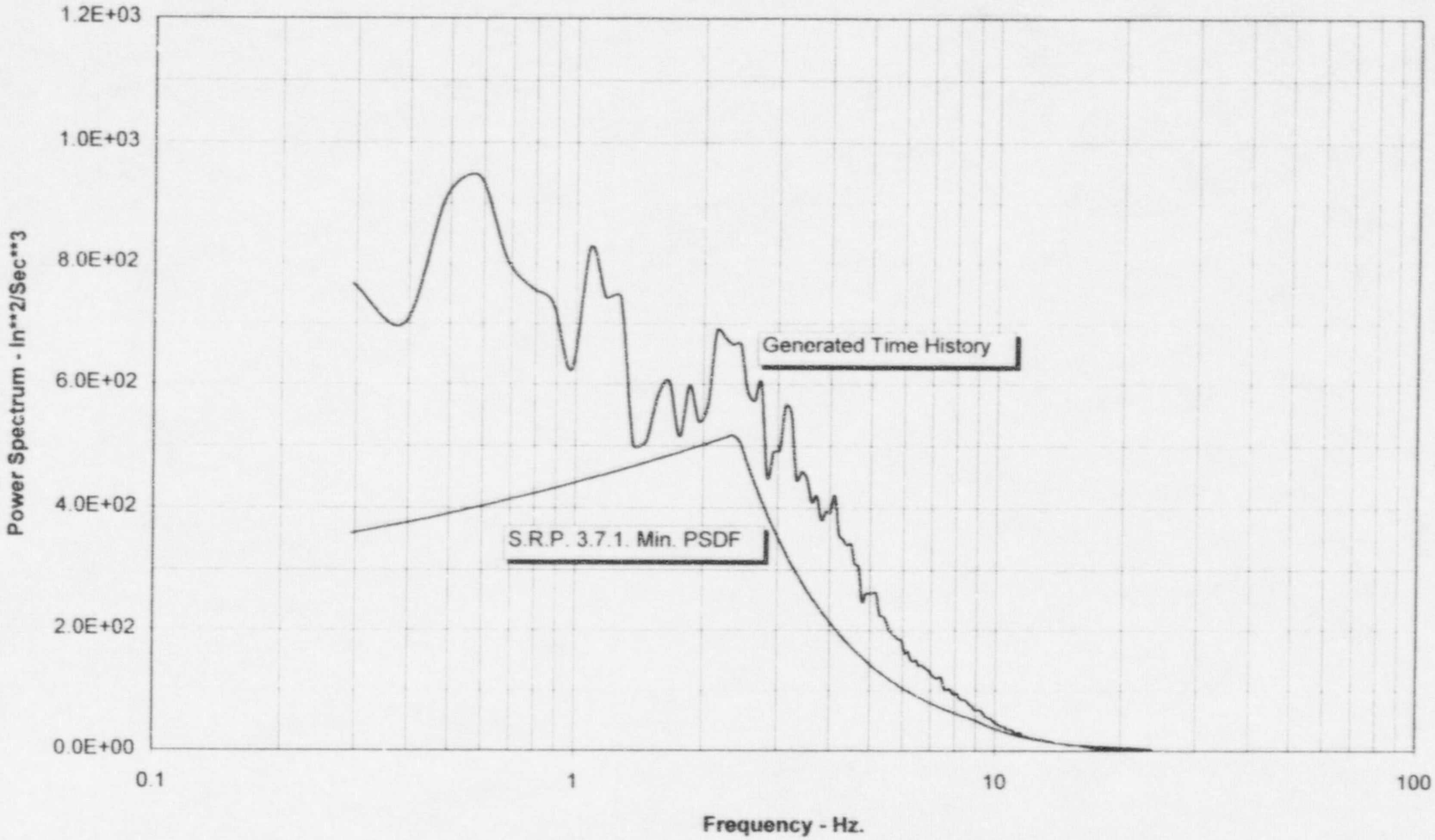

Figure 3 -- E--W Acceleration Time History Power Spectrum

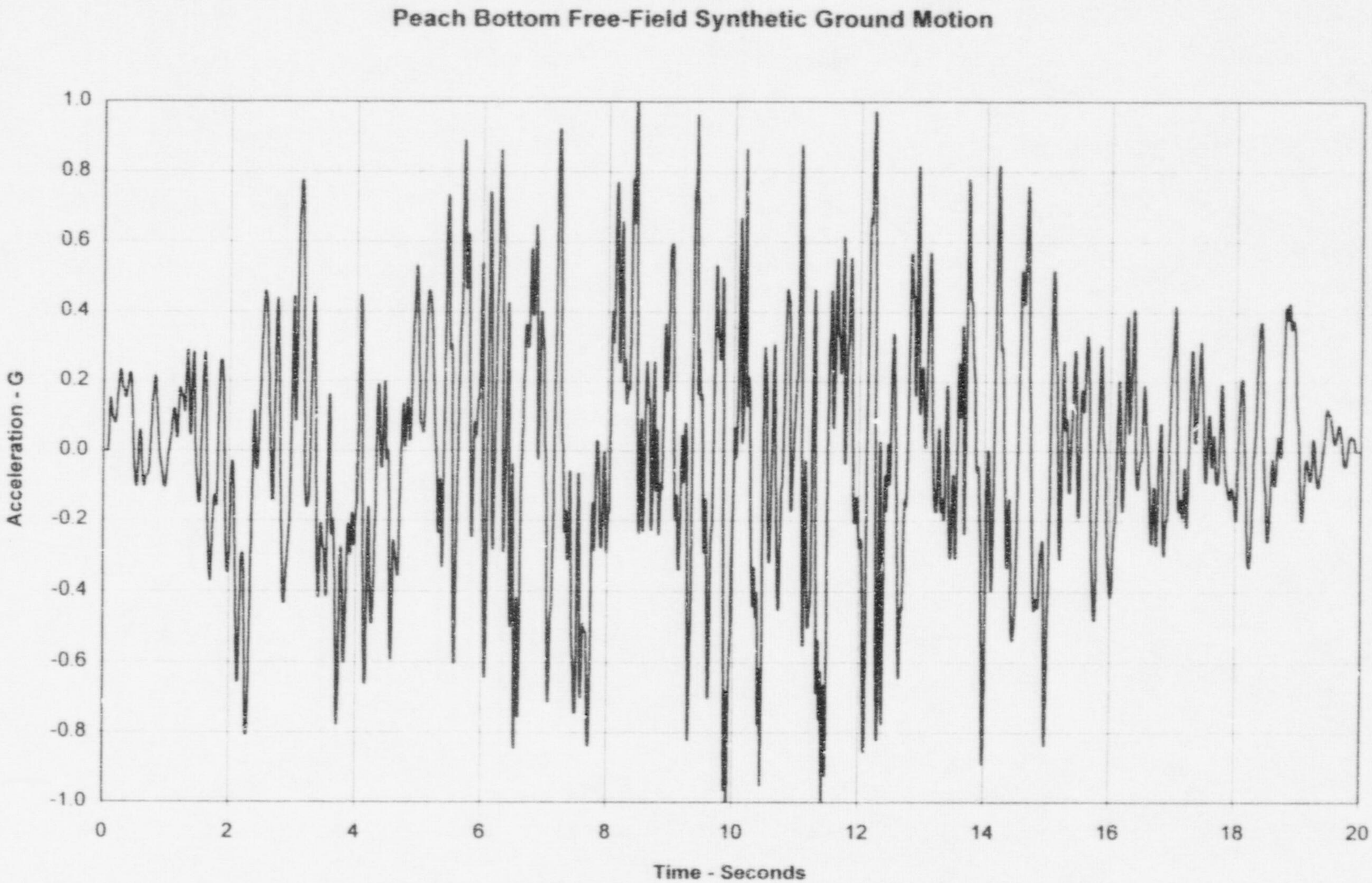

Figure 4 - N-S Acceleration Time History

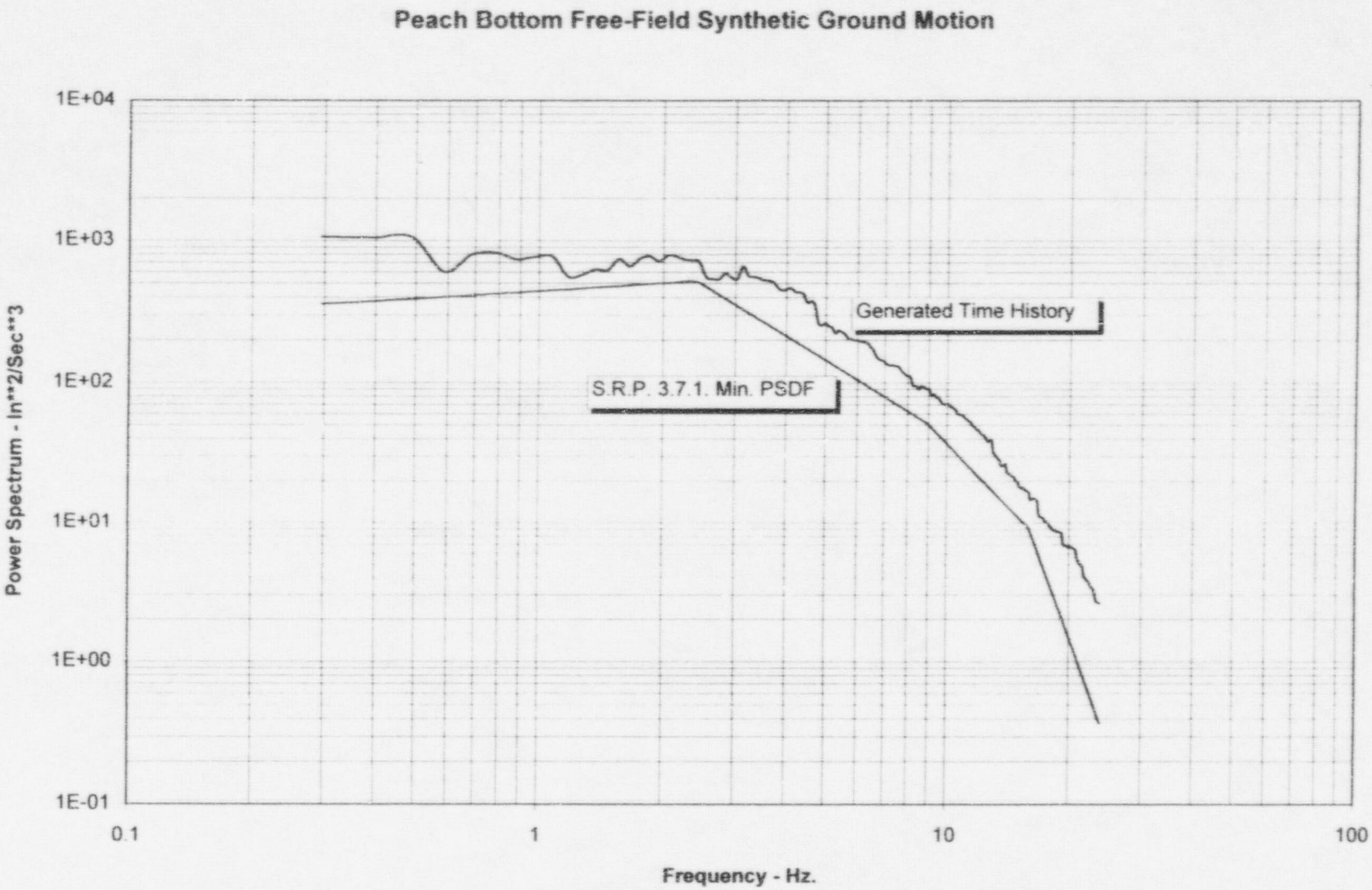

Figure 5 -- N-S Acceleration Time History Power Spectrum

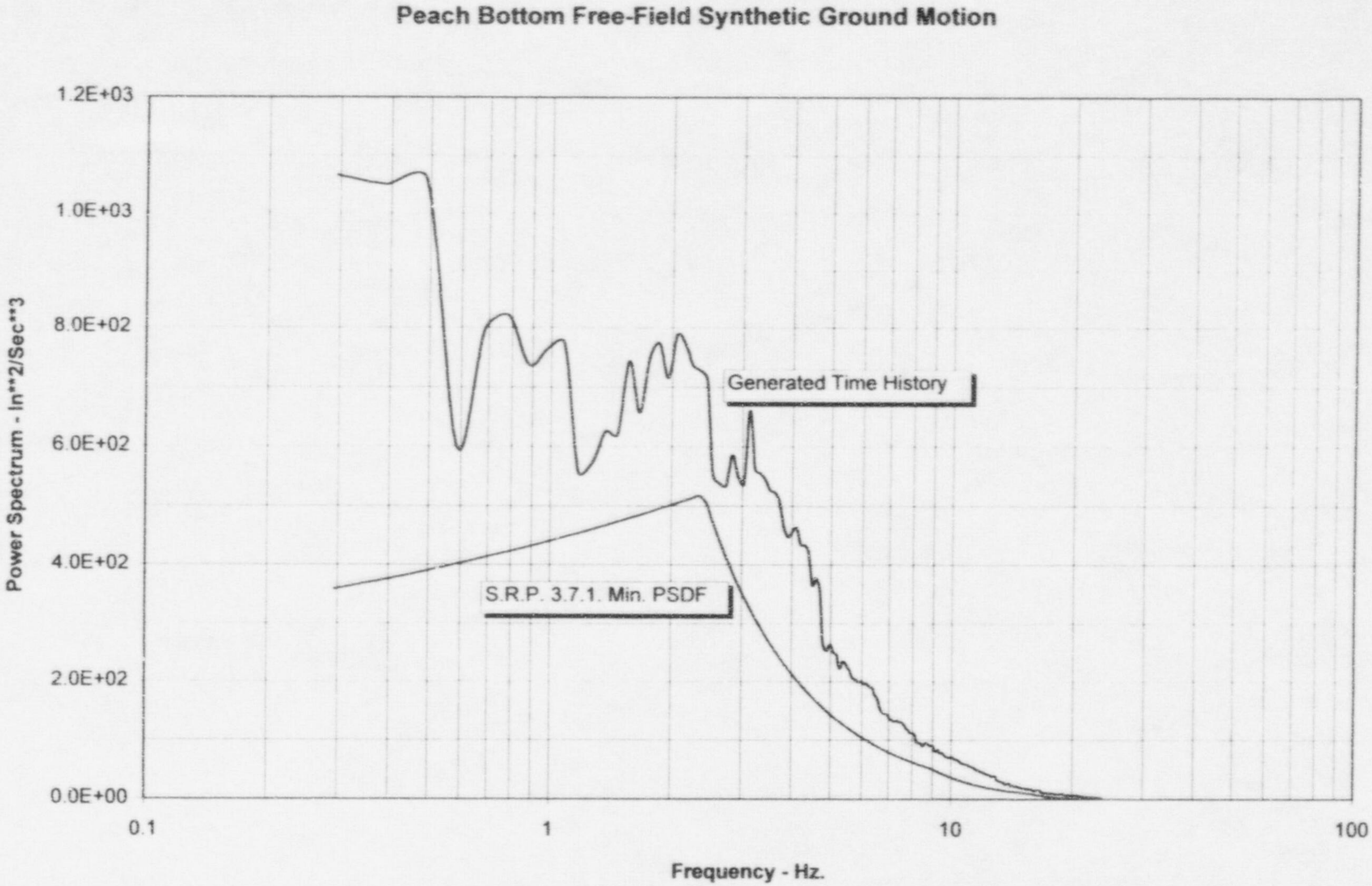

Figure 6 -- N-S Acceleration Time History Power Spectrum

ATTACHMENT B

Philadelphia Electric Company
Peach Bottom, Units 2 & 3

Primary Structure Seismic Model Sketches

- **Figure 1. Seismic Model (~Shroud Repair Project)**
- **Figure E1. Peach Bottom 2 & 3 - Primary Structure Seismic Model (Recirculation Piping Reanalysis)**

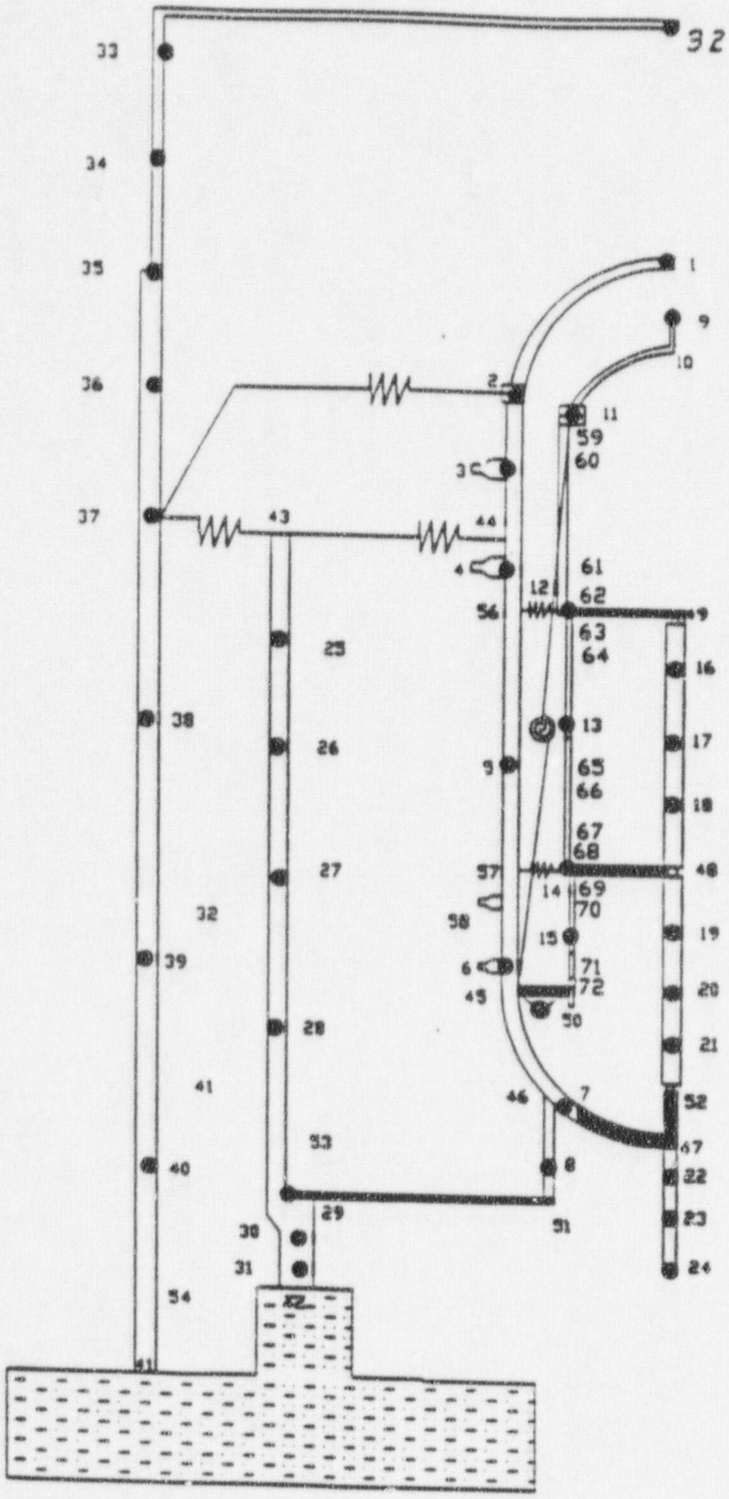

Figure 1 Seismic Model

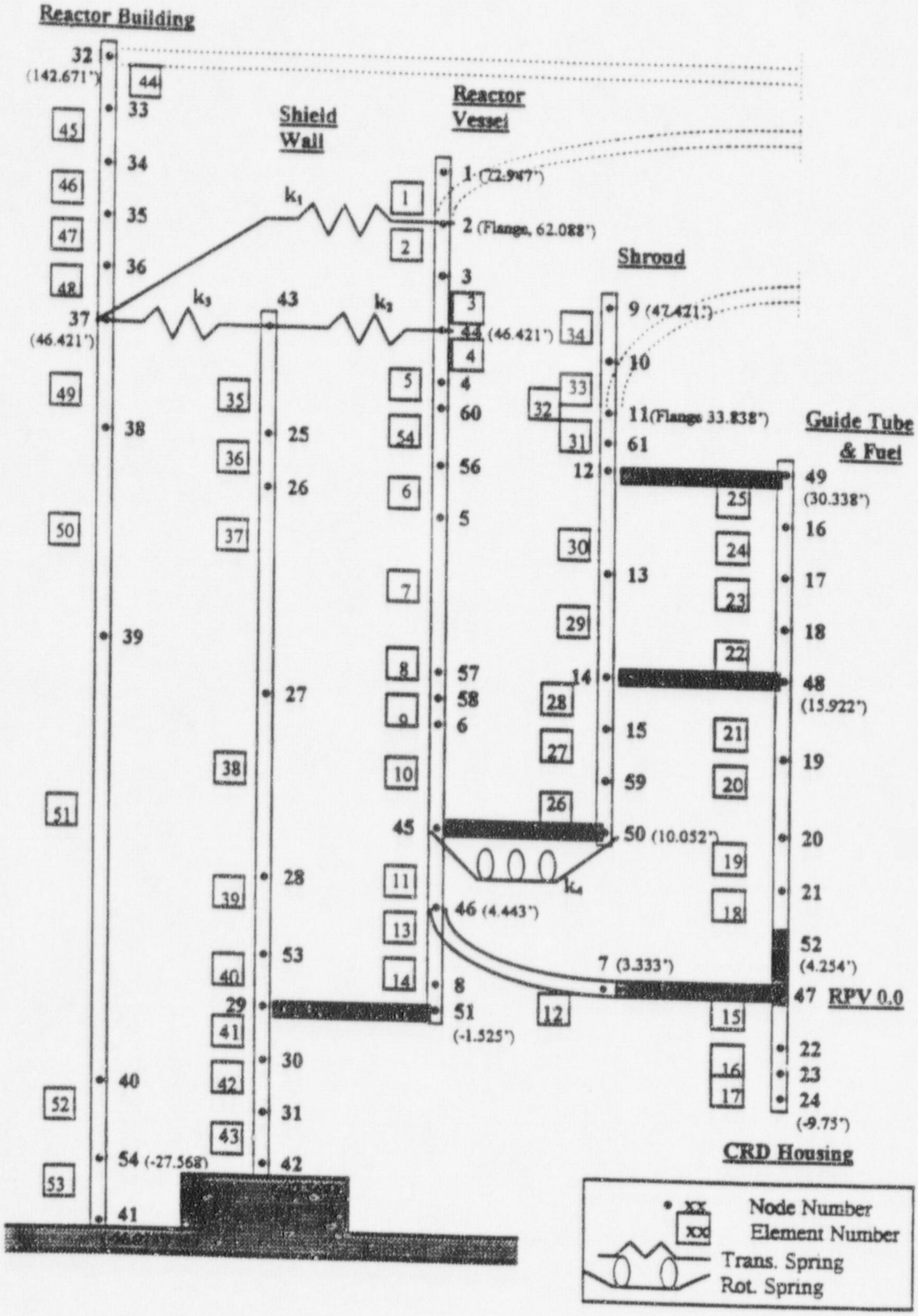

Figure E1 Peach Bottom 2 and 3 - Primary Structure Seismic Model

ATTACHMENT 3