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VARGA,S.A. Operating Reactors Branch 1

SUBJECT: Forwards responses to Structural Engineering Branch 810403 request for addl info re 801201 submittal for expansion of spent fuel storage capacity.

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August 28, 1981

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Office of Nuclear Reactor Regulation
ATTENTION: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
United States Nuclear Regulatory Commission
Washington, D. C. 20555

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H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2
DOCKET NO. 50-261
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REQUEST FOR ADDITIONAL INFORMATION CONCERNING
SPENT FUEL POOL EXPANSION

Dear Mr. Varga:

This letter is in response to your request of April 3, 1981 for additional information concerning our December 1, 1980 submittal for the expansion of the spent fuel pool storage capacity at H. B. Robinson, Unit No. 2. Our responses to these questions are in Attachments 1 and 2. Please contact my staff if you have any questions regarding our proposed modification.

Yours very truly,

for E. E. Utley
Executive Vice President
Power Supply and
Engineering & Construction

SDF/jc (202-721)
Attachments

cc: Mr. J. D. Neighbors

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Attachment 1

RESPONSES TO STRUCTURAL ENGINEERING BRANCH
REQUEST FOR ADDITIONAL INFORMATION
H. B. ROBINSON UNIT 2 FUEL STORAGE MODIFICATION

QUESTION: 1. Provide a description of all items which may be moved over the spent fuel assemblies. State which of these heavy objects is the critical one during operation and during installation.

RESPONSE: 1a. The heaviest object to be handled during installation is the rack itself. For handling of the rack, see answer to question 1.f to the NRC questions of January 27, 1981. During installation the objects that may be handled were given in answers to question 1.

1b. Items considered critical during normal fuel movement and refueling operations are as follows:

(1) Spent Fuel Cask (moved adjacent to but not over assemblies)
(2) Lift rig for Spent Fuel Cask (moved adjacent to but not over assemblies)
(3) Rod Cluster Control Change Tool (to be procured at a later date)
(4) Fuel Assemblies
(5) Spent Fuel Pit Bulkhead (moved adjacent to but not over asssemblies)

Other items moved over Fuel Assemblies, but not considered critical are as follows:

(1) Underwater Television Camera
(2) Floating Viewing Box - a lightweight box of tubular construction that eliminates ripples on pool water surface
(3) Fuel Handling Tool (new fuel and spent fuel)
(4) Thimble Plug Tool
(5) Burnable Poison Tool
(6) Trash Baskets - Lightweight collection baskets that fit in storage rack cell.
(7) Miscellaneous Fuel Inspection Tools (rod length measuring tool, etc.)

QUESTION: 2. Indicate whether fabrication and quality control of the spent fuel racks are in conformance with Subsection NF of the ASME Code. If not, identify and justify the deviations.

RESPONSE: 2. The racks will be fabricated to a Westinghouse Process Specification that is in agreement with the ASME B&PV Code, Section III, Division I, specifically--Subsection NF 4000 for fabrication and NF for welding. All welding and weld

procedures will be in accordance with NF with the exception of the poison "wrapper" to cell welds which will be in accordance with procedures developed for that application.

QUESTION: 3. Provide the load combinations and the acceptance strains and/or the stress criteria used in the design of the fuel pool liner. Indicate how the leaktight integrity of the fuel pool liner will be maintained under heavy drop accident.

RESPONSE: 3. The spent fuel pool liner is provided as a leaktight membrane only and is not a structural element of the pool.

The heavy drop accident considered could be caused by a malfunction of the temporary non single-failure proof crane which lifts the new rack modules into their final locations after they have been lowered to the fuel pool floor by the single failure proof fuel cask crane.

The height of lift for the temporary crane will be limited such that the bottom of the racks will not be raised more than 6 inches above the pool floor, therefore, in the event of a free fall resulting from crane malfunction, tipping is not considered, in which case the weight of the rack assembly would be applied as a force to the fuel pool floor by all eight of the rack levelling pads.

A more conservative approach is to postulate that the crane malfunction will not result in a free fall but that a hang-up will occur resulting in tipping. In this case, it is conservatively estimated that 50 percent of the weight of the rack assembly would be retained by the crane and the remaining 50 percent would be applied as a force to the fuel pool floor through two of the eight levelling pads.

As an unknown time factor would be involved in the crane malfunction before the unsupported end of the rack assembly would rotate freely, the velocity on impact with the floor crane cannot be determined, therefore, a conservatively high value of one half the impact velocity resulting from a free fall of six inches is considered.

Under these conditions, the dynamic load on the pool floor would result in a penetration of the liner of 0.03 inches or 25 percent of its thickness, therefore, the liner will maintain its leaktight integrity under the worst postulated heavy drop accident.

QUESTION: 4. Provide the nonlinear finite element model used in the time history analysis. Describe in detail how the nonlinearities due to gaps, friction losses and boundary conditions are accounted for in the model and analysis. Discuss, also, the analysis and provide justifications.

RESPONSE: 4. The H. B. Robinson nonlinear fuel rack model, shown in Figure 1, is a simplified flow-cell representation of a spent fuel storage rack with a fuel assembly contained within each cell. This model has two cells so that the analysis can be performed for fully loaded, partially loaded, and empty rack conditions by using two fuel assemblies, one fuel assembly, and no fuel assemblies, respectively.

Impact elements are used to model the impact phenomena between the fuel assembly and cell caused by the fuel/cell gaps. Friction interface elements are used at the rack supports to model liftoff, sliding and tipping behavior of the fuel rack. Since the fuel racks are located in the spent fuel pool which is filled with water, the effects of water on the response of the fuel rack system is included. The effects of surrounding water and water within cell assembly are modeled by using fluid (mass) elements. The spent fuel pool and fuel rack geometrical properties are used in determining the magnitude of hydrodynamic mass for the fuel rack system. The structural characteristics of the nonlinear fuel rack seismic model are obtained from the detail linear finite element model.

To obtain the nonlinear response of the fuel racks, the WECAN Computer Code was used. WECAN is a general purpose proprietary finite element code developed by Westinghouse for performing structural analysis. The WECAN Computer Code has the capability to handle nonlinearities due to impact and sliding between structural components.

QUESTION: 5. Discuss the method used to account for the effect of sloshing water on the fuel pool walls and fuel racks

RESPONSE: 5. The fuel storage racks have been evaluated using the methods of publication, TID-7024, Division of Technical Information USNRC, to account for the effects of sloshing water. It is concluded that the fuel rack elevation compared to the pool geometry and water elevation is such that sloshing water loads are not applied to the rack.

QUESTION: 6. Provide the method of analysis used to obtain the equivalent static load due to the cask drop on the slab.

RESPONSE: 6. An equivalent static load due to the cask drop on the slab was not analyzed. Use of the single-failure-proof cask handling crane described in the April 15, 1975 letter from E. E. Utley (CP&L) to Karl R. Goller (NRC), Serial No. NG-75-534, precludes a cask drop as a credible event. (See answers to questions 1.f,2,4 and 9 of your January 27, 1981 questions).

QUESTION: 7. Provide the numerical values for the "load correction factors" and describe how these factors are accounted for in the analysis of the rack assembly.

RESPONSE: 7. Since the detail finite element model does not include the nonlinear effects of the fuel assembly/fuel cell impact or the rack support lift off or sliding, the internal loads and stresses for the rack assembly obtained from the detail model are corrected by load factors to account for these nonlinearities. The load factors are obtained by comparing the support pad loads, shear force and vertical load, of the two models and calculating the ratio to be applied to the linear model so that the interaction with the environment, pool floor, for both models is the same. Since the structural properties of the nonlinear model are obtained from the detail linear model, the application of these factors to the detail linear model results will produce internal loads and floor loads which represent the nonlinear effects of the fuel/cell interaction and rack support conditions.

The numerical values for the load correction factors are given below:

Vertical Load Factor	$R_M = 0.76$
Shear Load Factor	$R_S = 2.08$

QUESTION: 8. Discuss in detail the analysis used to account for the fuel handling crane uplift accident and provide the criteria used to assure the criticality in the racks is not violated.

RESPONSE: 8. Two cases of crane uplift accidents were considered:

(1) load applied directly to a cell within the rack module array, and
(2) load applied to the top grid structure of the rack module.

In case 1, the entire 3,000 lb. uplift load was imposed on the (a) cell wall material and (b) welds securing the cell to the rack module structure. The analyses substantiated that neither the cell wall nor welds would incur damage due to the postulated crane uplift load application, thus the subcritical geometry of the design is maintained for this accident condition.

Case 2 assumptions considered various loading patterns of stored fuel in a rack module with crane uplift load applied at the extremity of the rack module top grid structure. It was concluded that the crane uplift load was insufficient to cause rack module displacement or tipping, thus the subcritical geometry of the design is maintained for this accident condition.

QUESTION: 9. Provide the criteria used in the design of the two added steel columns.

RESPONSE: 9. In order to maintain the stresses in the concrete floor of the fuel pool within acceptable limits after the installation of the new racks and their associated fuel assemblies, an additional support consisting of a steel column will be provided under the pool floor.

Before the steel column is placed in position, the water level in the pool will be lowered by approximately seven feet. This will reduce the deflection in the floor slab present due to existing loading.

The loads carried by the steel column are dependent on the deformation of the foundation. On the one hand, if there is no deformation of the foundations, the column will carry a full share of the additional loading. On the other hand, if the foundation deforms, the system will allow the deformation of the pool floor.

Provided that the deformation of the pool floor is less than that under current loading conditions, acceptable safety factors will be provided. Considering the extreme stiffness of the foundation, it is not expected that the fuel pool floor will deflect as much as it does at present. Therefore, the moments and shears in the slab will be maintained at acceptable levels.

The steel column will be designed in accordance with the AISC Manual of Steel Construction, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, November 1978 Edition.

The loads and load combinations are set forth in Section 4.4 of this application.

A reanalysis of the fuel pool floor including the additional steel column has been performed using final loads and load combinations of the new racks and additional fuel assemblies.

QUESTION: 10. Provide and justify the time history and floor response spectra used in the seismic analysis of the fuel rack assembly.

RESPONSE: 10. The seismic time history excitation used in the nonlinear analysis of the fuel rack assembly was developed from the ground response spectrum and damping values contained in the USNRC Regulatory Guides 1.60 and 1.61 respectively, using the ground acceleration of 0.20 G's horizontally and 0.134 G's vertically for the SSE event. Using this information, the design time history was synthesized. The synthesized acceleration time history for horizontal SSE and vertical SSE are given in Figures 2 & 3. In addtion, response spectra developed from the synthesized time histories are represented

in Figures 4 & 5. These figures show both the response spectrum developed from the synthesized times history and the response spectrum developed from Regulatory Guide 1.60, and it is seen that the response spectrum developed from the synthesized time history envelopes the Regulatory Guide response spectrum.

<u>QUESTION:</u> 11. Indicate if this proposed modification conforms with the NRC position on fuel pool modification entitled "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications", issued on April 14, 1978, and later amended on January 18, 1979. If not, identify and justify the deviations.

<u>RESPONSE:</u> 11. As stated in Section 1.0 of the "H. B. Robinson Unit No. 2 Spent Fuel Storage Expansion Report" submitted with our request for license amendment dated December 1, 1980, the design was based on the recommendations provided in "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications."

Attachment 2

RESPONSES TO ADDITIONAL INFORMATION REQUIRED BY
CHEMICAL ENGINEERING BRANCH ON THE PROPOSED
H. B. ROBINSON SPENT FUEL STORAGE EXPANSION (TAC 42415)

QUESTION: 281-1 (9.3.2)

The December 1, 1980 amendment request does not indicate (proposed modification of the spent fuel pit cooling loop (SFPCL) in conjunction with the proposed modifications for high-density spent fuel storage. Describe what changes, if any, will be made to the SFPCL to maintain the level of pool water purity with respect to visual clarity and activated corrosion and fission product buildup the same as for the original spent fuel storage capacity. Assume that the number of defective fuel assemblies increase in proportion to the increased spent fuel storage capacity. If no changes to the SFPCL are to be made, indicate how the same level of pool water purity will be maintained.

RESPONSE: 281-1

Additional storage of spent fuel provides a potential for an increase in crud buildup in the pool water due to the additional surface area of the irradiated fuel and racks. However, this contribution from long-decayed fuel is expected to be small because most of the radioactive crud in the pool comes from the reactor during refueling operations rather than the racks themselves.

In addition, performance of the filter and demineralizer in the Fuel Pool Cleanup System is continuously monitored, assuring high quality of water within the pool. If an increase in crud level occurs, it will require more frequent changes in filter media and ion exchange resin to maintain water clarity.

QUESTION: 281-2 (9.3.2)

Describe the samples and instrument readings and their frequency of measurements that will be performed to monitor the water purity and need for demineralizer resin replacement. State the chemical and radiochemical limits to be used in monitoring the spent fuel pool water and initiating corrective action. Provide the basis for establishing these limits. Your response should consider variables such as: conductivity, gross and iodine activity, demineralizer differential pressure, pH and crud level.

RESPONSE: 281-2

The spent fuel pit will be monitored on at least a weekly basis for chlorides (limit $\leq$ .15 ppm), radionuclides (limit <1.0 mci/gm or < $100/\bar{E}$), tritium, gross alpha, ph, conductivity and cleanup filter Δ P. Suspended solids and demineralizer DF will be monitored on at least a monthly basis. At certain times,

especially after a refueling outage, the spent fuel pit demineralizer is used to clean up the refueling water storage tank. This may lead to a short time interval when the spent fuel pit demineralizer DF and Filter Δ P may not be obtained. Action will be taken prior to reaching the above limits to insure the spent fuel pit water is of good quality. The basis for above limits on chlorides and activity are the Technical Specification limits set on the reactor coolant system.

FIGURE 1 Non-[illegible]near Finite Element Model of F[illegible] Storage Rack Used in H. B. Robinson Unit 2 Seismic Ana[illegible]sis

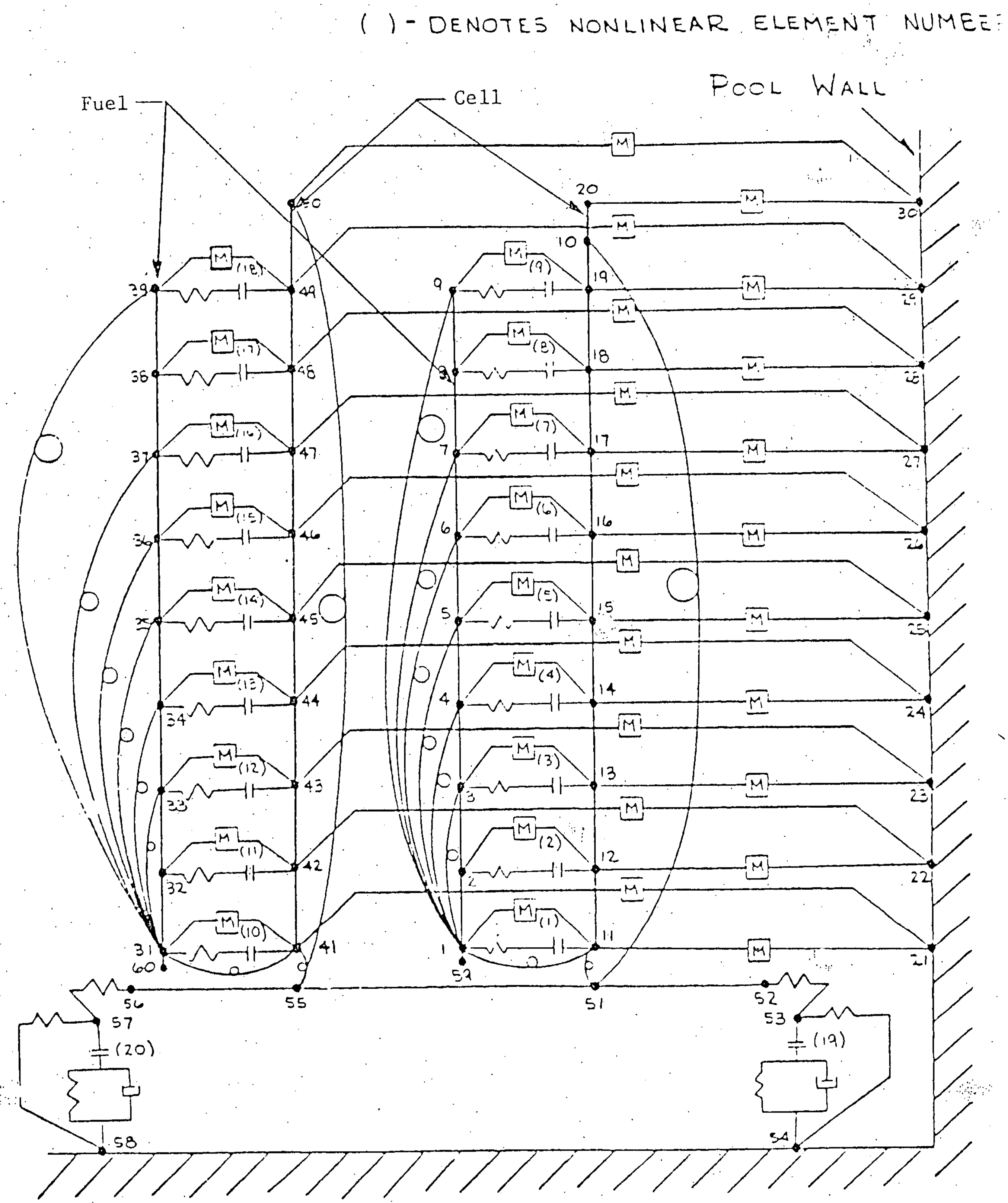

FIGURE 2 H. B. Robinson Unit 2 Horizontal SSE Acceleration Design Time History

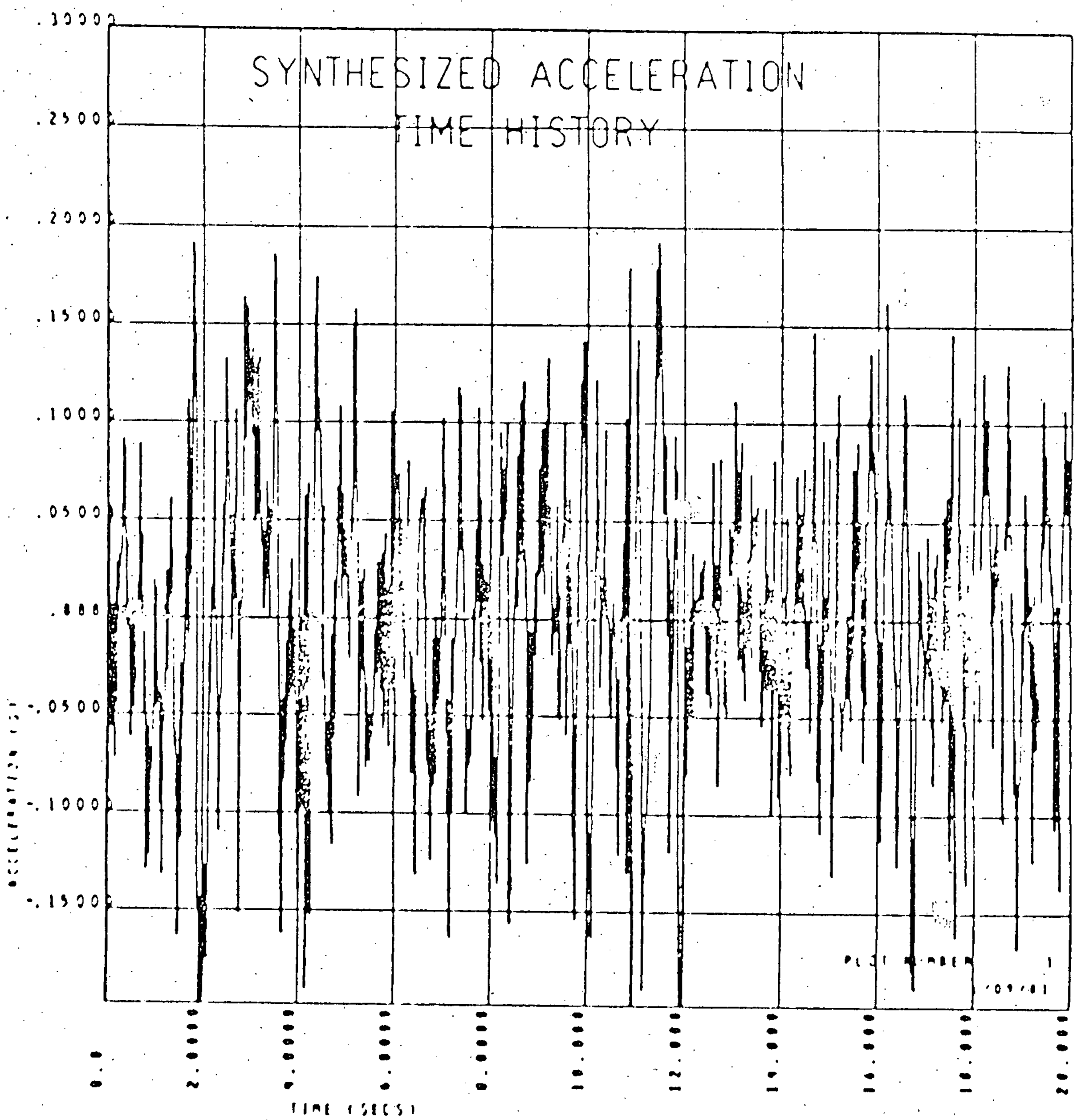

FIGURE 3 H. B. Robinson Unit 2 Vertical SSE Acceleration Design Time History

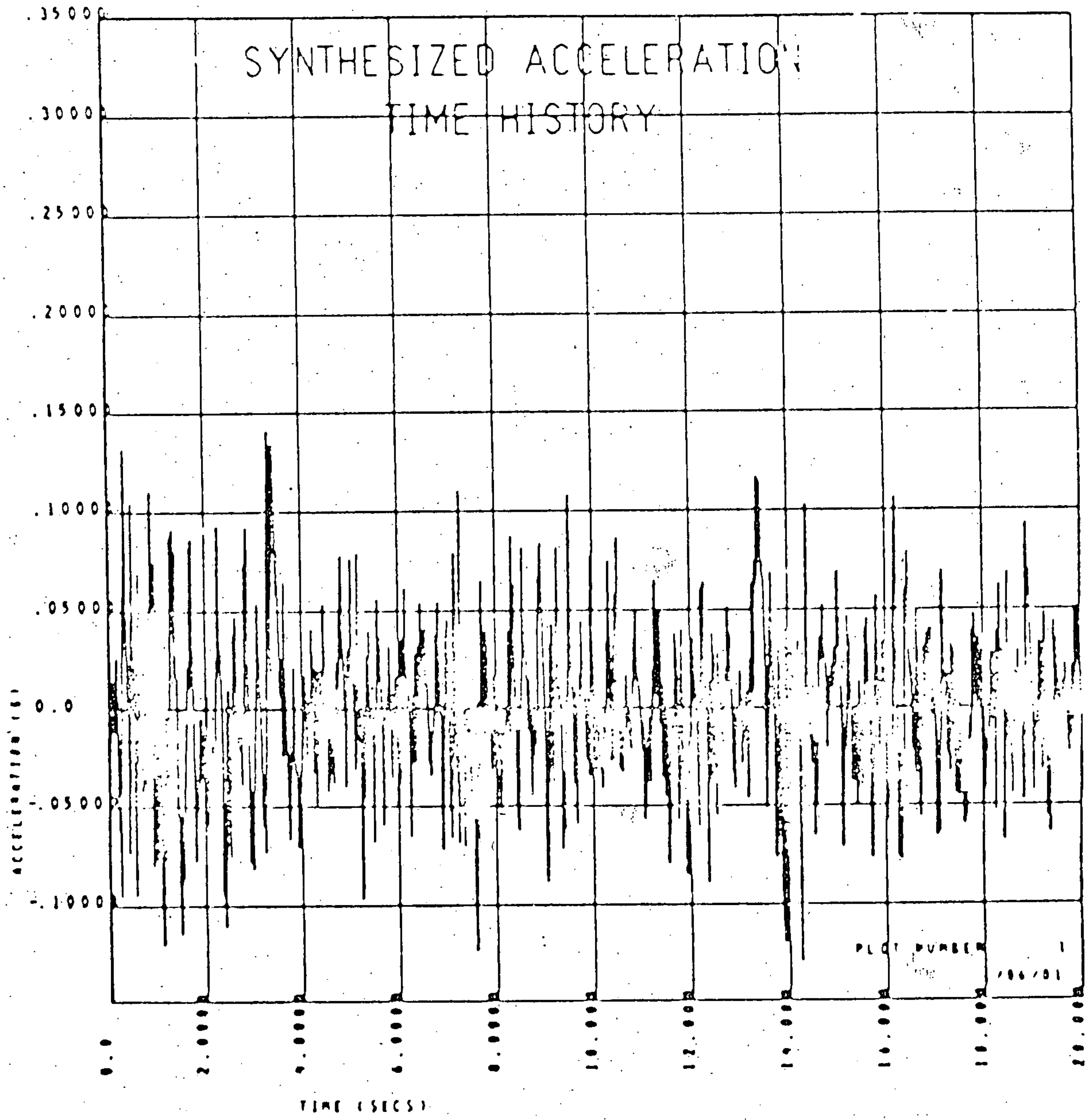

FIGURE 4 . H. B. ROBINSON UNIT 2 HORIZONTAL SSE DESIGN
& R. G. 1.60 SPECTRA

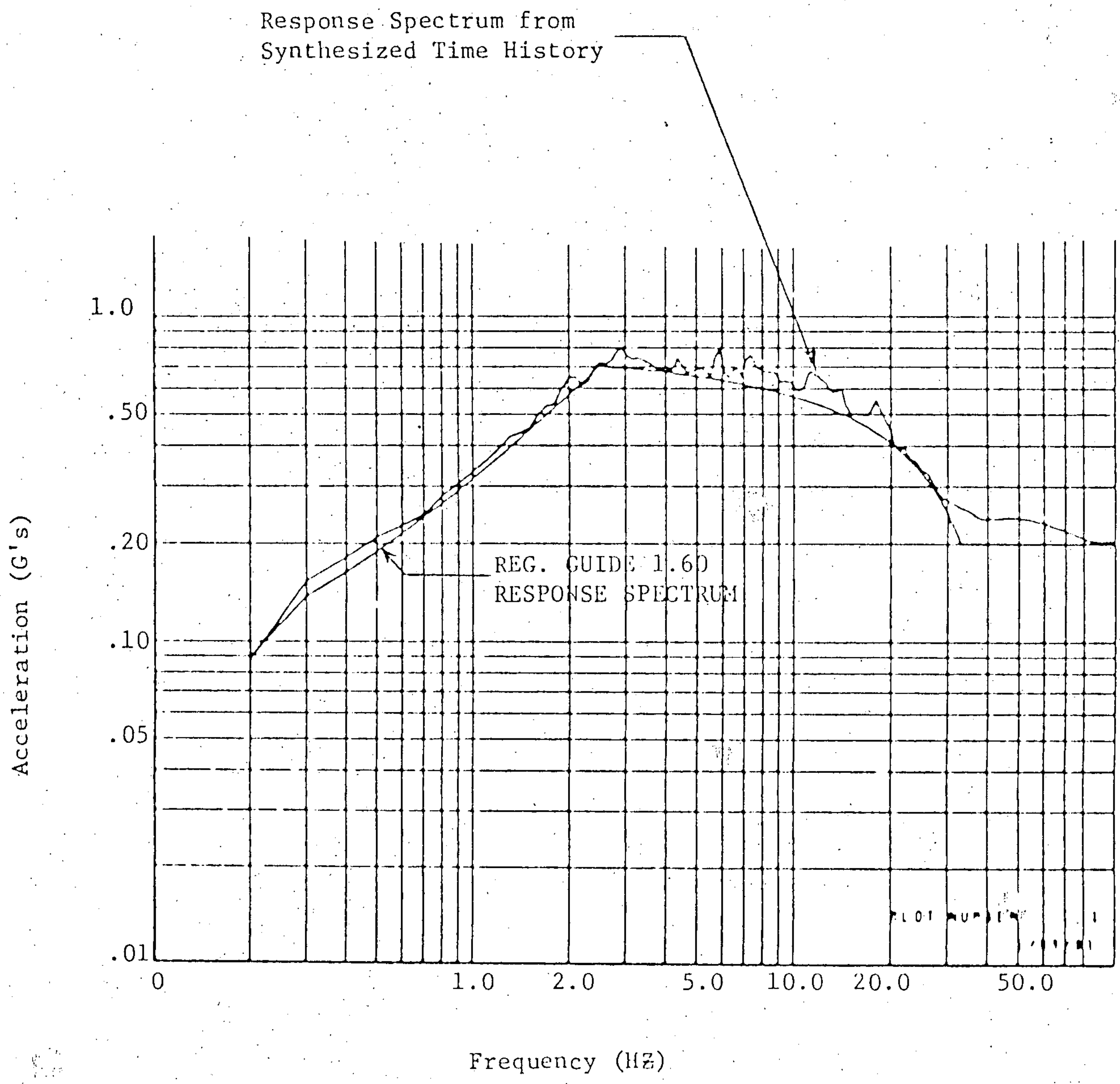

FIGURE H. B. ROBINSON UNIT 2 VERTICA SSE DESIGN
& R. G. 1.60 SPECTRA