UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 19, 1996

MEMORANDUM TO: Richard H. Wessman, Chief
Mechanical Engineering Branch
Division of Engineering

THRU: Kamal A. Manoly, Chief
Component Integrity Section
Mechanical Engineering Branch

FROM: Pei-Ying Chen, Sr. Mechanical Engineer
Component Integrity Section
Mechanical Engineering Branch

SUBJECT: TRIP REPORT - AUDIT OF BROWNS FERRY UNIT 3 USI A-46/IPEEE IN-PROGRESS SEISMIC WALKDOWN, OCTOBER 16-20, 1995

During the week of October 16-20, 1995, a team of two NRR staff members from EMEB and ECGB, and two contractors from Brookhaven National Laboratory, conducted an audit of the USI A-46/IPEEE in-progress seismic walkdown activities performed by the licensee of the Browns Ferry Unit 3 plant. The RES staff did not participate in this audit due to other commitments. The licensee is implementing the Generic Implementation Procedure, Revision 2 (GIP-2), developed by the Seismic qualification Utility Group (SQUG) and previously approved by the NRC. The objective of the audit was to observe and assess the licensee's effectiveness in identifying the seismic concerns with the safe shutdown electrical and mechanical equipment. The audit did not focus on the evaluation of seismic adequacy of equipment, which will be done when the licensee submits its A-46 evaluation reports to the NRC. Therefore, the audit did not cover the full extent of the necessary staff's effort to reach closure on these two programs.

An entrance meeting in the early afternoon of October 16, 1995, and an exit meeting the morning of October 20, 1995, were held at the site. The attendees of these two meetings are listed in Attachment 1.

Attachment 2 provides the details of the staff audit results, observations and assessments of the licensee's seismic walkdown activities. The audit team has successfully accomplished its objectives of assessing the licensee's effectiveness in its seismic walkdown activities and gathering information concerning the licensee's practice in implementing the GIP-2. The audit team found that the licensee's walkdowns of seismic adequacy of mechanical and electrical equipment were performed by its contractor, EQE, Inc., and the walkdowns of cable and conduit raceways were conducted by the licensee's engineers. All walkdown engineers that the audit team contacted had the SQUG-sponsored training course and were qualified for the seismic walkdowns.

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However, the audit team noticed some potential concerns in the areas of interface between different disciplines, some of the personal judgements exercised by the licensee's engineers or its contractor, and the use of industry guidelines that were not reviewed and approved by the staff.

During the audit, the staff identified a technical concern with the use of GIP-2 criteria by the licensee regarding the alternative methods for the comparison of seismic demand with the seismic capacity for equipment installed in the plant. The technical details of the concern are described in Attachment 2 under the heading of "Response Spectra." The staff conveyed the concern to TVA at the Browns Ferry audit exit meeting, and informed the SQUG Steering Group of the potential generic impact through the representative of the MPR Associates at the meeting. The issue is being discussed between the staff and the SQUG Steering Group.

Attachments: 1. Attendance Lists
2. Audit Report

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However, the audit team noticed some potential concerns in the areas of interface between different disciples, some of the personal judgements exercised by the licensee's engineers or its contractor, and the use of industry guidelines that were not reviewed and approved by the staff.

During the audit, the staff revealed a significant technical concern with the use of GIP-2 criteria by the licensee regarding the alternative methods for the comparison of seismic demand with the seismic capacity for equipment installed in the plant. The technical details of the concern are described in Attachment 2 under the heading of "Response Spectra." The staff conveyed the concern to TVA at the Browns Ferry audit exit meeting, and informed the SQUG Steering Group of the potential generic impact through the representative of the MPR Associates at the meeting. The issue is being discussed between the staff and the SQUG Steering Group.

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BROWNS FERRY UNIT 3 IN-PROGRESS SEISMIC WALKDOWN
LISTS OF MEETING ATTENDEES

Entrance Meeting on October 16, 1995

NAME	GROUP/TITLE
James W. Davenport	TVA, Licensing
Kamal K. Bandyopadhyay	BNL/NRC Team
Yong S. Kim	NRC/NRR/DE
Pei-Ying Chen	NRC/NRR/DE
Daniel D. Kana	SWRI/NRC
R. D. Cutsinger	TVAN Corp. Civil
Joe Valente	TVA/BFN Site Eng.
Steven W. Austin	TVA/BFN Site Lic.
John O. Dizon	EQE
J. R. Glass	TVA/BFN Site Eng.

Exit Meeting on October 20, 1995

NAME	GROUP/TITLE
Joe Lenahan	NRC, RII
Joe Williams	NRC/NRR Project Manager
Len Wert	NRC, Sr. Resident
Richard Starck	MPR Associates, Inc.
Paul Baughman	EQE
Perry Robinson	Winston & Strawn
Pedro Salas	TVA
H L. Williams	TVA, E&M
James W. Davenport	TVA, Licensing
Yong S. Kim	NRC/NRR/DE
Pei-Ying Chen	NRC/NRR/DE
R. D. Cutsinger	TVAN Corp. Civil
Joe Valente	TVA/BFN Site Eng.
John O. Dizon	EQE
J. R. Glass	TVA/BFN Site Eng.

BROWNS FERRY IN-PROGRESS SEISMIC WALKDOWN AUDIT REPORT

INTRODUCTION

The licensee for Browns Ferry Unit 3 is implementing the USI A-46 program following the procedures developed by the Seismic Qualification Utilities Group (SQUG) and documented in the Generic Implementation Procedure, Rev. 2 (GIP-2, Reference 1). An audit of the licensee's "in-progress walkdown" for the A-46 implementation program has been performed at the site on October 16-20, 1995. BNL members participated on October 16-18, 1995. The purpose of the audit was to observe the licensee's implementation plan, and assess whether the licensee is reasonably implementing the criteria and procedures delineated in the GIP-2 and the NRC Supplemental Safety Evaluation Report (Reference 2). In addition, the audit offered the staff an opportunity to review the qualification of the licensee's seismic review team members.

SEISMIC REVIEW TEAM

The Seismic Review Team (SRT) for Browns Ferry consisted of the following civil engineers from EQE International:

John O. Dizon
Richard D. Augustine
Brantley C. Buerger
Farzin R. Beigi
James R. Disser

All of the five engineers have attended the SQUG training course on equipment walkdown screening and seismic evaluation. The SRT members have substantial experience in practicing structural engineering, especially dynamics. Three of the SRT members have a professional engineering license. Thus, these engineers are well qualified for the A-46 work and exceed the minimum qualification requirements for seismic engineers as delineated in the GIP-2. Although some interaction might have taken place, it was not clear whether a system engineer or a plant operator participated in the seismic walkdown effort as recommended by the GIP-2. Such synergisms are expected to provide a reliable comprehensive review and a better understanding of the safety functions of the equipment. Moreover, the audit team learned that the EQE engineers perform the walkdown in a group of two engineers. The group always includes at least one professional engineer as required by the GIP-2. The other personnel involved in the program included cable tray and conduit engineers Anand Relwani and Cesar Pascna, who were trained by SQUG, system engineers John D. McCamy and Matthew Williams, and a field coordinator consultant, Roy Smallwood.

SAFE SHUTDOWN EQUIPMENT

According to the licensee, the safe shutdown equipment list (SSEL) was prepared considering the need for maintaining the safe shutdown condition for 72 hours. Approximately 400 equipment items are in the SSEL for Unit 3 (and 650 for Unit 2).

RESPONSE SPECTRA

The Browns Ferry site SSE ground motion spectrum (approximately 0.3g spectral acceleration for a critical damping value of 5% and 0.2g ZPA) is substantially below the GIP-2 "Bounding Spectrum" (0.8g spectral acceleration for critical damping value of 5% and 0.33g ZPA). Therefore, in accordance with GIP-2, equipment items located at an elevation of up to 40-feet above effective grade may be adequate, provided that they satisfy the fundamental frequency requirement of about 8 Hz or higher. Alternatively, the GIP-2 also allows a comparison of the in-structure response spectrum with the equipment capacity spectrum, i.e., "Reference Spectrum." During the staff's audit, it was noted that if this second alternative is used, the licensing-basis seismic demands for some equipment items installed in the Diesel Generator (DG) Building and the Intake Pumping Station (IPS) will substantially exceed the "Reference Spectrum," i.e., the seismic demand measured by the in-structure response spectrum exceeds the seismic capacity of some equipment at certain elevations. Attachment 3 (Fig B.1.1), that was provided by the licensee during the audit, depicts curves representing seismic capacity vs. seismic demand for DG and IPS buildings. The figure signifies the magnitude of exceedence above the reference spectrum (1.5 x Bounding Spectrum) at various frequencies for various floor elevations in these buildings.

The staff does not consider the licensee's choice of the first alternative in the GIP-2 acceptable, since it results in a deviation from the licensing basis for the plant.

For Browns Ferry, it appears that the unexpected amplifications in-structure response spectra are due to large amplifications through the soil and the structures, especially at high frequencies for the DG Building and the IPS. In general, however, the staff contends that the use of the first method in the GIP-2 is only appropriate for facilities that do not have in-structure response spectra in their respective licensing basis documents. The staff believes that the lack of specificity in the GIP-2 with regard to the selection of the appropriate method for determining equipment seismic adequacy, has led to the identified non-conformance. The staff is pursuing this issue with the SQUG Steering Group.

SITE AUDIT

The NRC team observed the licensee's SRT performing a "walkdown" of the following equipment items:

1. CAD Inserting System Panel, 2-PNLA-009-0054 and 0055 (Line Nos. 9064 and 9065).

2. Control Bench Board, 2-PNLA-009-0003A and B (Line Nos. 9040 and 9041).

3. Diesel Generator Panel, 3-BDGG-254-0003C (Line No. 39003).

4. Batteries, 3-BATB-254-0000C (Line No. 39002).

5. Battery Charger, 3-CHGR-254-0000CB (Line No. 39004).

6. Motor Control Center, 3-BDBB-219-0003EB (Line No. 39005).

7. Medium Voltage Switchgear, 3-BDAA-211-0003EC (Line No. 39001).

8. Pump-LPCI MG Set 3DN (Line No. 39015).

9. Transformer, 3-XFA-231-TS3B (Line No. 39006).

10. RCIS Auxiliary Panel, 2-LPNL-029-0031 (Line No. 9074).

11. Accumulator Tanks, 0-TNK-086-0651A.

12. Low Voltage Switchgear, ARD-2H-BKR.

13. 480V Reactor MOV Board (Line Nos. 39007 and 39008).

14. Horizontal Nitrogen Tank for Containment Atmosphere Dilution System.

15. RHR Service Water Vertical Pump, 0-PMP-023-0015-01.

In general, the audit team noted the following:

1. The SRT was observed to take notes on the as-built configurations of equipment (e.g., overall dimensions), open cabinet doors in some instances to visually inspect the internals, verify anchorage, and check potential spatial interactions.

2. The information needed in the field for verification of seismic adequacy of equipment according to the GIP-2 approach was typically more than what was collected by the SRT during the walkdown that the NRC team observed. Verification of mounting of essential relays is an example (additional examples are included in Appendix A). Of course, it is possible that the SRT either had collected the needed information in prior "walkdowns" or planned to collect in subsequent additional walkdowns. Euipment-specific observations are included in Appendix A.

SUMMARY AND CONCLUSIONS

The licensee's SRT members were observed to be well qualified and organized for the seismic "walkdown." In general, they were found to follow the GIP-2 criteria. The staff has noted certain equipment specific observations that are discuseed in Appendix "A." However, the licensee is not required to separately respond to these observations. It is expected that these observations will be addressed and resolved in the licensee's final evaluations.

In regard to the selection of the appropriate method to determine equipment seismic adequacy concerning seismic capacity compared to seismic demand, the staff finds the use of the first method in GIP-2 inappropriate in that it underpredicts the seismic demand for certain equipment as defined by the licensing basis in-structure response spectra. The staff believes the deviation was the result of inappropriate guidance in the GIP-2. The

potential inconsistency between the GIP-2 alternatives for determining equipment seismic adequacy and the licensing basis in-structure response spectra will be pursued with the SQUG Steering Group.

REFERENCES

1. Generic Implementation Procedures, Revision 2 (GIP-2), Seismic Qualification Utilities Group (SQUG), February 14, 1992.

2. U.S. NRC Supplemental Safety Evaluation Report No. 2 on Generic Implementation Procedure, May 22, 1992.

APPENDIX A

AUDIT ITEMS AND OBSERVATIONS

The audit team observed the licensee's SRT perform the walkdown of several equipment items. A brief description of each item and observations of the licensee's walkdown for the items are provided below. The licensee is not required to separately respond to these observations. It is expected that these observations will be addressed in the licensee's final evaluations.

1. 2-PNLA-009-0054 and 0055 (Line Nos. 9064 and 9065)

   This was identified as a CAD inserting system panel which is basically a two-bay vertical panel bolted sidewise and mounted on an embedded channel. This item was for Unit 2 and was stated to be similar to that for Unit 3. The SRT performed the walkdown following the GIP-2 procedures. There were several sources for potential interaction or impacting with other components as listed below:

   - A cabinet on one side and CRT monitors on the other side.
   - Potential rattling that can affect relays in the panel.

   In addition, the mounting details could not be observed well to verify the adequacy and conformance of mounting with available drawings.

2. 2-PNLA-009-0003A and B (Line Nos. 9040 and 9041)

   This is one bay of the horseshoe-shaped control bench board. The panel was bolted to the adjacent bays. The SRT verified the mounting with plates and welds and noted some of the following concerns:

   - A bundle of cables was sagging inside the cabinet apparently due to a missing support. (This condition existed for at least another bay.)
   - The center pins of the rear door were missing creating a potential for rattling.
   - A long instrument was overhanging within the cabinet by about 20 inches. The licensee stated that this instrument was shake table tested. Verification of test data was not performed during the audit.

3. 3-BDGG-254-0003C (Line No. 39003)

   This is a wall-mounted diesel generator panel containing switches, fuses and breakers. The audit team identified the following observations, which were also noted by the SRT:

- The vertical clearance between the panel and the supporting wall was uneven. (The concern is the effectiveness of mounting.)
- A large damper-like component was located above the panel creating a potential for interaction.
- The depth of the panel may exceed the GIP-2 limit.

4. 3-BATB-254-0000C (Line No. 39002)

The batteries for the diesel generator were located on stepped racks in one corner at elevation 565 feet of the Diesel Generator Building. The SRT verified the GIP-2 caveats including the spacers between battery cells. The following concerns were noted by the audit team:

- Structural adequacy of the racks appeared questionable, however, some structural calculations to support its adequacy may exist.
- Potential fall of a duct/damper above the batteries.

5. 3-CHGR-254-0000CB (Line No. 39004)

This is a wall-mounted battery charger panel. The SRT performed the inspection including visual examination of the mounting. It was stated that a similar charger was shake table tested. The similarity of this item with the tested specimen may be used for demonstration of equipment seismic adequacy.

6. 3-BDBB-219-0003EB (Line No. 39005)

This is an eight-bay free-standing motor control center manufactured by General Electric (GE). The SRT verified the GIP-2 caveats. The following observations were noted by the audit team:

- The thin sheet metal of the MCC enclosure was bent inward for connecting to the base channel with a screw at each corner of each bay. The flexibility of the connection and stripping of the screws may be of concern.
- The seismic capacity of the MCC may exceed the demand at the location.

7. 3-BDAA-211-0003EC (Line No. 39001)

This is a 13-bay GE 4-KV switchgear. The SRT was observed checking mounting and taking notes. The following observations were noted by the audit team:

- Existence of an unusual eccentrically located swinging box on top of switchgear.
- Potential for rattling of panels containing relays.

8. LPCI MG Set 3DN (Line No. 39015)

This pump-motor assembly mounted on a common skid is located in the Reactor Building at an elevation of 621 feet. This is a commonly used equipment item. The SRT performed the walkdown following the GIP-2 criteria. The audit team observed possible interaction of a thin pipe line (about 3/4 inch diameter) which extended from the assembly.

9. 3-XFA-231-TS3B (Line No. 39006)

This is a 4KV/480V transformer manufactured by BBC. The installation arrangement for this equipment was unusual with a heavy I-beam skid but the transformed was apparently unconnected in the extended front part. Also, there was a block wall next to the transformer and another interaction potential. The SRT noted all these installation conditions. The coil support of the transformer could not be verified. Equipment-specific test data may exist.

10. 2-LPNL-029-0031 (Line No. 9074)

This is an RCIS auxiliary panel welded to the skid. The panel houses many relays including GE HGA which has been designated as a "Bad Actor" relay. There was a duct above the panel but its supporting conditions were not clear. The SRT noted the duct but probably did not note the HGA relay since it might have been beyond their charter. Rear doors were very loose when closed and the potential banging is a concern.

11. 0-TNK-086-0651A

These are diesel generator accumulator tanks stored in framed structures from the ceiling in the Diesel Generator Room. Cross-bracings were provided for stiffness of the steel frame. Rod straps were used for anchoring the tank to the frame. It was stated that probably not all of the tanks were safety related.

12. 3-BDBB-231-0003B (Line No. 39007, 480V SD Board 3B)

This is a GE low-voltage 8-section switchgear with cables and conduits entering from the top. There was a moveable hoist on top of the switchgear. The SRT indicated that a walkdown data package was completed for this item.

13. 480V Reactor MOV Board (Line No. 39008)

This is a 20-section panel screwed to the base channel which is welded to embedded steel. The sheet metal and screws at the connection resulted in an undesirable flexible anchorage. Therefore, it was identified as an outlier according to the GIP-2.

14. Nitrogen Horizontal Tank for Containment Atmosphere Dilution System

This is a horizontal tank supported by two skirts. A cantilever panel is connected on one end of the tank. The bolts connecting the skirts to the concrete were not properly engaged in the nuts.

15. RHR Service Water Vertical Pump (O-PMP-023-0015-01)

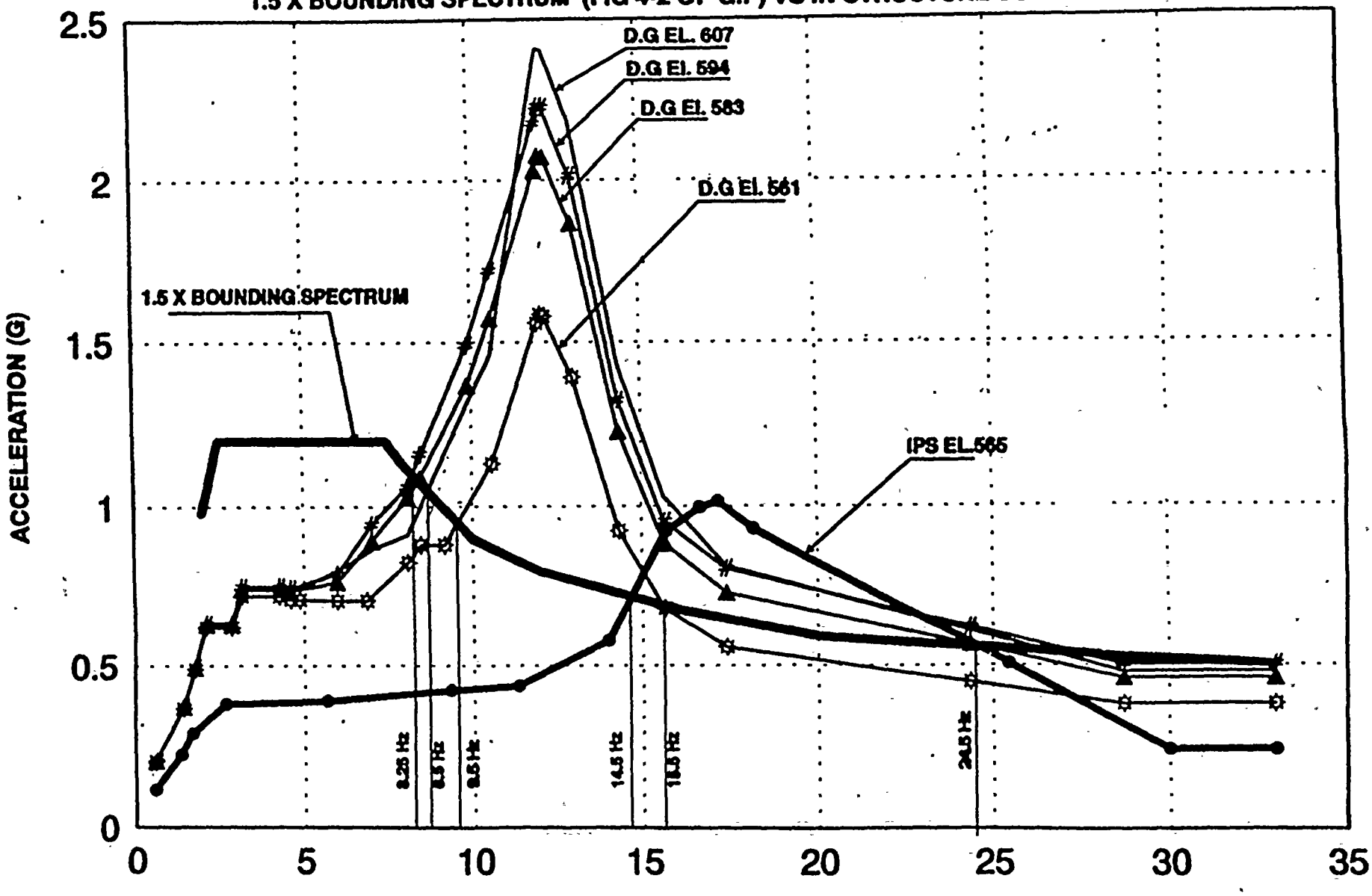
This is an outdoor GE RHR service water pump mounted on a pedestal. The anchorage between the pedestal and the concrete below, as well as the effects of long unsupported piping on the pump performance under seismic loads appeared questionable.

FIG B.1.1 (DG & IPS)

SEISMIC CAPACITY VS SEISMIC DEMAND

SPECTRA COMPARISON FOR DG AND IPS BLDG 5% DAMPING

1.5 X BOUNDING SPECTRUM (FIG 4-2 OF GIP) VS IN-STRUCTURE SSE RESPONSE



NOTE: REFER FIGURE F-NS-1.6, F-NS-4.6,F-NS-5.6, F-NS-6.6, A.2-EW-5.6 OF MARS REPORT FOR IN-STRUCTURE RESPONSE SPECTRA (DG BLDG UNBROADENED BY 15% & IPS UNBROADENED BY 10%)

ATTACHMENT 3