Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

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Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Systematic Evaluation Program (SEP) Topic III-6
Relating to the Structural Integrity of Reactor
Pressure Vessel (RPV) for
Dresden Nuclear Power Station Unit 2
NRC Docket No. 50-237

Reference: (a) Teleconference between CECo (P. Piet, et al.) and U. S. NRC (C. Wu) dated August 6, 1992

As a result of the SEP seismic review of Dresden Nuclear Power Station Unit 2 in 1982, an open issue relating to the structural integrity of the reactor pressure vessel (RPV) and internal shroud support was identified.

In response to the open SEP issue, the basic approach was to confirm the integrity of the RPV and internals by comparison with the other SEP plants - Millstone and Oyster Creek (Ref. NUREG-0823 Supplement No. 1 Pg 2-16). This approach was discussed with the NRC staff. In a telecon dated July 11, 1991 with Messrs. Byron Siegel, Hsu Ho and Dave Terao of the NRC staff, Mr. Terao stated that the NRC had conducted extensive inspections and had performed several evaluations of the Browns Ferry seismic design program which included the RPV and internals. He further stated that it would be prudent for CECo to compare the seismic design of the RPV and internals against Browns Ferry Unit 2. The NRC staff indicated that they do not anticipate the exact same design of the two RPVs and internals; however, a seismic equivalence of the components is acceptable.

Based on the NRC staff recommendation, CECo performed the comparison of seismic design of the RPV and internals of Dresden Unit 2 to Browns Ferry Unit 2. The overall frequency, the seismic input spectrum and seismic responses of the two plants were compared and found to be very similar. The comparison report is included as Attachment 1 to this letter. A total of 13 components were selected for this comparison. Ten of the 13 components are seismically equivalent to Browns Ferry components. The remaining three components, although different in design, are adequately designed for Dresden design basis seismic loads.

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The RPV and internals have additional design margins. It is recognized that the seismic design input spectra for Dresden is conservative compared to a more appropriate spectra-the NRC staff approved site specific spectra. A comparison of the seismic inputs is included in Attachment 2. Based on this comparison, there is a margin of 1.54 in the RPV and internals seismic design.

In summary, based on the NRC staff recommendations, a comparison of the seismic design of the RPV and internals of Dresden Unit 2 to Browns Ferry Unit 2 has been made. The Dresden Unit 2 seismic input and the response is bounded by the Browns Ferry Unit 2 input and response. The comparison of 13 components shows the seismic equivalence of 10 components and confirms that Dresden's design basis is adequate for 3 components. In addition, further design margin of 1.54 has been identified due to conservatisms in the design basis seismic input spectra for Dresden station.

This completes CECo's response to the open SEP issue on Topic III-6 confirming the structural integrity of the reactor pressure vessel and internals.

If there are any questions concerning this matter, please contact this office.

Sincerely,

Peter L. Piet
Nuclear Licensing Administrator

Attachments: 1 - Comparison of Seismic Design of Reactor Pressure Vessel (RPV) and Internal Components of Dresden 2 to Browns Ferry 2

2 - Dresden 2 Seismic Input

cc: A.B. Davis, Regional Administrator - RIII
B.L. Siegel - NRR Project Manager
W.G. Rogers - Senior Resident Inspector
C. Wu - NRR

ATTACHMENT 1

COMPARISON OF SEISMIC DESIGN OF REACTOR PRESSURE VESSEL (RPV) AND INTERNAL COMPONENTS OF DRESDEN 2 TO BROWNS FERRY 2

The purpose of this document is to present a comparison of the seismic design of reactor pressure vessel (RPV) and internal components of Dresden 2 to Browns Ferry 2.

The seismic equivalency of a component is determined on the basis of comparing its physical dimensions and the weight. Physical dimension and the weight of a component manifest into its natural frequency. For a given seismic input motion, response of a component depends on its natural frequency. Therefore, components with similar physical dimensions and weight are considered seismically equivalent.

The 13 components selected for this comparison are listed and discussed below:

Identical Components

Four of the selected components have identical designs for Dresden 2 and Browns Ferry 2. The following components are identical in design: control rod drive, control rod drive housing, control rod guide tube, and incore housing. Thus these components are seismically equivalent. It should be noted that Browns Ferry 2 has 8 more control rods than Dresden 2.

Top Guide

The top guides are very similar. The only significant differences are: the Browns Ferry top guide supports 40 additional fuel assemblies, and the horizonal shear connection between the top guide and shroud was strengthened in Browns Ferry.

Core Support Plate

The core support plates are very similar. The only significant differences are: the Browns Ferry core plate supports 40 additional fuel assemblies, and the Browns Ferry design has 8 fewer core support plate bolts. Thus the core plates are seismically equivalent.

Orificed Fuel Support

The hydraulic orificing is different between the two plants. However, the orificed fuel supports are structurally and therefore seismically equivalent.

Fuel Assemblies

There are 764 fuel assemblies in Browns Ferry 2 as compared to 724 in Dresden 2. The fuel channel thickness is the same for both reactors. Thus the fuel assemblies are seismically equivalent.

Control Rod Drive Housing Support

The control rod drive housing support does not provide any horizontal load carrying ability. The only function of these devices is to carry vertical loads. The predominate vertical load occurs during the postulated ejection of a control rod drive housing. Thus, for this comparison of horizontal seismic characteristics, the control rod drive housing supports are seismically equivalent.

The seismic design adequacy of the CRD housings is addressed and evaluated in Reference 10.

Reactor Pressure Vessel Support Skirt

The RPV supports skirts are seismically equivalent for the two reactors.

Reactor Pressure Vessel Shroud Support

The RPV shroud support is composed of two main components: a ring and a group of legs or stilts. The ring design is seismically equivalent in the two reactors. However, the stilt design is different. Dresden 2 has a group of 6 stilts. Two of the stilts are 2.31 by 20 inches in cross section and the other four are 2.25 by 10 inches in cross section. Browns Ferry 2 also has a group of 6 stilts. Two of these stilts are 2.31 by 20 inches in cross section and the other four have a cruciform cross section as shown in Figure 1.

The RPV shroud support is the connection between the core shroud and the RPV. It was supplied as part of the RPV. Per Reference 2, the Browns Ferry 2 shroud support has been analyzed for an operating basis seismic load of 11,467 ft-kips moment and 445 kips shear. Per reference 3, the Dresden 2 shroud support has been analyzed for an operating basis seismic load of 5993 ft-kips moment and 378 kips shear.

The shroud support stiffness used in the Browns Ferry 2 dynamic analysis (Reference 5) was 31,000,000 ft-kips per radian. The original dynamic analysis of Dresden 2 (Reference 6) did not include the explicit mathematical model of reactor internals; rather, the mass of internals was lumped with the RPV. Thus, the shroud support stiffness was not used. However, in the design confirmation analysis performed later (Ref. 1), shroud support stiffness of 29,300,300 ft-kips per radian was utilized.

Reactor Pressure Vessel Ring Girder

The RPV ring girder designs are similar for the two reactors. However certain dimensions are different. Figure 2 shows the values of the dimensions that are different.

The RPV ring girder is bolted to the bottom of the RPV support skirt and to the top of the concrete pedestal. Per Reference 2, the Browns Ferry 2 ring girder has been analyzed for an operating basis seismic load of 40,138 ft-kips moment and 1083 kips shear. Per References 3 and 4, the Dresden 2 ring girder has been analyzed for an operating basis seismic load of 25,2000 ft-kips moment and 820.7 kips shear.

However, it should be noted that the RPV support skirts are seismically equivalent for the two reactors.

Reactor Pressure Vessel Stabilizer

The RPV stabilizer designs are different in the two plants. Dresden 2 has four stabilizer brackets and Browns Ferry 2 has 8 brackets of a different design. The most efficient way to compare the two designs is to compare the design specification loads. Each of the four stabilizer brackets in Dresden 2 was designed for a total horizontal load of 335,000 pounds. Since the stabilizers can only carry loads parallel to the tension rods, the group of four stabilizers was designed for a total load of 670,000 pounds in any horizontal direction. Similarly for Browns Ferry 2, each stabilizer bracket was designed for 481,000 pounds and the group of 8 was designed for 1,924,000 pounds.

The RPV stabilizer is a system of preloaded loads, which connect the RPV to the top of the shield wall. Each of the 8 Browns Ferry 2 stabilizers were analyzed, per Reference 2, for an operating basis seismic load of 300 kips parallel to the rods. each of the four Dresden 2 stabilizers were analyzed per Reference 3, for an operating basis seismic load of 245 kips parallel to the rods.

It should be noted that the stiffness of the system of stabilizer is different for the two reactors. Per Reference 6, the stabilizer stiffness for Dresden 2 is 48,000 kips per ft. Per Reference 5, the stabilizer stiffness for Browns Ferry 2 is 480,000 kips per ft.

The RPV shell thickness at the stabilizer bracket locations are the same for Dresden 2 and Browns Ferry 2.

Comparison of Overall RPV/Internals/Support Model

The overall frequency of the RPV/Internals/Support Model for the Browns Ferry and Dresden plants is quite comparable. For Browns Ferry, the overall frequency based on the predominant mass participation factor is about 6 Hz. (Ref. 8, Tables 12.1-17.1A and 12.2-17.1B). The corresponding overall frequency for Dresden is about 6.8 Hz (Ref. 9). The slight (about 13%) variance can be attributed to the fact that the Browns Ferry's frequency is based on a computer analyzed current and detailed seismic model;

whereas the Dresden frequency is based on hand calculations of a less detailed model.

Comparison of Seismic Input Spectrum

The site specific SSE seismic input spectrum for Dresden is compared in Figure 3 with the SSE seismic input spectrum for Browns Ferry (which is Figure 2.5-10 from Ref. 8). Both the spectrum are plotted for 5% damping values.

The seismic input spectra are compared at the foundation level since the models for both plants are supported at the foundation level and as noted earlier, the overall frequency of the two plant's model is similar. Comparison of the seismic input for the two plants in Figure 3 shows that the Dresden site specific input spectrum is completely bounded by the Browns Ferry seismic input spectrum.

Comparison of Seismic Response

As a further confirmation of similarity between the two plant's models and seismic response, as an example, the OBE displacements of the CRD housing are compared. The OBE displacements for CRD housing based on the El-Centro earthquake time history input at Browns Ferry is 0.65 inches (Ref. 10 pp.5). The corresponding displacement for Dresden 2 plant computed using data in Reference 1 is 0.58 inches (Table 2). The responses are comparable and furthermore, the Dresden response is enveloped by the Browns Ferry response.

Design Confirmation

The three components - RPV ring girder, RPV stabilizer and RPV shroud support - although different in design from Browns Ferry, are designed adequately. A detailed time History method of analysis of Dresden Specific RPV and internals was performed (Reference 1). In this analysis, refined models of the RPV and internals including the shroud support and stabilizer stiffnesses were used. The model adequately represents the current Dresden 2 design of RPV and internal components and their supports including RPV stabilizer and skirt.

The input seismic time history was applied at the appropriate support points in the model. The design forces in internals were obtained using time history motion of the north-south component of 1940 El-Centro earthquake. As shown in Table 1, the detailed seismic analysis of the refined RPV and internals's model confirms the adequacy of licensing basis design values used in the design of RPV and internals including afore-mentioned three components-ring girder, shroud support and the stabilizer.

The Dresden specific RPV and internals analysis based on El-Centro earthquake time history is inherently conservative. In accordance with Ref. 8, the frequency range of interest for RPV and internals is 1 to 7 Hz. A comparison of El-Centro and the Dresden site specific spectra (Figure 3) shows that in the frequency range of interest, the El-Centro spectra is at least 50% higher than the Dresden site specific spectra. This in turn will reduce the forces further in RPV and internals obtained in Reference 1 and reported in Table 1 by about 50%. In fact, the licensing basis seismic loads for RPV and internals are conservative by at least 50%.

Summary

Based on the above discussion, it can be seen that out of 13 components selected for comparison, 10 components are seismically equivalent to Browns Ferry components. The remaining 3 components, although different in design, are adequate for Dresden specific seismic loads.

The overall frequency of the RPV/internals/support model and the response for the Browns Ferry and Dresden are very similar. The Dresden site specific seismic input spectrum is completely enveloped by the Browns Ferry seismic input spectrum.

As confirmed by the analysis of a detailed refined seismic model which represents the current Dresden 2 design of RPV and internal components and their supports including RPV stabilizer and skirt, the licensing basis seismic design loads for Dresden 2 RPV and internals are conservative.

REFERENCES

1) GE Internal Report 257HA718 "Seismic Analysis of Reactor Internals for the Dresden II", December 1968.

2) RDE Memo Report 30-0889 dated September 15, 1989, "Seismic Assessment of Browns Ferry 2 Reactor Vessel and Internals".

3) GE VPF 1248-436-1 Design Report for the Dresden 2 Reactor by B & W Co.

4) GE Drawing 718E699 Reactor Vessel Support.

5) GE Internal Report 257HA928 "Seismic Analysis of Browns Ferry 1 Reactor Vessel and Internals".

6) John Blume Co., "Earthquake Analysis of Reactor Pressure Vessel for Dresden 2 and 3", February 24, 1966.

7) Report #11 'Stress Analysis - Shroud Support System' Dresden 1 by Babcock & Wilcox dated April 1970.

8) Browns Ferry Nuclear Plant, Final Safety Analysis Report (FSAR) Amendments 7, 8.

9) Dresden UFSAR, Appendix D, Exhibit H, Sheet 19.

10) NRC Inspection Report 50-260/89-39 (Docket No. 50-260) pp. 6.

TABLE 1

Selected RPV Components	Dresden Design Basis (Ref. 6)	Dresden Refined Analysis (1)
Vessel Skirt-Moment (kip-ft)	25,200	12,800
Vessel Skirt-Shear (kips)	820.72	728
Shroud Support-Moment (kip-ft)	6000 (Ref. 7)	5360
Stabilizer Force (kip)	486.43	202

TABLE 2

COMPUTATION OF OBE DISPLACEMENTS FOR CRD HOUSING

DESIGN DATA: (REF. 1)

CRD HOUSING MOMENT,	M = 880 KIP-FT (OBE)
MOMENT OF INERTIA,	I = 0.213 FT^4
LENGTH,	L = 3X3.83 = 11.49 FT.
MODULES OF ELASTICITY,	E = 3740000K/FT^2

MAXIMUM OBE DISPLACEMENT $= \frac{ML^2}{3EI}$

= 0.0486 FT.

= <u>0.58 INCHES</u>

FIGURE 1

RPV SHROUD SUPPORT

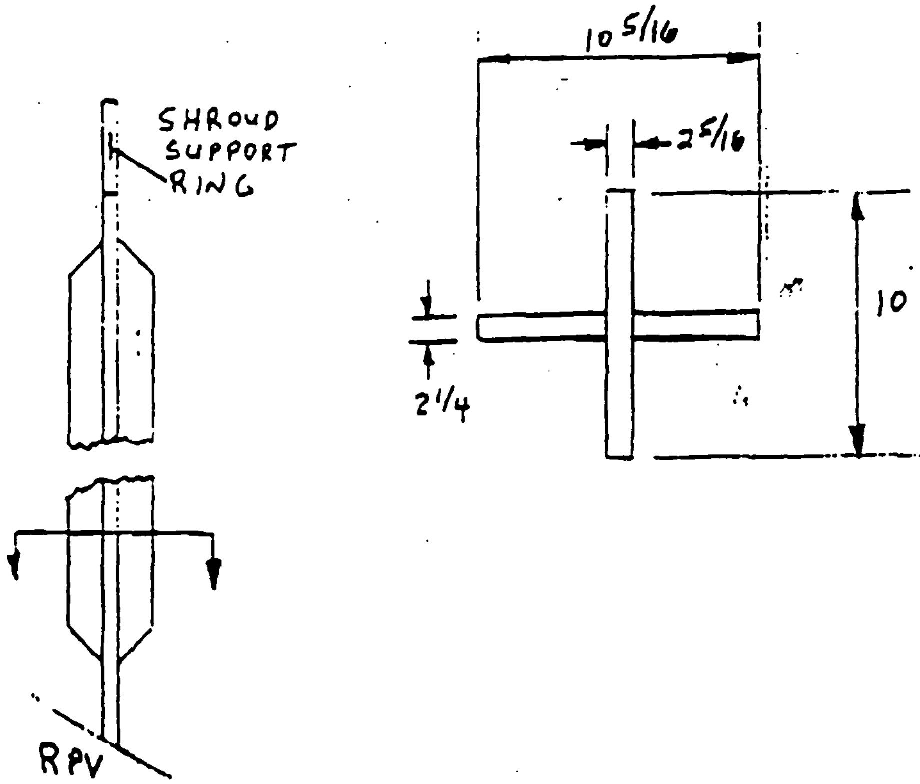
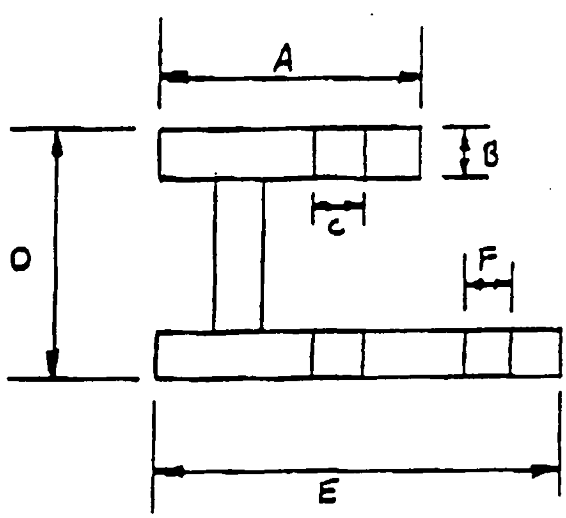


FIGURE 2

RPV RING GIRDER

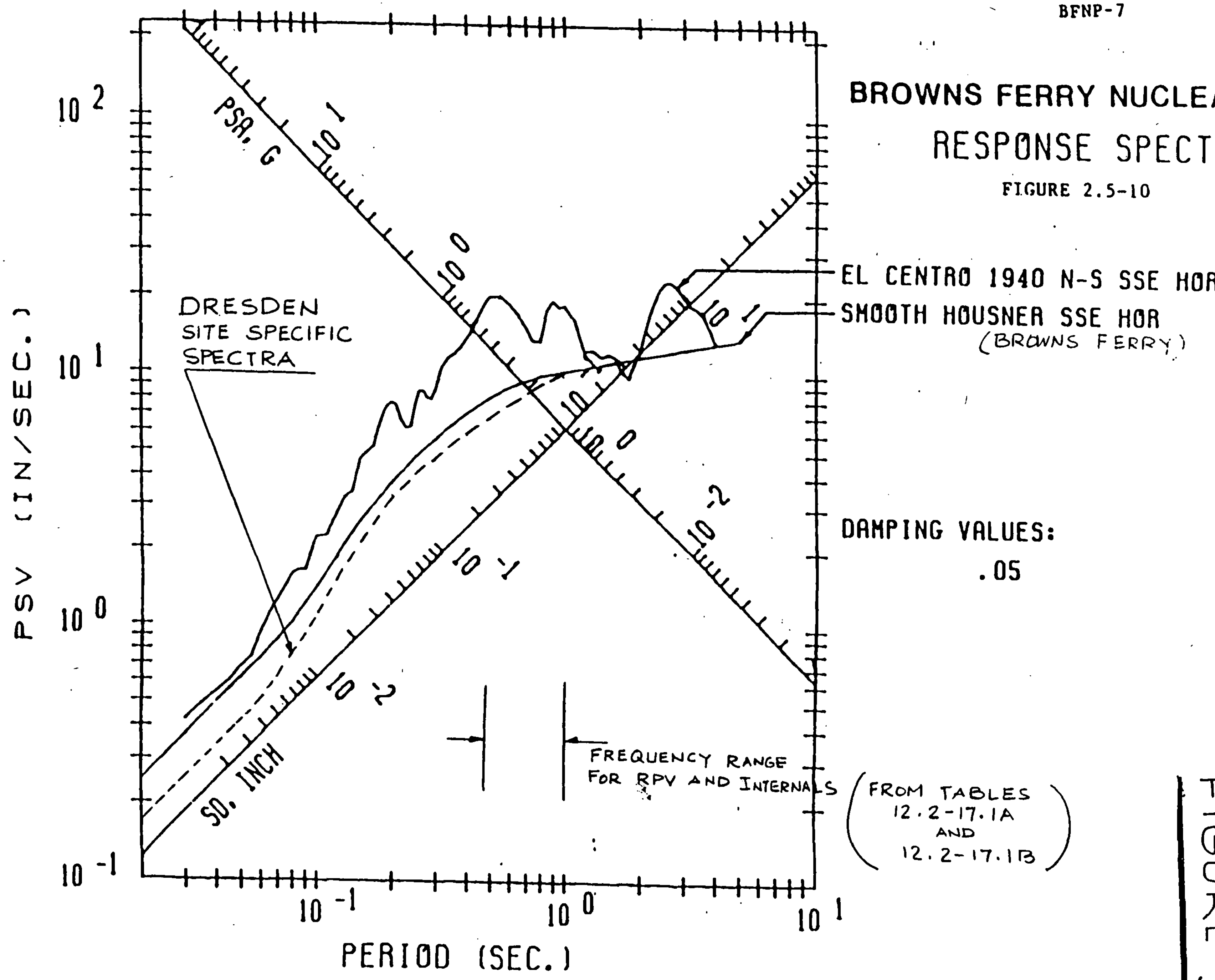
DIMENSION IDENTIFICATION	DIMENSION VALUE DRESDEN 2	BROWNS FERRY 2
A	13.5	15.0
B	2.25	2.5
C	60 bolts 1.75 OD	60 bolts 2.25 OD
D	12.0	13.0
E	18.5	24.0
F	120 bolts 1.75 OD	120 bolts 2.75 OD



BROWNS FERRY NUCLEAR PLANT

RESPONSE SPECTRUM

FIGURE 2.5-10



AMENDMENT 7

FIGURE 3

ATTACHMENT 2

DRESDEN 2 SEISMIC INPUT

SEISMIC INPUT

In July 1979, SEP Reviewer (Reference 1, pp 134-135) expressed concern regarding the seismic design adequacy of RPV and Internals. The Regulatory Guide 1.6 spectra anchored at 0.2g was used in the SEP assessment. SEP reviewers recognized (Reference 1, page 6) Regulatory Guide Spectrum to be conservative compared to a more appropriate spectra - the Dresden site specific spectra, and observed that ".....margins of safety will even be greater than those reported here.....", (if site specific spectra is used). However the Dresden site specific spectra was not available at the time of initial SEP review.

For Browns Ferry 2, a similar conclusion stated below was arrived at by the NRC (Reference 2).

> "Using the new refined RPV and internals model with Regulatory Guide 1.60 response spectra and Regulatory Guide 1.61 damping values would result in lower loads than using the new model with the FSAR Design Spectra and Damping Values."

Then the NRC issued a Dresden site specific spectra (Reference 3) and recommended its use (Reference 4) in resolving any open issues. "This site specific spectrum is appropriate for assessing the actual safety margins present for any structures, system, and components that have been identified as open items."

Also, a comparison of site specific and Regulatory Guide 1.6 spectra is made by the NRC (Reference 4) and shown in Figure 1. The zero peak acceleration (ZPA) for site specific spectrum is 0.13g. Based on this comparison, there is an additional margin of safety of 1.54 (.2g/.13g = 1.54). The comparison further shows that the FSAR seismic input is conservative with respect to the site specific spectrum.

Based on the conservatisms in the seismic input, Commonwealth Edison has concluded that the design of Dresden RPV and internals is adequate for the NRC recommended site specific seismic input.

References

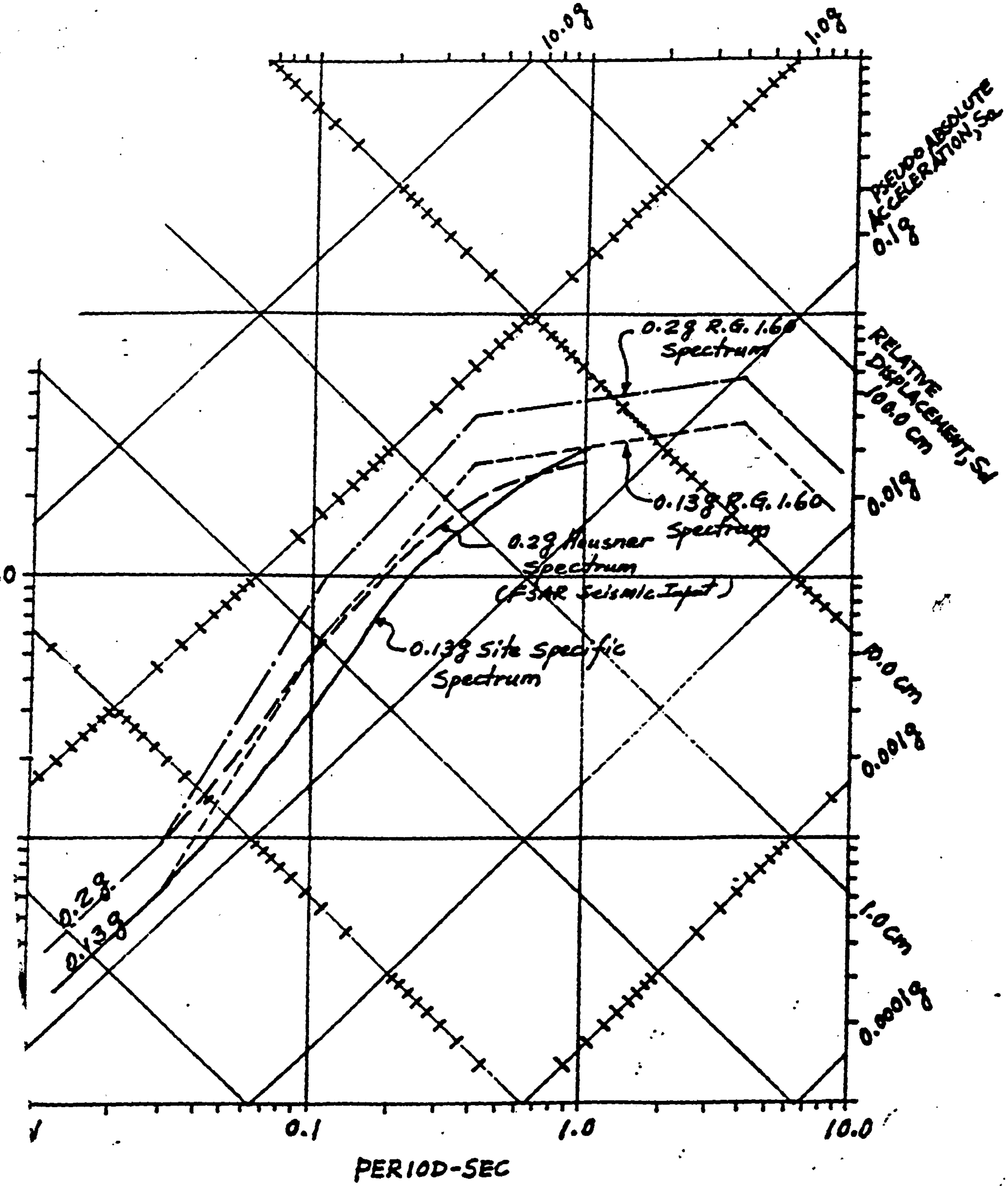
1) SEP Report on Dresden (NUREG/CR-0891).

2) NRC Inspection Report 50-260/89-39 for Browns Ferry 2, approved November 3, 1989.

3) NRC letter, dated June 17, 1981, from Crutchfield to SEP owners.

4) SER - Attachment to letter from NRC to L. DelGeorge, dated June 30, 1982.

TAKEN FROM REF: 4



COMPARISON OF GROUND RESPONSE SPECTRA AT DRESDEN 2 SITE

FIGURE 1 (ATTACHMENT 2)