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Downers Grove, Illinois 60515

July 20, 1994

Mr. William T. Russell, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Dresden Nuclear Power Station Units 2 and 3
Quad Cities Nuclear Power Station Units 1 and 2
Clarification of Issues Related to the Seismic Inputs for the Core Shroud Cracking Analysis at Dresden Unit 3 and Quad Cities Unit 1
NRC Docket Nos. 50-237/249 and 50-254/265

References: (a) P. Piet letter to W. Russell, dated July 8, 1994.

(b) Teleconference between Commonwealth Edison (ComEd) and the NRC Staff, dated July 19, 1994.

Mr. Russell:

In Reference (a), ComEd described our seismic analysis of the subject core shroud with a postulated 360 degree through-wall crack (see ComEd response to question RS-3). During the Reference (b) teleconference, the basis for our seismic analysis including input assumptions and seismic modelling techniques was discussed with members of the NRC staff. At the conclusion of the Reference (a) teleconference, the NRC staff requested ComEd to clarify the basis for our seismic conclusions. The purpose of this letter is to provide a summary of ComEd's technical audit of the calculations regarding the seismic displacements of the core shroud with a 360 degree through-wall crack. The attachment to this letter provides our discussion of the subject issue.

To the best of my knowledge and belief, the statements contained in this response are true and correct. In some respects, these statements are not based on my personal knowledge, but obtained information furnished by other Commonwealth Edison employees, contractor employees, and consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

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

Sincerely,

Peter L. Piet
Nuclear Licensing Administrator

Attachment: ComEd Technical Audit Report Regarding the Calculations of the Seismic Displacements of the Shroud With a 360 Degree Through-Wall Crack

cc: J. B. Martin, Regional Administrator - RIII
J. Stang, Project Manager - NRR
C. Patel, Project Manager - NRR
C. Miller, Senior Resident Inspector - Quad Cities
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ComEd Technical Audit Report Regarding The Calculations of the Seismic Displacements of the Shroud with a 360 Degree Through Wall Crack

The primary structure seismic model used was a mathematical, center-line model comprised of standard beam elements and spring elements. The mathematical center-line model is a coupled composite model comprised of: (i) a detailed model of the RPV and internals, (ii) the reactor building and drywell, and (iii) the turbine building and accounts for the dynamic interaction between these various structures. The analytical model is identical to the original seismic licensing basis model contained in the Quad Cities FSAR except for appropriate modifications to account for the degraded H5 weld condition. A sketch of the analytical model is provided in Attachment No. 1.

Two bounding analyses were performed to account for the 360 degree through-wall cracked condition at H5. The shroud was considered to be pin-connected at the weld elevation in the first analysis and roller-connected in the second analysis. In the first case, only shear could be transferred across the cracked weld (i.e. moment is not transferred). In the second case, neither shear nor moment is transferred across the cracked weld. For both cases, very soft springs were added between the RPV and the shroud at both the top guide elevation and the core support plate elevation. The addition of the soft springs resulted in essentially zero change in the eigendata set for the uncracked model. The soft springs were required to rid the model of the singularities introduced by the assumed pinned-connected and roller-connected conditions in the shroud at the H5 weld elevation. The resulting SSE forces in these springs were also divided by the soft spring stiffness to obtain the relative displacements between the RPV and the shroud at the top guide and the core support plate locations.

The Quad Cities plant was used to perform this parametric evaluation because it has higher seismic values than Dresden (e.g. a shroud base shear of 1208 Kips for QC versus 654 Kips for Dresden). The Golden Gate time history was used to perform the seismic analysis as it is the original design basis time history for the Quad Cities plant and it has ground displacement characteristics representative of a rock site.

The fundamental response periods of the core shroud for the analysis with a roller connection at the H5 weld location is 13.68 seconds and 7.36 seconds for the first and second modes respectively. The corresponding accelerations for this low of a frequency are not shown on the Dresden or Quad Cities response spectra (e.g. for El Centro or Housner spectra, see Attachments No. 2 & 3), but are included in the acceleration time history used. Note that the response spectra shown in the UFSAR for Dresden and Quad Cities are not plotted beyond a maximum period of approximately 2.0 seconds (0.5 hz.) and thus the response at such low frequency ranges as applicable for a roller connected shroud (0.073 to 0.14 hz.) cannot be directly extrapolated from these spectra. Reviews performed by several independent seismic specialists have concluded that for a very low frequency structure the maximum differential displacement for the core shroud will be approximately equal to the maximum ground displacement. Note that for the Golden Gate time history record used (normalized to 0.24 g) the maximum ground displacement is 0.72" which is approximately equal to the calculated maximum differential displacement of 0.68". The differential displacement for the shroud in this low frequency range can be concluded to be approximately equal to the maximum ground displacement of the earthquake time history used. For this reason, it is important that a corresponding rock site time history be used to perform the parametric analysis. A soil site time history such as the El Centro 1940 North-South record is not appropriate for this range of low frequencies as the corresponding maximum ground displacements are representative of a deep alluvial soil site. Note that both soil and rock site time histories were used to develop the Housner spectra and thus the average maximum ground displacement associated with this spectra is not applicable for this type of low frequency analysis.

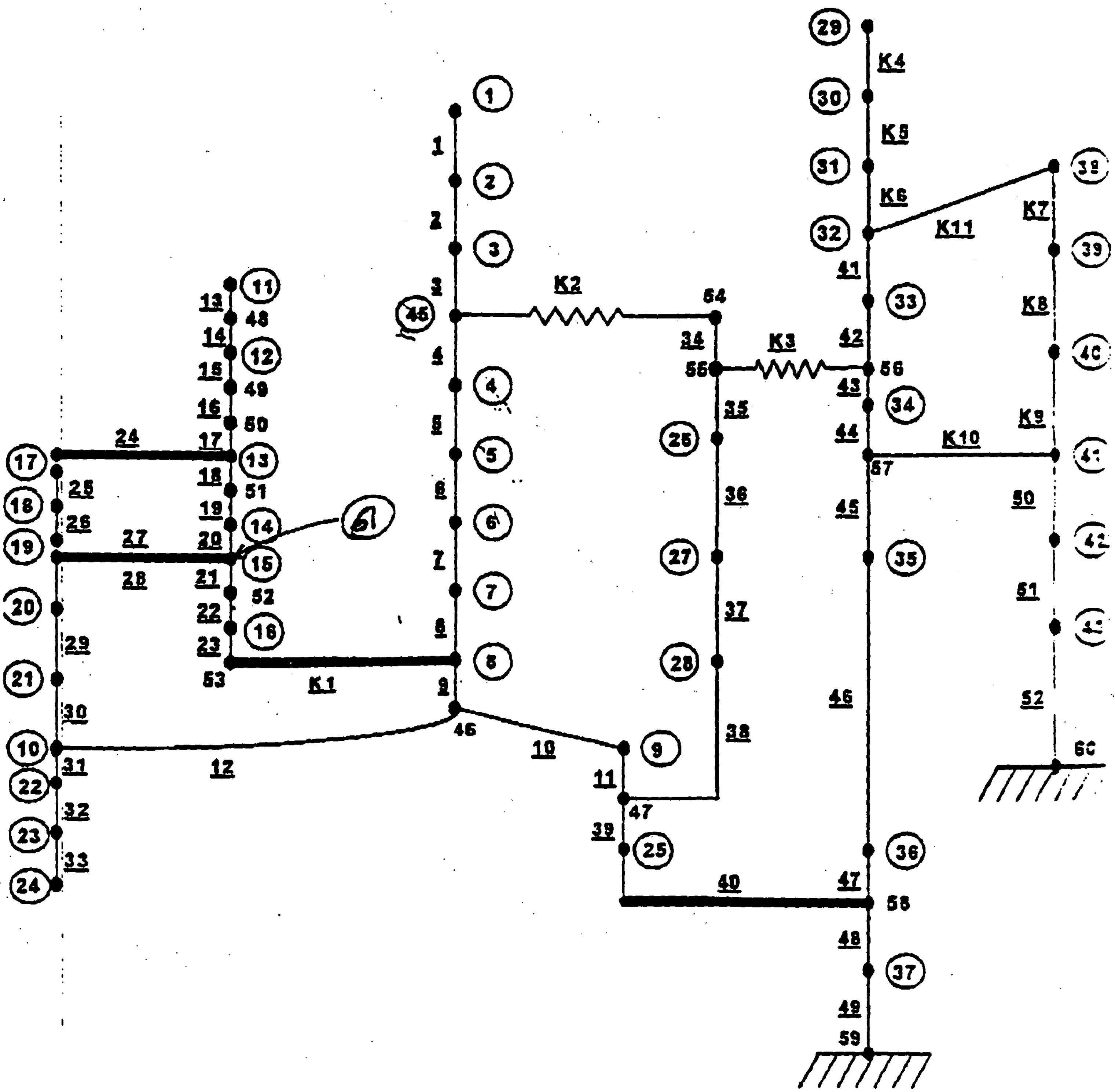
Since the maximum ground displacements for rock sites are comparable to the 0.72" maximum displacement for the Golden Gate Time History it can be concluded that the maximum differential shroud displacement is less than the approximately 2" upper bound limit. This conclusion is based on a comparison of the typical maximum ground displacements for rock site earthquake records, with consideration of the fact that the ground response displacements are converging to a constant value within the low frequency range of concern. The maximum relative displacement of 0.68" calculated is much less than the upper bound limit of at least 2", which was established to be the acceptable limit with respect to maintaining the capability to insert the control rods (reference GE report 383HA617, "Evaluation of CRD Scram Characteristics Under Simulated Earthquake Conditions").

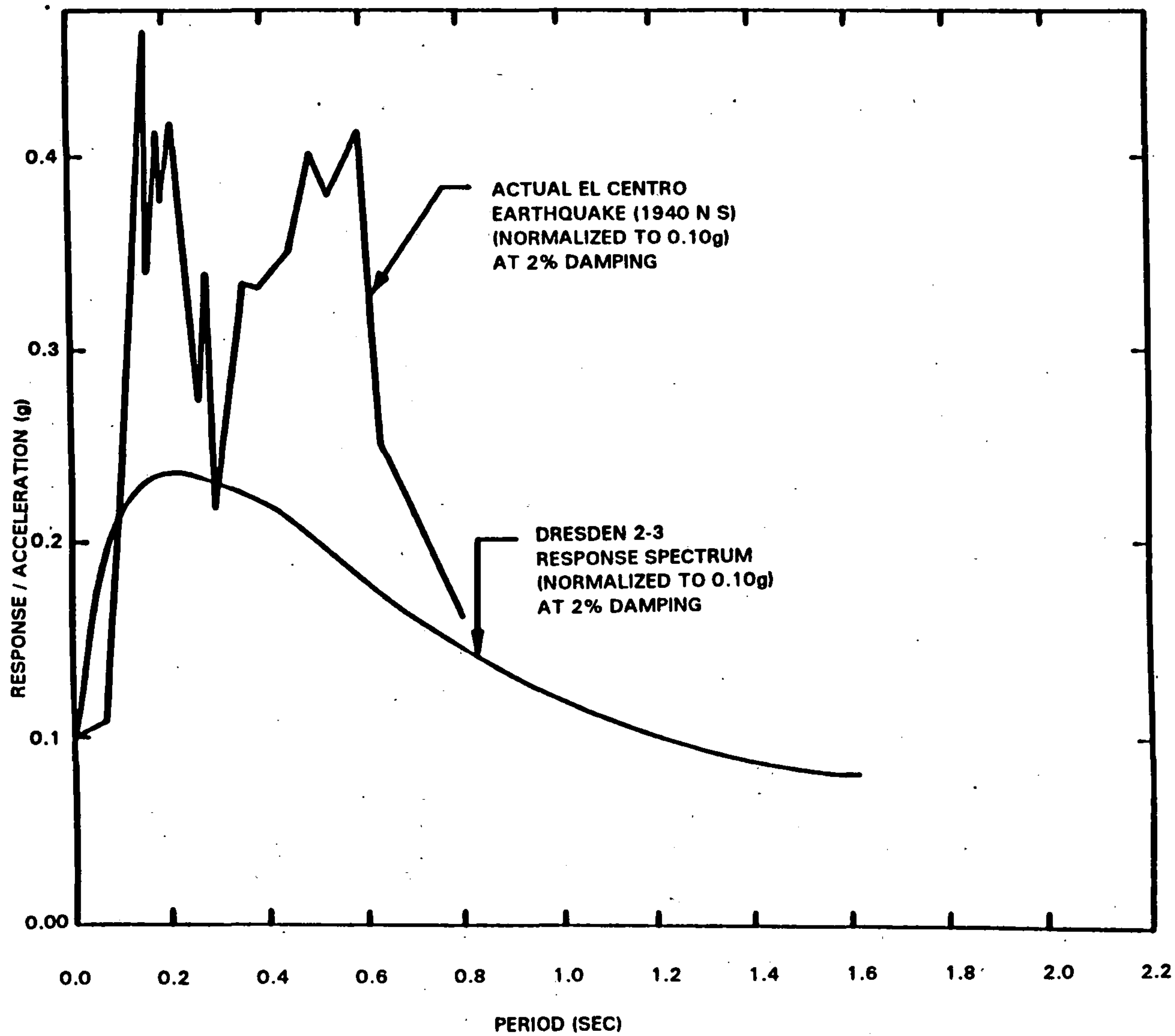
The engineering judgements described above are in the process of being validated by an additional parametric analysis of the roller connected seismic model using an appropriate rock site time history. The results of this confirmatory analysis are projected to be available by July 27, 1994.

Attachment No. 1

Lumped Mass Model of Quad City Unit 1 and 2 Nuclear Power Plant

○ — **Mass at Node**





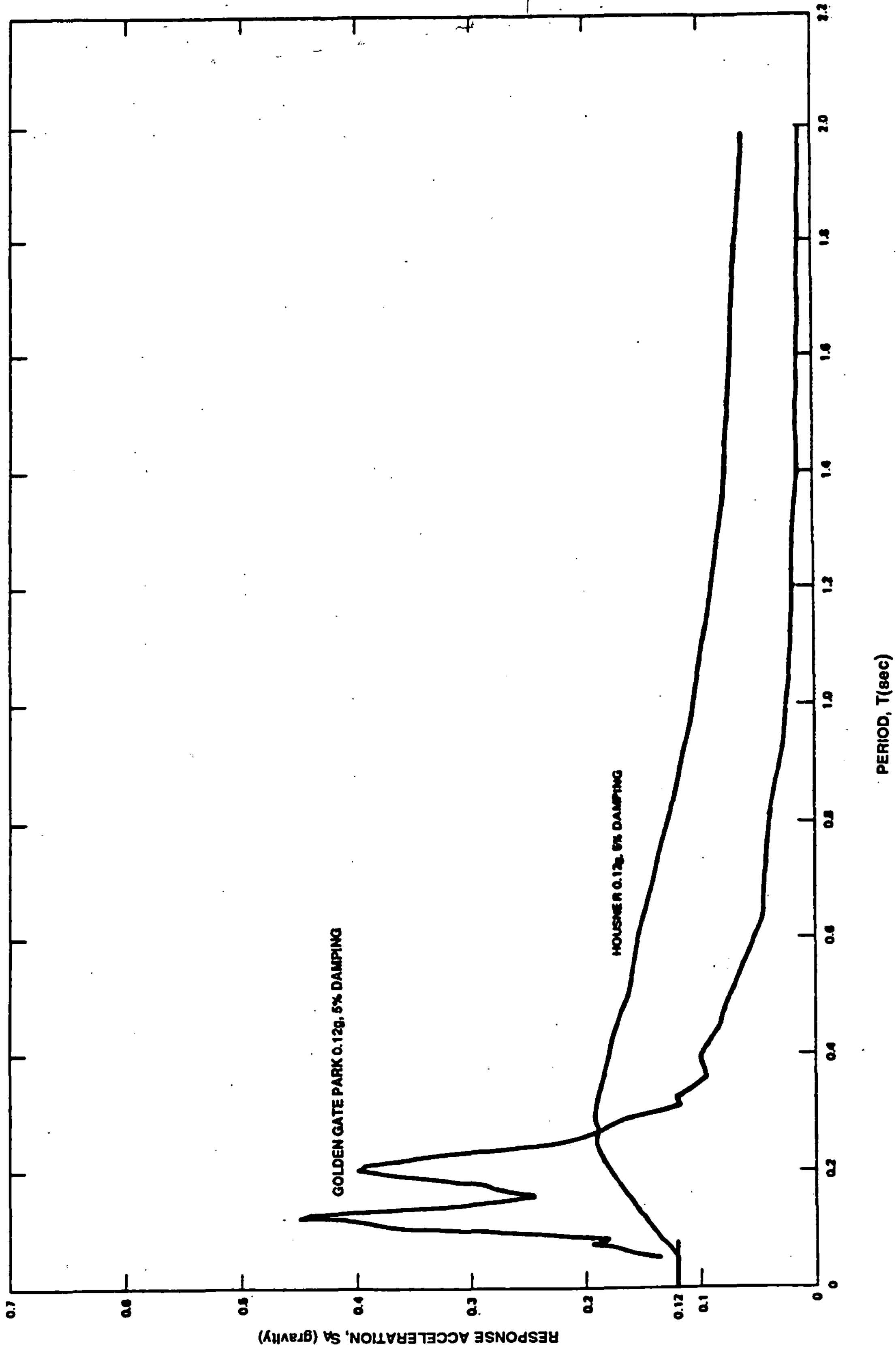
Attachment No. 2

DRESDEN STATION
UNITS 2 & 3

RESPONSE SPECTRUM CURVES FOR
EL CENTRO EARTHQUAKE

FIGURE 3.7-1

Attachment No. 3



QUAD CITIES STATION UNITS 1 & 2
COMPARISON OF GOLDEN GATE PARK AND HOUSNER GROUND RESPONSE SPECTRA
FIGURE 3.7-2