November 22, 1985

Docket No.: 50-206
LS05-85-11-030

Mr. Kenneth P. Baskin, Vice President
Nuclear Engineering
Safety and Licensing Department
Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770

Dear Mr. Baskin:

SUBJECT: SAN ONOFRE UNIT 1 - PIPING/STRUCTURE INTERACTION

During the staff's review of the return to service seismic evaluation, confirmatory evaluations of inelastic behavior of structural elements were requested as discussed in a staff letter dated August 7, 1984.

By letters dated October 25, 1984 and June 26, 1985, you provided responses to this request. As discussed in the enclosed letter report by a staff consultant, clarification concerning your evaluation techniques and the sample analyses you provided is required. We propose that the issues raised in the enclosure be addressed during a meeting planned for December 17, 1985 at our consultant's office.

Original signed by: J. Zwolinski

John A. Zwolinski, Chief
Operating Reactor Branch #5
Division of Licensing

Enclosure:
As Stated

cc w/enclosure:
See Next Page

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DRAFT

ATTACHMENT 3

October 30, 1985

Dr. Long-Chin Shieh (L-196)
Project Leader, SONGS 1
Nuclear Systems Safety Program
Lawrence Livermore National Laboratory
P. O. Box 808
Livermore, CA 94550

Re: Summary Report on the Evaluation of Interaction of Piping and Structures, San Onofre Unit 1, Return to Service
(LLNL/WJH Agreement 4776305)

Dear Dr. Shieh:

This letter report on the above noted topic is submitted in accordance with your letter of September 24, 1985.

As background material pertaining to the basis for the comments that follow, the following items are referenced.

1. Letter from W. J. Hall to Mr. Bert L. Barnes, EG&G Idaho/TSB and Dr. Tom Cheng, SEP Branch, USNRC, dated May 21, 1984 pertaining to SONGS Unit No. 1, and specifically the adequacy of structural beam supports for safety related piping.

2. Southern California Edison Company Report submitted under date of October 25, 1984 to J. A. Zwolinski, USNRC, from M. O. Medford, of which Enclosure 1 is entitled "Evaluation of Interaction of Piping and Structures" dated October 1984, and Enclosure 2 consists of a set of calculation sheets.

3. Letter report from Southern California Edison Company to Mr. J. A. Zwolinski, USNRC from M. O. Medford, dated June 26, 1985 with a copy noted thereon to Dr. W. Hall, although this report was not received by W. J. Hall until the end of September, 1985, when transmitted by LLNL. The report is titled "Summary Report on the Evaluation of Interaction of Piping and Structures," San Onofre Unit 1, Return-to-Service, June 1985.

The rather brief, concise summary presented in the latest submittal (Item 3) prompted me to return to the major document (Item 2) wherein I also noted reference made therein to sets of other letters and meetings on Page 5. I perceive

that in many cases I have portions of these documents but that is really somewhat immaterial since in my opinion the documents that are being reviewed should stand on their own. In this regard, irrespective of whether or not one is concerned with a "return-to-service" type of evaluation or a "long-term" service seismic reevaluation" the principles are the same, and in this regard the comments presented in my memorandum of May 21, 1984 (Item 1) still stand in full in all detail. In that document, and in the interest of brevity I shall not repeat most of the observations made therein, but on Page 5 for example I made reference to ascertaining whether or not difficulties (loss of system function) could be expected if the earthquake excitation were slightly larger than the criteria specified, and I still share this concern in view of the importance of the system and the potential for earthquake excitation. Also, on Page 6 among many other comments I noted the desire for one or two simple coupled analyses for portions of the system for comparison purposes with uncoupled analyses. Many other important points are made therein. My concerns and suggestions still stand.

I have spent considerable time going through all three of the items noted above, particularly Items 2 and 3, and trying to come to a focus as to my views relative to the current situation. Through careful comparison of Items 2 and 3 I note that for the most part Item 3 is a re-statement of portions of Item 2, with enhancement in places to attempt to explain more fully what analyses were undertaken and the results thereof. Unfortunately, the observations are still quite difficult to interpret in light of the background information provided.

It is my opinion from careful reading of the material that one possibly might surmise that the approaches employed in Item 2, the main report, are satisfactory in terms of arriving at some estimate of the strength on a quick "return-to-service" basis. However, that observation is tempered by the fact that I could find no clear set of simple calculations with interpretation, as I had suggested, which would permit one to confirm the adequacy of the approaches followed. The secant stiffness evaluation energy based approach provided as Appendix I to Item 3 appears to be one variation of the reserve energy approach. It is known generally that as long as the energy of the replacement system is essentially equivalent to that of the original system, that the total deformation is more or less the same in both cases, at least for simple systems. It seems to me that some simple calculations should be included in confirmatory material to demonstrate that this is actually correct.

The calculations are not as simple as that response depicted in Figures 1 and 2 of Appendix I of the June 26, 1985 submittal, for in reality in a nonlinear system it is quite likely that there will be reversal of motions and/or cyclic behavior which will complicate the response, and this matter should be reflected in the calculations to ascertain that they are indicative of behavior that is believed to be essentially representative of the actual situation.

With regard to further comments on Item 3, some of the descriptive wording in the report I find difficult to understand. On Page 2 under Item 4.1 there is reference to explicit representation of piping. I am not sure what is meant there except in the sense of what the word "explicit" means. This would imply that there was implicit representation and I cannot help but wonder what it may have been? I do not understand the meaning of "seismic thermal" in Item 4.1.b although I would assume this means that thermal effects were included and seismic effects considered thereafter. Item 4.1.c suggests that in these analyses design margins were addressed, although throughout Items 2 and 3 it is difficult to trace easily and to understand the nature of these margins.

In the description of the model and the nodes on Page 3 under 4.2 Step 1, for example, I could never find in the plots presented Node point 162, but perhaps this is my inability to read Fig. 1 correctly.

On Page 4 there is reference in Line 5 to pipe support margins, although there is no explanation given. Furthermore in Step 3 on that same page, Method A, there is reference to "capacity remains" which suggests to me that again there is attention to margins as discussed later therein. It is not clear to me how the margins were evaluated.

As a result of many such observations of which these are typical, I went back and undertook a detailed study of Item 2, the principal report, again to see if I could understand what might have taken place. In some cases this was helpful; in other cases I was not able to decipher the meaning of the findings. By way of explanation, for example, in Enclosure 2 in the calculation sheets I find on Sheet 82 of 82 at the bottom reference to a ductility factor of 40.1 which seems to me to be quite large, and I do not have any idea of how one interprets such a number, nor the basis for the expression that was used there in deriving the value. A similar observation appears on Page 80 of 82, wherein a ductility factor of about 90.3 is shown at the bottom of the page with no further explanation. Many of the figures are unintelligible; citations are made to vague and unknown references; and, an absolute minimum of interpretative

material is given. It is this type of largely undocumented (i.e. without explanation of criteria, theory, assumptions, and interpretation) material that creates all types of concerns and questions in my mind.

On the basis of my study of the material submitted, I have no specific reason to believe that the procedures outlined and supposedly followed were of a type that would not lead to a satisfactory quick evaluation of the adequacy of the systems involved. In fact, the evaluative statements for the various final systems given in Item 3 suggest that indeed the responses calculated did meet the adequacy criteria. On the other hand, I am unable to track the assumptions or the precise calculations in sufficient detail and clarity so as to provide me with a basis for endorsing the approach used; also the largely undocumented background calculations appended in Enclosure 2 of Item 2 lead one to have concerns as well. Documentary calculations with proper interpretation and explanation are definitely necessary. Thus, again, I am unable to endorse the summary findings.

It is my recommendation, in order to expedite the review of this important system, that the staff of the United States Nuclear Regulatory Commission and/or their consultants, in conjunction with the engineering personnel of Southern California Edison Company and their consultants, undertake essentially a program such as that outlined by me earlier in Item 1. By this I mean undertake some simple calculations to demonstrate that the approximate approaches employed are representative of the expected type of response of the type encountered herein. I find no such basic simple generic calculations in the material I have in hand. Following this task I suggest that the calculational approach be employed in appropriate form for each specific situation with proper attention to the assumptions made, the properties of the materials, the modelling, and the representation of the loading and the resistance characteristics of the system. The findings of these analyses should then be reviewed in conjunction with a physical inspection of the actual system at the plant site to ensure that the adequacy of the findings, as represented by the approximate analyses, is appropriate to the physical situation encountered. In other words, the analyses should be reinforced by an actual on the spot inspection and judgmental evaluation by the team of engineers responsible for reviewing this entire topic, on both an element and system basis. I find no evidence that such and approach, or one similar, has been undertaken.

Finally, I wish to comment on the matter of margins of strength. In view of the uncertain nature of earthquake excitation, it is very important to assure through various analysis techniques, for example variation of parameters in

the analyses, and through judgmental assessment of inherent resistance, that adequate margins of strength are present. Such assurance can be achieved through physical examination of the systems involved, as well as calculated stresses, strains, and deformations versus known allowables when they are available, to confirm with reasonable assurance that the ability exists to accommodate a certain amount of "overloading" in the event this should occur. This evaluation should be made to ensure that there would be no serious loss of function as a result of some responses that are in modest exceedance of those that might plausibly be assumed to occur. And, documentation of these points is essential. It seems to me that the aforementioned steps represent the very least that should be done as a part of the "return-to-service."

In summary, the general approaches outlined in the material at hand suggest that the systems may be adequate for return to service but the documentation presented is of a form which makes it impossible for me to judgmentally confirm the adequacy of the detailed technical aspects, as I have outlined above. The steps I have noted above will entail some additional effort, but I think will lead to a technical clarification of the evaluated adequacy of the systems. It is my belief that the approach recommended above can be carried out fully by the USNRC staff and their designated consultants internally, without any need to obtain further outside consultative aid.

Thank you and good luck in bringing this task to a successful conclusion.

Sincerely yours,

W. J. Hall

W. J. Hall

WJH:efh