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NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

Docket Nos. 50-275
50-323

Place - Avila Beach, California

Date - 8 February 1979

Pages 8912 - 9099

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the matter of:

PACIFIC GAS & ELECTRIC COMPANY : Docket Nos. 50-275
: 50-323
(Diablo Canyon Units 1 and 2) :
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Cavalier Room,
San Luis Bay Inn,
Avila Beach, California.

Thursday, 8 February 1979

The hearing in the above-entitled matter was
reconvened, pursuant to adjournment, at 8:30 a.m.

BEFORE:

ELIZABETH BOWERS, Esq., Chairman,
Atomic Safety and Licensing Board.

DR. WILLIAM E. MARTIN, Member. (Not present.)

GLENN O. BRIGHT, Member.

APPEARANCES:

On behalf of Applicant, Pacific Gas & Electric Company:

BRUCE NORTON, Esq., 3216 No. Third Street,
Phoenix, Arizona 85012.

PHILIP CRANE, Esq., Legal Department, Pacific
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Pacific Gas & Electric Company, 77 Beale St.,
San Francisco, California 94106.

mpb2

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APPEARANCES: (Continued)

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On behalf of Joint Intervenor:

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DAVID S. FLEISCHAKER, Esq., Suite 602,
1025 15th Street, N.W., Washington, D.C.

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STEPHEN KRISTOVICH, Esq., Center for Law in
the Public Interest, 10203 Santa Monica Blvd.,
Los Angeles, California 90067.

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On behalf of the NRC Regulatory Staff:

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JAMES R. TOURTELLOTT, Esq., MARC STAENBERG, Esq.,
and EDWARD KETCHEN, Esq., Office of Executive
Legal Director, U.S. Nuclear Regulatory Commission,
Washington, D.C. 20555.

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On behalf of Office of the General Counsel, NRC:

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MARJORIE S. NORDLINGER, Esq., Office of General
Counsel, U.S. Nuclear Regulatory Commission,
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C O N T E N T S

<u>Witnesses:</u>	<u>Direct</u>	<u>Cross</u>
Mihailo D. Trifunac)	8915	9013
Enrique Lucio)		
(Continued)		

<u>Exhibits:</u>	<u>For Id.</u>	<u>In Evid.</u>
Board Exhibit 2A	8964	9012
(Updated version of Trifunac resumé)		
Board 2D; 2E; 2F; 2G; 2J		9012

WRB/wb1

P R O C E E D I N G S

MRS. BOWERS: We'd like to begin.

When we adjourned yesterday afternoon there was a brief discussion about the summary of the documents that Dr. Luco had prepared. Mr. Fleischaker, do you want to begin?

MR. FLEISCHAKER: Thank you.

Whereupon,

MIHAILO D. TRIFUNAC

and

ENRIQUE LUCO

resumed the stand as witnesses and, having been previously duly sworn, were examined and testified further as follows:

CROSS-EXAMINATION (Continued)

BY MR. FLEISCHAKER:

Q To save time, rather than request that you summarize each of the points in the document, in your written comments, Dr. Luco, what I would like to do is ask you a series of discrete questions about each of the documents. And, depending on how large the documents are, the questions will vary.

We left off yesterday talking about the comments on the ACRS Committee meeting on 7/7/78. And the question I have for you is: Do these comments represent your current opinion on the matters discussed in the comments?

WRB/wb2

1 A (Witness Luco) Are you referring to that
2 particular letter?

3 Q That's correct.

4 A Yes.

5 Q Okay.

6 Let's move on, then, to your comments that are
7 dated May 30th, 1978, and which had been previously marked
8 as Licensing Board Exhibit No. 2, Attachment C. It is one
9 of the documents in Attachment C. The name of it is:
10 Review of Seismic Evaluation for Postulated 7.5 magnitude
11 Hosgri Earthquake, Units 1 and 2, Diablo Canyon Site.

12 Let me ask you the same question, with one
13 exception: At page 8 of this document you have a recommenda-
14 tion and I would like to hold for a moment your views on
15 the recommendation so we can deal with that all at once.

16 But with the exception of the one paragraph there
17 on page 8, which is the second full paragraph on the page,
18 do the comments that are set forth in the May 30th, 1978
19 comments represent your current opinion on the matters dis-
20 cussed in the comments; and, if not, could you identify
21 those instances where your current views are different?

22 A This comment still represents my views.

23 Q Okay.

24 Now we've discussed in some detail, or you testi-
25 fied in some detail yesterday about Points 1, 2 and 3 in

WRB/wb3

1 these comments. I'm not sure, however, that we have gone
2 through Point 4 as it is presented in this comment. And I
3 would like you to, if you would, briefly summarize the
4 point that -- your comments which are listed under Arabic
5 numeral 4 on page 6, Soil-Structure Interaction.

6 A Well there I was addressing the question of
7 whether the effects of the soil-structure interaction could
8 reduce the input motion at foundation level as compared with
9 the motion on the free field. And based on the work of
10 Dr. Seed that appears in Appendix DILCA presented by the
11 applicant, we could reach one conclusion, and that is that
12 if we assume vertically incident waves then the effects of
13 interaction, plus the effect of tau, in this case the
14 scattering would be associated only with the embedment of
15 the foundation, that those two effects combined were not
16 significant, that the response obtained by Professor Seed,
17 considering soil-structure interaction and considering the
18 tau effect for vertically incident waves was almost the same
19 as the one you would get from a rigid base analysis in which
20 you assumed that the soil is rigid, and in which you do not
21 consider the reduction by tau effect.

22 So the point of this comment was to -- there
23 were two points that I was trying to make: one, the Soil-
24 structure interaction effects were not going to significantly
25 modify the response of the structure, and, two, that for

WRB/wb4
1 vertically incident waves the tau effects would not be
2 significant. And I reached that conclusion based on the
3 results obtained by Dr. Seed for the applicant.

4 MR. FURBUSH: Mrs. Bowers, I would like to have
5 the first part of that answer reread, up to about the half-
6 way mark.

7 MRS. BOWERS: Fine.

8 (Whereupon the Reporter read from the record
9 as requested.)

10 WITNESS LUCO: I made a mistake there. What
11 I meant to report was the fixed base analysis-- What I say
12 in the report is that the comparison with the fixed base
13 analysis included the tau effect. I would have to go back
14 to the original document. I am not sure if that was the
15 case. But, at any rate, what I have in the report is that
16 the comparison with the fixed base analysis included the
17 tau correction for horizontally propagating waves.

18 BY MR. FLEISCHAKER:

19 Q Dr. Luco, yesterday you mentioned Dr. Seed's
20 work in response to some of the questions about soil-structure
21 interaction. Was it this work to which you were referring
22 yesterday?

23 A (Witness Luco) No. At the time I wrote this
24 report I knew only of his work with vertically incident waves.
25 At the last ACRS meeting, I believe it was in July, he

WFB/wb5

1 indicated that they had performed some additional soil-
2 structure interaction studies in which they included a
3 Rayleigh wave excitation; that is, a surface wave propagating
4 horizontally. And the results of that-- At the ACRS meeting
5 he stated that there were some differences between the
6 response obtained by that procedure and a fixed base
7 analysis. The main difference was that additional rocking
8 of the foundation occurred.

9 So when I wrote this report I had not seen that
10 second document.

11 Q There has been introduced into evidence as
12 Joint Interveners Exhibit No. 58 a report by Dr. Seed and
13 Dr. Lysmer, and I think that it's entitled "The Analysis of
14 Soil-Structure Interaction Effects During Earthquakes, for
15 the Diablo Canyon Nuclear Power Station."

16 Have you had an opportunity to examine that
17 document?

18 A I read it some time ago. I would like to have a
19 few minutes to go over the conclusions of that report, if
20 that's possible.

21 Q Is that the document that you were referring to
22 yesterday? Is that the study that you were referring to
23 yesterday?

24 A No. Yesterday I was referring to the first study
25 in which vertically incident waves were used.

WRB/wb6

Q Okay.

MR. FLEISCHAKER: Mrs. Bowers; I would like to suggest we take a short break here while Dr. Luco reviews Joint Intervenors Exhibit No. 58. I'd like to ask him some questions about the conclusions that were reached.

MRS. BOWERS: It's a thick document. Of course it's mostly charts in the back. The narrative runs fourteen pages. So, what? ten minutes?

BY MR. FLEISCHAKER:

Q What would be an appropriate time?

A (Witness Luco) That's fine, ten minutes.

MRS. BOWERS: Then we'll be in recess. A little early.

MR. FLEISCHAKER: Thank you.

(Recess)

End WRB
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1 Madelon

2 JRB 1B

3 c2 npp1

MRS. BOWERS: We'd like to resume.

BY MR. FLEISCHAKER:

Q Dr. Luco, I believe you have before you actually two reports by Dr. Seed. One of them is published in DDL Appendix B to Amendment 50, and it's DL-3A, and a second later study which is marked as Joint Intervenor's Exhibit number 58.

Let me ask you first: are the conclusions of these two studies in your opinion consistent?

A (Witness Luco) Before I answer that question, I would like to go back to the previous question to clarify one point.

Q Okay.

A In the report to ACRS of May 30, 1978, dealing with soil-structure interaction, I referred to two comparisons. One is in Appendix DDL-3A. In that comparison the Applicant compared the response of a fixed base axis symmetric model with an input that included the tau effect for horizontally propagating waves with the response obtained by Dr. Seed for the vertically incident waves, and which also includes soil-structure interaction.

I state in the report that I do not consider that comparison valid because the structural model used in the finite element model is not consistent with the structural model used for the fixed base axis symmetric model, fixed base

mp2

axis symmetric analysis.

In the report I also mentioned the comparisons or the results presented by Dr. Seed in Appendix DLI-3B. In that appendix he uses as input a motion that is consistent with the Newmark spectrum with no reduction for tau. That is to say it has a peak acceleration of the order of .75g. Then he goes to a soil-structure interaction analysis for vertically incident waves, and the results of that study show that the response of the structure including soil-structure interaction for vertically incident waves are not significantly different from those you would obtain from a fixed base analysis without tau reduction.

So I wanted to clarify that.

Now maybe you could repeat.

Q Let me ask you one or two questions about that.

The first comparison, that is the fixed base with tau effect, as compared to vertically incident, which includes soil-structure interaction, which appenuices is that analysis presented in?

A Pardon me?

Q You described two comparisons here in number four. The first one was a fixed base with a tau effect compared to one of vertically incident -- that included vertically incident waves and soil-structure interaction. And your conclusion was that that was not a valid comparison.



mp03

1 Is that your current opinion?

2 A Yes. The structural models used for the --
3 used by Seed is not consistent with the structural model
4 used for the fixed base axis symmetric study.

5 Q Where is that comparison found?

6 A The comparison is presented in Appendix DLL-3A of
7 Seismic Evaluation for Postulated 7.5 Magnitude Hosgri
8 Earthquake, Units 1 and 2, Pacific Gas and Electric.

9 Q Okay.

10 Now the second comparison was contained in DLL-3B,
11 is that correct?

12 A Yes.

13 Q Okay.

14 You describe that comparison as one which had a
15 Newmark input plus vertically incident waves compared with
16 a fixed base without tau reduction.

17 A Not precisely. They have a soil-structure inter-
18 action analysis for vertically incident waves in which the
19 control motion at the surface of the ground was consistent
20 with the Newmark spectrum without tau reduction. That was the
21 input for the soil-structure interaction analysis. And the
22 comparison is made with a fixed base model with that same
23 input.

24 So in this study we can see if vertically incident
25 waves will produce a significant tau effect, and we find that

mpb4 1 that's not the case.

2 The second conclusion we may reach from that
3 study is that the effects of interaction are also not
4 significant.

5 Q What is your opinion with respect to the conclu-
6 sions to be drawn by the comparison in 3B?

7 A I tend to agree with the conclusion that the
8 tau effect for vertically incident waves would be small, and
9 that soil-structure interaction effects would also be small
10 given the fact that the foundation material is quite hard.

11 Q Let's move now to the Seed and Lysmer report,
12 which is marked as Joint Intervenors' Exhibit number 58.

13 What are the basic conclusions of that study as
14 you understand them?

15 A The first thing that I should mention is that I
16 didn't have access to this document before the July meeting,
17 The July ACRS meeting. The document is dated July 7, 1978,
18 the same day of that day's ACRS meeting.

19 In this study Seed and Lysmer analyzed the response
20 of the structure, including the effects of soil-structure
21 interaction for a Rayleigh wave excitation. That is a
22 surface wave propagating horizontally. Their conclusion is
23 that -- and here I'm quoting:

24 "Essentially similar values of response
25 are obtained for this site whether the base motions

mpb5

1 are considered to consist of a system of vertically
2 propagating shear waves -- vertically propagating
3 shear and compression waves, or a system of hori-
4 zontally propagating Rayleigh waves. And except
5 for a small increase in rocking which affects the
6 outer edges of the foundation slab, the calculated
7 responses are essentially similar to those computed
8 for a rigid base analysis where the control motions
9 are used directly as base excitation for the
10 structure."

11 End of quote.

12 Now the control motion that they used in this
13 case is characterized by a peak acceleration of .75g, and
14 this is on page 2 of that document. So that corresponds to
15 a control motion that does not have a reduction by tau effect.

16 Now we find that their conclusion here is that
17 where you have vertically incident shear waves and where you
18 have horizontally propagating Rayleigh waves, the response of
19 the structure is essentially the same as you would have for
20 a structure on a rigid soil with an input that does not in-
21 clude the tau effect.

22 If we believe in the results, the only conclusion
23 we can draw is that the tau effects are not significant, and
24 that the interaction effects are not significant. They do
25 mention that there is some additional rocking in the case of

mpb6

Rayleigh wave excitation.

Q Do you have an opinion as to the validity of the conclusions drawn in the report?

A I have not done the calculations myself. But in general I tend to agree with the conclusions that there will be no significant reduction by tau effect, and that Rayleigh waves will induce a larger amount of rocking.

Q Let me move to the last item that you cover in your May 30, 1978 report to the ACRS. That's item 5, Seismic Risk Analysis. I don't believe we've discussed -- questioned you about that.

Could you summarize very briefly the point that you're making there and indicate whether it is your current opinion?

A What I was trying to do there was to analyze in detail some of the limitations of the seismic risk analysis presented by the Applicant. And in particular, compare the results of that seismic risk analysis with the studies of Trifunac and Anderson.

If you compare both studies you find that there is a difference by a factor of 100 or 200 in the probability of exceeding an acceleration of .75g in a period of 50 years. The Applicant estimates the probability to be .1 percent, and the results of Anderson and Trifunac would indicate that the probability was of the order of 10 to 20 percent.

mpb7

1 So what they did was to go in detail and find
2 out the limitations in the analysis of the Applicant and
3 where this factor of 100 or 200 could come from.

4 Q Did you reach any conclusions as to --

5 A My conclusion was that using the same data that
6 Applicant used, but correcting for what they thought were
7 deficiencies, I would end up with estimates of the probability
8 of the same order as obtained by Anderson and Trifunac.

9 Q What were the deficiencies that you believed
10 existed in the Applicant's analysis?

11 A They are listed in the report.

12 The first one was that the Applicant tries to
13 estimate the probability of exceeding an effective accelera-
14 tion of .75g, but actually uses the probability of exceeding
15 a 1.15 instrumental peak acceleration. Since I do not believe
16 in this reduction by effective acceleration, I considered
17 that they should simply look at the probability of exceeding
18 a peak acceleration of .75g.

19 If we do that and we use the data that is
20 presented by the Applicant, we find a factor of four.

21 The second problem I see in the analysis is that
22 they used the sum four and the sum five procedure to calculate
23 peak accelerations. In my view that introduces an error in
24 the probability of the order of a factor of ten.

25 Finally, I looked at the seismicity models used

mpb3

1 and I concluded that easily we could find in there a factor
2 ranging from 2.5 to 4.

3 Q Are the items that you set forth there under
4 number five your current opinion?

5 A Yes.

6 Q Okay.

7 Let me move on now to -- I'm going to skip the
8 recommendation of 12/8/76 to come back and cover all of the
9 recommendations at once. So let me move on to the November 13,
10 1976 comments that you submitted, which are entitled
11 Comments on the Proposed Seismic Design Reevaluation of
12 the Diablo Canyon Nuclear Power Plant, and has been identified
13 previously in the record as Licensing Board Exhibit number 2,
14 attachment page -- and I think that we have previously discussed
15 in some detail all of the subject matters that you have dis-
16 cussed in that paper.

17 So let me ask the question of whether the comments
18 listed there represent your current opinion, and if not, in
19 what way your current opinion differs?

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1 A Well, under point number 4, I was suggesting that
2 a complete soil-structure interaction analysis be made, and
3 in the recommendations I state that the complete soil-structure
4 interaction analysis should be conducted. "This analysis will
5 include automatically the defraction of waves by the foundation
6 as well as possible rocking and torsional effects." A more
7 accurate evaluation of the resonant frequencies appearing on
8 the floor response spectra will also be obtained by this
9 approach."

10 Under ideal conditions I would still make the
11 same recommendation. However, --

12 Q Let me see if I can -- before we get into recommenda-
13 tions, I wanted to cover those all at once, because you made
14 recommendations at different points in time.

15 What I wanted to direct your attention to at this
16 point were the substantive comments, and ask the question of
17 whether the substantive comments that are contained here are
18 now your current opinion?

19 A Yes.

20 Q Okay.

21 Let's move on to the last document. The last
22 document is dated October 11, 1976, and it's entitled, "A
23 Review of the Proposed Seismic Design Criteria for Reevaluation
24 of the Diablo Canyon Nuclear Power Plant," and it has been
25 previously identified in the record as Licensing Board Exhibit

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1 Number 2, Attachment I.

2 I ask you again, directing your attention to the
3 substantive comments, whether the substantive comments that
4 are set forth here represent your current opinions and, if
5 not, would you identify those areas in which you've changed
6 your opinions?

7 A Yes. In general they are still valid in my
8 opinion, except maybe for point 3. In there I said that the
9 evaluation of the torsional response for horizontally
10 propagating SH waves presented by the Applicant is quite
11 crude and some errors are apparent.

12 Some of those errors have been corrected. I still
13 believe that they are not accounting for the complete
14 torsional input that you would get if you assume horizontally
15 incident waves. Also that the use of an equivalent eccentric-
16 ity does not seem to me to be the best way of obtaining the
17 torsional response of the structure, because when you do that
18 then you get coupling between the translational and torsional
19 modes of the structure with frequency change, and things get
20 quite complex. It could be done much better.

21 But when I wrote these comments, I had some other
22 points in mind, and those have been corrected.

23 Q Let me ask you now about the recommendations.

24 You've made recommendations here in various places
25 over the two-year period. Starting with the most current, page

1 8 of the May 30, 1978, there was a recommendation that a
2 complete three-dimensional soil-structure interaction analysis
3 for vertically and horizontally incident shear waves be
4 conducted.

5 There are a set of recommendations set forth in a
6 paper dated 12-8-76, and which is identified as Attachment H
7 to the Licensing Board Exhibit Number 2.

8 There are recommendations set forth on page 3 of
9 the November 13, 1976 comments, which you briefly read from
10 and which is also identified as Attachment H.

11 And then there is a first set of recommendations
12 that are set forth in the October 11, 1976 Attachment I, page
13 10.

14 Let me ask you -- these recommendations occurred
15 over a two-year period, and additional work was done -- so let
16 me ask you the question:

17 What is your current view as to the recommended
18 analysis that would be necessary, in your view, for a valid
19 reanalysis of the seismic design of the facility?

20 A In essence, the recommendations that I presented
21 over that period of two years are still valid except for some
22 points where the work has already been done.

23 For instance, in the list of recommendations of
24 12-8-76, I included some sensitivity analysis for different
25 values of structural damping, and some of those sensitivity

1 analyses were performed.

2 I also recommended soil-structure interaction
3 analysis for horizontally incident waves and for vertically
4 incident waves. We have the two reports of Dr. Seed, and
5 although it is not exactly what I had in mind it provides
6 some idea for what happens if we have vertically propagating
7 waves and horizontally propagating waves.

8 The additional recommendation that I would include
9 now would be that an inelastic analysis be performed. I think
10 it's the only realistic way of assessing the response of the
11 structures.

12 In terms of soil-structure interaction, I suggested
13 that a full three-dimensional soil-structure interaction
14 analysis be performed. I believe that that would be a very
15 useful analysis, particularly if the Applicant insists in
16 claiming a reduction by tau effect. On the other hand, I think
17 that we have enough evidence to see that effect is not
18 significant. If that point of view is accepted, and also
19 based on the results obtained by Dr. Seed that showed that
20 the soil-structure interaction effects are not very significant,
21 in my mind I feel that they have done enough work to study
22 the interaction effects.

23 Q Does that mean that you would find acceptable a
24 response spectra which does not include a reduction for tau
25 effect?

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1 A Well, there are two reductions used. The first one
2 is for the effective acceleration, the second is for τ
3 effect.

4 I do not agree with either one.

5 Q Let me ask you about the kinds of studies that
6 you're proposing.

7 First of all, with respect to the three-dimensional
8 soil-structure interaction analysis, are such analyses
9 currently being performed in industry?

10 A Yes, they are being performed at a few plants.

11 Q Do you know whether they have been performed or
12 are being performed on nuclear power plants?

13 A Yes.

14 Q Which power plants?

15 A I mentioned yesterday, I believe, the Vogtle nuclear
16 power plant and a Japanese nuclear power plant. And there
17 might be others that I don't know.

18 Q Have you personally been involved in conducting
19 such an analysis?

20 A In those two cases, yes.

21 Q The second kind of analysis was an analysis of
22 the inelastic response of the facility. Is such an analysis
23 currently performed in industry?

24 A I don't believe that it is common. I believe that
25 it can be done. And in the case of Diablo Canyon in my mind

1 it is the only way of evaluating the response of the structure.
2 So whether it is common or not, we do not have yet a common
3 situation. This is a special situation, and I believe that
4 it is necessary.

5 Q What is the basis of your opinion that it can be
6 done?

7 A Well, there are many people prepared to do this
8 type of analysis, and if you look at the different universities
9 you will find engineers capable of doing this sort of analysis.

10 It has been done, I believe, for some elements of
11 nuclear power plants. I have not done a linear analysis myself,
12 but I do understand that some computer codes are available
13 that perhaps could be used.

14 I understand there is one program called MARK.
15 There is another one called ADENA.

16 Q Could you spell those, please?

17 A M-A-R-K. A-D-E-N-A.

18 Q Do you know to whom those codes belong?

19 A I'm not sure. Perhaps MARK is General Electric's.
20 But I'm not quite sure.

21 Q Do you have in your mind any estimate as to the
22 amount of time --

23 A I have told you, I have not performed that type of
24 analysis, and it would be just an absolute guess.

25 Q I just want to clear up one or two points from your

wal 7

testimony of yesterday, Dr. Lucco.

Yesterday in discussing the tau effect you stated that the foundation embedment was shallow, and that that was an important feature in your conclusions that the scattering defraction of high-frequency waves was likely to be insignificant.

Could you explain why the depth of the embedment would affect that physical phenomenon?

A If you have a very deep foundation, the presence of that intrusion into the soil will scatter energy, or will modify the motion of the ground that you would have in the absence of that intrusion. And the net effect of that is that the motion of that foundation -- the translational components of the motion of that foundation may be less.

On the other hand, again, depending on the type of excitation that you have, you input vertically incident shear waves, you can induce some rock.

And the situation, in rough terms, is similar to what you have for horizontally propagating waves. In there the waves were travelling horizontally and the foundation was horizontal. In here, the waves are propagating vertically and you have a certain vertical dimension of the foundation.

It's the same sort of phenomenon.

Now, these effects are significant if the structures are deeply embedded and if you have a significant contrast, or

1 if the soil is soft.

2 But again in this case we have a hard material
3 and the embedment is not large. So these two characteristics
4 combined can lead to the result that reduction by tau effect
5 for vertically propagating waves will be small, as shown by
6 the calculation performed by Dr. Seed.

7 Q Let me move to the subject of damping to ask a
8 question.

9 You have, I think, the Amendment DLL-9 contained
10 in a book that I think was provided. DLL-9 is an amendment
11 that discusses damping ratios, and yesterday you offered
12 some opinions on the use of a 7 percent damping and the
13 existence of data that justified or may not have justified
14 damping in structures.

15 My question is: Have you reviewed this particular
16 paper?

17 A Yes, I did read it sometime ago.

18 Q And did you take the opinions expressed in the
19 data and information in consideration in reaching your
20 conclusions?

21 A Yes, of course.

22 Q In your testimony so far you've addressed the Staff
23 and Applicant analysis assuming the occurrence of a 7.5
24 magnitude event on the Hosgri fault within 10 kilometers of
25 the Diablo Canyon site, and a corresponding ground motion at

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7 the site characterized by peak acceleration of 1.15g.

8 I'd like you to assume the occurrence of a 6.5
9 magnitude earthquake on the Hosgri fault within 10 kilometers
10 of the site, and ask you whether you have an opinion as to
11 whether the Staff and Applicant analysis is adequate to
12 demonstrate the structural response, assuming the occurrence
13 of that event?

14 A Okay. If we go through the same process again, and
15 we used the USGC Circular to estimate the peak acceleration,
16 I believe that for 6.5 the peak acceleration is of the order
17 of .9 g, or something like that.

18 Q Do you have that in your table, Table 1 of your
19 May 30 comments, I think it is? You have some comparisons
20 there.

21 Would you take a moment and find that?

22 A Yes. I have it. The USGC Circular for the 6.5
23 magnitude earthquake within 10 kilometers of the fault indicates
24 a peak acceleration of .90, 90 percent of g.

25 If you use Trifunac's correlations you get a
slightly lower value, something of the order of .69 g, or
roughly 70 percent of g.

Now, still even in that case we find a gap that
is not so wide as before between this peak acceleration and
the peak acceleration that the structure can withstand within
the linear range, the elastic range. And if you take the

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1 turbine building, for instance, it has been analyzed for a
2 peak acceleration at foundation level of the order of 54
3 percent of g.

4 So if we were to use something like .7, .8 or .9
5 as peak acceleration for a 6.5 magnitude earthquake, we still
6 would have a gap there. And since I do believe that the
7 soil-structure interaction effect would be significant in
8 this case, and that there would be no reduction essentially
9 for tau effect, that the structure will go into the inelastic
10 range.

11 No analysis has been performed, so I cannot
12 predict what's going to happen.

13 If you take the containment, and the containment
14 has been analyzed for a motion characterized by a peak
15 acceleration of the order of .67, I believe, there the gap
16 will be smaller and probably the containment, under those
17 conditions, will not have a very significant inelastic
18 response.

19 But even in that case, I think it should be looked
20 at very carefully, considering that the tau reduction simply
21 has not been justified, just by carefully analyzing the
22 results obtained by the Applicant itself.

23 If I could present my views on this without a
24 question -- I don't know if it is proper or not . . .

25 MR. FOURTELLOTT: Mrs. Bowers, I don't think the

wel 11

1 witness has really answered the question that was asked, and
2 I'd be interested in knowing what the answer is. He gave an
3 explanation of how he viewed the general area, but the
4 question was very specific: Did he agree or disagree that
5 the Applicant's and Staff's analysis was adequate?

6 I can't discern on the basis of what he said
7 whether that means yes or no.

8 MRS. BOWERS: Could you clarify it?

9 WITNESS LUCO: I don't believe that was the
10 question. The question was if it was adequate for the 6.5
11 magnitude earthquake, and that's what I answered.

12 MR. TOURTELLOTTE: Well, Mrs. Bowers, again if it's
13 adequate for the 6.5 earthquake or not, I still can't discern
14 whether he said yes or no, if it's adequate or not adequate
15 for that purpose.

16 I understand that he has a range of views on it,
17 on the basis of his answer, but I don't know whether it's
18 yes or no. And I think it can be answered yes or no.

19 MR. FLEISCHAKER: I think he answered the question
20 directly, and would propose that if Mr. Tourtellotte wants to
21 pursue that further that he should do that on cross-examination.

22 MRS. BOWERS: Well, but right now let's clear this
23 up.

24 Yes or no?

25 WITNESS LUCO: In the first place, I don't think

wel 12

1 I can answer the question yes or no. It's impossible for me
2 to do so.

3 In this case --

4 MR. FURBUSH: We'll stipulate to that, after having
5 taken his deposition. It's impossible for him to answer any
6 question yes or no.

7 (Laughter.)

8 WITNESS LUCO: I stated clearly --

9 MR. TOURTELLOTT: Wait a second.

10 MR. FLEISCHAKER: Just a minute. Just a minute.

11 I'd like to -- that was a totally inappropriate remark, and
12 I'd like to request it be stricken from the record.

13 MR. FURBUSH: Well, I object to having that
14 stricken from the record. I think we will demonstrate later
15 on that it's an entirely appropriate remark, and I think it's
16 appropriate based on what we've heard here for the last day.
17 It certainly is in the deposition.

18 MR. FLEISCHAKER: This isn't a wrestling match,
19 it's an adjudicatory proceeding.

20 MR. FURBUSH: Well, then, I hope you treat it as
21 such.

22 MRS. BOWERS: Let's not proceed with this any
23 further.

24 We made it very clear that while a witness may feel
25 comfortable saying yes or no, the witness is certainly free

wal 13

1 to give any explanation that follows. If the question is
2 such that the witness feels he cannot say yes or no, then
3 he should explain why.

4 MR. FLEISCHAKER: I'm not sure where we are. I
5 had a motion before the Board.

6 MR. TOURTELLOTTE: Wait a minute. I had the
7 motion before the Board, and --

8 MRS. BOWERS: And I thought we ruled on it by
9 asking the witness to try to say yes or no.

10 MR. FLEISCHAKER: Can I restate my question, then?
11 I don't think Mr. --

12 MRS. BOWERS: Go ahead, Mr. Tourtellotte.

13 MR. TOURTELLOTTE: Well, maybe I can get a yes
14 or no out of this question:

15 Do I understand Dr. Luco to mean that in the
16 answer that he gave to the question he really wasn't saying
17 yes or no, that he couldn't answer that question yes or no,
18 and that his answer was a qualifying answer? That's satisfac-
19 tory with me if that's what it is, but I'd kind of like to
20 get it cleared, instead of trying to mind read all the parties
21 here as to what this meant.

22 MR. FLEISCHAKER: I'm not sure exactly where we
23 are. If the Board is going to request that I pass my direct
24 examination and that Mr. Tourtellotte be permitted to cross-
25 examine at this point, that's one thing. If Mr. Tourtellotte

wel 14

1 would like to have the answer re-read, that's another thing.

2 In order to obtain a yes or no answer, I can
3 re-state the question that I asked. But unless the Board is
4 going to now rule that Mr. Tourtellotte is to be given the
5 opportunity to cross-examine, I think the questions that I
6 asked are the ones that should be answered.

7 MRS. BOWERS: We'll take it one step at a time.

8 Mr. Tourtellotte, to go back to your point, my
9 memory is that that's essentially what the witness said; that
10 he didn't feel comfortable saying yes or no, that he had to
11 give an answer somewhere in between.

12 Dr. Lucio, am I stating it correctly?

13 WITNESS LUCO: Could I explain the reason for
14 not being able to say yes or no?

15 MRS. BOWERS: Fine.

16 WITNESS LUCO: Okay.

17 The question is: Is the analysis or the design
18 adequate for the 6.5 magnitude earthquake?

19 I stated that the turbine building was analyzed
20 for a peak acceleration of .54 g. If we take a 6.5 magnitude
21 earthquake, the peak acceleration would be of the order of
22 .7 to .9 g.

23 Now, if that happens, the turbine building is
24 going to go beyond the elastic range. No analysis has been
25 performed -- at least I have not seen any analysis -- on the

wel 15

1 response of the structure when it goes beyond the elastic
2 range.

3 In those conditions, and since I do not have a
4 crystal ball, I simply cannot state if the structures will be
5 able to withstand that or not. I'd require that an inelastic
6 analysis be made. Once the results are available they can
7 be looked at, and then the decision can be taken as to whether
8 the structures are adequate or not for that particular
9 earthquake.

10 So it is impossible for me to answer yes or no
11 before that analysis is performed.

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2 MR. FURBUSH: This is the problem we have,
3 Mrs. Bowers: I hate to interrupt. The question is whether
4 the analysis was adequate, notwhether the design of the
5 structures is adequate. And that was how we got into this.

6 The question is whether the analysis is adequate,
7 not whether the---

8 MRS. BOWERS: I thought he was responding to
9 that by saying he didn't feel the analysis was complete
10 enough.

11 MR. FURBUSH: Complete enough?

12 MRS. BOWERS: Well there wasn't the elastic
13 methodology used that he feels is necessary.

14 Am I correct?

15 WITNESS LUCO: Yes. The analysis at the present
16 time is elastic in the linear range. And for those peak
17 accelerations that range would be exceeded. And no
18 analysis -- I have not seen any analysis into the inelastic
19 range. So definitely from my point of view the analysis is
20 not adequate.

21 Now the conclusion as to whether the structures
22 are adequate or not will have to wait until that analysis
23 is performed.

24 MR. FURBUSH: Would a free translation of No
25 be adequate for that answer?

MRS. BOWERS: He's explained why he cannot say

WRB/vb2

yes or no. He feels he needs additional data in order to feel comfortable saying either yes or not.

MR. FURBUSH: That's just the point. You know, it's not my position to be arguing with the Chair. But there are two separate things: one, whether the structures are adequate, two, whether the analysis is adequate. He is saying: I cannot determine whether the structures are adequate because the analysis is insufficient. Therefore the answer to the question whether the analysis is adequate is No, in his opinion.

WITNESS LUCO: And I stated so.

MRS. BOWERS: Let's go back to Mr. Fleischaker for a minute.

You objected to Mr. Tourtellotte's question which was really a request for clarification.

MR. FLEISCHAKER: I withdraw all my objections.

MRS. BOWERS: All right.

MR. FLEISCHAKER: Including the one to Mr. Furbush.

MR. TOURTELLOTTE: I would appreciate it if he would withdraw the remarks, too.

MRS. BOWERS: You know, you were kind of snide, saying that Mr. Tourtellotte was taking over, and--

MR. TOURTELLOTTE: I feel it was a very appropriate procedure. It's one that is usually used. I addressed the Chair; I did not address this witness. And I'm not in the

WRS/wb3

1 game of insulting either Mr. Fleischaker or the applicant.
2 And whatever else goes on in the room, I don't want to be a
3 part of it.

4 MR. FLEISCHAKER: Well, I didn't intend to
5 imply that Mr. Tourtellotte was making a personal attack;
6 rather, what I was making was a legal argument that it
7 was inappropriate for him to be conducting cross-examination
8 in the middle of my direct examination. And I will withdraw
9 my objections. But I think the record should stand as it
10 is.

11 MRS. BOWERS: Well, and as we said, we thought
12 his request for clarification was very appropriate, and it
13 has frequently happened in this proceeding as well as others.

14 MR. FLEISCHAKER: I have no problem.

15 Shall we move on?

16 MR. TOURTELLOTTE: That certainly wasn't
17 cross-examination by any stretch of the imagination.
18 I really resent remarks like that, whoever they come from.

19 MRS. BOWERS: Well, Mr. Tourtellotte, in January
20 in the heat of battle you said something about Mr. Fleischaker
21 that you regretted. You later apologized on the record.

22 MR. TOURTELLOTTE: Well....

23 MRS. BOWERS: Why don't you proceed?

24 MR. FLEISCHAKER: Okay.

25 MRS. BOWERS: Do you have much further direct

WRB/wb4

1 examination, Mr. Fleischaker?

2 MR. FLEISCHAKER: No. Do you want to take a
3 break now?

4 Maybe I can finish up with Dr. Luco.

5 MRS. BOWERS: Okay.

6 MR. FLEISCHAKER: Mr. Hubbard would like to
7 consult with me. It may be a good time to take a break
8 and then we can finish up with Dr. Luco and move right in
9 to Dr. Trifunac after the break.

10 MRS. BOWERS: We'll take a 10-minute break at
11 this time.

12 (Recess)

13 MRS. BOWERS: We'd like to begin.

14 MR. FLEISCHAKER: After having had a break, if
15 I said something that was inappropriate I would like to
16 apologize to Mr. Tourtellotte, because I certainly didn't
17 mean to imply that he was being non-professional in his
18 conduct. I have a great deal of respect for his ability and
19 the way he has conducted himself in this proceeding.

20 So let's move on.

21 BY MR. FLEISCHAKER:

22 Q I have two matters I would like to question you
23 about. The first has to do with the results obtained from
24 the accelerometers that were located respectively in the
25 Hollywood Storage building and in the parking lot next to the

WRB/wb5

1 building, and the interpretations that were given in .
2 Dr. Newmark's rationale, that is, Appendix C in Supplement 5,
3 and ask you whether in your opinion the results that were
4 obtained on those two accelerometers and the difference in
5 the spectrum that were derived from the time histories in the
6 high frequency range, if those results are applicable to
7 Diablo Canyon?

8 A (Witness Lucio) Okay. I think that the first one
9 to notice the tau effect was Professor Hausner who looked at
10 the strong motion records obtained in the Hollywood Storage
11 building for the Kern County earthquake of 1952. He observed
12 that the motion at foundation level was, in the high frequency
13 portion was much lower than the one recorded on the free
14 field. And he advanced the hypothesis that this reduction
15 was caused by an ironing of the waves by the foundation.

16 Together with Professor Duke and others we
17 conducted a detailed study of the Hollywood Storage building
18 for that earthquake, and we found that the reduction of the
19 motion at foundation level, as compared with the free field,
20 could be explained by this scattering effect.

21 Actually, we had a mathematical model of the
22 structure, the foundation and the soil, and the mathematical
23 model predicted reasonably well the results, the observed
24 data.

25 In the case of the Hollywood Storage building the

WRS/vb6

1 shear wave velocities in the soil are much, much lower than
2 the ones -- than the shear wave velocities at Diablo
3 Canyon. The average shear wave velocity in the first hundred
4 feet is of the order of 800 to 900 feet per second at the
5 Hollywood site. At Diablo Canyon we have something of the
6 order of, say, 3500 at foundation level.

7 In the Hollywood Storage building the foundation
8 consists of a basement and, in addition to that, you have
9 piles. Now for very high frequencies this combination of
10 basement plus the piles acts approximately as a rigid founda-
11 tion there of considerable depth. And the effect of that
12 is that a pronounced tau effect is obtained.

13 So there we have a typical case where the tau
14 effect occurs and is due to a combination of two factors,
15 one is that the soil is soft compared with Diablo, and that
16 the foundation, considering the piles, is deeply embedded.

17 Also in the case of the Kern County earthquake
18 it is possible that the seismic excitation of the site cor-
19 responded to Rayleigh waves, and that could also tend to
20 increase the tau effect as measured by the translational
21 response at foundation level.

22 If you compare that site with Diablo then the
23 main differences are that the embedment is shallow in the
24 case of Diablo Canyon, the rock is much harder, and that the
25 seismic excitation will consist of mainly vertically incident

- WRB/wb7

1 waves.

2 Q Are there examples that would demonstrate,
3 examples of structures failing that would demonstrate the
4 risks of reducing the actual levels of ground motion for
5 use of values -- for use in design of a structure?

6 A Well the only well documented case that I could
7 think of corresponds to the Olive View Hospital. There you
8 have, or you had a modern reinforced concrete structure. It
9 was designed according to codes. I believe it was officially
10 opened on January 9th, 1971. One month later, February 9th,
11 1971, the San Fernando earthquake occurred and the structure
12 suffered large permanent deformation, so large that it had
13 to be demolished.

14 Now maybe you can use that case as a test of the
15 procedures that have been suggested by the Staff and the
16 Applicant. We know the magnitude was 6.3. If we go to the
17 USGS Circular the peak acceleration that we see in 10 kilo-
18 meters would be .9g. If we used the Trifunac correlation
19 it would be .7g. So let's pick a value of, say, .8g for the
20 6.3 magnitude earthquake.

21 Let us apply a reduction for effective accelera-
22 tion of the same order as used for Diablo Canyon, 30 percent
23 reduction, say. So instead of .8g you now have .56 or some-
24 thing like that, .56g. I do not recall the exact dimensions
25 of the hospital, but in plan they were quite large. So we

WRB/wbs

1 will have a tau effect. So instead of .56g let's reduce it
2 some more to maybe .4g because of tau effect.

3 Now what would happen if we analyzed the
4 structure in the linear range for a .4g? Even better, what
5 happens if we analyze that structure in the inelastic range
6 for .4g?

7 Well this has been done by Bertero and associ-
8 ates. They found that if they put an input motion at founda-
9 tion level of the order of .4g the calculated permanent
10 deformation of the structure would be 5 inches, I believe.
11 The actual deformation of the structure was 30 inches as
12 quoted in that paper.

13 So there you have a clear example of if you
14 apply this procedure of reducing by an effective accelera-
15 tion, reducing by a tau effect that is not justified, you
16 may end up with a result that does not agree with the
17 observations.

18 If you take that same hospital and you say,
19 Well let's forget about the tau, let's forget about the
20 effective acceleration, compute the response for .8g and do
21 an inelastic analysis, again Bertero has done that. And what
22 they find is, they predict a permanent deformation of 20
23 inches. That's getting close to the observed value, but it
24 is still falling short.

25 So I think there you have a well documented case.

WRB/wb9

1 Bartero has written several papers on the response of the
2 structure where this procedure simply doesn't work. The
3 structure is within 10 kilometers of the fault, the founda-
4 tion material -- I do not recall the exact values, but it
5 probably was not harder than the one you have at Diablo,
6 it's probably softer.

7 So in that particular case I find this complete
8 process not adequate.

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MR. FLEISCHAKER: I believe that concludes my
direct examination of Dr. Luco, and I would like to move on to
Dr. Trifunac.

MRS. BOWERS: All right.

Now tell us what documents you're going to be
referring to.

MR. FLEISCHAKER: Excuse me.

What I neglected to do and what I need to do is
I would like to move into evidence the documents that have been
previously identified as Licensing Board exhibits, attachments
B --

MRS. BOWERS: B is already in. You offered that
yesterday.

MR. FLEISCHAKER: C, H, and I.

MRS. BOWERS: Mr. Tourtellotte, Board Exhibit
number 2-C, -H, and -I are now being offered in evidence.

MR. TOURTELLOTTE: I don't have any objection.

MR. NORSON: No objection.

Mrs. Bowers, the reason we were going to have the
direct examination of both Drs. Luco and Trifunac before
cross-examination was so that the other parties would have
an opportunity to prepare their cross-examination, now having
received any testimony from these two people prior to the
hearing.

Mr. Fleischaker did not state so, but it was

mpb2

1 implied that both of those direct examinations would take
2 place yesterday, so that we would have last evening, and
3 that was the premise on which we scheduled. We would prefer
4 to do the cross-examination of Dr. Luco now, because I
5 suspect that that will take perhaps a large part of the day,
6 and it may well allow for Dr. Trifunac, then, to do his
7 direct late this afternoon so that we do have an opportunity
8 to prepare for that cross.

9 We did have the opportunity to prepare for most
10 of Dr. Luco's last evening.

11 MRS. BOWERS: Well, I'll check with the other
12 parties. As you know, this was the Board's preference
13 yesterday.

14 MR. NORTON: Well, but we thought we could get
15 both of them in yesterday. We had no idea that the direct
16 would take as long as it did.

17 MRS. BOWERS: Well, let me take care of some
18 unfinished business first.

19 Documents that have been identified as Board
20 Exhibit number 2-C, -I, and -H are accepted in evidence.

21 (Whereupon, the documents
22 previously marked as
23 Board Exhibit 2-C, 2-I, and
24 2-H were received in evidence.)

25 MR. FLEISCHAKER: Thank you.

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MRS. BOWERS: Now what about this suggestion?

Mr. Fleischaker?

MR. FLEISCHAKER: I regret that Dr. Trifunac is going to be here tomorrow, because that's what it looks like.

I don't have an objection.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: I don't really see what time advantage is gained because -- I don't have any objection, but, you know, if you take Dr. Trifunac's direct now or you take Dr. Trifunac's direct later on, it doesn't make a whole lot of difference.

MRS. BOWERS: No, I don't think it will make a difference.

MR. TOURTELLOTTE: It's going to take the same amount of time either today or tomorrow. And I did have some indication from Mr. Fleischaker at the break that Trifunac would not take as long as Luco. I don't know what that means.

MR. FLEISCHAKER: I would hope that would be the case.

But I don't have any objection; whichever way the Board wants to go.

MRS. BOWERS: Well, time-wise I'm sure you're right. But we just felt it would be a more orderly record to follow the normal procedure of the direct and then the

mpb4

7 cross-examination.

2 But there was a special -- it seemed there was a
3 special circumstance yesterday that no longer exists. So
4 our preference is to go ahead with the cross-examination of
5 Dr. Luco now.

6 MR. TOURTELLOTTE: There is one other considera-
7 tion that having gone through Dr. Luco's transcript last
8 night, if indeed we have cross-examination of Dr. Luco and
9 that lasts for the rest of the day, we really won't have any
10 time to understand what it is that we have to cross-
11 examine Dr. Trifunac about until tomorrow, and after he gets
12 through with his direct case, which may pose some kind of a
13 burden. It would pose a burden on me, not that it's insur-
14 mountable, but....

15 MRS. BOWERS: Mr. Norton?

16 MR. NORTON: Well, I guess maybe I'm too much of
17 an optimist. I thought we could finish with Dr. Luco fairly
18 early this afternoon, but perhaps not. And what Mr.
19 Tourtellotte says is correct, if we got to the point where
20 it was five o'clock and we were still cross-examining Dr.
21 Luco then we would be faced tomorrow with requesting some
22 time after Dr. Trifunac testified to sit down with our
23 consultants and discuss what he said.

24 I just assumed we could finish Dr. Luco prior to
25 that. But again, I don't know how long the Staff is going to

mpb5

1 take with Dr. Luco.

2 MR. FLEISCHAKER: Can I make a --

3 MRS. BOWERS: We don't have a strong position on
4 this one way or the other. And some of the things you've
5 been saying, of course, make some sense.

6 MR. FLEISCHAKER: I don't have any problem with
7 the -- I think it's exceptional that the parties would get
8 some additional time to consider the testimony after it's
9 given. I don't have a problem with that.

10 What I am concerned about is the possibility
11 that Dr. Trifunac might have to come back after the weekend
12 so that there can be cross-examination of his direct testi-
13 mony. And maybe we could work it out by putting on his
14 direct the latter part of the day regardless of where we are
15 in Dr. Luco's cross-examination so that we can complete them
16 both tomorrow.

17 I mean my consideration, having talked to both of
18 them about their scheduling, is that they both be permitted
19 to leave after tomorrow. And perhaps if either the Staff or
20 the Applicant have an objection, we can stop cross-examination
21 if necessary in order to obtain Dr. Trifunac's direct, and
22 that would give the Applicant and the Staff time over the
23 evening to examine it.

24 MRS. BOWERS: Well, that sounds a little bit like
25 a hedge-podge, stopping cross to put on the direct.

mpb6

1 We think, considering all circumstances, that
2 it would be better to go ahead with Dr. Trifunac's direct
3 right now.

4 MR. FLEISCHAKER: Okay.

5 MR. TOURTELLOTTE: Before we do that, I wanted
6 to raise one point just to clarify the record and make sure
7 that I didn't leave the wrong impression yesterday.

8 At page 8861 --

9 MRS. BOWERS: Wait a minute.

10 (Pause.)

11 MRS. BOWERS: Okay.

12 MR. TOURTELLOTTE: -- 8861 at lines 13 actually
13 through 15 is all I'm interested in, Mr. Fleischaker stated
14 that he would offer Dr. Luco as an expert in the area of
15 civil engineering and seismic design of nuclear power plants.
16 Then subsequent to that time Mr. Furbush said that he had
17 no problem with his resume, which is all right. And then I
18 stated that I have no objections to his qualifications.

19 And I wanted to make certain that that wasn't
20 interpreted as an acceptance of the fact that Dr. Luco is
21 in fact an expert in seismic design of nuclear power plants.
22 We're accepting -- the word "qualifications" was referring to
23 his resume, just as Mr. Furbush was more precise and referred
24 to his resume.

25 But I didn't want to leave the impression in the

mpb7

1 record that we may not challenge his expertise in the area
2 of seismic design of nuclear power plants.

3 MRS. BOWERS: Fine.

4 Mr. Fleischaker, do you want to go ahead? Is
5 Dr. Trifunac ready?

6 Are you going to identify documents first?

7 MR. FLEISCHAKER: The documents that Dr. Trifunac
8 had written for the ACRS. We can go ahead and do that if you'd
9 rather.

10 MRS. BOWERS: Fine.

11 MR. FLEISCHAKER: Okay.

12 BY MR. FLEISCHAKER:

13 Q Could you state your full name for the record,
14 please?

15 A (Witness Trifunac) My name is M. D. Trifunac.

16 Q Okay.

17 Dr. Trifunac, you've testified in proceedings
18 before, and I take it that you understand you're under oath
19 and what you're saying is being recorded, so that if you could
20 state explicitly your answers to the questions and not simply
21 nod your head yes or no it would be better for the record.

22 The first business that I think we'd like to take
23 care of is to identify for purposes of the record the documents
24 that you submitted as a consultant to the ACRS.

25 But first let me ask you:

mpb8

1 You did serve as a consultant to the ACRS in that
2 committee's review of the seismic design of Diablo Nuclear
3 Power Plant, is that correct?

4 A Yes.

5 Q Okay.

6 And in the course of that consulting you submitted
7 some written materials, documents, to the ACRS, is that correct?

8 A Yes, I did.

9 Q Okay.

10 I have copies of documents that have been prev-
11 iously marked, and I would like to show you what these are to
12 verify that these are the same documents that you submitted to
13 the ACRS.

14 MR. FLEISCHAKER: Mrs. Bowers, all of these
15 documents that I am about to give to the witnesses, we have
16 extra copies here for Counsel and the Board if they need
17 copies of them. I'll identify them shortly.

18 There was one exchange of documents we would like
19 to make. That is Attachment A to Licensing Board Exhibit
20 number 2 is Dr. Trifunac's curriculum vitae. This is an old
21 curriculum vitae, and I have an update here. And what I
22 would like to do is substitute the more recent curriculum vitae
23 for the older version. And I have copies of the newer document
24 here, or the newer curriculum vitae.

25 MRS. BOWERS: You have a copy of this old one in

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1 the thing that was submitted last August.

2 MR. FLEISCHAKER: I'm giving three copies of the
3 newer curriculum vitae to the Reporter.

4 (Distributing documents.)

5 BY MR. FLEISCHAKER:

6 Q Okay.

7 The purpose of this is to verify that the documents
8 we have in the record are the same as the ones you submitted
9 to ACRS.

10 The first is a document entitled Comments on
11 Seismic Design Levels for Diablo Canyon Site in California,
12 dated April, 1978, and that has been previously marked as
13 Licensing Board Exhibit 2, Attachment D.

14 You have a copy of that. -- Is that the same as the
15 document you submitted to the ACRS?

16 A (Witness Trifunac) Yes, it is.

17 Q Okay.

18 A second document is dated -- well, there is a
19 June 12 cover letter from Mr. McKinley to Mr. Siess, and a
20 letter from you, dated June 8, 1978, to Mr. McKinley and
21 attaching some tables, about five or six pages of tables.
22 That has previously been identified as Licensing Board Exhibit
23 number 2-F, Attachment F.

24 Is that the same as the document that you submitted
25 to ACRS?

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A Yes, it is.

Q Okay.

The third document I would like you to examine is one entitled Comments on SAM-V Procedure for Estimating Earthquake Accelerations by M. D. Trifunac, with appendices A through D. And that has been previously identified as Licensing Board Exhibit number 2, Attachment E.

Is that the same document that you submitted to ACRS?

A Yes, it is.

Q A further document is entitled Uniform Risk Absolute Acceleration Spectra for Diablo Canyon Site, California, by J. G. Anderson and M. D. Trifunac, dated December 30, 1976. And that previously has been identified as Licensing Board Exhibit number 2, Attachment J.

Is that the same document that you submitted to ACRS?

A Yes.

Q And the final document submitted to ACRS -- no, excuse me.

There are really two documents here. One is dated December 7, 1976, entitled Recommendations by Dr. Trifunac. That's a two-page document. And the second document is entitled Comments and Recommendations for the Proposed Seismic Design Criteria for the Reevaluation of

mpbli 1 Diablo Canyon Site, by M. D. Trifunac, dated November 11, 1976.
2 These two documents have been marked as Licensing Board
3 Exhibit number 2, Attachment G.

4 Were those two documents submitted by you to ACRS?

5 A Yes.

6 Q Okay.

7 Now you also have before you a curriculum vitae
8 for Mihailo D. Trifunac. Is that your current curriculum
9 vitae?

10 A Yes.

11 Q Okay.

12 MR. FLEISCHAKER: I'm not sure how the best way to
13 handle the marking of this new document would be.

14 MRS. BOWERS: Well, is it -- is your purpose to
15 substitute it for what had been previously marked Board
16 Exhibit 2-A?

17 MR. FLEISCHAKER: That's correct. This is an
18 update, simply an update.

19 MRS. BOWERS: Let me check with the other parties,
20 then.

21 Mr. Tourtelotte, it's been suggested that an
22 updated version be substituted for what had been previously
23 submitted for qualifications, for resume.

24 MR. TOURTELLOTTE: I have no objection.

25 MRS. BOWERS: Mr. Norton?

mpb12

MR. NORTON: No objection.

MRS. BOWERS: Well, what you've handed out this morning as the updated version of Dr. Trifunac's resume will now be, then, Board Exhibit A -- Board Exhibit 2-A, Attachment A.

(Whereupon, the document referred to was marked as Board Exhibit 2-A for identification.)

BY MR. FLEISCHAKER:

Q Dr. Trifunac, before we get into the substance of your testimony, I have a few introductory questions I would like to ask you.

First of all, for the record, are you here -- you've been issued a subpoena, haven't you, demanding that you appear and testify at this proceeding?

A (Witness Trifunac) Yes, I have.

MR. NORTON: Excuse me.

I'm sorry, I'm still back on the documents. I thought the first item you identified was an October '78 document, and I don't have such a document. I have an April '78 document. And I don't know whether I misheard or you misspoke or if there are indeed two documents.

MR. FLEISCHAKER: I'm not sure, but I intended to say April, 1978.

WFO13

MR. NORTON: Okay. Then we don't have a problem.

MR. FLEISCHAKER: Okay.

MR. NORTON: And that was Board 2-D.

MR. FLEISCHAKER: Correct.

MR. NORTON: Okay.

BY MR. FLEISCHAKER:

Q Had you previously been contacted by parties to the proceeding and requested whether you would testify willingly at this proceeding?

A (Witness Trifunac) I was.

Q And could you indicate by whom you were contacted and approximately when?

A I was contacted by you some time ago to testify on behalf of Intervenor, and I rejected that invitation.

Q Do you recall approximately the time of that?

A More than six months ago. I really don't remember precisely when that was.

Q Were you contacted again in December or January and requested -- and asked whether you would be willing to appear here?

A No.

Q Okay.

What were your reasons for not wishing to appear willingly at the proceeding to testify?

A The reasons were that I participated in discussions

mpb14 which took place during various committee and subcommittee
meetings of the ACRS, where I consult with them on my views.
And I felt that I already participated in the case to the
extent that would not allow me to participate in any other
form.

Q I'd like to direct your attention briefly to your
curriculum vitae, and ask you to summarize briefly your
educational experience with particular reference to your
training in earthquake engineering.

A I have a diploma engineering degree from the
University of Belgrade in 1965. This degree represents
civil engineering degree with emphasis on structural design
and structural theory.

I have a Masters of Science degree from Princeton
University in 1966. And that degree reflects my work at
Princeton primarily in experimental methods in shell structures
in civil engineering.

I have a doctorate degree from California
Institute of Technology in 1969 in the areas of civil
engineering and geophysics. That degree reflects my
graduate work in the areas of seismology and earthquake
engineering.

MRS. BOWERS: Just a minute.

Mr. Hancock, you're in the back row. Can you
hear the witness?

mpb15

MR. HANCHETT: Yes, ma'am.

MRS. BOWERS: Fine.

You see, the speakers are facing that way, and I think that's why they're getting it.

BY MR. FLEISCHAKER:

Q Since receiving your Ph.D. degree in 1969 from California Institute of Technology, have you been employed in teaching at universities?

A (Witness Trifunac) Yes, I have.

Q Could you briefly summarize your teaching experience to date?

A I taught briefly at Columbia University in the areas of seismology and earthquake engineering. I taught at California Institute of Technology for several years in the areas of earthquake engineering, experimental methods in civil engineering, and dynamics of structures. I have taught at the University of Southern California subjects that deal with earthquake engineering, seismology as applied to earthquake engineering, statics and dynamics and undergraduate courses, methods of applied mathematics in graduate courses, and a number of related similar activities.

Q And your present employment is as an associate professor of civil engineering at the University of Southern California, is that correct?

A Yes.

mpbl6 1 Q Dr. Trifunac, have you done any consulting work
2 since?

3 A Yes.

4 Q Well, could you state what consulting work you've
5 done, if any?

6 A Yes, I have done it.

7 Q And have you consulted for industry in any respects?

8 A Yes, I have.

9 Q Could you indicate to us what the nature of that
10 consulting work has been, over what period of time?

11 A It has been over the period of time of several
12 years. And the nature of that work has been to introduce
13 research results in engineering practice to reduce typically
14 university research into a form where it is readily applicable
15 to engineering problems and where it is accessible to
16 engineering level of routine design.

17 Q For how long have you been consulting to ACRS?

18 A I believe from either 1970 or '71. I don't
19 remember the starting date.

20 Q And what has been the nature of your responsibilities
21 as a consultant to ACRS?

22 A I have been invited by ACRS to participate in
23 subcommittee and committee hearings that deal with my area
24 of specialty. And I have reviewed in that course a number of
25 nuclear power plants in this country. And I have commented on

mpb17 1 seismic issues relating to design of these plants.

2 Q Do you have in your mind the number of times --
3 or the number of plants that you reviewed for ACRS?

4 A The number is somewhere between half a dozen and
5 a dozen. It would be difficult now to give you the precise
6 number.

7 Q When did you begin your consulting work to ACRS
8 in its review of the seismic design of the Diablo Canyon
9 Nuclear Power Plant?

10 A Again, I really don't remember precisely, but
11 it was at the time when the Kogri fault was discussed and
12 brought to everybody's attention. My rough estimate would
13 be four, maybe five years ago, something on that order.

14 Q And could you briefly describe the nature of your
15 activities, the tasks that you undertook as a consultant to
16 ACRS during the last four or five years?

17 A Well, I participated in numerous presentations
18 that dealt with geological considerations as to whether this
19 fault is active or not. Then considerations that followed as
20 to how big a magnitude that fault might generate, a variety
21 of seismic issues associated with that. And I have participated
22 throughout most of the hearings that dealt with engineering
23 implications of that analysis and questions that dealt with
24 derivation of appropriate levels of ground motion, soil-
25 structure interaction, and dynamic analysis to some extent.

apb13

Q During the course of that review, what materials, what submissions by Applicant and by Staff did you personally review?

A A very large amount. I really cannot tell you each one by name or reference. But I have reviewed probably most of the documents that relate to seismic design of the plant.

Q Do you recall specifically whether you had the opportunity to review the -- Dr. Newmark's rationale which is set forth in Appendix E to Supplement 5 of the Safety Evaluation Report?

A I believe I have reviewed that.

Q And did you have an opportunity to review Amendment 50 of the reanalysis of the adequacy of the design of the facility for postulated 7.5 magnitude earthquake and the attachments, the appendices to that?

A I have reviewed a good part of that, and I have reviewed quite a few attachments. I don't believe I had an opportunity to go through the whole material.

Q As a result of the work that you've done for ACRS over the course of the last four to five years and the review that you've conducted, do you have an opinion as to the validity of the procedures used by the Applicant and the Staff for the development of response spectrum used to determine the structural response for a postulated 7.5 Hosgri earthquake?

mpb19

1 A Yes, I do.

2 Q What is that opinion?

3 A Well, that opinion has been essentially summarized
4 in a number of my writings to ACRS.

5 Do you want me to quickly summarize it?

6 Q Could you please do that?

7 A I had first difficulty with 7.5 magnitude earth-
8 quake. I did not believe that that number was appropriate or
9 representative of the situation. I had some difficulty with
10 utilization of a typical approach, as I have seen it applied
11 to other sites in this country, those that I have looked at,
12 in that I felt that the situation here was such that it invited
13 perhaps a little bit broader approach to the problem. And
14 that has been expressed in my oral discussions to ACRS and
15 through some of those written documents where I suggested a
16 number of alternatives which would increase the confidence
17 with which we might be able to decide on what the ground
18 motion levels ought to be for use in design.

19 Further on down the line, irrespective of whether
20 we discussed formally 7.5 magnitude on the Hosgri fault, or
21 something like 6.5 magnitude on the Hosgri fault, which would
22 have been my personal preference, I have difficulty with terms
23 tau effect and with effective acceleration. I could not see
24 enough physical basis and acceptance in the professional
25 community to see justification for the use here, nor I could

mph20 : see sufficient physical evidence to justify the use here on
2 the basis of analysis for this particular case.

3 I had difficulty seeing why we have to go through
4 a very lengthy and cumbersome sequence of procedures to try
5 to assess whether ξ_{tan} is relevant or not, whether there is
6 some reduction of input acceleration or not, whether soil-
7 structure interaction analysis is important or not. I thought
8 it would be much simpler and more expedient to go right
9 through three dimensional soil-structure interaction analysis
10 and find out automatically through proper analysis whether
11 these things take place or not.

12 Finally, I have difficulty seeing justification
13 for the largest possible damping as recommended by or suggest-
14 ed by Regulatory Guide 1.61, which in this case turns out to
15 be seven percent, I think.

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16 And this is a brief summary of my view.
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Q I'd like to ask you some question about these three procedures or three concepts that have been utilized by Applicant and Staff in this case, notwithstanding use of 7.5 or 6.5 magnitude earthquake, and then get back to that after we just discuss the question of effective acceleration, tau and damping.

You've indicated that you had some difficulty with the concept of effective acceleration. What is that difficulty, and what is the basis for your concern about that?

A Well, the difficulty is that the term was introduced into discussions and into reports --

Q Excuse me. Dr. Trifunac, can I ask you to either move the microphone closer to you, or speak a little louder?

A The difficulty is that this term has been introduced into discussions and into written reports without what I consider satisfactory physical explanation of what this term represents.

I could gather on a number of occasions what it might present, but I felt it would be proper to try to understand its complete physical basis.

I learned that it might represent judgment in some cases, or substitutes for things that we cannot do otherwise, more directly. But I felt that it would be proper to define it, and if it can be justified and defined, to evaluate whether it can be used.

wel 2

1 But as of today I really don't think that I fully
2 understand what it means.

3 Q What would you utilize instead of an effective
4 acceleration for deriving a response spectra to be used in
5 the reanalysis of the design of the facility?

6 A Well, at this point, except for being able to
7 communicate with the other groups involved on this problem,
8 I would not want to use acceleration at all, personally. But
9 I understand it may not be clear to everybody, so I would want
10 to use peak acceleration that represents maximum what might
11 be recorded ground motion in the future, an estimate of that
12 quantity.

13 Q Do you have an estimate of that quantity, first,
14 for a 7.5 magnitude earthquake, and then for a 6.5 magnitude
15 earthquake?

16 A If you'll permit me to give you a number from my
17 memory, I'll be glad to do that. But I don't have any numbers
18 in front of me, or any tables, to calculate it for you.

19 Q Okay.

20 A Okay, what?

21 (Laughter.)

22 Q Let's have the number from your memory.

23 A If you postulate a magnitude 7.5 earthquake at a
24 distance, I presume, of the order of 5 to 10 kilometers, I
25 would be talking about a number which is likely in excess of

1 g. The numbers that were mentioned by Dr. Luco earlier today and yesterday would probably be quite in order, though I have not double-checked them myself. They look correct to me.

If you were talking about a magnitude 6.5 earthquake on Hosgri at the same distance under similar conditions geometrically relative to the site, I think that the numbers that would correspond to expected value of the peak acceleration would be somewhere in the vicinity of .7, .8 g.

Q What are your concerns regarding the use, or what difficulty do you have with respect to the use of a tau, what has been called a tau reduction, in this case?

A My difficulty is that I don't see sufficient numbers of physical prerequisites to associate with this particular site, its foundation and its -- by foundation, I mean structural foundation -- and with its foundation in the sense of rock on which it rests, to justify significant effect.

Something that I believe people like to call tau, I wouldn't want to call it tau myself, obviously exists. We have known that for a long time. The extent to which it can be applied to a particular case depends on the physical parameters that represent that physical case.

And my judgment is that in this instance the physical parameters we have at our disposal are essentially the impedance jump between the soil and the foundation medium

val 4

1 is such that it does not call for any significant assignment
2 of so-called tau effect to this particular case.

3 Q You are aware that there are two ways in which tau
4 has been presented. One is a horizontally propagating wave
5 that systematically travels across the base, and some credit
6 is given for an ironing out of the high frequencies.

7 The second way is an incoherency in the wave form
8 as it reaches the base as vertically incident waves pass
9 through random inhomogeneities in the soil layering.

10 Have you considered both of those models of wave
11 propagation in reaching your conclusion that tau reductions
12 would not be significant at the Diablo Canyon site?

13 MR.NORTON: Excuse me. Mrs. Bowers, I wouldn't
14 have any real objection to the question if this witness had
15 just set forth all of the postulations made by counsel, but
16 I'm not so sure, after taking his deposition, and as picky
17 as Dr. Trifunac is with words, that he would describe those
18 exactly that way. And I think the question lacks sufficient
19 foundation, until Dr. Trifunac agrees or states the way the
20 tau takes place.

21 MRS. BOWERS: Do you want to respond to the
22 objection?

23 MR. FLEISCHAKER: I'll withdraw the question and
24 lay a foundation.

25 BY MR. FLEISCHAKER:

Q Dr. Trifunac, are you familiar with the Applicant's

vol 5

1 and the Staff's explanation of the so-called tau effect?

2 A I believe I am.

3 Q Okay. Could you explain what your understanding
4 of the explanation is?

5 A Those explanations have somewhat varied over time.
6 Originally my understanding had been that the so-called tau
7 effect refers to low pass filtering effect of strong ground
8 motion in the high frequency range by a rigid intrusion
9 represented by foundation.

10 A reference was made by -- I hope I'm not mistaken,
11 but I believe by both Applicant and Staff -- this is to be
12 associated with horizontally propagating waves, although that
13 is really not a necessary assumption, if you want to look at
14 the phenomenon, its full physical generality. But that was
15 my understanding.

16 Later on, and more recently on more frequent
17 occasions, I have heard the word incoherency. That physical
18 grounds would be a different phenomenon which could be viewed
19 in the light of some averaging process, not the way tau was
20 defined originally, but since tau was never defined precisely
21 one could modify the definition and see whether something like
22 low pass filtering effect could be ascribed to that phenomenon
23 as well.

24 So this is what I have understood to have taken
25 place over a period of time.

wel 6

1 Q In reaching your conclusions regarding the magnitude
2 of the reduction that would take place in the high frequency
3 range, did you take both of those, or all of those explanations
4 of the phenomena into account?

5 A Well, neither of the explanations are acceptable
6 on physical grounds.

7 What I have done is I have tried to look at the
8 proper physical basis for this, and I have tried to mold my
9 response through the framework of their viewing and working
10 and naming of the problem.

11 If I do that, and if you understand what I am
12 telling you, then my answer is that I don't believe that
13 either of the two will be acceptable.

14 Q Let me move to the third area, which is damping.

15 Do you have an opinion on the use of a 7 percent
16 damping in the reanalysis of the design of the Diablo Canyon
17 facility?

18 A Yes, I do.

19 Q And what is that opinion?

20 A That opinion is that it seems high, in that
21 throughout or during a number of presentations made by
22 Applicant and by Staff, I tried to look at the data that they
23 presented in support of that choice. I preferred not to look
24 at the meaning of Appendix 161. I was looking for proper
25 engineering judgment as to what would be adequate here.

wel 7

1 The difficulty I have with this number is that
2 it is largely influenced by the data that unfortunately does
3 not permit us, with the analysis that I have seen so far,
4 to draw conclusions that it indeed should be so high.

5 The reason for saying this is that in the analysis
6 as I understand it that number represents a fictitious
7 description of the degree to which energy is dissipated in
8 the structure. In other words, that number refers to energy
9 dissipation in the structure.

10 The data we have seen, the data that have been
11 accessible to me and presented during some of these hearings,
12 relates to -- what, for lack of a better word, I would call
13 overall damping in the overall system, and specifically I
14 mean damping that is, to various degrees in different examples
15 of measurements, influenced by energy dissipation in soil
16 material that supported those buildings for which those
17 measurements were taken.

18 So I have really difficulty seeing how we can use
19 that data to support an estimate just for the building energy
20 dissipation alone.

21 Q Is there a method currently available to get a
22 better fix on the structural damping for the Diablo Canyon
23 structures?

24 A There are some methods being developed, but it
25 is probably fair to say that there is no generally accepted

vol 6

1 method that would allow us to go back to all the data and say,
2 what will be a modification of their data so that we might
3 use it for design of Diablo.

4 Q Do you have, then, a different value for damping --
5 strike that.

6 How would you, then, recommend that the phenomenon
7 of energy dissipation be taken into account, energy dissipation
8 in the structure be taken into account in a reanalysis?

9 A I felt that the numbers that were used originally
10 would probably be more appropriate.

11 Q Why?

12 A Because some of the measurements I have seen
13 suggest to me that damping in reinforced concrete type
14 structures of the kind that we have here would probably be
15 less than 7 percent.

16 Q Let me go to the first matter that you mentioned,
17 which was that you had difficulty accepting 7.5 magnitude
18 for reanalysis of the design of the facility.

19 What value would you select, and what is the
20 basis for that selection?

21 A Frankly, I would rather avoid magnitude at all.

22 But obviously we have to operate within a framework,
23 or somewhat within the framework in which we have been
24 operating so far. So magnitude seems like a necessity.

25 Using my judgment and seismological background, and

wel 9

1 providing a variety of other inputs that relate to my
2 understanding of the earthquake source, if I had no other
3 choice but to operate within the framework of specifying
4 magnitude, then I would probably be talking about something
5 in the neighborhood of 6.5.

6 But I want you to understand that I am not
7 endorsing that approach. That is, if I have no other
8 alternatives.

9 Q I want to explore with you the parameters that
10 would be associated -- the ground motion parameters that
11 would be associated with that 6.5 magnitude earthquake at
12 the site, but before I do, let me ask you what are these
13 other approaches that you considered or set forth in your
14 comments at the ACRS?

15 A Well, this approach of sort of following the
16 typical sequence of procedures as it has been done in the
17 past for numerous other sites in this country would have
18 resulted in my estimate of the earthquake at Hosgri of the
19 order of 6.5. Let's call that approach number 1.

20 The other approach I would have considered -- I
21 would like to consider still, and I have written about it
22 in my comments that you have presented here -- is the one
23 where one utilizes our knowledge about the earthquake source.
24 And having studied some of those sources, myself, in
25 California, I would have preferred to see an approach where

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2 we make a physical estimate of the phenomena that may take
3 place at the source. Recognizing the fact that we're not
4 very far away from the source, less than 10 kilometers or so,
5 I would have used the near-field source theory that was
6 proposed in literature in the early seventies, and tested in
7 a number of cases against recordings in California as well.

8 So, if you call that approach number 2, I would
9 have used that approach to see what kind of motions I would
10 get at a distance of about 10 kilometers from the fault,
11 assuming a number of physical parameters that would be
12 reasonable in a dislocation model representing an event on
13 the Hosgri fault.

14 The third approach I would have liked to see, and
15 was looked at to some extent -- perhaps not enough -- is to
16 ask the question: With what degree of confidence do we want
17 to select strong ground motion representative of what might
18 happen in the future at the site, and to look not as Hosgri
19 alone, but at everything around Hosgri.

20 I like this approach very much, because I considered
21 playing the Devil's Advocate at one time, and I asked, well,
22 what do we know about other faults that we haven't discovered
23 yet? And so in that approach I would have looked in
24 considerable detail at seismicity of the area, I would have
25 described that seismicity through numerous interpretations
of not one, but many, expert seismologists and geologists and

we1 11

1 earthquake engineers, and I would have arrived at a spectrum
2 which does not reflect either of these specific views, but
3 represents a cross section of judgment as to what the seismicity
4 is, and what the resulting shape and amplitude of the earth-
5 quake ground shaking would have to be so that, not from one,
6 but from a whole sequence of possible events, properly weighted
7 by their likelihood of happening, would be required to draw
8 that spectral shape and amplitude.

9 This was done to a limited extent by an associate
10 of mine and myself, in what you referred to as Document number
11 2, Attachment J, I believe, but it included only several
12 interpretations and suggested methodology. And I wish I
13 saw a more detailed, more extensive analysis which would
14 represent broader spectrum of biased experts' opinions as to
15 what seismicity in the area should be.

16 So I was hoping that we can look at all these
17 approaches together on the same piece of paper at the same
18 time, and then try to evaluate what level do we want to take.

19 Q Let me ask you some questions about each of the
20 three. Let me start with the first one, where you designate
21 6.5 as the magnitude and utilize the approaches that are
22 typically used in assessing the seismic risks of the
23 facility.

24 Let me ask you first of all, what do you mean by
25 the approaches that have been typically used in other power

e1 12

1 plant sitings? To what are you referring there, specifically?

2 A Well, the typical approach is to find sources of
3 strong ground shaking, active faults or areas where earth-
4 quakes can occur. Then one finds the distances involved and
5 tries to estimate what is the closest and largest possible
6 source in the vicinity of the site.

7 Then one utilizes some type of attenuation curve,
8 which translates that information into a response spectrum.

9 Q Assuming a 6.5 magnitude earthquake occurring on
10 the Hosgri, and utilizing that approach, what would be the
11 characteristics of the response spectrum that would be
12 derived? Do you have an opinion on that?

13 A Yes.

14 Q What is that?

15 A The high frequency end would probably have
16 amplitudes of the order of maybe .7 g. In the mean sense it
17 could be as little as .4. It could be maybe smaller than
18 that. It could be as large as 1.-some g's. The spread is
19 enormous. The average amplitude in the high frequency range
20 would be probably of the order of .7 g, give or take. The
21 shape would be similar to just about all of the spectra
22 we have seen, with some minor deviations.

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Q Would you consider the Newmark spectrum for which the zero period has been designated as 0.75g, as an approximation of the response spectra that would reflect a 6.5 magnitude earthquake occurring on the Hosgri under the conditions that you have described on the fault closest to the -- on the point of the fault closest to the site?

A Which Newmark spectrum? He has a number of spectra.

MR. NORTON: Excuse me; I believe he said the one with the zero period being .75g.

WITNESS TRIFUNAC: Does that imply no tau effect?

BY MR. FLEISCHAKER:

Q Tau equal to zero.

A (Witness Trifunac) I think if there is no tau effect and the peak is .75g I would consider the Newmark spectrum quite acceptable and quite appropriate for my 6.5 earthquake.

Q Let me skip to the third method that you have described, which is set forth in Attachment J to Licensing Board Exhibit No. 2.

The name of that is "Uniform Risk Absolute Acceleration Spectra for the Diablo Canyon Site, California," and that was submitted to the ACRS back in December of 1976.

What conclusions did you reach in that paper

WRB/vb2

1 with regard to the amplitudes and the shape of the spectrum
2 that should be utilized for re-analysis of the design of
3 the facility?

4 A I did not reach any conclusions. I was really
5 not trying to even get to those conclusions. I was asked
6 by the staff of the ACRS to do this calculation and basically
7 provide them with a basis for a relative comparison such
8 that they would be able to look at other spectra that have
9 been proposed and, in the light of this analysis, see what
10 would be the probability of exceeding or not exceeding other
11 spectra that have been proposed.

12 Q So this study gives you a risk assessment, it
13 assesses the risk of certain amplitudes being exceeded
14 during the life of the facility?

15 A Not quite, but almost like that.

16 It gives you an estimate of the probability
17 with which various shapes that have been suggested utilizing
18 other methods may be exceeded, gives you a probability of
19 exceedance or not exceedance either way.

20 Q What is the probability of exceedance for a
21 7.5 earthquake? Can that conclusion be derived from this
22 paper?

23 A No.

24 Q Maybe the best way to get at this is to ask you
25 to briefly summarize the information in this paper that would

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1 be useful in today's proceeding; that is, in the uniform
2 risk absolute acceleration spectra for the Diablo Canyon
3 site.

4 A The information useful, as I can guess, for this
5 proceeding would be that it would give you an alternate
6 point of view that could be utilized as a reference to
7 estimate the probability with which overall spectrum shapes
8 and their amplitudes, or just spectrum shapes, would depend
9 on the variety of seismic models that characterize the environ-
10 ment of the site. And I have there four models and neither
11 of them is perfect, but in some way they suggest the
12 uncertainties, the spreads which reflect our judgment and
13 our understanding of how our crystal ball can predict the
14 future in the sense of seismicity.

15 So I think it is a useful comparison in the
16 limited sense, because we did not have an opportunity to do
17 a very exhaustive study. But it is, nevertheless, a useful
18 way to compare the results of uniform risk spectrum ampli-
19 tudes and a variety of other analyses as they produce
20 response spectra to give you an idea of what is the
21 probability that these other independent estimates of response
22 spectrum amplitudes will be exceeded and with what
23 probability.

24 Q In your submission to the ACRS that was dated
25 June 8th, 1978 you attached several tables. And, as I

WRS/wb4

1 understand it, these tables were derived from the informa-
2 tion presented in this larger study which has been marked
3 as Licensing Board Exhibit No. 2, Attachment J. And I'd like
4 to direct your attention actually what is marked as Figure 1,
5 Figure 2, and ask you whether those assist us in determining
6 the levels of probability that certain accelerations will be
7 exceeded over the lifetime of the facility.

8 Could you explain Figure 1 and Figure 2?

9 A Yes, they do assist us in that direction.

10 Figure No. 1 is a summary from the previous study
11 of December of '76. The numbers for that figure have been
12 directly extracted from the bigger study. And it answers the
13 following question: If you assume that the seismicity in
14 the vicinity of Diablo can be modeled by four specific
15 seismicity models, here labeled A, B, C, D and E -- this is
16 five, not four; I beg your pardon. And if it is assumed
17 that the events in time observe a Poissonian sequence,
18 which means that you are not stating that these events will
19 occur but you're saying that there is a rate at which these
20 events occur, then this figure gives you an estimate of the
21 probability with which a chosen level of peak ground accelera-
22 tion, which are indicated on the righthand side of the
23 vertical axis, or logarithms of which are indicated on the
24 lefthand side of the vertical axis, would be exceeded with
25 the probability that is indicated on the horizontal axis of

WEB/wb5

1 Figure 1.

2 Now this is for an expected period of time of
3 fifty years.

4 Figure 2 does just about the same thing, but
5 it does not have subscripts 'p' on A, B, C, D and E designa-
6 tions for these specific seismicity models. That is somewhat
7 of an extreme assumption, but I thought it might be helpful
8 to some people because this model, in contrast to what is
9 depicted in Figure 1, says that all the earthquakes that are
10 assumed in this seismicity model will occur. And, as you can
11 see, the probabilities slightly increase.

12 I believe personally that it would be more
13 reasonable and useful to concentrate on Figure 1 within the
14 framework of our discussion, and for purposes of using this
15 as an independent basis to discuss other levels that we have
16 seen in the course of looking at the Diablo site.

17 Q To make sure that we are reading, then, this
18 Figure 1 correctly, what is the probability that would be
19 associated with exceedance of a .7g for each of the-- you
20 have five models there, each curve represents one of the
21 five models.

22 A If you permit me a gross error because I don't
23 have a very good set of tools here, that probability would
24 range, I would say, from a little less than 10 percent and
25 perhaps would approach something like 20 percent for various

WRB/wb6

models.

Q Now where are these models described?

A These models are summarized very briefly in the table which is called Table 2, and it just precedes those figures. But they are described in considerable detail in the report of December 1976.

Essentially, to just illustrate the point for persons who are not acquainted with this, one of the models assumes that there is no such thing as the Hosgri fault, there is just seismicity in the area. That is one extreme case.

The other extreme case is that nothing else is really important but just Hosgri is important.

Q Can I ask you to direct your attention to Table 1 where the five models are given, are listed, and then there's a brief description, and then ask you which of the two you're referring to there?

A Yes. Okay.

Model No. A simply assumes that there is no such thing as a specific fault; you have an area, a very large area, around the site, and that area is designated here by latitudes and longitudes which you can read from the description of Model A: 119 West to 132° West, and 33° North to 57° North. It's a large rectangular area centered around the site.

WRB/wb7

1 That model assumes that the seismicity that
2 happened there before would most likely be representative of
3 the seismicity in the future. And it does not make any
4 assumptions as to where these earthquakes occur. It does
5 allow large earthquakes, however, to occur on very large
6 faults. And it considers all possible orientations in the
7 ranges of these faults. That is Model A.

8 Model B is labeled "Hosgri Fault Only," it
9 perhaps illustrates another extreme where you are saying
10 no earthquakes will occur in the next fifty years anywhere
11 but on the Hosgri Fault. It's a hypothetical example.
12 And we have taken for this particular example the length of
13 the fault as 140 kilometers, and then assumed a rate of
14 occurrence that would be reasonable for this one fault and
15 looked at the probability that would result from that
16 model.

17 The other models are somewhere closer to
18 reality, and they do represent contributions from other
19 faults, contributions from random events in space and
20 faults, and in various combinations.

21 Q Let me move to the second approach that you indi-
22 cated you believed would be useful in assessing, or in
23 addressing the seismic design of the facility; and that is
24 to consider near-source theory and to use that in conjunction
25 with other analyses in order to derive some response spectra.

WRB/wc8

1 Could you explain a little more fully what that
2 analysis would entail?

3 A Well that analysis would essentially avoid
4 the difficulty associated with naming a magnitude.

5 We have named here-- When I say "we" I mean
6 the USCS has named here a magnitude on the basis of the
7 length of the fault. And it is well known to all the
8 people in seismology that that is associated with a large
9 degree of uncertainty. So this analysis that I mentioned
10 in my recommendations would avoid that whole question alto-
11 gether, in the sense that it would simply allow for a large
12 surface represented by the Hosgri Fault at a distance that
13 would be appropriate from the site, and would ask the
14 question: What can happen on that surface.

15 Now we have done a number of studies in the past
16 which can give us an idea of what are the reasonable or
17 extreme possibilities for such an event. And so, looking
18 at all the data we have in California, siting in California,
19 one would try to either take an average value or an average
20 plus a standard deviation, or perhaps some kind of upper
21 bound, of the effective stress drop that might be associated
22 with an earthquake in the worst possible case, opposite the
23 site.

24 One would, based on geological data, evaluate,
25 in this case essentially, the largest width of the fault

WRB/wb9

1 which would probably be something of the order of the
2 distance between the surface of the ground and the deepest
3 point that might be indicated to move on the basis of past
4 geological results and on the basis of a number of investi-
5 gations that were done in conjunction with the Hosgri
6 Fault, and on the basis of overall experience in California.

7 So we would have an estimate of stress drop,
8 we would have an estimate of the width of the fault, we
9 could assume the fault is as long as we want, so it could
10 carry any magnitude, magnitude 8 if you want: it doesn't
11 matter: and we would ask the question, What happens close
12 to the site on the basis of fault parameters?

13 Now it can be shown that under those conditions
14 the magnitude doesn't play a significant role in that type
15 of approach, but the properties of physical dislocation at
16 the fault.

17 Now from either average or average plus a stand-
18 ard deviation or an upper bound which would depend now on
19 the judgment of people who are doing this analysis, one could
20 get a Fourier amplitude spectra of strong ground shaking at
21 a distance of 5 kilometers or 10 kilometers away from the
22 site. From that Fourier amplitude spectra one could directly
23 create any number of time histories that one wants for the
24 analysis, and one could use those as an input to dynamic
25 analysis with or without site-structure interaction, again

WRE/wb10

1 depending on what is decided later on.

2 One could use that Fourier amplitude spectrum
3 to infer the relative velocity spectrum, and from there one
4 could get the supervelocity spectrum, acceleration spectrum,
5 again depending on the need. But that would be the general
6 outline of that approach.

7 MR. FLEISCHER: I think it's about noon. Is it
8 convenient to take a break now?

9 MRS. BOWERS: We'll plan to reconvene at one
10 o'clock.

11 (Whereupon, at 12:00 o'clock noon the hearing
12 in the above-entitled matter was recessed, to
13 reconvene at 1:00 o'clock p.m., the same day.)
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AFTERNOON SESSION

(1:20 p.m.)

MRS. BOWERS: We're ready to proceed.

Whereupon,

MIHAILO D. TRIFUNAC

AND

ENRIQUE LUCO

resumed the stand as witnesses, and, having been previously duly sworn, were examined and testified further as follows:

MRS. BOWERS: Are you ready, Mr. Fleischaker?

BY MR. FLEISCHAKER:

Q Dr. Trifunac, we left off before lunch talking about the approach that you would have preferred to see utilized in the reanalysis and there were three suggestions that you put out, one limiting the safe shutdown earthquake to a magnitude 6.5 and utilize the standard procedures. The second one was to utilize source theory and model the fault mechanism to come up with some estimates of strong ground motion at the site. And the third was to develop an analysis of the distribution of amplitudes of strong earthquake ground motion at the site.

Is that a fair characterization of your testimony?

A (Witness Trifunac) Yes.

Q And then you would have the decision-makers take a look at these three, the conclusions derived from these

mpb2

1 three, and then to arrive at some judgment as to the appro-
2 priate characterization of the levels of shaking to character-
3 ize the strong motion for reanalysis.

4 Is that --

5 A Yes.

6 Q Okay.

7 Well, in a sense one of the ways has been adopted
8 here. That is, there is a -- as I understand your testimony --
9 a response spectrum that characterizes ground motion equivalent
10 to a 6.5 earthquake, and that's the Newmark response spectra
11 with tau equal to zero, is that correct?

12 A Yes.

13 Q Okay.

14 I also take it from your earlier testimony that
15 you do not agree with the reduction or the reductions to that
16 spectrum by use of the tau effect.

17 A That is correct.

18 Q And that you would prefer to see five percent
19 damping used in reanalysis.

20 A Of the building structure, of the containment?

21 Q Let me ask you:

22 You mentioned that you would prefer to see five
23 percent damping. What was the thrust of that testimony?

24 A For the analysis of structure, containment.

25 Q Okay.



pb3

1 What damping would you prefer to see utilized
2 for the turbine building?

3 A I'm afraid I can't answer that because I don't
4 think I have studied the details of turbine building enough
5 to give you my judgment on that.

6 Q What risks, if any, are there -- well, let me
7 state my understanding.

8 Is it your understanding that the -- strike that.

9 What risks, if any, are there by incorporating
10 a reduction for the tau effect equivalent to the reduction
11 that the Newmark spectrum contemplates in the reanalysis of
12 the design of Diablo Canyon Nuclear Power Plant?

13 MR. NORTON: Objection.

14 I'm not certain, but I believe the testimony is
15 that the --

16 (Telephone ringing.)

17 MRS. BOWERS: I'm sorry, that was a call from my
18 other job.

19 (Laughter.)

20 MR. NORTON: Well, if I can remember exactly where
21 we were, I think the question that Mr. Fleischaker asked
22 asked about his basic objection to the reduction of the
23 response spectrum by a tau factor. As I understand it,
24 though, there's more than one spectrum. There are spectra
25 for different structures that are reduced by different ways

mpb4

1 and in different amounts because of the differences in the
2 size of the structures and so on and so forth, or whatever
3 the reasons may be. And the question is overly broad. It
4 doesn't specify which spectrum we're talking about and what's
5 the amount of the tax reduction and which structure we're
6 talking about.

7 It's meant to be a specific question but it's
8 way too broad.

9 MRS. BOWERS: Do you want to respond to the
10 objection, Mr. Fleischaker?

11 MR. FLEISCHAKER: I'll withdraw the question and
12 rephrase it. I'm not sure that I agree in whole with Mr.
13 Norton. But in any case, I'll rephrase the question.

14 BY MR. FLEISCHAKER:

15 Q Spectrum have been developed for each of the
16 structures. And do you know what the magnitude of the tax
17 reduction is for the spectrum that have been developed?

18 A (Witness Trifunac) There are two tax reductions
19 that were discussed. One is by Dr. Blume and the other is
20 Dr. Newmark.

21 Are you addressing both, or which one?

22 Q Well, let's address both. And let me direct
23 your attention to two structures in particular, the turbine
24 building and the containment building. And ask you this
25 question:

mpb5

1 Do you believe -- do you have an opinion as to
2 whether the response spectra that were utilized to reanalyze
3 the seismic design of those two structures are adequate,
4 either Staff or Applicant?

5 A I would like to make one thing very clear before
6 I answer your question.

7 I said -- and I hope that was understood -- that
8 if you take one of the approaches which is essentially like
9 a common approach that we see in this work, and if you accept
10 6.5 magnitude earthquake, and if you assign to it the spectrum
11 that is associated with tau equal to zero as proposed by
12 Dr. Newmark, and if you take that as the representative
13 ground motion, then I think that tau reduction which I believe
14 ranges between zero and maybe 20, 30 percent depending on the
15 frequency we're talking about, is not appropriate.

16 You see, I did not mean to imply that because
17 the spectrum for 6.5 earthquake alternative proposed by
18 Newmark is in agreement with that alternative that I want
19 to base everything on that spectrum. The spectrum that I
20 would like to see may be smaller than that one, it may be
21 larger than that one. But if you base your question on that
22 spectrum then I think that I don't think that reduction of
23 20 or 30 percent, 10 percent, 5 percent, depending on where
24 you are, would be acceptable reduction in subsequent analyses.

25 Q What -- if you employ that reduction, and that has

mpb6

1 been the case, what are the problems in terms of analysis.
2 of design, if any?

3 MR. NORTON: Again, the same objection, because
4 Mr. Fleischaker is talking in a singular reduction that would
5 presumably apply throughout. And I think Dr. Newmark is making
6 it very clear that he's talking about various reductions --
7 excuse me, Dr. Trifunac -- various reductions between zero
8 and perhaps up as high as 30 percent in various frequencies
9 and for various structures. And I think that the question
10 is overly broad, again, because I can't believe whatever
11 answer he would give could possibly cover all of those situa-
12 tions that he's described.

13 MR. FLEISCHAKER: I think the question is appro-
14 priate in view of the answer. The answer, as I understood it,
15 was that if you took the 6.5, if you took the spectrum that
16 has been proposed for τ equal to zero, then my understanding
17 is that Dr. Trifunac would not utilize a τ reduction at
18 all. That reduction varies depending on the structure and
19 the magnitude of the reduction varies depending on the
20 frequency you're looking at.

21 But my understanding of his testimony is that
22 he wouldn't utilize a τ reduction at all. So regardless of
23 the magnitude, I'm asking him what is the problems associated
24 with using a reduction for either one of the structures.

25 MR. NORTON: Excuse me, Mrs. Bowers.

mpb7

1 There is a very simple problem to overcome, and
2 that is to ask him if the problem would be uniform regardless
3 of what amount of reduction you're talking about or what
4 frequency you're looking at. If the answer to that question
5 is yes to uniform problem, then the question that he's asking
6 as to what is the problem is proper.

7 But I suspect it is not a uniform problem over
8 the broad spectrum that we're talking about.

9 MR. FLEISCHAKER: Well, it may well not be. But
10 I think Dr. Trifunac can probably respond to the question as
11 I put it to him.

12 MRS. BOWERS: Well, we still have a pending
13 objection, then.

14 Mr. Tourtellotta, does the Staff want to comment
15 on this matter?

16 MR. TOURTELLOTTA: No, ma'am.

17 (The Board conferring.)

8.165 18 MR. FLEISCHAKER: Mrs. Bowers, I might be able to
19 restate the question and then we can see if we can go from
20 there. I'll withdraw the former question and restate the
21 question.

22 MRS. BOWERS: All right.

23 Could you possibly interrupt your direct here and
24 we could have a bench conference?

25 MR. FLEISCHAKER: Okay.

mpb8

(Whereupon a bench conference was had.)

MRS. BOWERS: Well, I'm sorry, Mr. Fleischaker.

BY MR. FLEISCHAKER:

Q I have withdrawn the former question, Dr. Trifunac, and let me state this question.

Dr. Trifunac, what risk, if any, is associated with incorporating a tau reduction to the Newmark spectrum used in the reanalysis of the containment building?

A (Witness Trifunac) You say risks?

Q Risks, if any.

A I don't like the word "risks", but I think I can answer the question.

I think what you're doing, if you employ tau, you're changing the shape of the spectrum that represents ground motion and you are getting some results within the containment. You are -- by "results" I mean amplitudes, motions, spectra. And you are creating a situation where you are subjecting pieces of equipment and the rest of whatever is within the containment to conditions that are solely related to the assumption that deals with the structure. And I think that under realistic circumstances some high frequency motions may not be adequately diminished by tau-like effect and may be seen within the containment either at different levels or on the foundation of the containment as used in the analysis of other components, equipment,

mpb9

1 everything that is in the containment.

2 Q Would that be equally true for incorporating a
3 tau reduction in the turbine building?

4 A Well, in principle this would be true for any
5 building. And the extent to which it would be important
6 would be related to the extent to which reduction was intro-
7 duced for each particular building. But in principle it's
8 true for any building.

9 Q By "reduction incorporated" you mean the tau
10 reduction incorporated into the response spectra?

11 A Of that particular building.

12 Q And what effect would that have -- what effect
13 might that have on the reanalysis of the equipment critical
14 to safety?

15 MR. NORTON: Object.

16 I don't believe this witness has been qualified
17 anyway to test about analysis of equipment. I think his and
18 Dr. Luco's expertise is very clearly set forth, and there's
19 been no foundation laid they have the expertise to discuss
20 the analyzation of equipment.

21 MRS. BOWERS: Dr. Trifunac.

22 MR. NORTON: And Luco, both of them. But it's
23 Dr. Trifunac, of course, that the question is being asked of.
24 but I don't believe there's been any foundation that they
25 have the expertise in the analysis of equipment.

mpb10

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MR. FLEISCHAKER: Well, there are two levels

2

here. One of them is the mechanical engineer who goes out

3

and conducts the tests. But the first step is to give the

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input to the piece of equipment, and that input is derived

5

from the building response spectrum. And I think that that

6

is absolutely clear from the testimony of all the panels.

7

I know Mr. Kristovich's cross-examination began

8

by establishing that the input into the equipment analysis

9

was the response spectra for the building and that response

10

spectra incorporates damping and tau reductions and all the

11

rest. And I believe that the transcript is absolutely clear

12

on that.

13

And to that extent I believe Dr. Trifunac can

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talk about -- is qualified to talk about the analysis of the

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equipment, the initial input, motion into the analysis of the

16

equipment.

17

MR. NORTON: Excuse me, Mrs. Bowers.

18

The question didn't go to the input -- and I have

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no objection to him talking about that. That's what he has

20

been talking about.

21

The question said what would the effect be on the

22

analysis of the equipment. That was the question.

23

MR. FLEISCHAKER: I think that's the same question.

24

MR. NORTON: Not at all.

25

MRS. BOWERS: Does the Staff have a position?

mpb11 1

2 MR. TOURTELLOTTE: We have to agree.. And as I
3 recall, I think the question was asked of both of these
4 witnesses in the depositions, and they both indicated that
5 they do not profess to have any expertise in the mechanical
6 engineering aspects of this case, that they are simply going
7 to testify about the structures.

8 And while I agree also that the question can be
9 asked as to the input, you can't ask these witnesses what
10 the effects of that input would be upon the piping and the
11 mechanical part of the plant, because they don't know. They
12 are not qualified that way.

13 And I might add, even with the rather elaborate
14 explanation by Mr. Fleischaker, the fact remains he has not
15 qualified these witnesses to testify in any respect about
16 the mechanical portions of the plant.

17 (The Board conferring.)

18 MRS. BOWERS: Well, the objection is sustained.

19 Now if you want to rephrase it and go to the input
20 rather than the effect of the input, why, we would consider
21 that appropriate.

22 MR. FLEISCHAKER: Could you find that initial
23 question back for me, and then I'll rephrase it.

24 (Whereupon, the Reporter read from the record
25 as requested.)

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BY MR. FLEISCHAKER:

Q The question is, What effect would incorporating the tau reduction have on the input into the re-analysis of equipment in the building?

A (Witness Lucio) That you would not get reliable information on what to excite the equipment with.

MRS. BOWERS: Mr. Fleischaker, I'm sorry to interrupt.

Does any party here have anyone who might be able to go to Western Union in San Luis Obispo to get a copy of the telegram that we just heard about? It's addressed to me here.

There isn't a Western Union in Avila Beach, is there?

MR. HOCH: It's at Western Union at San Luis Obispo?

MRS. BOWERS: I assume so.

MR. HOCH: We'll pick it up for you.

MRS. BOWERS: You might make a phone call first. In that way we'd have it this afternoon.

BY MR. FLEISCHAKER:

Q Let me ask this question, Dr. Trifunac:

You have indicated a preference for a different damping value to be used in the re-analysis of the containment building. What would be the effect of utilizing the

WRB/wb2

1. seven percent damping as opposed to the five percent
2. damping in re-analysis of the containment?

3. A (Witness Luco) Well, roughly speaking, in the
4. overall sense, the effect of seven versus five percent would
5. be to give you amplitudes of motions at different points in
6. the containment, and all the other results that result from
7. these amplitudes that are smaller than what you would get
8. if you were to have a lower value of structural damping.

9. Q Would use of the higher damping value affect
10. the input motion that is used in the analysis of equipment?

11. A Well, yes, just as well -- it affects the
12. whole picture.

13. Q Dr. Trifunac, I wanted to ask you a few
14. questions about the attachments that we have identified for
15. the record early in the direct examination.

16. First of all let me start with the most recent
17. submission to the ACRS, which is your June 8th, 1978 letter
18. that attaches several tables and a couple of figures and has
19. been identified for the record as Licensing Board Exhibit
20. No. 1, Attachment F, and ask you whether that submission
21. constitutes your current opinion?

22. A Yes.

23. Q Let me ask you, then, about the April 1978
24. submission which has been identified as Licensing Board
25. Exhibit No. 2, Attachment D. And I think we discussed all

WRB/wb3

1 this so we don't need to summarize any of it.

2 Does this constitute your current opinion?

3 A Essentially, yes.

4 Q Okay.

5 Let me turn to the submission that is entitled
6 "Comments on the SAM-V procedure for estimating peak
7 earthquake accelerations," which has been identified as
8 Licensing Board Exhibit No. 2, Attachment E. We haven't
9 talked about this, so let me ask you briefly to summarize
10 the conclusions contained in that submittal.

11 A I was asked by Mr. McKinley to provide a sum-
12 mary of my evaluation of the so-called SAM-IV and SAM-V
13 procedures by John Blume for estimating peak ground accelera-
14 tions as a function of magnitude and distance and site
15 conditions. And this report summarizes my view, which--

16 Do you want me to summarize the views?

17 Q Yes, if you can do that quickly.

18 A In summary, the equations are typical of the
19 kind you find in this work. They utilize a parameter,
20 $B\text{-bar}$, which is explained in some previous work but which
21 has never been supported by the data. And the output of
22 these results appear to be in considerable disagreement
23 with the majority of other published results in the sense
24 that it underestimates peak ground accelerations, depending
25 on the distance, by factors that could be characterized by

WRB/wb4

1 a range maybe between two and five, and that it is difficult
2 to answer why this is so. Because it is not possible to
3 find any, at least accessible to me, published work which
4 explains how B was assigned to the data that represented
5 the body for this analysis and regression procedure.

6 So that I was forced to conclude that there may be either
7 an error or a misinterpretation in how the data is utilized,
8 and the results that come out of this formula -- and by
9 'formula' I refer to SAM-IV and SAM-V procedure -- is biased
10 toward predicting smaller amplitudes of ground motion,
11 peak acceleration ground motion, than essentially all other
12 published work in the literature.

13 Q Does this represent your current opinion?

14 A Yes.

15 Q And we discussed, I think, the submission dated
16 September 30th, 1976, "Uniform Risk Absolute Acceleration
17 Spectra for the Diablo Canyon Site," which is marked as
18 Licensing Board Exhibit No. 2, Attachment J.

19 Does this represent your current opinion?

20 A This is difficult to answer because the question
21 is not precise.

22 This represents a summary of a limited part of
23 my opinion for use in other considerations. My opinion has
24 been, and still is, much broader than what is in that report.
25 I was forced to do this study in a very short period of time.

WRB/wb5

1 Inasmuch as this does not contradict any of my opinion now
2 it does not represent my opinion then or now, it is a part
3 of my opinion.

4 Q Let me ask you: In what way does it contradict
5 your current opinion?

6 A It does not contradict it. It does not cover
7 the complete set that represents my opinion at this time.

8 Q Okay.

9 The final submission has been noted as Licensing
10 Board Exhibit No. 2, Attachment G, and it consists really
11 of two documents. The first one is Comments and Recommenda-
12 tions for the Proposed Seismic Design Criteria for the Re-
13 evaluation of the Diablo Canyon Site. And that's dated
14 November 11th, 1976.

15 Let me ask you whether this-- First of all,
16 putting aside the recommendations, the substantive comments
17 in this paper-- Directing your attention to the substan-
18 tive comments, does this submission constitute your current
19 opinion; and, if not, can you indicate where you have a
20 different opinion?

21 A Essentially it does.

22 Q Now you have set forth some recommendations in
23 your comments, the recommendations on page 3 of the
24 November 11th, 1976 submission, and then there's a list of
25 recommendations that are set forth on the paper that's dated

WRB/wb6

1 12/7/76. Since that time -- that was two years ago -- a
2 substantial amount of work has been done. Things have
3 changed.

4 Let me ask you: What is your current view as
5 to the recommended analysis that would be necessary for a
6 valid re-analysis of the Diablo Canyon site?

7 A Well, some of the things I mention here have been
8 looked at, and so some of the things here would not be
9 necessary any more.

10 But I would still like to see a three-dimensional
11 site-structure analysis being done, with realistic conditions
12 and material properties, and so forth, and assuming vertical
13 and horizontal incident waves, so that the two can be com-
14 bined to envelope the overall response.

15 So I think that is No. 3. I would still like to
16 see that.

17 I would also like to see the last paragraph
18 one, which is to essentially expand on this idea of uniform
19 risk spectrum, because I believe that has certain properites
20 of at least partly insuring against future surprises of the
21 kind that are exemplified by Hosgri.

22 Q Dr. Luco has recommended an analysis of the
23 inelastic response of the facility. What is your opinion of
24 that recommendation?

25 A In general I think it is a good recommendation.

WRB/wb7

1 MR. FLEISCHAKER: At this time we would like to
2 move those exhibits that have been marked as Licensing
3 Board Exhibit No. 2, Attachment A, D, E, F, G and J into
4 evidence.

5 MRS. BOWERS: Mr. Tourtellotte?

6 MR. TOURTELLOTTE: No objection.

7 MR. NORTON: No objection.

8 MRS. BOWERS: Well the documents that you just
9 identified will be accepted into evidence.

XXXXXX

10 (Whereupon the documents referred to,
11 heretofore marked for identification
12 as Board Exhibit No. 2, Attachments
13 A, D, E, F, G and J, were received
14 in evidence.)

15 MR. FLEISCHAKER: I have no further direct
16 examination.

17 MR. NORTON: Mrs. Bowers, we'd like to take a
18 couple of minutes to discuss with counsel informally off the
19 record as to who to proceed with in terms of the cross-
20 examination. I have a feeling Dr. Trifunac's cross-examina-
21 tion may be considerably shorter than Dr. Lico's and we
22 might well be able to finish it this afternoon so that
23 Dr. Trifunac could get away. Otherwise he's going to have
24 to sit here for almost a day waiting to be cross-examined,
25 and it might make more sense to proceed that way.

WRB/wb8

1 So if you could give us a couple of minutes to
2 discuss it informally off the record we might be able to
3 reach some accord.

4 MRS. BOWERS: Fine. We'll recess.

5 (Recess)

6 MRS. BOWERS: Are you ready to begin?

7 MR. NORTON: Mrs. Bowers, we've discussed it,
8 and I guess the two gentlemen came together and one is going
9 to wait for the other in any event. So we will then proceed
10 as planned, with Dr. Luco, and do Dr. Trifunac tomorrow.

11 MRS. BOWERS: Fine.

12 CROSS-EXAMINATION

13 BY MR. FURBUSH:

14 Q Dr. Luco, are you the same Dr. Luco who appeared
15 here yesterday and earlier this morning and testified?

16 A (Witness Luco) I hope so.

17 Q I was hoping for a yes.

18 (Laughter)

19 MRS. BOWERS: What if he'd said no?

20 (Laughter)

21 BY MR. FURBUSH:

22 Q Dr. Luco, I take it that you have appeared here
23 as an expert witness and have given your opinion; is that
24 correct?

25 A (Witness Luco) Yes.

WRE/wb9

1 Q And that opinion, or opinions, is what the word
2 means, your opinion. You do not contend that what you have
3 said in each and every instance here is a fact, do you?

4 A It's a different opinion based on the information
5 that I have available.

6 Q Is it also an opinion based on your judgment,
7 your engineering judgment?

8 A To a degree, yes.

9 Q And you accept the proposition of engineering
10 judgment, do you not, that there is such a thing as engineer-
11 ing judgment?

12 A Yes.

13 Q And that engineering judgment performs a proper
14 role in analysis and evaluating structures?

15 A Well in engineering we are faced with situations
16 in which we do not have all the information we need. It is
17 something like a chain, if you want to think in those terms,
18 and we have some links. The links that are missing must be
19 put in there through use of judgment. But we cannot forget
20 the links that already exist.

21 Q The judgment depends, does it not, on the facts
22 available, the analysis available, as well as the experience
23 of the person exercising that judgment; is that not correct?

24 A Yes, to a degree. But I must emphasize that
25 certain pieces of information are available and we cannot

WRB/wb10

1 disregard the facts that we have.

2 Q But then when you look at different points or
3 bits of information that are available, different people
4 may evaluate the importance of that information to different
5 degrees; is that not correct?

6 A It is possible, yes.

7 Q Are there any links in this chain which you
8 mentioned before that do not involve judgment?

9 A We do not have a perfect complete knowledge of
10 the response of the structures during seismic excitation.
11 And under those conditions some degree of judgment is
12 required.

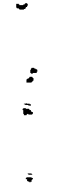
13 Q I may have to jump around a little bit, Dr. Luco,
14 because some of the things which you said are fresh in my
15 mind and I would like to get to them as early as possible.

16 It's my understanding that you accept the
17 existence of the so-called tau phenomenon.

18 A I explained that the phenomenon exists in
19 general. But the effects of the phenomenon depend on the
20 conditions of the particular case you are considering.

21 Q Yes. And you did testify, am I not correct,
22 that in your opinion the recordings made at the Hollywood
23 Storage facility indicated the existence of tau at that
24 site during the episode that was being recorded?

25 A What I said is that that is a possible explanation



WRB/wb 1

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and probably the most probable explanation.

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There is another possibility, and that is that the record in the free field was affected somehow by the presence of the structure. But that's a possibility. I tend to believe that the first alternative -- that is to say, that the reduction we observed in the basement is due to scattering of waves by the presence of the foundation.

Q And then the question of whether or not tau should be considered in the analysis of the Diablo Canyon plant depends on whether or not the conditions exist there which would permit the tau phenomenon to be experienced; is that correct?

A Correct.

Q And so therefore in essence any dispute which you have with someone who has used tau would be in the determination as to whether those conditions exist or not; is that correct?

A Yes. We must determine if the conditions are such that the tau effect would be significant or not at the site.

Q Now let's move over to something else which has some relationship to this.

You are aware of the soil-structure interaction study performed by Dr. Seed which is referred to in DL-3, are you not? As a matter of fact you commented on that, did

1 you not?

2 MR. FLEISCHAKER: Could I ask for a clarification,
3 if we're talking about 3A or 3B?

4 MR. FURBUSH: I was talking about 3A.

5 BY MR. FURBUSH:

6 Q My question was: You are aware of this study?
7 How about a Yes to that, Dr. Luco?

8 A (Witness Luco) Just a minute.

9 I'm not sure if that study was made by Dr. Seed
10 or not. There is no author under the title of the report.

11 Q Well you were aware of the soil-structure interaction
12 study that is referred to in DLL-3A, are you not?

13 A Well it is not a soil-structure interaction study,
14 it's just a comparison between the results of Dr. Seed with
15 one model and the results obtained by a different model, a
16 fixed base model.

17 Q I'm sorry; you say it is not a soil-structure
18 interaction model?

19 A No; what I said, it is not a soil-structure
20 interaction study; it is just a comparison between the results
21 obtained by Seed, including soil-structure interaction, and
22 the results obtained by a fixed base analysis of tan axis-
23 symmetric model of the structure on a rigid base.

24 Q All right.

25 Now the comparison is a comparison of what? A

1 comparison of results; is that what it is?

2 WRB/wb13 A There is a comparison there of response spectra
3 at a certain point. I'm not sure at which point it is.
4 Probably the top, or something like that.

5 The important consideration here is that the
6 structural models used in that comparison are not compatible.

7 Q I want to talk about that. That's what you said
8 in your letter, did you not?

9 A Yes.

10 Q --that they were not compatible.

11 Now what I want to find out is, What difference
12 does it make whether they're compatible or not when you are
13 comparing results?

14 A The objective of the Appendix DLL-3A was to
15 show that there was some soil-structure interaction effect
16 and that the response that you would obtain using a soil-
17 structure interaction model would be slightly lower, as
18 shown on the graph, than the response that you would obtain
19 using a fixed base model. But for that comparison to be
20 valid the structural models must be equivalent, they must
21 be consistent.

22 Q All right.

23 Well, what I want to find out is, Why, when you
24 are comparing results, the structural models must be con-
25 sistent? Because is it not what you are trying to determine

1 what will be the motion, the seismic motion, if you will,
2 at that particular point in the structure? Is that not the
3 purpose of the inquiry?

4 MR. FLEISCHAKER: I have an objection because
5 there are two questions pending.

6 MR. FURBUSH: Very well.

7 BY MR. FURBUSH:

8 Q Is not the purpose of the inquiry to determine
9 what the motion will be at a particular point in the struc-
10 ture?

11 A (Witness Luco) No. I don't know what the
12 purpose of this appendix was. The only thing I can infer
13 is from the title. It is called Comparison of Soil-
14 Structure Interaction Analysis and Fixed Base Analysis with
15 Tau filtered input. So the objectives of that report were
16 to determine the effects of soil-structure interactions.
17 And, if you want to do that, you must keep all parameters
18 the same.

19 Q Okay. Well let's look at it in another way,
20 then. Let's just look at it on comparing results, look at
21 the results at a certain level in the structure by one
22 analysis, and is it your testimony that another analysis has
23 to be entirely consistent with the first analysis before the
24 results have any validity from the second analysis?

25 A Well what I am saying is that the conclusion

1 arrived at in that appendix -- and I will read it:

2 "It may be concluded that the use of
3 tau filtered input with fixed base models as used
4 for seismic analysis of Diablo Canyon structures
5 is conservative."

6 To arrive at the conclusion you must determine
7 if the effects of soil-structure interaction for vertical
8 incident waves, no tau reduction for horizontally propagat-
9 ing waves, are higher.--

10 Q You are saying--

11 A Excuse me.

12 MRS. BOWERS: Let him finish.

13 WITNESS LUCO: --are lower than those you would
14 obtain from a fixed base analysis with the tau effect. In
15 that case the conclusion is valid.

16 Now to arrive at the conclusion you must main-
17 tain the same structural models; otherwise you are comparing
18 apples and oranges. That was what I wrote in my report to
19 the ACRS.

20 End WRBloom

21 WELandon fls

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BY MR. FURBUSH:

Q All right, this is where you lose me, because -- let's forget about whether you are trying to determine the existence of tau or not, but assuming that you have the fixed base model which was utilized there with tau in it, and you get certain results at a certain level in the structure, what difference does it make what other method you employ if you want to compare that with another -- compare the results with another method, assuming that the other method has integrity itself?

A But that's the whole thing, if I change the structural model, I can arrive at any conclusion I want. If I use a different structure in the soil-structure interaction analysis, I could get any result I want.

Q Well, you're saying neither one of them models the structure which is the subject of inquiry?

A I am saying that the two models are different, and that a comparison of this type that tends to pinpoint the effects of soil-structure interaction and the effects of tau is not valid, because you are comparing two different models.

If the only difference between the two models was that one included soil-structure interaction and the other did not, I would accept the results.

But that's not the case.

Q Well, I have a little difficulty here. You mean that answers always depend on the type of model that's



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wel 2

1 employed?

2 A Certainly they do.

3 Q And why is that? Because of assumptions and
4 engineering judgment that's employed?5 A No, not at all. If I took a one-storey structure
6 instead of a containment model, I am going to get a different
7 result.8 MRS. BOWERS: Just a minute. Mr. Nieberger, Mr.
9 Allison, would you mind going outside to have your conversation?

10 MR. ALLISON: Sorry.

11 BY MR. FURBUSH:

12 Q Well, in any event, it is your opinion that the
13 results of those two models, if you will, cannot be compared,
14 and results in this instance are the estimates of motion at
15 the same point in the structure? And you say that the
16 comparison cannot be made?17 A I must repeat that the objective of this report
18 was to isolate effect of the tau effect and to isolate the
19 effects of soil-structure interaction. That's my understanding
20 of the objective of this by the title.21 Now, that objective cannot be achieved by this sort
22 of comparison.23 Q All right. Then let's go back to what I thought
24 I was asking about, and that is this:

25 Let's forget about the objective that's specified

wel 3

1 in that report, DLI-3A, and let's just look at the motion at
2 the particular point in the structure that is referred to in
3 that report.

4 Now, directing your attention to that, do not the
5 two studies -- if you'll call them studies -- or two models
6 produce very similar motions at that particular level?

7 A That's not a valid comparison, and they could be
8 identical, they could be completely different, depending on
9 the difference between the structural models.

10 I presented a figure in my ACRS report where I
11 compare the fixed-base analysis with the soil-structure inter-
12 action analysis conducted by Dr. Seed, and this is Figure 3
13 in my report of May 30, 1978. There I consistently use the
14 results of Dr. Seed, the same structural model. And if you
15 look at the results there in that figure you will see that
16 they are quite a bit different.

17 Q Now, when you talk about consistent, is that
18 different from equivalent? YOU think the two models are not
19 equivalent?

20 A The two models are not equivalent. The resonant
21 frequencies for the two systems are different.

22 If you look at the structural model on fixed base,
23 used by Dr. Seed, the peak occurs at the frequencies slightly
24 higher than 5 hertz.

25 If you look -- I cannot tell very well here, but

wel 4

1 I checked this, and the frequencies -- well, the frequencies
2 were displaced. That means that the two models are not
3 equivalent.

4 Q Do you mean that the fundamental frequencies of
5 them are different?

6 A Yes.

7 Q And you believe that two different fundamental
8 frequencies were employed?

9 A I don't know whether it was employed, but the
10 two models are different if they have different resonant
11 frequencies.

12 Q Well, let me ask you this:

13 Does not soil-structure interaction always change
14 the frequency of a system?

15 A I am comparing two fixed-based analyses where there's
16 no soil-structure interaction. The fixed-base analysis
17 performed by Dr. Seed for the Applicant, and the fixed-base
18 analysis conducted by Dr. Blume for the Applicant. There is
19 no soil-structure interaction effect.

20 Q There is no soil-structure interaction effect in
21 Dr. Seed's?

22 A He did two calculations, one with soil-structure
23 interaction and one without soil-structure interaction.

24 Q Well, the one with. What about that comparison?

25 A We were not discussing that point. We were

wel 5

1 discussing if the two structural models were equivalent.

2 Q And --

3 A I am telling you that they are not equivalent,
4 because when you put them both on a rigid base the resonant
5 frequency is different.

6 Q Well, let me get this clear:

7 You are saying that Dr. Seed had a model, which
8 model was not affected in any way by soil-structure interaction,
9 which may have affected its frequency. You're saying that
10 that is what he did?

11 A I didn't say that. I said that he performed two
12 calculations, one in which he included soil-structure
13 interaction, and a second calculation in which he attempted
14 to exclude soil-structure interaction by considering an
15 extremely rigid soil.

16 Now, that he calls the fixed-base model. That
17 fixed-base model has a higher resonant frequency than the
18 fixed-base model employed by Dr. Blume.

19 If there was any residual soil-structure inter-
20 action effect left in Dr. Seed's calculation, the opposite
21 would occur. The frequency would have been lowered.

22 Q I'm a little bit confused now. Do you mean that
23 the comparison which is in this document is not between Dr.
24 Blume's study and Dr. Seed's?

25 A Which document are you referring to?

wel 6

1 Q DLL-3A.

2 A I said that I believe that's a comparison between
3 a fixed-base analysis, using an axisymmetric finite element
4 model and that's essentially Blume's analysis. The R curve
5 is for a soil-structure interaction analysis with a different
6 structural model performed by Dr. Seed.

7 Q And you're saying that the resonant frequency
8 of Dr. Seed's structure model was not affected by the soil
9 under that?

10 A I am not saying that.

11 Q Well, I thought you said the frequencies were
12 different between the two, and that the one in Dr. Seed's was
13 not affected by soil-structure interaction?

14 A I must repeat that Dr. Seed performed two calcula-
15 tions, one including soil-structure interaction, the other with
16 no soil-structure interaction.

17 And I am comparing the two results that do not
18 include soil-structure interaction. The fixed-base analysis
19 performed by Dr. Seed, with the fixed-base analysis performed
20 by Dr. Blume.

21 I compared both, and I see that the resonance
22 frequencies are different. That means that they used different
23 structural models.

24 Now, you don't need to ask me. You can go to the
25 report by Dr. Seed, and he concludes that there is no

wel 7

1 significant soil-structure interaction effect, that there is
2 no -- he doesn't state that, but that the motion at foundation
3 level is the same as in the free field. And that means that
4 there is no tau effect.

5 Q But, nevertheless, the results of his analysis
6 equal the results of Dr. Blume's analysis at the particular
7 level in the structure.

8 A But that comparison is not valid, because it uses
9 different structural models. If they had used the same
10 structural model, I would agree with you. But they did not.

11 Q Well, you are aware, are you not, that testimony
12 in this record indicates that Dr. Seed obtained the
13 frequencies from Dr. Blume?

14 A Well, I am just . . . maybe they plotted this
15 wrong in the figures that you provided me, but if I look in
16 that I see that the frequencies are different.

17 Q Well, in any event, that's your opinion, that
18 it's not a valid comparison?

19 A Indeed, it is not.

20 Q It is or is not your opinion?

21 A If you want to call everything an opinion, I think
22 that anybody that could look at those results would conclude
23 that you have two different structural models, and on that
24 basis the comparison is not valid.

25 If you want to call it my opinion, all right.

1 wel 8 1 Q Is it your testimony, then, that any educated
2 structural engineer familiar with this field would come to
3 the same conclusion that you have come to?

4 A The natural frequencies for the two fixed-base
5 analyses are different. That can only mean one thing. If
6 they used the same input, and both are linear analyses, it
7 can only mean that they have different structural models.

8 Q I will ask the question again:

9 Is it your testimony that any educated structural
10 engineer would come to the same conclusion that you've come
11 to, and express the same opinion that you've expressed?

12 MR. FLEISCHAKER: I object on the basis of
13 relevance.

14 MR. FURBUSH: Well, I want to find out whether this
15 is an independent -- Mrs. Chairwoman, I would like to find
16 out whether this is an independent opinion, or whether he
17 believes it is a universally accepted proposition.

18 MR. FLEISCHAKER: Well, I recall, just to respond
19 to that, that on many occasions I heard the argument that this
20 isn't a popularity contest, and I would tend to agree with
21 that.

22 So I think the question is irrelevant, and object
23 to it on that basis.

24 MRS. BOWERS: There have been questions allowed in
25 the area of, Does the scientific community generally adopt

wel 9 1 this theory or that theory?

2 (The Board conferring.)

3 MR. TOURTELLOTTE: Mrs. Bowers, as I understand
4 the question, the question is designed to elicit information
5 from this witness which would indicate what weight might be
6 given. Because if it is a universal fact then it would be
7 given more weight than that of an opinion. Even though an
8 opinion is not certainly without weight, it would not have
9 the same weight.

10 I think it is a legitimate question and deserves
11 a fairly direct response.

12 (The Board conferring.)

13 MRS. BOWERS: The Board finds the question
14 objectionable in form, and for that reason the objection is
15 sustained.

16 We do think it's appropriate to ask Dr. Luco if
17 this is a matter that has been considered in the scientific
18 community, and does he know if there's general support in
19 the scientific community for his opinion.

20 There have been an awful lot of questions on this
21 so far.

22 BY MR. FURBUSH:

23 Q Is this a generally accepted principle?

24 A Which one?

25 Q The principle that you're alleging here?

wel 10 1 A Could you . . .

2 Q Well, I take it the principle is that this type
3 of study -- these two types of studies are not comparable,
4 and, therefore, the results have no validity.

5 A I am not trying to make any philosophical point.
6 There is a conclusion in that report. In my view, that
7 conclusion is not valid because it's based on a comparison
8 of two different systems.

9 That's my opinion. I will not speak for other
10 engineers. I just express my hope that if they look at two
11 systems that have different frequencies, they will agree with
12 me that the systems are different.

13 Q All right.

14 Now, did Dr. Seed perform any other soil-structure
15 interaction studies with different types of models, structural
16 models?

17 A I don't know what studies he performed, except
18 for what appear here in Appendix DLL-3B, and in the more
19 recent report entitled, "Analysis of Soil-Structure Interaction
20 Effects During Earthquake for the Diablo Canyon Nuclear Power
21 Station."

22 Q And would you think that those results are
23 comparable to the Blume type study? Can they be compared,
24 or do they have the same defect that you allege exists in the
25 other comparison?

wel 11

1 A I think that the analysis that Dr. Seed conducted
2 in Appendix DLL-3B -- and here I assume that he performed that
3 analysis. Again, there is no indication of author. That
4 analysis is consistent. What he did in there, he took the
5 same structural model, and he obtained the response with
6 soil-structure interaction and without soil-structure
7 interaction.

8 I have no problem with that. That is a consistent
9 analysis.

10 Q Did he obtain results at any particular levels?

11 A I see two figures here describing some results,
12 yes.

13 Q Well, do you know whether or not those results
14 are close to those obtained by Dr. Blume on the basis of his
15 model?

16 MR. FLEISCHAKER: For the record, can we get some
17 specificity with respect to the results that we're talking
18 about?

19 MR. FURBUSH: I'm talking about the results that
20 Dr. Luco is referring to.

21 WITNESS LUCO: Again, it depends on what you're
22 trying to establish.

23 If you're trying to establish that the effects of
24 soil-structure interaction are or are not important, that the
25 tau effects are or are not important, when you do that you

wel 12

must keep the remaining aspects of the models fixed.

And that's what Dr. Seed has done, and the comparisons that you see in Figure 3B number 2, and 3B number 3, show that in one case the rigid base analysis gives slightly higher response. That's for the containment exterior. And that rigid base analysis does not include the tau effect.

In the next figure, Figure 3B-3, you see that the soil-structure interaction results are slightly higher than those obtained in the rigid base, without any tau reduction.

If you were to apply a tau reduction, then what you would find is that the soil-structure interaction results would be higher than those on the rigid base with tau correction.

Q Then it's your understanding that Dr. Seed, on the basis of his studies, would not confirm the results of Dr. Blume's analysis, is that correct?

A I cannot speak for Dr. Seed. All I have in front of me is what he wrote.

Q Well, I'm trying to get your interpretation. That's all I'm asking about. Not -- is it your interpretation or understanding that Dr. Seed would not confirm what Dr. Blume did?

A I would not try to interpret his opinion. I will just go by what he has written.

Q Have you had a chance to review the most recent

wel 13

1 study of Dr. Seed?

2 A As I said before, this document was not distributed,
3 or at least I didn't receive it . . .

4 MRS. BOWERS: Are you talking about Joint
5 Intervenors' 58 dated July 7?

6 MR. FURBUSH: Yes, Mrs. Bowers, we are.

7 WITNESS LUCO: Yes.

8 I did not receive this document before the last
9 ACRS meeting of July. Later on I received a copy, and I
10 read through the paper.

11 BY MR. FURBUSH:

12 Q Does it add anything to what we've been talking
13 about here for the last few minutes?

14 A Yes, and I quoted that this morning.

15 Q What's the relevant portion, in your estimation?

16 A Give me a minute to find it here.

17 (Pause.)

18 Well, in the conclusions -- and I will quote again,
19 Seed and Lysmer state:

20 "Essentially similar values of response are
21 obtained for this site whether the base motions
22 are considered to consist of a system of
23 vertically propagated shear and compression waves,
24 or a system of horizontally propagating Rayleigh
25 waves, and except for a small increase in rocking

1 which affects the outer edges of the foundation
2 slab, the computed responses are essentially
3 similar to those computed for a rigid-base
4 analysis where the control motions are used
5 directly as base excitations for the structure."

6 The control motion that he used had a peak
7 acceleration of .75 g. That means it had no correction for
8 tau effect.

9 So my interpretation of that conclusion is that
10 whether you put vertically incident shear waves, or horizon-
11 tally propagated Rayleigh waves, you get essentially the
12 same result as you would get from a rigid-base analysis using
13 the free-field motion with no correction for tau effect.

14 The implications are two:

15 (1) The effects of soil-structure interaction are
16 not important;

17 (2) There is no tau effect, no significant tau
18 effect, for vertically incident waves, there is no significant
19 tau effect for horizontally propagating waves.

20 And this is the work of your consultant.

21 Q So you are interpreting Dr. Seed's and Dr. Lysmer's
22 study as indicating that Dr. Blume's analysis, which includes
23 tau, as being incorrect? Is that your interpretation?

24 A I think it is very -- to make any comparison, we
25 must remain within a consistent system. And Seed and Lysmer



wel 15

1 have used a consistent system. They kept the structure the .
2 same. And their conclusion is that there is no significant
3 soil-structure interaction effect, and that there is no
4 significant tau effect. That's all I am saying.

5 Q Do you agree with the methodology employed in that
6 study?

7 A I would -- my own preference would be a different
8 type of analysis, but --

9 Q It's a recognized method, though?

10 A Oh, yes, it's a standard method.

11 Q I want to change the subject for a moment and go
12 to the --

13 MR. FLEISCHAKER: Excuse me a moment. Is this a
14 good time for the afternoon break?

15 MR. FURBUSH: Yes.

16 (Laughter.)

17 MRS. BOWERS: You people will use any excuse to
18 have a break.

19 (Laughter.)

20 We'll have a ten-minute recess, then.

21 (Recess.)

22 Madelon
23 fls

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4 Madelon 1 MRS. BOWERS: We'd like to resume.

2 BY MR. FURBUSH:

3 Q Dr. Luco, could you direct your attention to the
4 material study of the Olive View Hospital which you referred
5 to?

6 MR. FLEISCHAKER: I'm not sure Dr. Luco has a
7 copy of that in front of him. I have a copy, I think.

8 WITNESS LUCO: Excuse me, I'm trying to find it.

9 MR. FURBUSH: This was the one that was Bertexo,
10 Mahim and Herrera, the three co-authors, or tri-authors.

11 WITNESS LUCO: Yes, I have it now.

12 BY MR. FURBUSH:

13 Q Now are you familiar with a much more detailed
14 report which was prepared by Dr. Mahim and Bertero, which
15 was the Response of the Olive View Hospital Main Building
16 During the San Fernando Earthquake, a rather extensive docu-
17 ment?

18 A (Witness Luco) I haven't read that report.

19 Q Okay. Thank you.

20 It's a rather large document; as you'll probably
21 recall.

22 Now I'll have to confess -- and I don't want you
23 to attribute the confusion which I'm going to express to you
24 now to any of our consultants, but just attribute it to the
25 Counsel.

-mpb2

1 I have a very difficult time in understanding
2 your interpretation of the study which you referred to in
3 your letter. And that letter was the letter of September 22,
4 1978.

5 MRS. BOWERS: Which is marked Board number 2-C.

6 MR. FURBUSH: 2-C, that's correct.

7 BY MR. FURBUSH:

8 Q Now let me ask a series of questions and see if
9 we can clear up my confusion.

10 It's my understanding -- and perhaps just because
11 of some difficulty with the English language that I have, at
12 least in reading it, on page 32, which is actually the second
13 page of this study, they indicate that the derived Pacoima Dam
14 record shows that the high peak accelerations registered at
15 Pacoima Dam after six seconds may not be characteristic of
16 ground motions experienced at other nearby sites.

17 Now is that not what they say on page 32 of that?

18 MR. FLEISCHAKER: Could we have a more specific --

19 MR. FURBUSH: Well, it's the second page of their
20 study below Figure 1.

21 MR. FLEISCHAKER: Thank you.

22 WITNESS LUCO: There is a statement to that
23 effect in the paper, yes.

24 BY MR. FURBUSH:

25 Q So that indicates that their conclusions at least

mpb3

1 were that the Pacoima Dam record was not characteristic of
2 the ground motions experienced at other nearby sites, i.e.,
3 that it was higher than experienced at other sites, is that
4 not correct, for the last six seconds -- I'm sorry, after six
5 seconds, subsequent to six seconds.

6 A (Witness Luco) Just a minute. I cannot find any
7 reference to six seconds.

8 MRS. BOWERS: Do you have the page?

9 MR. FURBUSH: Yes, it's the second page. It's
10 the first sentence below Figure 1.

11 WITNESS LUCO: Okay.

12 The authors indicate that it may not be
13 characteristic of ground motion experienced at nearby sites,
14 yes, they say that.

15 BY MR. FURBUSH:

16 Q Yes, and of course the derived Pacoima Dam
17 record showed lower peak accelerations, didn't it?

18 A (Witness Luco) Yes.

19 What they called derived Pacoima Dam records
20 at the lower peak acceleration, I don't recall the exact
21 value, maybe .8g or something like that.

22 Q .4? Would .4 sound respectable?

23 MR. FLEISCHAKER: At this point I think that if
24 we're going to do more cross-examination or some detailed
25 cross-examination on the basis of this it might be well to

mpb4

1 give the witness a short amount of time to review the article.
2 We've done that a number of times.

3 MR. FURBUSH: Do you have copies you'd like to
4 put in?

5 MR. FLEISCHAKER: No, that's not what I said.
6 I simply am asking -- I'd like to request the Board that the
7 witness be given time to review, to scan the article if
8 Counsel is going to engage in further cross-examination on
9 this article.

10 MR. FURBUSH: Well, but the direct testimony
11 contains this letter of Dr. Luco which makes certain statements.
12 And we assume he prepared for the direct testimony before
13 he came.

14 I'm speaking to the Board now. I should have
15 used a little different tone.

16 (laughter.)

17 MRS. BOWERS: Well, the witness I think had a
18 copy with him, or was it Dr. Trifunac?

19 Can you tell us if you've reviewed it very recently
20 and feel you are familiar with it?

21 WITNESS LUCO: I certainly read the paper carefully
22 when I wrote my comments, and those were mailed in September
23 of last year.

24 MRS. BOWERS: Do you think you need a few minutes
25 to go through it?

epb5

1 WITNESS LUCO: If the question is very specific
2 and I can find it here, I have no trouble.

3 MRS. BOWERS: Well, why don't we proceed.

4 And, Mr. Furbush, if you'll identify the page
5 we won't waste time.

6 MR. FURBUSH: Thank you. I will.

7 BY MR. FURBUSH:

8 Q Now the reason I asked that question, of course,
9 is because in your letter you said, "Since the observed" --
10 and I am referring to the second page of your comments on the
11 meeting of 6/14/78, regarding Diablo Canyon Nuclear Power
12 Plant, which was an attachment to your letter of September 22
13 which I believe is identified as Attachment C.

14 Now the last page, which is the second page,
15 reads in part as follows:

16 "Since the observed permanent drifts
17 were in excess of 30 inches it seemed that the
18 peak acceleration at the site of the Olive View
19 Hospital was not significantly lower than that
20 recorded at Pacoima Dam."

21 A (Witness Lucio) Yes, I wrote that.

22 Q Now, first, do you consider that the sentence
23 to which I called your attention a moment ago would indicate
24 that you might have been in error when you wrote that letter?

25 A No. When I wrote that -- that last comment is my



mpb6

1 opinion. It's not in quotes. There are portions of the
2 paper that I referred to in the letter that are in quotes.

3 Q I see.

4 But in any event, on the basis of their study
5 which indicates that the peak acceleration was not what was
6 recorded at the Pacoima Dam, rather that the derived Pacoima
7 Dam record was more accurate, nevertheless you believe that
8 the paper supports the peak acceleration of the Pacoima Dam
9 record.

10 MR. FLEISCHAKER: Can I have that read back,
11 please?

12 (Whereupon, the Reporter read from the record
13 as requested.)

14 MR. FLEISCHAKER: I'm going to object to that
15 question because I think it's ambiguous. I don't understand
16 it at all.

17 MR. FURBUSH: I'll rephrase it.

18 BY MR. FURBUSH:

19 Q Do you believe that this paper supports your
20 conclusion that the Pacoima Dam record is a correct --
21 correctly records the ground motion in vicinities near the
22 Pacoima Dam?

23 A (Witness Luco) Well, I will stand by what they
24 wrote.

25 In my opinion this results, and I was referring

mpb7

1 there to the comparisons between the calculated permanent
2 displacement and the observed displacement indicate that
3 the Pacoima records are representative of the motion in the
4 near fault region, and that the USGS recommendation of a peak
5 acceleration of 1.15 is not excessive for a 7.5 magnitude
6 earthquake.

7 Q Let me ask you this:

8 On the basis of your experience and education
9 and review of this paper, is it your conclusion that that
10 permanent drift is attributed by the authors of that paper
11 to a peak acceleration?

12 A Certainly it is not.

13 Q What is it attributed to?

14 A It is attributed to a large velocity pulse.
15 However, to obtain the derived Pacoima Dam record they have
16 filtered the high frequencies to a much higher degree than
17 the lower frequencies. That means that to explain the
18 permanent drift they need a higher velocity pulse.

19 Now since they have filtered the high frequencies
20 to a higher degree than the intermediate frequencies, my
21 conclusion is that the peak acceleration should be much
22 higher than the one they considered here of a .4g.

23 Q Well, you have before you, do you not, the
24 Pacoima Dam record, which is on the second page?

25 A Yes.

mpb8

1 Q Now, were those velocities, those peak velocities
2 the high velocities? Did they come at the same time as the
3 peak acceleration?

4 A I am not referring to that.

5 Q Well, I thought the permanent drift was attributed
6 to high velocities which were at the early part of the record.

7 A Yes.

8 Q And rather lengthy pulses, is that not right?

9 A Yes.

10 Q Now that occurred much earlier than the peak
11 accelerations, did they not?

12 A Yes. But in the calculations they used the
13 derived Pacoima Dam record, and that is obtained by some
14 filtering. The filtering affects the higher frequencies to
15 a higher degree than the frequencies at which the velocity
16 pulse is present.

17 You can see by comparing the two figures there
18 that the Pacoima record has a peak velocity of 46.4 inches
19 per second. The derived record has a peak velocity of 42.1.
20 So there was a very slight change in peak velocity.

21 There was a tremendous change in peak acceleration.

22 Now, to explain the observed permanent displacement
23 they need a higher peak velocity. That means that they filtered
24 the original records too strongly. If they removed that
25 filtering, the high frequency portion is going to move up much

mpb9

1 more than the frequencies involved with that velocity pulse.

2 Q Well, you disagree with the authors of the paper,
3 then, in the way they did it.

4 A I don't believe they derived the Pacoima Dam
5 -- the derived Pacoima Dam record. I think that that was
6 taken from some of our publications. They referred to the
7 work of Raimann.

8 Q And what do they say above Figure 1?

9 "It should be noted that the derived record
10 was based on erroneous orientation initially report-
11 ed for the PD record."

12 And then it goes on and says:

13 "However, it is believed that this error
14 does not materially affect the basic character-
15 istics of the derived motion."

16 A Yes.

17 Q Do you believe that -- well, you're relying on
18 the paper. Now do you accept the paper and the conclusion of
19 the authors, or don't you accept them?

20 A I don't have to accept every statement in the paper.

21 I believe that they have done a good analysis of
22 inelastic response, and that's what they have used. I don't
23 think that we have at the present time accurate methods to
24 correct the Pacoima Dam record for the effect of the reach,
25 if any.

mpb10

1 The methods that we have at the present time are
2 limited in frequencies. We cannot go to very high frequencies.
3 So any calculation of a derived Pacoima Dam record is not
4 necessarily accurate because the methods simply do not permit
5 you to do that at the present time.

6 So I do not agree with that first portion of the
7 paper. I do agree with the inelastic analysis that they
8 have performed, and those are independent.

9 Q Well, but you were using the paper for the
10 proposition that the permanent drift which was observed
11 indicates that the peak accelerations recorded at the
12 Pacoima Dam were an accurate representation of the motion
13 at Olive View Hospital, are you not?

14 A What I am saying is, that the motion at the
15 hospital probably had peak accelerations higher than .8g.

16 Q Higher than what?

17 A Higher than .8g. Otherwise you cannot explain
18 the observations.

19 Q Well, let me ask you this, as a structural
20 engineer:

21 Could the higher displacement of 30 inches come
22 from the longer duration pulse of 4g rather than a higher
23 amplitude pulse of the same duration?

24 A I'm sorry --

25 Q .4g.



mpb11 1 Could the higher displacement of 30 inches come
2 from a longer duration pulse of .4g?

3 A When we go into the inelastic range the response
4 depends on many many factors, and one is the individual
5 duration of the pulses. The amplitude of the velocity
6 pulses and the total duration of the record, and how the
7 different pulses succeed each other.

8 Q Well, isn't that the real subject of this
9 paper, that the pulses cause -- read the summary:

10 "Long duration acceleration pulses which
11 result in unusually large ground velocity incre-
12 ments..."

13 A I have no problem with that.

14 Q Well, you have no problem with it, but does that
15 substantiate the proposition that the peak acceleration
16 recorded at the Pacoima Dam was also experienced at the
17 Olive View Hospital?

18 A I gave you the reason why I believe that.

19 Q All right.

20 But you do not get that out of this paper, do
21 you, because the paper would indicate the opposite.

22 A It would not. The paper does not.

23 Q Well, do you believe the Bertero paper tells us
24 the amplitude of peak accelerations at Olive View?

25 A I believe that the results in the report suggest

mpb12

1 that the peak accelerations there were higher than .8g.
2 What actually you need is an increase in the velocity pulse,
3 but to reach that -- and since the derived Pacoima Dam record
4 has been obtained by filtering -- if you want to increase that
5 pulse you will have to increase the high frequency to a higher
6 degree. And that in my view implies that the peak accelera-
7 tion would have to increase much more than the peak velocity.

8 Q Dr. Luco, did you say something earlier today or
9 yesterday about Olive View Hospital and soil-structure inter-
10 action? My memory is not too accurate on this. I thought
11 you said something about soil-structure interaction and the
12 effect at the Olive View Hospital. If you didn't, say you
13 didn't because it will clear it up for me.

14 A I don't recall saying that. I may have confused
15 names. Maybe I was referring to the Hollywood Storage
16 Building.

17 Without having a record -- I don't believe I did.

18 Q All right, because you don't believe there is
19 any sort of a soil-structure interaction effect at the Olive
20 View Hospital, do you?

21 A I have not said that.

22 Q Well, was there one or not? Do you have any idea?

23 A I am trying to remember the soil information.

24 Q Would that make any difference, the soil informa-
25 tion?

mpb13

1

A Pardon me?

2

Q Would the soil information make any difference

3

for the Olive View Hospital?

4

A Well, you asked me a question whether there was

5

soil-structure interaction effects or not, and to answer that

6

question I need the information about the soil properties.

7

And I do not recall those soil properties.

8

Q What would the effect be of the foundation? Was

9

it not a different type of foundation at Olive View?

10

MR. FLEISCHAKER: Objection.

11

The question is ambiguous and different from what--

12

BY MR. FURBUSH:

13

Q Well, different from the usual type you utilize

14

when you're making a soil-structure interaction study.

15

A (Witness Luco) I do not recall enough details

16

about the foundation to answer that question.

17

Q Would you assume for the moment that the Olive

18

View Hospital was located at the foot of the San Gabriel

19

Mountains on an alluvial fan of sand and gravel deposits

20

from the Wilson Canyon, would you take that assumption?

21

A Okay.

22

Q Now would there be soil-structure interaction?

23

A That's not enough. I need some estimates of the

24

velocities and so on.

25

The structure had three towers -- four, pardon me.

mob14 1 Three of them collapsed. The fourth one remained inclined.

2 I visited the site after the earthquake. Someone
3 in there mentioned to me that the foundation material on that
4 side of the building, on that side of the building, was
5 different from the one on the other side. And actually that
6 tower I believe was directly founded on the soil, on a harder
7 soil. The other towers were supported on beams, supported by
8 beams, basement beams.

9 So based on that I believe that the properties of
10 the foundation material under the site varied significantly
11 from point to point. But, again, I do not recall all of the
12 detailed information.

13 Q Well, that was probably a digression because my
14 memory may have been wrong. I thought you referred to soil-
15 structure interaction, but obviously you haven't studied
16 it.

17 Now just so that the record is very clear on
18 this, the Diablo Canyon structures are not of the same type
19 as those at the Olive View Hospital, are they?

20 A I have not said that they are of the same type.
21 They are not.

22 Q They are not.

23 And wasn't one of the great problems with the
24 Olive View Hospital that a mechanism developed in the structure?
25 You must accept the fact that what I'm using here is a word

mpbl5 1 which was told to me in passing the other day, so this
2 mechanism which is of a hinge-like nature in a moment resisting
3 frame is something which you'll have to go into detail on if
4 it's important.

5 A Well, the columns at the first floor level
6 experience very large inelastic deformation. I believe that's
7 what you were referring to.

8 Q And that's what caused this permanent drift to
9 which you refer, is it not?

10 A Yes.

11 Q And that type of motion is caused by the pulses
12 which get -- which have an effect on the motion of that
13 -- of the frequency of the structure, is that not right?

14 A In this particular case the large velocity pulse
15 may account in part for that.

16 Q In other words, the duration of the ground motion
17 pulses relative to structure, period of vibration is a very
18 important ingredient to consider, is it not?

19 A There are many factors. The lengths of the
20 different pulses, the amplitude of the different pulses, the
21 sequence of pulses, and the total duration of the record.

22 Q Well, as a matter of fact you could have zero
23 acceleration after four seconds on that record, and you could
24 have had the same damage at Olive View, could you not have?

25 A I have not done the calculation. I could not tell.

mpb16

1 Q Well, what would you say when you look at that
2 record?. Look at the velocities in the first four seconds.
3 Wouldn't you say that's when the damage occurred?

4 A I see one large velocity pulse followed by several
5 long velocity pulses that have smaller amplitudes.

6 But if you were to set accelerations to zero,
7 those velocities would not be there, and they may have contri-
8 buted to the observed effect.

9 Q Well, Let's move along, then.

10 Do you know whether or not Diablo Canyon has been
11 designed to withstand large velocity pulses?

12 A No inelastic analysis has been made or reported.
13 And so that hypothesis has not been tested.

14 Q Let's talk about inelastic analysis for a moment.

15 Is it your opinion that an inelastic analysis on
16 the base of the present state of the art of inelastic analysis
17 will give you more reliable information than an elastic
18 analysis pushed up to high accelerations?

19 MR. FLEISCHAKER: I have to object to that ques-
20 tion because it's ambiguous. I don't understand the term
21 "pushed up to high accelerations".

22 MR. FURBUSH: Well, then, we'll change it. We'll
23 take out "pushed up".

24 BY MR. FURBUSH:

25 Q In an elastic analysis coupled with judgment --



mpb17

1

MR. FLEISCHAKER: . Could we have the question back?

2

MR. FURBUSH: I will restate it.

3

BY MR. FURBUSH:

4

Q Is it your opinion based on the present state of

5

the art of inelastic analysis that such an analysis, inelastic

6

analysis, would give you more reliable information than an

7

elastic analysis coupled with judgment?

8

A (Witness Luco) It depends on the judgment. You

9

have to give me more information. The judgment implies that

10

the input to the elastic analysis would be higher, that it

11

would be lower--

12

Q That it would be higher, and in the elastic analysis

13

is showing that you're going to yield.

14

A I still don't understand the question.

15

You have an inelastic analysis --

16

Q No, you don't have an inelastic analysis, you have

17

an elastic analysis.

18

A You have an elastic analysis.

19

Q An elastic analysis technique.

20

A And then what input do you use?

21

Q Well, you use a high input.

22

A Higher than the one you would use for the in-

23

elastic analysis?

24

Q Than inelastic?

25

A No.

mpb18

1

Q No, no, I'm using --

2

A Well, it's impossible for me to answer that unless

3

you specify precisely what you mean.

4

Q Well, what is the state of the art of an inelastic

5

analysis at the present time?

6

A I have done very little work on non -- inelastic

7

analysis and I don't believe I am qualified to answer that in

8

general.

9

I believe that you can find expertise, and here

10

you have an example, the analysis of the Olive View Hospital,

11

so that it can be done. Perhaps I cannot, but....

12

Q Well, we got into this discussion on another

13

occasion on the inelastic field or range by your statements

14

that the Diablo Canyon structure would go into the inelastic

15

range on the basis of a 7.5 Hosgri event.

16

A Yes, that's what the calculations presented by the

17

Applicant indicate.

18

Q Well, and at the time of the deposition -- I'd

19

like to be specific about that.

20

When you say the calculations you mean at some

21

points the calculations indicated that the structures would go

22

into the inelastic range.

23

A Yes.

24

Q At some points.

25

A Yes.

mcb19

1 Q And then you take that to mean that the entire
2 structures, all other points of the structures will go into
3 the inelastic range?

4 A I said that it would go beyond the elastic range
5 at some point.

6 Q At some point. That's just what I want to get
7 clear here.

8 You're not talking about everywhere?

9 A If you exceed slightly the peak acceleration
10 values used in the analysis, if you exceed those peak accelera-
11 tions by a considerable margin, then the inelastic or the
12 situations where inelastic behavior occurs will be more
13 extent.

14 Q Do you have any idea of how much more that would
15 be?

16 A No. No analysis has been presented.

17 Q Well, now, when we talk about the inelastic analy-
18 sis, what do you mean when you discuss it in these terms?
19 The moment you get into inelastic analysis you have trouble
20 with the structure, structural difficulties with it?

21 A I didn't say that. I said that the structures
22 may go into the inelastic range, and it is possible that
23 they will experience some permanent deformation depending on
24 the type of excitation that you have, and that must be
25 analyzed carefully.

mpb20

1 I think I was specific in saying that by going
2 inelastic that didn't imply necessarily that the structure
3 would collapse or anything like that. It is simply that they
4 will go into a different type of behavior and that that
5 behavior has not been analyzed.

6 I am particularly concerned about ducts connecting
7 different structures where relative displacement could be
8 important. I am concerned about the turbine building where
9 you have two different types of materials. You have steel and
10 you have concrete shear walls. If there is a significant
11 deformation of the more flexible portions, steel, that could
12 compromise the effectiveness of the shear walls.

13 So in my opinion a careful inelastic analysis must
14 be made, and those issues must be addressed.

15 and Madelon.
16 WRB1com Elws
17 (1E)
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WRB/wbl
s Madelon

Q Now you do, obviously do, but let's just do it for the record, draw a distinction between inelastic and failure.

A Certainly I do. I must repeat again that by the fact that the structures go into the inelastic range does not necessarily imply failure or collapse. I am just stating that by the use of an effective acceleration and by the use of a tau effect that in my opinion are not justified, that analysis has been by-passed.

It may be that after the analysis is made it will be found that everything is acceptable.

Q And on the basis of your experience it is your opinion, is it not, that there is a great deal of strength left in a structure even when it goes into the inelastic range prior to failure?

A I don't really understand what you mean.

We'll go back to the previous question. And I state again that purely by going into the inelastic range that that does not necessarily mean failure.

Q Do you have any idea of how much additional strength is left in the structure when it moves into the inelastic range, as a general proposition? There are those who have made estimates, are there not?

A I don't know.

Q But you don't have any opinion?



1

2

3



4

5

6



1 A No.

WRB/wb2

2 Q Well, now I would like to go into an area
3 which really has to do with your understanding of what
4 others have done, because a lot of your testimony is
5 based on other studies.

6 Now it's my understanding that one of the reasons
7 that you utilize, or rely upon for your statement that you
8 believe that the free field acceleration of 1.15 is a proper
9 acceleration for the Diablo site are the studies of
10 Dr. Trifunac; is that correct? --that you rely on them?

11 A That's one study. The other is provided in
12 Circular 672.

13 Q Now are you aware, or have you read the
14 critique, if you will, of Dr. Trifunac's attenuation
15 correlations which was prepared by Dr. Cornell and included
16 in the record as D-24?

17 MR. FLEISCHAKER: Can I have a minute to get it
18 out?

19 MR. FURBUSH: It's DLL-24D.

20 MR. FLEISCHAKER: I think the witness might have
21 that before him.

22 WITNESS LUCO: I read that appendix several
23 months ago. I don't know if I have a copy of it.

24 MR. FLEISCHAKER: Can we have a moment? We
25 have an extra copy here we can provide to the witness.

1 WITNESS LUCO: What's the number?

WRB/wb3

2 MR. FLEISCHAKER: 24.

3 MRS. BOWERS: Do you want a few minutes?

4 WITNESS LUCO: If you're going to go into -- if
5 you are going to address this report in some detail I
6 would need some time to review it.

7 BY MR. FURBUSH:

8 Q What I was going to ask you is: Doesn't
9 Dr. Cornell indicate that perhaps Dr. Trifunac's attenua-
10 tion laws result in higher accelerations for close-in
11 sites --

12 A (Witness Lucio) I do not recall. I would have
13 to read it.

14 Q --than would be reasonable?

15 MRS. BOWERS: Is it a long article?

16 MR. FURBUSH: One of the purposes of this
17 question is -- I don't think it's necessary to go into it.
18 I just wanted to see whether Dr. Lucio has reviewed the
19 literature and material which conflicts with some of the
20 opinions that he has to properly evaluate the other side of
21 the coin.

22 MR. FLEISCHAKER: Do we have a question?

23 MR. FURBUSH: My question is-- That's what I'm
24 trying to get at here. And if he hasn't reviewed it I think
25 we have already determined that he hasn't -- that he does not



1 have any definite views on the subject.

2 WITNESS LUCO: I stated that I read the report
3 several months ago, but I am not prepared to go into the
4 report in detail without having time to read it.

5 BY MR. FURBUSH:

6 Q Well, then, let's not go into it in detail, then,
7 now. Let's talk about your understanding of Dr. Trifunac's
8 work.

9 Now is it not correct that those correlations
10 are based on a great deal of data at 40 kilometers and
11 greater?

12 A (Witness Lucio) There is a large number of data
13 within that range, yes.

14 Q And that correlations between magnitude and
15 peak acceleration were determined by the data located in that
16 range?

17 A Not only in that range. There was some data at
18 shorter distances, namely, the San Fernando data, and other
19 earthquakes that I do not recall. And there was some data
20 at higher distances.

21 Q Have you ever taken the correlations, plotted --
22 or taken the plots which were the basis for the correlations,
23 extended that inward to the episode -- and I guess in this
24 instance is it the epicenter that he's utilizing?

25 A The epicenter.

WRB/wb5

Q --the epicenter where the episode occurred, and reviewed the shape of that curve and compared it with one which was made with all of the close data regardless of magnitude, all the close site data?

MR. FLEISCHAKER: I'm going to object to the form of the question, in that it's ambiguous. Because in the first part of the question there was a reference to plots, and I would like to object to the question because that's not sufficiently specific.

I would like the questioner to identify what plots he's talking about.

MR. FURBUSH: Well I asked him if he ever plotted them.

MRS. BOWERS: Well the objection is sustained. Plotted what against what?

BY MR. FURBUSH:

Q Did you ever plot the curves which are the correlation curves which he gets from this? Did you ever plot them and then compare them?

A (Witness Luco) I have not plotted them. I have calculated once the values that I would obtain for peak acceleration at different epicentral distances. But I have not plotted that.

Q Did you ever consider the alternative procedures which were -- you might get from the data presented by Hanks



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1 and Johnston?

2 WRB/wb6

3 MR. FLEISCHAKER: Again an objection to the
4 form of the question in that it's ambiguous. The question
5 fails to identify what data of Hanks and Johnson is being
6 referred to.

7 BY MR. FURBUSH:

8 Q Well let me ask you: Have Hanks and Johnson
9 prepared any data that you're aware of?

10 A (Witness Luco) They do have some plots of
11 peak accelerations recorded for some low magnitude earth-
12 quakes.

13 Q Have you ever reviewed those?

14 A I read the paper some time ago, yes.

15 Q But you have never taken their plots, their
16 curves, and compared them with Dr. Trifunac's?

17 A No, I have not.

18 Q But you subscribe to the proposition that
19 accelerations, peak accelerations are magnitude-dependent
20 at close-in sites; is that correct?

21 A Yes.

22 Q And you don't draw any distinction between peak
23 acceleration and mean of the peak acceleration in this
24 instance, do you?

25 A Mean of what?

Q Of the close-in sites for any particular-- Well,



1 let's put it this way. Let's strike that.

WRB/wb7

2 Do you subscribe to the proposition that for
3 a 4 magnitude earthquake and for an 8 magnitude earthquake
4 that the peak accelerations will be different at all times?

5 A I don't understand the "at all times."

6 In my opinion the probability of having a
7 larger peak acceleration for an 8 magnitude earthquake would
8 be larger than the probability that you would have for a
9 4 magnitude earthquake.

10 Q But would the maximum earthquake acceleration ---
11 would the maximum acceleration of which an 8 magnitude
12 is capable be greater than the maximum acceleration of a
13 4 magnitude earthquake for a close-in site?

14 A In absolute terms?

15 Q Yes, in absolute terms.

16 A I don't think I can answer that.

17 Q Let me ask you this: Which would give you the
18 most reliable information or the most reliable estimate for
19 close-in motions, regression analysis with the distance
20 for magnitude 6.5 to 7.5, or regression with magnitude 4,
21 distance less than 10 kilometers?

22 A I'm sorry; could you repeat the question?

23 Q Well, I'd rather do it this way:

24 Which will give you the most reliable information,
25 a regression analysis for recorded magnitudes in excess of

WRB/wb8

1 magnitude 6.5 at 40 kilometers and greater, or a regression
2 analysis for all magnitudes within the 10 kilometer range
3 of the epicenter; which would give you the best and most
4 reliable information for a close-in site?

5 A Are these regressions with respect to epicentral
6 distance?

7 Q Distance from the rupture. --No, I'm sorry; it's
8 distance from the epicenter, not from the rupture.

9 A I'm totally confused by the question.

10 Q Well of course it's just another way of saying,
11 or asking what I asked before: which is going to give you
12 the best information, the most reliable for a close-in
13 site? All of the information that you have for close-in
14 sites, regardless of magnitude, or merely large magnitudes
15 at a greater distance?

16 A I would not rely only on one type of informa-
17 tion or the other. Most of the information in the near-
18 source region is for low magnitude earthquakes. And since
19 I believe that the probability of having a higher accelera-
20 tion is larger for larger earthquakes I would not assign
21 much weight to these observations.

22 Q Well do you believe that the magnitude dependency,
23 if you will, with distance -- I'm sorry; acceleration-
24 magnitude-distance correlation is going to be different for
25 large magnitude earthquakes than small magnitude earthquakes?

1 A It may very well be, yes.

2 Q Well what's your reason for believing that it
3 might be?

4 A For the small earthquake you have a small fault
5 and the problem of attenuation is completely different from
6 the attenuation you would have for a large fault. The
7 geometries are different. You have a small fault and you are
8 comparing with the epicentral distance. In the case of a
9 large magnitude earthquake you have a large fault and you
10 are comparing with the distance. So that on pure geometri-
11 cal grounds you would expect different attenuation.

12 Q For a close-in site?

13 A Pardon?

14 Q For a close-in site?

15 A Everything is relative. What you call close
16 in one case--

17 Q Under 10 kilometers.

18 A Well, but you see, what you call 'close' depends
19 on the length of the fault. If you have a fault that is
20 one kilometer long and you are ten kilometers away, that's
21 far. If you are ten kilometers away from a fault that is
22 eighty kilometers long, you are close. So we're talking
23 about relative distances here compared with the lengths of
24 the faults, not absolute differences.

25 Q I think I have a filler, Dr. Luco.

1 Do you know of any tests which demonstrate that
2 you will not get seven percent damping as you increase strain
3 up to yield in a structure?

4 MR. FLEISCHAKER: Let's see: I have an objection.

5 MR. FURBUSH: If you give him long enough H
6 he'll think of one.

7 (Laughter)

8 MR. FLEISCHAKER: The basis of the objection is
9 that the question is overbroad. I think there needs to be
10 identification of what kind of structure we're talking
11 about, reinforced concrete or reinforced concrete and steel
12 or a masonry structure, or what.

13 MR. FURBUSH: Well he can answer it any way he
14 wants.

15 MRS. BOWERS: The objection is overruled. We
16 think the witness should be able to answer this question.

17 WITNESS LUCO: I mentioned this morning, I
18 believe, that the only tests that I know of that could have
19 some bearing on the discussion have very little information
20 on them. One was for those shear wall panels, reinforced
21 concrete, and there you had damping -- I don't recall the
22 exact number: maybe of the order of four percent with very
23 low strength, and then you have damping of the order of nine
24 percent, I believe, for high strengths.

25 There's a set of tests I referred to for

WRB/wbll

1 reinforced masonry: that's not exactly the same type of
2 material: and in that set of tests they have the data, they
3 have not processed the data, so I cannot quote any number.
4 they have analyzed the data up to strain levels about half
5 of what you could call yield. And in a second set the
6 damping was essentially constant, three percent to half
7 percent yield. I would assume it would increase later on,
8 but I do not know how will be the dependence of damping with
9 strain.

10 In one of the questions you mentioned that the
11 structure --that only a few points in the structure are at
12 the yield level, so most of the structure is below that
13 point. So I ask: Why should be use the seven percent
14 damping that applies to small portions of the structure
15 as compared with the rest? We do not have a large number
16 of data to support the position.

17 BY MR. FURBUSH:

18 Q I guess my question was somewhat different.
19 My question was: Do you know of any tests which indicate
20 that seven percent is not a proper damping figure to use?

21 A (Witness Luco) I quoted two tests that I know.
22 And based on that I cannot draw any definite conclusion.

23 But, on the other hand, only a few points within
24 the different structures reach that yield level. So strains
25 in the majority of the structural elements would be below

1 yield, so we should not use seven percent.

WRB/wb12

2 Q Now this is another jumping-around question:

3 Do you know what magnitude, either local or
4 surface, Dr. Trifunac used in his calculations of his attenua-
5 tion correlations?

6 A I believe they were local magnitudes.

7 Q Have you ever heard of a local magnitude of 7.5?

8 A I have heard of a local magnitude of 7.2 with a
9 standard deviation of .2. That means that it could have
10 been 7.4 or 7.

11 Q So I guess the answer is that you have never
12 heard of a local magnitude of 7.5?

13 A I don't believe I have for southern California,
14 no.

15 Q Anywhere in the world?

16 A Well I do not recall the-- Well there is no
17 estimate for the local magnitude for many large earthquakes,
18 so that it is possible that if they had been determined
19 they could have been 7.5. But because there were no instru-
20 ments there, or because the instrument went out of scale,
21 they could not be determined.

22 Q It's also possible the other way, isn't it?
23 And wouldn't you say it's probable the other way, based
24 on the recordings that you do have?

25 A I'm not sure. You have the Kern County earthquake

1 with a 7.2 magnitude and with a standard deviation of .2.

2 That does not exclude the 7.5.

3 Q You know, you've talked about almost vertically
4 emerging waves as being the type of wave motion that would
5 probably be seen at the Diablo site from an event on the
6 Hosgri. You mentioned that before, haven't you?

7 A I think that in the case of the Diablo Canyon,
8 given the characteristics of the site, the epicentral dis-
9 tance, that would be a good working assumption to calculate
10 the response of the structure. And in support of that I
11 have the fact that the epicentral distance is short compared
12 with the width of the fault. And you have the word of your
13 own consultant who estimates that most of the high frequency
14 will be arriving at the site nearly vertically, if I use
15 his words correctly.

16 Q Well, would that same theory indicate that the
17 wave motions arriving at the Hollywood Storage facility
18 would be vertically emerging?

19 A No, it would not.

20 Q It would not?

21 A The epicentral distance for the 1952 earthquake
22 was much longer than 5 kilometers. I have the number some-
23 where and I can find it for you.

24 Q You referred to Dr. Frazier's analysis. Have you
25 read his analysis someplace?

WRE/wbl4.

MR. FLEISCHAKER: Before we go on to the next question, can we get the full answer to the question that was pending?

MR. FURBUSH: Okay.

BY MR. FURBUSH:

Q You had something you wanted to refer to?

A (Witness Luco) You asked me about the Hollywood Storage building.

Q Yes.

A In that case the epicentral distance for the Kern County earthquake of 152 was about 76 miles, as compared with something of the order of 3 to five miles for Diablo Canyon. The Hollywood Storage building is on much softer soil, and I would expect a much higher proportion of surface waves.

So you have two facts there: a long epicentral distance and softer soil. And that would increase the proportion of surface waves as opposed to vertical incident waves.

Q That would increase the proportion, you say, of surface waves?

A Yes.

Q At what frequency?

A Well, within the frequency of interest.

Q What about high frequency waves?



1 A For extremely high frequency waves probably you
2 would have, on the one hand, a higher contribution of
3 vertically incident waves. But those will be attenuated by
4 the softer material.

5 Q By what softer material? At the Hollywood
6 Storage facility?

7 A Yes.

8 The material in there has a shear wave velocity
9 of the order of 800 feet per second. The rigidity of the
10 soil is measured by the shear modulus that is the square
11 of the velocities. That means that the Hollywood conditions
12 at the site, the rigidity there is ten times lower than the
13 one you have at Diablo.

14 Q Dr. Luco, let's address your attention to USGS
15 Circular 672.

16 How do you interpret the recommendations of the
17 USGS which they made to the NRC staff in respect to the peak
18 acceleration that should be used for the re-analysis of the
19 Diablo site for the Hosgri event?

20 A The way I interpret it is that 7.5 magnitude
21 earthquake was postulated at the fault, and that USGS
22 Circular 672 should be used as a basis to estimate peak
23 acceleration.

24 End WRBloom
25 WELandon fls



1 Q Now, was there no reference in 672 or the letter
2 from the USGS to the NRC Staff suggesting the use of effective
3 acceleration?

4 MR. FLEISCHAKER: Could you be more specific about
5 that? Do you mean Appendix C to Supplement 4 of the SER?

6 MR. FURBUSH: If Appendix C is the letter from
7 the USGS, that's what I mean.

8 MR. FLEISCHAKER: Well, why don't we provide a
9 copy of that to the witness? I have one.

10 (Document handed to Witness Luco.)

11 (Pause.)

12 WITNESS LUCO: Yes. At the bottom of page C-16
13 there is a statement saying that the earthquake so described
14 should be used in the derivation of an effective engineering
15 acceleration for the input in the process leading to a seismic
16 design analysis.

17 BY MR. FURBUSH:

18 Q So then the recommendation was to use effective
19 acceleration, was it not?

20 A (Pause.)

21 Q Does that change your absolute reliance on 1.15
22 as the peak acceleration to utilize?

23 A No.

24 Q Then does that change one of your basis that you
25 gave before, one of the four reasons you gave for using 1.15?

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1 One of them was that that was a recommendation of
2 USGS, wasn't it?

3 A No.

4 Q It wasn't?

5 A No. I said that that was a value indicated in
6 USGS Circular 672.

7 Q But the recommendation is to use an effective
8 acceleration.

9 A But they don't specify the value.

10 Q Well, do you think the effective acceleration --
11 when they use that, that they mean you should use -- when they
12 use the term effective acceleration, do you believe that they
13 mean you should use the absolute figures?

14 A I don't know what they mean, because there is no
15 definition for effective acceleration.

16 Q Well, then, that being the case, it would be
17 necessary for you to accept the testimony of Dr. Newmark and
18 of the USGS on that subject, wouldn't it?

19 MR. FLEISCHAKER: I object on the basis that we
20 asked the USGS if they had any opinion as to the values that
21 were given for effective acceleration. The USGS, Mr. Devine,
22 got up there and stated that they had no opinion.

23 MR. FURBUSH: What does that have to do with the
24 question, Mrs. Bowers?

25 MRS. BOWERS: What is the basis for the objection,

1 Mr. Fleischaker? Not because it's something someone else
2 testified to, is it?

3 MR. FLEISCHAKER: No. Well, the basis for the
4 objection is that the implication is that USGS has taken a
5 position with respect to the values that have been selected
6 for the effective acceleration, and I think that the record
7 shows quite clearly that USGS had no opinion as to the
8 values that were selected for the zero period limit.

9 MRS. BOWERS: The Board will overrule the objection.

10 MR. FLEISCHAKER: Can we have the question back?

11 My problem was that there was an implication that
12 USGS has arrived at a conclusion with respect to the validity
13 of the .75 g, and I believe that the testimony that was given
14 by USGS was that they did not draw -- they had no conclusion
15 as to the validity of the values selected for the zero
16 period limit.

17 MR. FURBUSH: I don't believe that's what the
18 record indicates. The record indicates that they have no
19 criticism of that employed by Dr. Newmark, that it is
20 compatible with 672.

21 MR. FLEISCHAKER: Well, I have -- they didn't
22 criticize it, they said they'd reached no conclusions and
23 that they might accept other values too, is my recollection.
24 But we'll let the record stand on its own. I'm sure it's
25 in the transcript and will be in the findings of fact.



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1 MRS. BOWERS: Well, the objection is overruled.
2 Does the witness need the question?

3 WITNESS LUCO: Could you repeat the question,
4 please?

5 BY MR. FURBUSH:

6 Q Dr. Lucio, inasmuch as you have no idea what
7 effective acceleration should be, and what would be acceptable
8 to USGS under their instructions, you would have to rely upon
9 what Dr. Newmark testified to, or the USGS, would you not?

10 A I don't believe in the idea of effective
11 acceleration. I accept the expertise of USGS in determining
12 a 7.5 magnitude earthquake. I accept the expertise of the
13 people who wrote USGS Circular 672.

14 But if they tell me that an effective acceleration
15 should be used to go with that, there is no definition for
16 such concept. I don't believe in such concept.

17 Q Well, try this thought, try this thought on for
18 size:

19 Suppose that the USGS were recommending an overall
20 theory, i.e., using effective acceleration and inasmuch as
21 you are to use effective acceleration we will employ a 7.5
22 earthquake. Did that thought occur to you?

23 A I will not accept a .75 g associated with a 7.5
24 magnitude earthquake.

25 Q Let me ask you this: Did you hear Dr. Trifunac



1 testify this afternoon that in his opinion one should have
2 certain studies made by different people, and then get them
3 together and see what the end result would be, how they
4 would compromise, and what they would finally end up with?

5 Did he say something similar to that this
6 afternoon?

7 A I don't think he said precisely that. He
8 recommended three types of studies that should be conducted,
9 and once the results were obtained then some conclusions
10 could be derived from them.

11 Q Now, is that --

12 A He didn't mention the word compromise or anything
13 like that, I don't believe.

14 Q But you draw a conclusion? One can draw a
15 conclusion from three different types of studies.

16 Now, you would not recommend that that be done in
17 this case, is that correct?

18 A Oh, I am all for it, those studies being made.

19 Q Well, I mean in this particular instance, in
20 trying to determine how you are going to pick an acceleration
21 to be used for design purposes, when you're confronted with
22 that question, would you go out and pick a magnitude as the
23 first step?

24 A I think your question is too general. Here we
25 have a very detailed set of circumstances:



Number 1, a 7.5 magnitude earthquake.

Number 2, Circular 672.

The third recommendation is that perhaps an effective engineering acceleration should be used.

That concept is not defined, so it's . . .

Q Is it your belief that 672 itself does not contemplate the use of effective acceleration?

A Again, it's the same problem. They can refer to effective acceleration, but that concept is not defined. So it is a useless comment.

Q I guess the point I'm trying to make is that you are willing to pick one part of the recommendation, but not the totality of it.

A When they recommend an effective acceleration, and they do not specify what do they mean by that, it's a useless recommendation.

So I pick what's useful.

Q Well, you pick what's useful and ignore another part of the recommendation, is that correct?

A — The other part has no meaning, so I cannot use it.

Q Was the concept of effective acceleration accepted by the other nine consultants in the ACRS?

A I cannot speak for them. I am not sure.

Q How about the ACRS itself?

A I cannot speak --



1 MR. FLEISCHAKER: Objection. I object to that
2 question.

3 MRS. BOWERS: We'll sustain that objection.

4 BY MR. FURBUSH:

5 Q Dr. Luco, can you make an estimate of how many
6 accelograph records are available within 10 kilometers of
7 earthquakes with magnitudes greater than 4.5?

8 A I'm not sure about magnitudes higher than 4.5.

9 If you restricted it further to magnitudes larger
10 than 6.5, I would say we have four.

11 Q You have four?

12 A Yes.

13 Q And what --

14 A Perhaps four. I'm not sure if -- we have three,
15 and the Tabaz earthquake, I do not know the epicentral
16 distance, the distance to the fault.

17 From the information I have, it's less than 10
18 kilometers.

19 Q And how many of those are 1.5 or over, 1.5 g
20 acceleration -- excuse me -- 1.15 g acceleration or over?

21 A Well, in the first place, and I will exclude the
22 Tabaz earthquake because I do not have the --

23 Q No, let's include it, though.

24 A I don't have the information, so --

25 Q You don't have the information on what the

1 acceleration was?

2 A I know the acceleration. I do not know the
3 epicentral distance.

4 Q Well, why don't you, just out of -- why don't
5 you just throw it in, to have the four that you mentioned?

6 (Laughter.)

7 MR. FLEISCHAKER: I'm going to object to that
8 suggestion.

9 (Laughter.)

10 I think the witness has answered the question,
11 and --

12 MR. FURBUSH: Well, he doesn't know.

13 BY MR. FURBUSH:

14 Q Well, then, of the other three tell us how many
15 of them are 1.15 or more?

16 A Well, we have the Pacoima Dam records for a 6.3
17 magnitude earthquake.

18 Q Which is highly suspect.

19 A Well, the magnitude is --

20 Q But the acceleration is highly suspect, is it not,
21 in respectable circles?

22 (Laughter.)

23 A Well, I won't get into the circle.

24 (Laughter.)

25 The Pacoima Dam record was obtained for the 6.3



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1 magnitude earthquake, and the peak acceleration was 1.25 g.

2 The Pacoima earthquake was for a magnitude 6.5,
3 and the peak acceleration was 63 percent of g.

4 Q 63 percent?

5 A Yes.

6 Q .63?

7 A .63.

8 For the Pacoima earthquake information I have here
9 it's for one component, and I do not recall the number for
10 the other component. It may have been higher.

11 For the Gazli earthquake, the surface wave
12 magnitude was 7.2. The peak acceleration in the vertical
13 component was 1.3 g.

14 Q That's the vertical?

15 A Yes.

16 Q But let's get the other.

17 A The other was .8 g. The peak horizontal accelera-
18 tion was .8 g. The peak vertical acceleration was 1.3 g.

19 Q Why didn't you mention peak vertical acceleration
20 of the others?

21 A I do not have the data.

22 Q So why is this one more important than the others?
23 Why get the vertical for this one, and not for the others?

24 A You asked me for the peak accelerations that I
25 knew, and I gave you my answer. That's what I know.

wel 10

1 MR. FURBUSH: I have no further questions at this
2 time.

3 MRS. BOWERS: We have another matter to discuss.
4 Perhaps now it would be appropriate, considering that it's
5 almost a quarter of 5:00, to temporarily excuse these
6 witnesses until tomorrow morning, and then we can go into a
7 discussion of the other matter.

8 Mr. Fleischaker, I'm talking about the telegram.

9 MR. FLEISCHAKER: Okay. Then can we be excused,
10 because I don't think we're involved in that telegram?

11 MRS. BOWERS: Well, you're named. We're supposed
12 to tell you, and you'll tell him..

13 MR. FLEISCHAKER: I'll stick around.

14 (Laughter.)

15 (Witnesses Trifunac and Luco temporarily excused.)

16 MRS. BOWERS: This can be on the record. It's not
17 a discussion of security, but a discussion of procedure and
18 substance.

19 Have the parties had an opportunity to read the
20 telegram?

21 Mr. Norton? Do you have a position, after you
22 read the telegram? Did you come to a conclusion?

23 MR. NORTON: Yes. I'm not sure that -- I don't
24 know the history of this. I haven't talked with this
25 gentleman. I only have the telegram, which isn't very much

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1. information to go on.

2. Frankly, it's a very, very unusual procedure for
3. somebody to pop up three or four days before a scheduled
4. proceeding and announce that they're going to participate.
5. I'm not sure, and the telegram doesn't say in any way how
6. he's going to participate. It simply says, and I quote:

7. "I intend to participate in the Diablo Canyon
8. security systems tour."

9. To what purpose? To walk along and look? And if
10. so, is there time to get a security clearance for him to do
11. that?

12. I don't know the answers to those questions.

13. Madelon fls

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6 Madelon 1 MRS. BOWERS: Well, let me ask you this:

2 If it had been Mr. Valentine or Mr. Jones would
3 you have insisted on a security clearance for either one of
4 them?

5 MR. NORTON: I frankly am not sure what Pacific
6 Gas and Electric Company did as respects Valentine and Jones.
7 I didn't get involved in the security question until long
8 after they were, and I have no idea what the company did as
9 respects that.

10 I suspect they may have done nothing until it was
11 determined what their involvement was going to be, and that
12 never was determined. In other words, there never was a
13 decision made.

14 As you'll recall the chain of events, it was
15 always up in the air until finally -- what? -- a month ago
16 or three weeks ago, whatever it was, they wrote the letter
17 saying they were withdrawing.

18 So I'm not sure that it had ever culminated to
19 the point where the company had to do anything or had to
20 make that decision. But that's not to say they didn't do
21 something. I just don't know.

22 MRS. BOWERS: Well, at the in camera session in
23 Los Angeles -- and this was two and a half, three years ago --
24 and I know you weren't there --

25 MR. NORTON: It was longer ago than that.

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1 MRS. BOWERS: -- Mr. Crane was there, both
2 Mr. Valentine and Mr. Jones signed protective orders. And --

3 MR. NORTON: But that was just simply discussions.
4 That was not a review of the security facilities at the site,
5 which is an entirely different proposition.

6 I would have very little objection probably --
7 well, I'm going to have to think about that. I wouldn't --
8 my objection would not be as strong if he was simply going
9 to sit in in the in camera session and listen to the testimony
10 -- well, I'll have to think about that because I'm not sure
11 of the nature of the Staff's testimony.

12 But to go out and physically inspect the security
13 devices and listen to the Staff testimony, I'm not prepared
14 to say that we can go along with that at all. We haven't
15 had an opportunity to discuss it with the security people or
16 with the company management. And I don't know what the Staff's
17 position on it is either, and I would be interested to hear
18 what they have to say.

19 MRS. BOWERS: Mr. Staenberg?

20 MR. STAENBERG: And now to the Staff?

21 MRS. BOWERS: Yes.

22 MR. STAENBERG: We have similar problems to those
23 just expressed by the Applicant. This comes to us rather
24 suddenly, and we are therefore unsure of exactly how to deal
25 with it. We do not know anything about Mr. Baldwin. He's not

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1 been a party to this proceeding heretofore. And as a result
2 without some more information about him and about what his
3 intentions are, it's rather difficult to speak to the issue
4 of letting him into the proceeding at this late date.

5 Beyond that, we're not sure without further
6 information from him what his plan or the Intervenor's plan
7 is for participation. It should be recalled that in Mr.
8 Valentine's pleading of January 19, 1979, it is stated on
9 page 4 that -- and I quote:

10 "It is impossible for this Intervenor to
11 prepare either for significant cross-examination
12 on the inadequacies of the Applicant's security
13 plan or to present affirmative evidence to support
14 Intervenor's contentions. Therefore this
15 Intervenor will not be able to participate in
16 the hearings now scheduled for the first week of
17 February as to the adequacy of the Applicant's
18 security plan."

19 Well, if it is impossible -- and that's their
20 word -- to participate, then we wonder what has changed in
21 order for this gentleman's appearance and participation to be
22 meaningful.

23 Perhaps I'm overstating it because in the tele-
24 gram that we've just received today he says nothing about
25 participating in the in camera session part of the hearing.



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1. Rather, all he says is that he wants to go on the tour.

2. We have similar problems in that regard to those
3. just expressed by the Applicant. That doesn't serve any
4. particular purpose in terms of moving ahead the record in
5. this proceeding, and therefore it seems to me it raises a
6. number of questions about what he wants to do and the security
7. plan and the security of the plant and compromising that
8. security plan and the security around the plant without any
9. countervailing benefit that might be derived if he were taking
10. part and participating in the making of the record here.

11. But on the one hand we're left with someone who's
12. not indicating any particular desire to participate at the
13. in camera hearing session and yet wants to go on a tour for
14. reasons that are simply not clear to us.

15. MR. NORTON: Mrs. Bowers, we've had a chance to
16. discuss this amongst ourselves, which we hadn't until this
17. time, and we'd read the telegram but we hadn't talked it over.
18. I would have to assume by this telegram, and I think we'd
19. better operate under the assumption that Mr. Baldwin intends
20. to participate in the in camera session also. I'm certainly
21. not going to base my position on the fact that he has not
22. evidenced desire to do that because I suspect he does intend
23. to do that.

24. Our position -- management has just spoken into
25. my ear and our position is somewhat firmer than I first thought.

mpb5 1 and with good reason.

2 First of all, the statement that was just read
3 by Mr. Staenberg is very true. Intervenor said they had
4 absolutely nothing to gain. That's the Intervenor's Counsel
5 speaking for Intervenor.

6 Now four days before somebody new, who no one
7 here apparently knows of at all, is suddenly going to become
8 involved. We know nothing about him and it is the Applicant's
9 position that he is not going to tour the security systems at
10 Diablo Canyon Monday absent an NRC Commission order that he
11 can do so.

12 MRS. BOWERS: Well, Mr. Fleischaker, you apparently
13 were in some sort of a meeting last night where this was
14 discussed.

15 Is it possible for you to talk about it on the
16 record?

17 MR. FLEISCHAKER: I'll be happy to talk about it
18 on the record.

19 But let me clarify one thing: There was no meet-
20 ing. Mr. Baldwin was sharing quarters with us and I overheard
21 a telephone conversation between him and Mr. Valentine and
22 discussed the matter briefly with Mr. Baldwin.

23 And I also want to make clear that -- I really
24 have nothing further to add because I cannot speak for any
25 client on this issue. And I think I, at the bench conference,

mpb6 1. informed the Board of the facts that I knew and would only
2 suggest this:

3 That perhaps in fairness that before the Board
4 reaches a decision they may wish to hear Mr. Baldwin state a
5 position Monday morning, and then make its decision.

6 MR. NORTON: That's not going to do a lot of good
7 in light of what I just said, and that is that Mr. Baldwin is
8 not going to tour Diablo Canyon facility, the security systems,
9 without an NRC Commission order. And that is not this Board.

10 In other words, we would go through the same
11 process we went through the last time. There is no way he's
12 going out to that facility and look at the security devices on
13 Monday. You can't get an NRC Commission order that soon.

14 MR. FLEISCHAKER: Well, I don't want to get involved
15 in the argument.

16 MRS. BOWERS: Well, let me ask:

17 Is there a spokesperson for the Mothers for Peace
18 here who is authorized to speak to this point?

19 MR. FLEISCHAKER: The answer is I don't think so.
20 I can't speak to it. The people who discussed this matter
21 with Mr. Baldwin last night are not here. That's Ms. Apfelberg
22 and I think he talked to Mrs. Silver and perhaps Mr. Silver,
23 Sandra and Gordon Silver. And I also know he had a telephone
24 conversation with Paul Valentine.

25 So that's all I can say. And I think that -- I

mpb7

1 understand the Applicant has a position, but my --- I think
2 the only person who can shed any light on this matter and
3 respond to the questions that have been raised both by the
4 Applicant and the Staff is Mr. Baldwin himself, and he'll be
5 here Monday morning.

6 MRS. BOWERS: Do you know that for a fact?

7 MR. FLEISCHAKER: I understand that to be the
8 case. I understand that he's going to return Monday. And we
9 can -- if the Board wants to set up a session so that they can
10 consider his remarks, we will call him and tell him that a
11 time has been set, and if he wishes to be here he should be
12 here.

13 MR. FURBUSH: Mrs. Bowers, with your indulgence,
14 I would like to address a couple of words to this subject.
15 This to me is extremely shocking to have some Intervenor
16 who purport to be interested in the security of that plant
17 arrange something like this at the last moment which has all
18 the indicia of being something that could compromise the
19 security of that plant. It actually boggles the imagination.
20 And I don't think we can just sit here and talk about this
21 in cold calm terms. When something like this comes up one
22 should be indignant. And I'm very indignant about this
23 because I think it has no basis in any of our jurisprudence.
24 It certainly has no basis -- no support in what their purported
25 position is, i.e., that there should be a secure plant.

mpb8

1 Now we have to come to grips with this thing
2 sooner or later. We've going to have to have some require-
3 ments that the Intervenor conduct themselves as other people
4 are forced to conduct themselves in proceedings. And I can't
5 see how we could in all good conscience do any sort of a
6 security plan -- permit a complete stranger to go into that
7 plant on Monday morning. I mean, that would be the height of
8 folly, and I certainly would never approve a security plan
9 which would permit that.

10 MRS. BOWERS: Well, as I read the telegram, the
11 Mothers for Peace have apparently retained new counsel.

12 MR. FLEISCHAKER: And I assume he's a member of
13 the California Bar.

14 MRS. BOWERS: He says he is.

15 When he wrote earlier talking about limited
16 appearance statements he mentioned in that letter that he
17 was a lawyer for the Friends of the Earth.

18 MR. FLEISCHAKER: I know it to be a fact that he
19 is a lawyer. There's no question about that.

20 MR. NORTON: Mrs. Bowers, the problem is the
21 Intervenor in the document that Mr. Staenberg had read
22 through their counsel have withdrawn from that. They can't
23 now come back at the eleventh hour with a new attorney and
24 through a telegram by fiat say we're going to be on the tour
25 Monday. I mean, that's incredible. And they're not going to



mpb9

1 be on the tour Monday, that's all I can tell you.

2 MRS. BOWERS: Well, let me ask you, you made a
3 statement about the Commission would have to issue an order.
4 Is there something special about security -- in other words,
5 if we arguendo --

6 MR. NORTON: I hear you.

7 (Laughter.)

8 MRS. BOWERS: -- if we happen to say yes, are
9 you saying that you just wouldn't act on that, that you
10 would have to go topside?

11 MR. NORTON: That's right. At this point it's
12 the same story as before. We felt the same way about Dr.
13 Danike. It's the same problem, only with much shorter context.

14 Management just spoke into my ear again. They
15 suggest because he's a lawyer doesn't make him a good guy, as
16 we all know.

17 (Laughter.)

18 MRS. BOWERS: Well, we can take official notice
19 of that fact.

20 (Laughter.)

21 MRS. BOWERS: Mr. Bright has raised a question.
22 Would something like this require an exemption to
23 Part 73?

24 MR. CRANE: Well, Part 73 prohibits tours and
25 things like that.

mpb10

1 MR. BRIGHT: I guess my concern was Part 73
2 merely lays down broad guidelines, but I assume that your
3 detailed security plan has a bunch of restrictions in it, and
4 one of those undoubtedly has to do with, as you say, tours
5 and that sort of thing. And I was just wondering, if you
6 violated that, something that's in your security plan firmly,
7 then you would be in effect violating -- requiring an excep-
8 tion anyway from Part 73.

9 MR. CRANE: Or we'd get a citation.

10 MR. NORTON: Excuse me, Dr. Bright. You know,
11 it's a little more involved than that. This is about the
12 third or fourth time now I've been asked about the security
13 plan. I don't know about the security plan. I don't want
14 to know about the security plan. And it is the company's
15 policy that the fewer people -- it's a need-to-know basis.
16 The security people know about it and certain people in
17 management know about it, but it's a very select group, and
18 the NRC knows about it. And this Board is going to be burdened
19 with knowing about it. I'm not.

20 I can't tell you whether it's going to be a
21 violation of the security plan to allow him to go there or
22 not Monday morning. I am told by management that he is not
23 going there on Monday, and that's as far as I can answer the
24 question.

25 MRS. BOWERS: Well, following through on this a few



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4-22-3



1 minutes, as you know the appeal board came down with a deci-
2 sion that had a very fine separate opinion by Dr. Quarles
3 and Dr. Johnson, where they broke out what they believed to
4 be six components of the security system, and then they
5 suggested on each one of the components to what depth
6 intervenors' expert witness would need to know in order to
7 evaluate the adequacy of the system without getting into the
8 details to an extent that the system could be sabotaged.

9 On a tour what do you do? Every so often put
10 blindfolds on us, and that's something we can't see?

11 MR. NORTON: I think the Board is entitled to
12 know what the security system is. They unfortunately have
13 that burden of knowing what the security system is and making
14 a judgment as to whether it's adequate or not.

15 The depth of what you see I guess depends on how
16 much you need to see to be satisfied that the plan and
17 facility is adequate as respects security.

18 MRS. BOWERS: I don't know how you'd handle a
19 tour, though.

20 MR. NORTON: It's not a tour in the judicial
21 sense of the word. It will be the security people and the
22 Board, and I suspect Mr. Staenberg and the Staff security
23 people who have reviewed the plan. I'm not going.

24 MRS. BOWERS: No, but won't we be looking at the
25 physical security system?

mpb12

1 MR. NORTON: Yes, you will.

2 MRS. BOWERS: So how on that --

3 MR. NORTON: You've been cleared, Mrs. Bowers.

4 (Laughter.)

5 MRS. BOWERS: Well, I'm talking about if it was
6 determined that Intervenor Counsel, you know, was part of the
7 group, how do you follow those appeal board guidelines as to
8 release of knowledge or information that we, of course,
9 have got to know.

10 MR. NORTON: That's the problem that we were deal-
11 ing with in the appeal. But the problem became moot even-
12 tually and we haven't had to cross that bridge yet. But
13 that's a good question. I don't know the answer to it. We
14 were never forced to make that decision. And some day some-
15 body's going to be forced to make it. I don't know the answer.

16 (Pause.)

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1 MR. NORTON: Mrs. Bowers, there really isn't any
2 point in continuing this discussion, because he's not going
3 on the tour, and there is no way there could be an appeal and
4 a decision through the Staff and Commission by Monday, in
5 any event.

6 So I guess he's going to have to make his case,
7 make his record, and if he wants to appeal it, appeal it.
8 But he's not going on the tour Monday.

9 MRS. BOWERS: Well, Mr. Fleischaker --

10 MR. STAENBERG: Which leaves open, of course, the
11 question of whether or not the Board is going to permit his
12 participation in the in-camera session. That's a separate
13 view.

14 I'm not sure that I subscribe to the Applicant's
15 reading of the telegram that this gentleman had intended to
16 participate in that in-camera session anyway, because all it
17 said in the telegram is, "Tell me where to show up for the
18 tour."

19 MR. NORTON: Well, but I have to assume that he
20 is intending to participate in the in-camera session.

21 MR. STAENBERG: And if you think you're correct,
22 then we have a separate question as to what to do -- the
23 Applicant has made its decision as to whether or not it's
24 going to allow this gentleman on the tour on Monday. There
25 may be an appeal by the Intervenor in that regard, and we

MR/wal 2

1 can wait and see.

2 We're faced now with a second question. Should
3 the Intervenor wish for Mr. Baldwin to participate at the
4 in-camera session on Monday, that's a separate question, in
5 which both the Applicant and the Staff take a strong interest
6 in whether or not he appears.

7 MRS. BOWERS: What's your position on the in-camera
8 session?

9 MR. STAENBERG: I think we can be governed, and
10 the Board can be governed, by some traditional procedural
11 decisions. Unfortunately, I don't have them at my fingertips,
12 but they do indicate that NRC has had situations in which
13 Intervenor have chosen to withdraw themselves, and the
14 Boards have made it clear that in so doing they do not have
15 a revolving door, they cannot come in and go out at their
16 discretion.

17 Having made the decision to withdraw, which I
18 believe Mr. Valentine's pleading of the 19th makes it
19 extremely clear, they have closed the door and I think the
20 Board can take note of that and make its decision based upon
21 that.

22 We don't have to get into the uniqueness of the
23 in-camera session and the security plan, and whether or not
24 an attorney can or cannot appear without a security clearance.

25 MR. NORTON: We would support that position. I

MB/wel 3

1 can't state it any better or any more fully than that.

2 (The Board conferring.)

3 MRS. BOWERS: Well, we will consider it over the
4 evening break.

5 Since Mr. Baldwin was able to sashay down here
6 yesterday, I'm sure he doesn't need a long lead notice if
7 it is determined that he can participate in any part of it.

8 MR. STAENBERG: If I might just add one note --
9 and this could be repeated at such time as the Board wants
10 to take further argument, but as the Board considers it, it
11 should again be noted that in the Valentine motion of the
12 19th they have set forth their reasons as to why they were
13 closing the door, and it is hard for us to see how the
14 introduction of a new attorney changes any of those substantive
15 reasons. None of those reasons have changed.

16 And so if the door is closed on the 19th, it's
17 still closed today and will be, presumably, still closed on
18 Monday.

19 MR. FLEISCHAKER: Can I just say one thing, Mrs.
20 Bowers?

21 MRS. BOWERS: We didn't bring copies of that with
22 us. We read it, but saw no reason, of course, to haul that
23 paper out here.

24 Could we borrow it overnight?

25 MR. STAENBERG: Yes..

(Document handed to the Board.)

MR. NORTON: Mrs. Bowers, one other thing. And that is that I would propose that the in-camera proceeding be held at the facility. As I can see it, there's only going to be a handful of people who are going to tour the facility, in any event, and I would suggest that some sort of a meeting room be arranged out there, rather than have it here. I don't think this is a very good place to have an in-camera session on the security plan.

MRS. BOWERS: Well, I spoke to the management at the Inn about posting signs, you know, that it was a closed session on Monday, and that sort of thing.

Does the Staff have a position on this matter? It's been suggested that the in-camera session be at the plant, rather than here.

MR. STAENBERG: The Staff would have no objection to that.

MRS. BOWERS: We have no problem with that. It was mentioned to me a day or so ago, and I thought, well, we're all set up here, and everybody's papers, and that sort of thing are here. But we're really talking about something else, and we can just leave things here.

Well, we'll think about this overnight and then announce first thing tomorrow morning -- we're really focusing on the in-camera session, rather than the plant visit,

Wel 5

1 because you sounded as if you meant it.

2 MR. CRANE: We meant it.

3 MRS. BOWERS: Well, I don't want to be thrown into
4 the slammer.

5 (Laughter.)

6 Well, let me check and see if there is any other
7 matter before we leave.

8 Mr. Norton, any other matters tonight?

9 MR. NORTON: No.

10 MRS. BOWERS: Mr. Fleischaker, any other matters
11 tonight which we should discuss before we recess?

12 MR. FLEISCHAKER: No. I just wanted to know
13 whether I should try to get hold of Mr. Baldwin to deliver
14 any message to him.

15 MRS. BOWERS: Well, you've heard what the
16 Applicant said about the facility.

17 MR. FLEISCHAKER: Yes, I understand.

18 Well, I guess the only question in my mind is
19 that I don't understand the full circumstances of Mr. Baldwin's
20 retention by the Mothers, but he is an attorney and they are
21 an intervenor. So there is an attorney-client relationship
22 there, apparently.

23 Again, the only thing I can suggest is that the
24 Board may want to hear from Mr. Baldwin before the Board
25 reaches a decision on the matter, irrespective of the

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1 Company's position.

2 So I wanted to know if the Board has any messages
3 they would like me to deliver, or try to deliver, to him.

4 I don't know whether I can reach him or not. I would
5 certainly try.

6 MRS. BOWERS: Well, you've heard the positions of
7 the parties, and, of course, some questions were raised as to
8 really what he had in mind.

9 MR. FLISCHAKER: I'm at a loss. I don't know,
10 and I don't think I'm in a position to speak for him. I
11 don't think that's appropriate.

12 MRS. BOWERS: Well, we'll consider it.

13 Let me check with the Staff. Mr. Staenberg,
14 anything else tonight before we recess?

15 MR. STAENBERG: No, I don't believe so.

16 MRS. BOWERS: We'll consider it overnight, and if
17 we feel that personal contact is warranted, we can set up
18 a conference call.

19 (Whereupon, at 5:10 p.m., the hearing was
20 recessed, to reconvene at 8:30 a.m., Friday, 9 February 1979.)

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