

NUCLEAR REGULATORY COMMISSION

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50-275

In the Matter of:

PACIFIC GAS AND ELECTRIC COMPANY

(Diablo Canyon Nuclear Power Plant,
Units 1 and 2)

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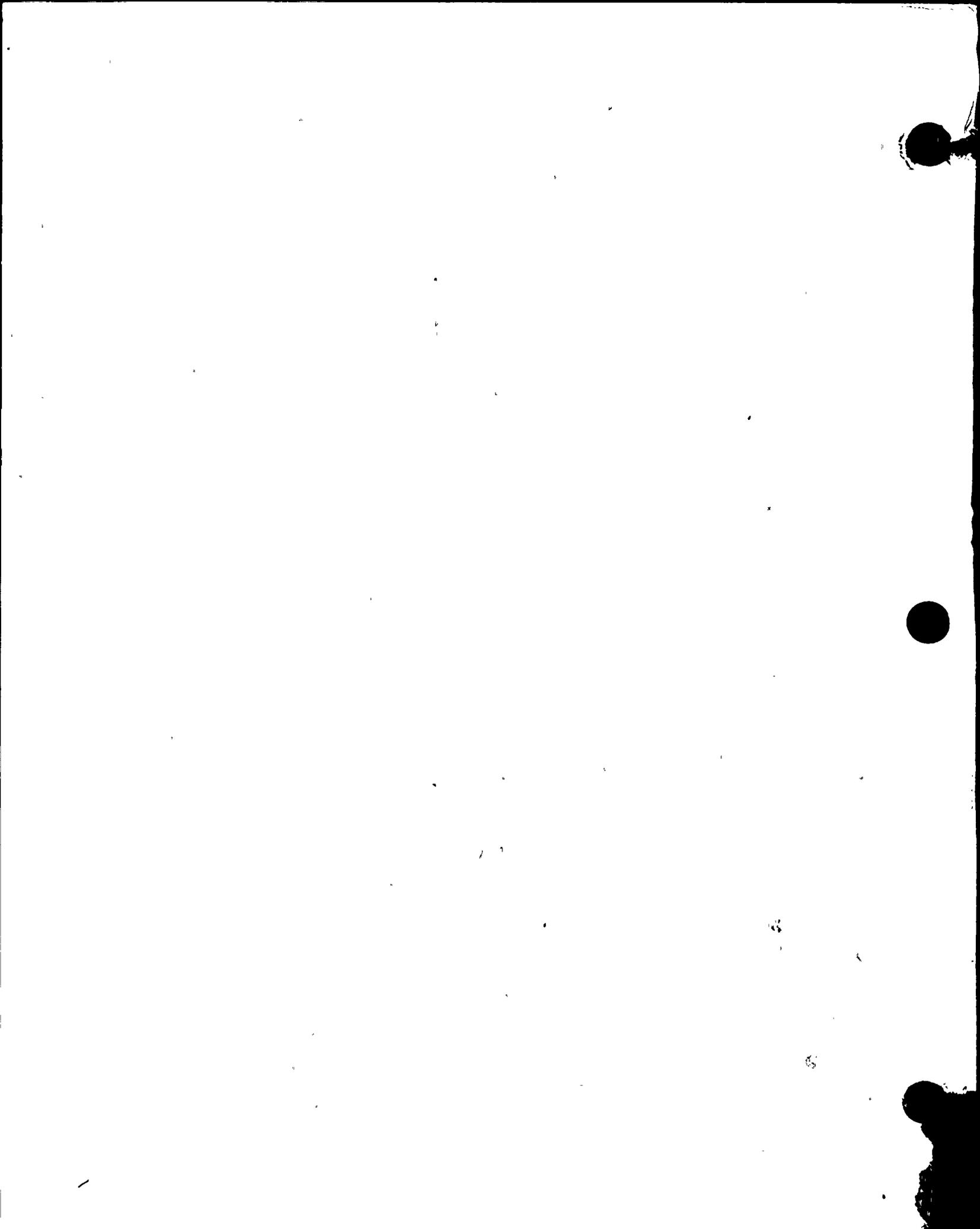
AT: San Luis Obispo, California

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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In the Matter of:
PACIFIC GAS AND ELECTRIC COMPANY
(Diablo Canyon Nuclear Power
Plant, Units 1 and 2)
----- x
Docket No. 50-275
Docket No. 50-323

Veterans Memorial Auditorium
San Luis Obispo, California
October 21, 1980

The above-entitled matter came on for hearing at .
8:30 a.m.

BEFORE:

- RICHARD S. SALZMAN, Chairman
- DR. JOHN R. BUCK, Member
- DR. W. REED JOHNSON, Member

APPEARANCES:

- On behalf of the Nuclear Regulatory Commission:
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- On behalf of Witnesses Luco and Trifunac:
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APPEARANCES: (Continued)

On behalf of Pacific Gas and Electric Company:

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<u>Witnesses</u>	<u>Direct</u>	<u>Cross</u>	<u>Board Exam</u>	<u>Board Cross</u>
G. Frazier)		232		
H. Seed)				
S. Smith)		362		
J. Blume)		Resumed		
R. Edwards)				
D. Hamilton			320	323

E X H I B I T S

<u>Number</u>	<u>For Identification</u>	<u>In Evidence</u>
Joint Intervenors'		
R-1		226
R-4		245
R-6	269	-
R-7	269	-
R-8	269	-
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P R O C E E D I N G S

1
2 CHAIRMAN SALZMAN: Good morning, ladies and
3 gentlemen, we will reconvene this session.

4 Before we turn to Mr. Fleischaker, who was cross-
5 examining yesterday, there is a preliminary matter concern-
6 ing the agreement about admission into evidence of geolo-
7 gic survey and two additional papers by the same authors.

8 As we left it, everyone was in agreement. Mr.
9 Lanpher wished to read the documents last evening, and he
10 would tell us whether he had any objections.

11 Mr. Lanpher.

12 MR. LANPHER: I have no objection, Chairma
13 Salzman.

14 CHAIRMAN SALZMAN: The three documents will be
15 admitted in evidence. I believe these are -- correct me
16 if I am wrong, please -- I have lost track of my numbers,
17 can you recall what numbers they were?

18 MR. FLEISCHAKER: The USGS Circular 795 was given
19 Joint Intervenor Exhibit R-1.

20 CHAIRMAN SALZMAN: Joint Intervenor Exhibit R-1
21 is admitted into evidence now.

22 The others were Applicant's Exhibits R-5 and R-6.
23 Applicant's Exhibits R-5 and R-6 will be admitted into
24 evidence.

25



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1 (The documents previously marked
2 for identification as Joint
3 Intervenor's Exhibit R-1 and
4 Applicant's Exhibits R-5 and
5 R-6 were received in evidence.)

6 MR. FLEISCHAKER: I have another preliminary
7 matter relating to that, Mr. Chairman.

8 Yesterday in our cross-examination on USGS
9 Circular 795, I think it was brought out to me the signifi-
10 cance of obtaining the testimony of Dr. David Boore. We
11 have three papers that he has written here, that he has
12 participated as an author, first of all Circular 795, and
13 two subsequent papers. Mr. Fraser has given his interpre-
14 tation as to how the subsequent papers may modify the
15 opinions that were expressed in USGS Circular 795.

16 I think that rather than speculate on that matter
17 and considering the significance of the issue, which is the
18 proper estimate of main peak accelerations expected in the
19 near field of large magnitude earthquakes, I am going to
20 request the Board either to subpoena Dr. David Boore, or
21 to request the staff to ask him to attend in order to
22 present testimony on the question of whether his opinions
23 expressed in 795 have changed, and if so how, as a result
24 of the new Imperial Valley data.

25 CHAIRMAN SALZMAN: Mr. Norton, do you have anything



1 to say?

2 MR. NORTON: We, of course, must strongly object.
3 Obviously, these proceedings could last forever if we
4 cross-examine witnesses with articles by others. Mr.
5 Fleischaker brought these up. He brought 795 up into this
6 hearing, gave it to the witnesses, and asked them what it
7 said. Then, of course, they pointed out that the same
8 author had written more recent papers.

9 If every time a paper is introduced, witnesses
10 cross-examined on it, and the attorneys move to bring in
11 the author of the paper, obviously they could bring in
12 several hundred authors and carry these proceedings on into
13 the 21st Century, which is perhaps what the motion is
14 intended to do.

15 CHAIRMAN SALZMAN: Mr. Lanpher.

16 MR. LANPHER: We support Mr. Fleischaker. I
17 think that USGS 795 truly stands on a different footing
18 than the other articles. As I was pointing out yesterday,
19 this was cited by the Board itself, and it is the central
20 focus of our reopened hearing.

21 So I think that there are good reasons to bring
22 Mr. Boore to testify.

23 CHAIRMAN SALZMAN: Mr. Olmstead.

24 MR. OLMSTEAD: Yes. Yesterday, I pointed out
25 that these papers coming into the record during the



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1 cross-examination are constantly going to be showing that
2 somebody has written something new about the Imperial
3 Valley earthquake.. I think that this is but another example
4 of the same thing.

5 We are going to have two people from the USGS
6 available this week. I don't think that you can go out and
7 get every single expert who has written anything on this
8 matter. This paper was available well before this time,
9 if the intervenors had wanted it as part of their evidence
10 in this case, they could have made these motions earlier.
11 So we object.

12 MR. FLEISCHAKER: May I make one reply to that?

13 CHAIRMAN SALZMAN: Mr. Fleischaker.

14 MR. FLEISCHAKER: Thank you.

15 The two papers that are subsequent to 795 were
16 received by us only yesterday.

17 Secondly, I would like to underscore that as far
18 as this proceeding is concerned, 795 stands on a different
19 footing than the other papers.

20 CHAIRMAN SALZMAN: How does it stand on a different
21 footing, sir?

22 MR. FLEISCHAKER: Before in their letter to the
23 staff ---

24 CHAIRMAN SALZMAN: Who is they?

25 MR. FLEISCHAKER: The USGS's letter to the staff



1 contained in Supplement 4 to the Safety Evaluation Report

2 --

3 CHAIRMAN SALZMAN: What date was that letter,
4 sir?

5 MR. FLEISCHAKER: That letter is dated January
6 28, 1975, and it is contained as Appendix D -- It is the
7 wrong one.

8 CHAIRMAN SALZMAN: This letter involves 795?

9 MR. FLEISCHAKER: Excuse me, sir.

10 CHAIRMAN SALZMAN: If it will be helpful, I will
11 point out to you that the Geological Survey circular bears
12 a July 1978 date, sir.

13 MR. FLEISCHAKER: If you will let me continue.

14 CHAIRMAN SALZMAN: Please.

15 MR. FLEISCHAKER: Supplement 4 to the SER con-
16 tains -- Appendix C to Supplement 4 of the SER is a letter
17 dated April 29, 1976, in which the USGS recommends that the
18 Diablo Canyon plant be reanalyzed for 7.5 magnitude earth-
19 quakes on the Hosgri fault, and that the description of
20 near fault horizontal ground motion as contained in USGS
21 Circular 672 be used as a start-up point in that seismic
22 analysis.

23 Bulletin 795 is an update of 672 in terms of the
24 USGS predictions of near fault horizontal ground motion
25 predictions of peak amplitudes of strong ground motion. It



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1 is the update, and the NRC staff adopted the USGS recommen-
2 dation to begin the description of horizontal ground motion
3 by 672, and it seems to me, thererfore, that since 795 is
4 the more current peak USGS position, it stands on a different
5 footing from the other articles that have been discussed in
6 this proceeding, such as Hanks and Johnson, Seed, and others.

7 CHAIRMAN SALZMAN: Mr. Olmstead.

8 MR. OLMSTEAD: Yes, sir, I want to add something
9 to what I said previously in light of that remark.

10 As I mentioned yesterday, these papers are part of
11 the open file material at the USGS, and I don't think that
12 it is a matter that we recently found out. There were
13 papers in the file yesterday which might have been used as
14 relevant to this proceeding.

15 CHAIRMAN SALZMAN: The Board will reserve its
16 ruling on this until we have had an opportunity to discuss
17 it privately.

18 MR. NORTON: Excuse me, Mr. Salzman, I would like
19 to make a correction in the reocrd.

20 Mr. Fleischaker said that they knew nothing
21 about these papers until yesterday, but I will quote from
22 Porcello and Boore's horizontal ground motion from the
23 1979 Imperial Valley earthquake comparison with data from
24 previous earthquakes, the acknowledgement, "We thank Gene
25 Broom for permission to use the UNAM/USD data in advance



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1 of the publication, and Tom Hooten for providing the CBMG
2 data listed in table 1." I don't think that Mr.
3 Fleischaker is quite as surprised as he said he was, since
4 he sits next to his witness Gene Broom.

5 CHAIRMAN SALZMAN: We will end this matter now.
6 We will reserve the decision.

7 Mr. Fleischaker, when you began your cross-
8 examination of these witnesses yesterday it was about 10:30
9 and ran through the full day, and we were fairly relaxed
10 about insisting that you not ask cumulative or argumentative
11 or repetitive questions.

12 However, the witnesses are here, and there are
13 other people who wish to cross-examine them. I am afraid
14 that we are going to insist that the questions be much
15 more pointed, be clear, and we will not permit this to go
16 further.

17 Are you prepared to tell us when you are going to
18 be able to complete your cross-examination? I am hoping
19 tthat you will be able to do so by 10:30 this morning, sir.

20 MR. FLEISCHAKER: I estimate around 11 o'clock.

21 CHAIRMAN SALZMAN: Don't be surprised, sir, if we
22 don't hold you to your estimate.

23 Please begin, sir.

24 ---

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Whereupon,

- GERALD FRASER
- H. BOLTON SEED
- STEWART SMITH
- JOHN BLUME
- ROBERT EDWARDS

the witnesses on the stand at time of recess, resumed the stand, and having been previously sworn testified as follows:

CROSS-EXAMINATION (resumed)

BY MR. FLEISCHAKER:

Q Dr. Seed, at the break yesterday we were discussing Figure 9 of the Joint Intervenor's Exhibit R-4.

A Yes.

Q Figure 9 is entitled "The Comparison of Maximum Ground Surface Acceleration for Rock and Deep Cohesionless Soil Conditions," and it shows, does it not, that in the distance of interest, that is five to 10 kilometers from the fault, you predict accelerations on rock to be higher than accelerations on soil for magnitudes approximately equal to 6.5.

A Yes, it shows that.

Q The accelerations at .7 G, and for magnitude of 6.5, you predict accelerations on rock to exceed those on soil by about 80 percent?



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1 A I predicted that in 1976.

2 Q However, as I remember, your responses to the
3 questions I asked yesterday, some colleagues have plotted
4 a new regression which you have adopted for the purposes
5 of this testimony to take the place of the line on Figure
6 9, entitled the "Mean for the Deep Cohesion-less Soil."

7 A That is right. It was not for the purpose of
8 this testimony. It was just in the interest of scientific
9 understanding. Nevertheless, colleagues have done that.

10 Q That has been introduced as Joint Intervenor's
11 Exhibit R-5, is that correct?

12 A Yes.

13 Q As I recall our calculations yesterday, they
14 were that accelerations of .6 G, you have a new prediction
15 for maximum magnitude 6.5, and it is that you predict the
16 accelerations on rock to exceed those on soil by about 40
17 percent.

18 A I worked it out last night, when I had the chance.
19 The new line for soil if it were put on there based on the
20 IV-79 data, it would start at about .53 G at one kilometer,
21 and fare into the other curve at some distance. That means
22 that the rock value is .7 and the soil value is .53.

23 Comparing those two numbers, if we go from deep soil to
24 rock, we increase by 32 percent. If we go from rock to
25 soil, we reduce by 25 percent. I rounded those numbers off



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1 since I don't think we deal in 32 percent, for engineering
2 purposes.

3 So I would say that it is now my opinion that
4 accelerations on rock would be about 30 percent higher than
5 the accelerations on deep soil.

6 Q Let me check this one item on this Joint
7 Intervenor's Exhibit R-5. What is the distance used to
8 plot the IV-79 data, sir?

9 This is the exhibit that you passed out yester-
10 day which contains new estimates.

11 A The direct distance to the causative fault.

12 Q Let me ask you, sir, when the mean curve in
13 Figure 9 of Joint Intervenor's Exhibit R-4 is compared to
14 the revised mean in the Joint Intervenor's Exhibit R-5 for
15 deep cohesionless soil, I estimate that you predict that
16 the --

17 Let me ask you if you can do this calculation.
18 At a distance of 5.8 kilometers from the fault for the 6.5
19 magnitude earthquake, what is the difference between the
20 predicted mean peak acceleration for rock and cohesion-less
21 soil?

22 A It would still be about 30 percent because my
23 understanding of rock and soil behavior says that the
24 higher the acceleration, the greater will be the difference.
25 Therefore, if I get 30 percent for high acceleration, I



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would not throw in a rock that showed more than that for any lesser acceleration.

Q Have you prepared the new curves for the mean of the rock. We discussed that yesterday.

A No.

Q You have not?

A No. In light of what I just said, I decided that I did not need to.



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1 Q I would like to very briefly review one point that
2 we covered yesterday when we were discussing the Luco Figure
3 II-1 --

4 A Yes.

5 Q Where you compared the spectral shape for rock
6 sites, mean plus standard deviation from your 1976 paper
7 normalized to 0.75 g and showed that it depicted amplitudes
8 of strong ground motion greater than a Newmark design
9 spectra in the frequency range of interest.

10 A Where I compared them?

11 Q The Luco exhibit compares that Figure II-2.

12 A Yes, it does.

13 Q And we went on to examine the assumptions on which
14 the plot was made, and there were four of them. You disagreed
15 with assumption one, and you could not comment on assumption
16 three.

17 A Yes, that is right.

18 Q Have you taken the opportunity to determine the
19 validity of assumption three?

20 A Yes.

21 Q And what is your opinion, sir?

22 A If you would refer to your piece of evidence,
23 R-5, which is called "Site Dependent Spectra for Earthquake
24 Resistant Design," a paper by myself, Lugas and Liesner --

25 Q Is that R-3?



1 A I have it marked R-5. I don't mind what number
2 it is.

3 MR. FLEISCHAKER: Excuse me while I find the
4 document.

5 MR. NORTON: What is the title of the document?

6 WITNESS SEED: The title of the document is "Site
7 Dependent Spectra for Earthquake Resistant Design."

8 MR. LANPHER: I think that was marked yesterday as
9 Joint Intervenors' Exhibit R-3.

10 WITNESS SEED: That is right. If you would refer
11 to that, Figure 7 compares spectra for -- mean spectra for
12 deep cohesionless sites with mean plus one standard deviation
13 spectra for deep cohesionless sites, and in the range of
14 interest to us which is from 0 to about .5 seconds or .6
15 seconds, which is where most of all of the interest is concern-
16 ed in nuclear power plant design.

17 The difference between those is about, by my
18 calculations, about 30 percent. And so with reference to
19 assumption three where Dr. Luco says that he has used a value
20 of 1.5 to convert from the standard deviation to the mean
21 plus one standard deviation, I would think that a value more
22 like 1.3 or 1.4 would be more appropriate.

23 He assumed that the ratio of the spectra would
24 be the same as that of the ground accelerations, and since
25 there is evidence that it is not, there is no need to make

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1 that assumption, and so I would use the data that we have
2 to get the right number. It turns out to be about 1.3, I
3 believe, and I would be quite happy for him to use 1.4.

4 BY MR. FLEISCHAKER: (Resuming)

5 Q Have you determined, sir, how the use of the number
6 1.4 would change the figure that is plotted on Luco Figure
7 II-2 -- strike that.

8 Have you determined, sir, how the use of either
9 a factor of 1.3 or 1.4 would change your curve as plotted
10 on Figure II-1 of Luco's testimony?

11 A No, I have not, but I presume that if one were to
12 use 1.3 rather than 1.5, it would be reduced in the ratio,
13 1.3 divided by 1.5. That is not a source of great disagree-
14 ment as far as I am concerned. My main disagreement is in
15 assumption one which I have studied overnight and before,
16 and in accordance -- and I also reported on at the last
17 hearing. And I disagree with Dr. Luco's assumption one.

18 Q Let me -- I am sorry.

19 A .75 g is an appropriate value for the mean expected
20 acceleration at a distance of 5.8 kilometers from the Hosgri
21 fault. My calculations indicate that about .5 to .6 would
22 be an appropriate value for the mean expected acceleration,
23 and .75 g would be an appropriate value and a conservative
24 value for the mean plus one standard deviation, acceleration
25 at a distance of 5.8 from the Hosgri fault.

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1 Q Let me pursue that a little, because that was the
2 point I wanted to examine you on briefly.

3 A I thought it might be, so I thought I would tell you
4 what I thought so you --

5 (Laughter.)

6 Q Directing your attention, sir, again to a figure --
7 Figure 5 of Joint Intervenors' Exhibit R-4, which is your
8 1976 article.

9 A Figure 5, yes.

10 Q And this is entitled, "The Relationship Between
11 Maximum Ground Accelerations and Distance from the Zone of
12 Energy Released for Rock Sites," and yesterday we agreed
13 that Diablo Canyon qualified as a rock site by the definitions
14 used in your paper here. And yesterday also I think we
15 agreed that your projected curves here resulted in a predicted
16 you predict a mean peak acceleration of .6 g.

17 A Yes.

18 MR. OLMSTEAD: Mr. Chairman, yesterday there was
19 a little confusion about these exhibit numbers, and I think
20 that you just referred to that as Exhibit -- Joint Inter-
21 venors' Exhibit R-4. My record shows it is R-3.

22 MR. FLEISCHAKER: This is 4.

23 CHAIRMAN SALZMAN: Talking about the report by
24 Seed and Morosca?

25 MR. FLEISCHAKER: That is correct.



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CHAIRMAN SALZMAN: Yes, then he is correct. It is 4.

MR. FLEISCHAKER: And we are on page 1334.

(Pause.)

MR. OLMSTEAD: That is not the way I have them recorded.

CHAIRMAN SALZMAN: Mr. Fleischaker is correct.

MR. OLMSTEAD: That is the way they were handed out.

CHAIRMAN SALZMAN: It was corrected yesterday.

MR. OLMSTEAD: Okay.

BY MR. FLEISCHAKER: (Resuming)

Q Now, Dr. Seed, I would like to -- Mr. Norton.

MR. NORTON: Excuse me. We are having a problem with the numbers, too. We are trying to find out if he has the right one.

CHAIRMAN SALZMAN: One moment. Off the record.

(Discussion off the record.)

CHAIRMAN SALZMAN: Please proceed.

MR. FLEISCHAKER: Thank you.

BY MR. FLEISCHAKER: (Resuming)

Q We talked about this figure yesterday, didn't we, Dr. Seed?

A Yes, we did.

Q And we agreed that your predictions from these



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1 curves were about .6 g for --

2 A For the mean acceleration.

3 Q For the mean acceleration.

4 A Yes.

5 Q And with a standard deviation it was about .71,
6 and that is consistent with your testimony this morning
7 except for one thing. This is for an earthquake magnitude
8 equal to 6.5 at a rock site, and the safe shutdown earthquake
9 for Diablo Canyon is supposed to be magnitude 7.5.

10 A Yes, that is right.

11 Q Sir, have you published any recent estimates of
12 the mean peak accelerations on rock for 7.5 expected in the
13 near field?

14 A I have not published any, but I do have data on
15 that which I -- since I take an interest in rock sites
16 I generally collect rock data, and I do have them in my
17 files.

18 Q Now, your standard deviation on this curve figure
19 which is represented on Figure 5 of Joint Intervenors' Exhibit
20 R-4 is 1.18, is that correct?

21 A Apparently so.

22 Q All right. And if we examine the linear portion
23 of the curve in Figure 5, I estimate there to be a standard
24 a constant standard deviation of about 1.4 to 1.5. Would
25 you agree with that? Is that a reasonable estimate?



1 A I have not checked it out. It looks a little bit
2 less than that to me. I have not done the mathematics.

3 Q Could you check that out very quickly here on the
4 curve?

5 DR. JOHNSON: May I interject here just a moment?
6 Did you not say yesterday, Dr. Seed, that these curves such
7 as were drawn in Figure 5 of R-4 were simply put in without
8 any particular basis?

9 WITNESS SEED: I said they were drawn in on the
10 basis, largely on the basis of judgment guided by three
11 things. One would be the Pacoima Dam value which occurs
12 at about 2 kilometers which gives guidance to where the
13 curve should go; secondly, the Parkfield earthquake which
14 gives guidance in the near field as to where the curves might
15 go; and thirdly, my understanding from Dr. Benioff in the
16 near field these curves are very flat.

17 DR. JOHNSON: But with regard to the standard
18 deviation of those curves is there any significant --
19 technical significance attached to the values of the standard
20 deviation as displayed on those curves?

21 WITNESS SEED: Not in the first 10 kilometers,
22 no.

23 DR. JOHNSON: Thank you.

24 BY MR. FLEISCHAKER: (Resuming)

25 Q Is there any technical significance to the standard

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1 deviation as displayed in the linear portion of the curves
2 beyond 10 kilometers?

3 A Yes. They were analyzed statistically to find
4 out what the standard deviation would be based on the data
5 shown in the rectangular zone.

6 Q And what was the basis for reducing the standard
7 deviation as you went from the linear portion of the curve
8 to the curved portion of the curve?

9 A There was no basis. I just told you what guided
10 me in drawing the lines as I went up. I had to draw the
11 line somewhere, and I used my judgment as to where those
12 lines should go.

13 Q Now, if we take your predicted mean acceleration
14 of .6 g for the rock sites and we apply a standard deviation
15 that was calculated for the linear portion of the curve,
16 what is the mean plus standard deviation value?

17 A It would be about .1 and .6, 20 percent perhaps.
18 That 20 percent is at the one kilometer zone, and I do not
19 have -- I have not worked out what it is in the other part.

20 Q I think the question was confusing. Let's go back.
21 What was the calculated standard deviation in the linear
22 portion of the curve on Figure 5?

23 A I told you, I have not worked it out.

24 Q I worked it out to about 1.5. Can you check that
25 very quickly, sir?

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A Yes.

(Pause.)

Oh, I would say about 1.35.

Q Okay. I will take your figure. So the mean plus one standard deviation on the basis of the standard deviation displayed in the linear portion there is about .81 g.

A I am sorry. Say it again.

Q Okay. If we take your predicted mean acceleration of .6 g for rock sites at 5.8 kilometers for a magnitude approximately equal to 6.5, and we multiply that times the standard deviation derived for the linear part of the curve, we get a mean plus standard deviation peak acceleration of .81 g.

A You would get that if you did that.

Q Thank you.

(Pause.)

MR. FLEISCHAKER: That is all I have, Dr. Seed.

At this time I would like to move Joint Intervenors Exhibit R-4 into evidence.

MR. OLMSTEAD: No objection.

MR. NORTON: No objection.

MR. LANPHER: No objection.

CHAIRMAN SALZMAN: The Reporter will mark R-4 as admitted into evidence this morning.



XXXX

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(The document previously marked
Joint Intervenors' Exhibit R-4
for identification was received
in evidence.)

CHAIRMAN SALZMAN: Mr. Fleischaker, did you offer
R-3?

MR. FLEISCHAKER: No, sir.

CHAIRMAN SALZMAN: Thank you.

DR. JOHNSON: Dr. Seed, Intervenors' Exhibit R-3,
which is a paper by you, Lugas, and Liesner --

WITNESS SEED: Yes.

DR. JOHNSON: In which you calculate spectra,
response spectra for various sites under various conditions.

WITNESS SEED: Right.

DR. JOHNSON: Have you changed any of your con-
clusions that were expressed in that paper since it was
written?

WITNESS SEED: As a matter of fact, we have done
this study over again in the past year or so, but it is
my recollection that the curves in the period range up to
about 0.6. They don't change significantly. So I would
not want to argue strongly about it.

DR. JOHNSON: I refer you to page 238 of that
paper, and you are discussing a magnitude 6.5 earthquake,
and down at the bottom there is a table for the various



1 maximum accelerations, and for a rock site you put a
2 maximum acceleration of approximately .5 g.

3 Do you still hold with that conclusion?

4 WITNESS SEED: Those numbers for different kinds
5 of sites, for maximum accelerations were taken relative to
6 each other based on the other paper which is Intervenors'
7 Exhibit R-4, which deals with maximum accelerations.

8 I just testified that I would change the curves
9 in that figure. I would necessarily have to change the
10 numbers in the table that you are referring to at the bottom
11 of page 238.

12 DR. JOHNSON: Well, then, do I understand that
13 these numbers are presently changed, that you would no longer
14 say .5 g?

15 WITNESS SEED: Oh, excuse me. Well, I think the
16 rock value would still be the same. The stiff soil value
17 would still be the same. The deep cohesionless soil value
18 would be changed. That was changed on the basis of the IV '79
19 data.

20 DR. JOHNSON: Would you read the last sentence --
21 the sentence which starts with the line, the last line on
22 that page, and answer do you still hold with this sentence
23 being a factual statement?

24 CHAIRMAN SALZMAN: Let's make certain that this
25 is in the record. Let me read the sentence, or Dr. Johnson,

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1 would you read the sentence?

2 DR. JOHNSON: Well, I am reading now a sentence
3 that starts at the bottom of page 238 of this Exhibit R-3,
4 and it says, "Since the motions developed at a distance of
5 5 miles from a magnitude 6 1/2 earthquake are likely to be
6 reasonably close to the strongest developed in any earthquake,
7 the spectral curve shown in Figure 19 might serve as a
8 general basis for the design in areas of highest seismic
9 intensity."

10 Is that still your conclusion?

11 WITNESS SEED: That is still my conclusion.

12 DR. JOHNSON: Would you compare the peak accelera-
13 tion in your Figure 19 referred to in that sentence, and
14 a period of approximately .2 seconds to the peak -- for
15 rock site to the peak acceleration displayed in Dr. Luco's
16 Figure II-1 for a rock site ascribed to Seed et al.

17 WITNESS SEED: Point two seconds spectral accelera-
18 tion on my Figure 19 is 1. -- 1.24 or something like that,
19 and Dr. Luco's Figure II.1, .2 seconds for rock sites. Based
20 on my curve he shows about 2.3.

21 DR. JOHNSON: In your curve you do not show plus
22 one standard deviation, is that correct?

23 WITNESS SEED: That is correct.

24 DR. JOHNSON: Is that the only difference between
25 if you were to draw the curve that Dr. Luco has drawn to



1 include the maximum plus one standard deviation, would you
2 simply add the one standard deviation to your curve --

3 MRS. NORDLINGER: Dr. Luco feels you are misinter-
4 preting something in his figures and wondered if he could
5 assist you.

6 CHAIRMAN SALZMAN: At this moment the answer is no,
7 Mrs. Nordlinger. Dr. Johnson is cross examining. Dr. Johnson
8 can ask Dr. Luco when he is on the stand about this.

9 MR. FLEISCHAKER: Can I ask one question, Dr. Johnson
10 I missed the figures that he gave as compared peak accelera-
11 tions. Can I get those back from Dr. Seed? You asked him
12 to say for the record the peak accelerations developed at
13 .2, and he gave those. I missed those figures.

14 DR. JOHNSON: Would you repeat the peak accelera-
15 tion values?

16 MR. NORTON: May I make one clarification? We
17 are really talking spectral acceleration as opposed to --

18 DR. JOHNSON: That is correct. The spectral
19 acceleration at the maximum in the response spectrum is
20 what I am asking for.

21 WITNESS SEED: You asked me to read from Figure
22 19 of Exhibit R-3, spectral acceleration in a period of .2
23 seconds, and I read off from there about 1.24 g. You asked
24 me to compare that with the value on Dr. Luco's plot at the
25 same period for acceleration at .2 seconds. Spectral

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1 acceleration he shows to be about 2.3.

2 DR. JOHNSON: Thank you.

3 MR. NORTON: There was a pending followup question
4 by Dr. Johnson when the witness was interrupted, and that
5 was -- had to do with if there was anything else that he
6 would do differently, something to that effect.

7 DR. JOHNSON: I asked if the difference between
8 the curve in R-3 and -- let me back up and ask again. If
9 you were now asked to generate a spectrum for the expected
10 motion plus one standard deviation, you would multiply the
11 curve which appears as Figure 19 of Intevenors' Exhibit R-3,
12 a factor which incorporates one standard deviation, is that
13 correct?

14 WITNESS SEED: That is correct.

15 DR. JOHNSON: Would you do anything else to correct
16 the figure in 19 to use it for the design of a structure?

17 WITNESS SEED: No.

18 DR. JOHNSON: That is all the questions I have.

19 WITNESS SEED: I should point out perhaps that
20 Figure 19 is drawn for 5 percent damping, and Dr. Luco's
21 figure is drawn for 7 percent damping, so there is a minor
22 difference in the amount of damping in comparing those two
23 figures.

24 DR. JOHNSON: Thank you, sir.

25 Mr. Fleischaker, back to you now.

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1 MR. FLEISCHAKER: One moment, please.

2 (Pause.)

3 DR. JOHNSON: I will fill in here for a minute,
4 if I may.

5 Dr. Seed, are you aware of recent compilations
6 of strong motion data which the conclusion -- the conclusion
7 of which is that in the near field there appears to be
8 little or no difference between rock and soil sites, one
9 of which, of course, is USGS 795?

10 WITNESS SEED: Yes, I am aware of that.

11 DR. JOHNSON: You then have a difference of
12 opinion at least with the authors of that study. Are you
13 aware of any other studies?

14 WITNESS SEED: I think most of my colleagues
15 perhaps on the panel share the point of view in their written
16 work that there is little difference between rock and soil
17 sites.

18 DR. JOHNSON: Could you explain for us why you
19 might be of -- I mean, is this difference simply your view
20 of the data which exists, or do you have a theoretical
21 basis on which to found the difference or your different
22 opinion?

23 WITNESS SEED: I don't have a theoretical basis.
24 I just have a different basis for separation; that is that
25 most people who compare these results compare all rock



1 versus all soil whereas in my separations of records I
2 separate them into rock, one group, what I would call stiff
3 soil sites which is soil up to 200 deep feet and composed
4 of sand and gravel, stiff soils, and very deep soil sites.

5 Not everybody separates out the very deep soil
6 sites from the others, and it is the very deep soil sites
7 which give the difference. If you don't make those separa-
8 tions, you will not see the difference.

9 DR. JOHNSON: All right.

10 WITNESS BLUME: I think it should be made clear
11 that this is a frequency dependent situation, and what
12 Dr. Seed said I would concur in at the high frequencies
13 or low periods, but at long periods there are differences
14 in my opinion between soil and rock.

15 DR. JOHNSON: Well, I may be wrong, Dr. Blume,
16 but I thought Dr. Seed had the difference -- thought that
17 there was a difference at all frequencies.

18 WITNESS SEED: I do. That is part of the disagree-
19 ment that goes on between different workers in the field.
20 I accept that I have a position different from my colleagues
21 on the panel and from the U.S. Geological Survey and from
22 some other groups. I suspect my position is also shared
23 by some other groups.

24 DR. JOHNSON: But referring back to this Figure 19
25 on Intervenors' Exhibit R-3, it is in the range from zero to

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1 .5 second period where the rock acceleration exceeds those
2 in soil, but for the longer periods your rock accelerations
3 in that spectrum are lower than the spectral accelerations
4 for soil.

5 WITNESS SEED: In that figure that is correct.

6 DR. JOHNSON: And that is a figure generated for
7 the near field, is that correct?

8 WITNESS SEED: Yes.

9 DR. JOHNSON: Thank you.

10 WITNESS SEED: I would be glad to present at
11 some time my version of where the spectra should be for
12 Hosgri and where they should be anchored. Maybe I will
13 get that done later to clarify any issues that need to be
14 clarified about this.

15 DR. BUCK: Dr. Seed, do I understand you are
16 saying that the difference between soil and rock is the
17 same for all frequencies? There is no change in the differ-
18 ence between soil and hard rock, for example, at all or --

19 WITNESS SEED: It depends upon the amplitude of
20 motions. It is a very complicated factor, and what I have
21 said is that in the near field for very strong acceleration
22 levels it is likely that rock motions will be higher than
23 those on deep cohesionless soil deposits.

24 DR. BUCK: For all frequencies?

25 WITNESS SEED: For all frequencies.

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1 DR. BUCK: And the difference -- what I am asking
2 you is you are saying the difference would be the same for
3 all frequencies.

4 WITNESS SEED: No, not for all frequencies, no.

5 DR. BUCK: How does it vary with frequency?

6 WITNESS SEED: I cannot tell you that offhand. I
7 don't think it would be the same for all frequencies.

8 DR. BUCK: Do you have a qualitative view as to
9 which way it changes with frequency?

10 WITNESS SEED: The spectrum for rock is very high
11 at low periods, and the spectrum for deep cohesionless soil
12 tends to be longer at longer periods, so they are likely to
13 cross over at some point in the plotting.

14 DR. BUCK: All right. Thank you.

15 WITNESS SEED: I should also point out at low
16 amplitudes of motion I believe, as many other people do,
17 at about .2 g level deep soils give about the same as rock
18 and that at lower levels of motion that deep soils give
19 higher values than rock. It is only at the strongest levels
20 of shaking that this difference comes into effect.

21 CHAIRMAN SALZMAN: Please continue, Mr. Fleischaker.

22 BY MR. FLEISCHAKER: (Resuming)

23 Q I would like to continue to question 4. Dr. Fraser,
24 these questions are for you.

25 Dr. Fraser, question 4 deals with the magnitudes



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1 of vertical and horizontal acceleration as measured during
2 the Imperial Valley earthquake, and the data indicated some
3 high vertical accelerations at close distances to the
4 causative fault.

5 And your conclusion, sir, is that these high
6 accelerations were due to unusual properties of the Imperial
7 Valley. Could you, sir, briefly describe these character-
8 istics of the soil and the mechanism which you believe
9 caused the high vertical accelerations during the IV '79
10 event?

11 MR. NORTON: For the record I am going to make
12 an objection to that question because it misstates the
13 testimony. I think the testimony speaks for itself, and
14 Mr. Fleischaker is summarizing it in two or three sentences
15 incorrectly, which is hardly fair as a question.

16 I have no objection to the basic question. If
17 you want to summarize the testimony, fine. But I do object
18 to Mr. Fleischaker's characterization.

19 CHAIRMAN SALZMAN: Mr. Fleischaker, why don't
20 you just ask the question? We can summarize the testimony
21 for ourselves, or you can summarize it in your brief, sir.

22 BY MR. FLEISCHAKER: (Resuming)

23 Q Dr. Fraser, could you briefly describe the
24 properties and the mechanisms that you believe lead to the
25 unusually high vertical accelerations during the Imperial



1 Valley earthquake?

2 A (Witness Fraser) Yes. I think the recordings
3 of the Imperial Valley earthquake resulted in vertical
4 accelerations that in some cases exceeded the horizontal
5 accelerations, and I think that there are -- it is a fairly
6 complicated problem, and we are learning about it all the
7 time. And I think there are probably several mechanisms.

8 The principal mechanism that I have concentrated
9 on in my testimony is that of earth structure. The properties
10 of the earth in the Imperial Valley are significantly differ-
11 ent than properties of earth at the region of Diablo Canyon,
12 and it is my opinion, as I stated in the testimony, that
13 those differences in properties of the earth will lead
14 to differences in ground motion at Diablo Canyon as opposed
15 to Imperial Valley.

16 The exceedingly high vertical accelerations that
17 were recorded in Imperial Valley were generally the result
18 of p. waves; that is, a wave in the earth like an acoustic
19 wave, the waves we have here in the room. That is observed
20 on the strong motion recordings by the fact that in the
21 unusually high vertical accelerations, the large value occurs
22 before the s waves come in, which are sheer waves. That
23 is before the horizontal shaking is strong in some cases
24 at least. In the ones that are unusually high, that is
25 particularly true.

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1 In many strong motion recordings the large
2 vertical acceleration is the result of a different type of
3 wave, not p waves. The p waves can be seen on the record,
4 but it does not lead to the high spike-like character that
5 we see in Imperial Valley. And it is my opinion that that
6 unusual behavior is a result of earth structure.

7 Q In your testimony, sir --

8 A I would like to correct my last sentence. It is
9 principally a result of earth structure. I think there are
10 other contributing factors.

11 Q You refer, sir, to an echo chamber effect in your
12 testimony. Could you describe that, please?

13 A Yes. The earth structure, that is, the properties
14 of the earth in Imperial Valley, are quite closely or can
15 be quite closely approximated by the wave speeds of the
16 earth increase approximately linearly with depth from quite
17 low numbers near the surface of the earth to a depth of
18 about 6 kilometers. It is deep sediments.

19 That gradient in wave speeds in the earth leads
20 to refraction of seismic waves. That is, when waves are
21 propagating in that material they always bend toward the
22 surface of the earth, and in fact, because at approximately
23 linear they approximately take circular paths, so any time
24 you try to send a wave out in any direction you want to
25 send the thing, so the waves tend to bend toward the surface



1 of the earth, and it does that in a more extreme manner
2 than in the earth structure at Diablo Canyon.

3 The gradient at Diablo Canyon is not as severe
4 as the gradient in Imperial Valley, so because of the --
5 I referred to that as an echo chamber effect; that is, as
6 you send waves out, and they always come popping up at the
7 surface in a very short distance. That leads to larger
8 ground motions at Imperial Valley than in, say, Diablo
9 Canyon for the same strength of sources.

10 Now, as Dr. Seed has just pointed out --

11 Q Could you repeat that sentence?

12 A Yes. That can lead to larger accelerations on the
13 surface at Imperial Valley than at Diablo because you are
14 getting an echo chamber effect at Imperial Valley.

15 Q Do you mean vertical accelerations or horizontal
16 accelerations or both?

17 A If the ground motions are very low, it can lead
18 to elevations at Imperial Valley from horizontals and
19 verticals. However, there is a compensating effect taking
20 place in the Imperial Valley. As the waves propagate, these
21 high frequency waves are dissipated by material histories,
22 and it seems that the Imperial Valley is likely to dissipate
23 more dramatically than is the rocks underneath Diablo, so
24 it is a compensating effect. Because the dissipation is
25 larger at Imperial Valley than it would be at Diablo, then

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1 you have the echo chamber tending to elevate at Imperial
2 Valley and the dissipation is tending to suppress at Imperial
3 Valley.

4 The p waves, the high frequency p waves are not
5 as severely affected by dissipation as are the s waves.
6 Therefore, it appears to me that the peak waves in Imperial
7 Valley are amplified by the echo chamber effect and are,
8 to a lesser degree, suppressed by material dissipation,
9 and therefore, the consequences are that we see large p
10 waves recorded during the main earthquake. That would not
11 be expected in other types of earth structure.

12 Q You don't define this term in your testimony, but
13 I will ask you this question and ask you whether this is an
14 accurate statement.

15 Do you conclude that the particular properties of
16 Imperial Valley result in a lower Q value for the s waves
17 than for p waves?

18 A Yes.

19 Q What is that value?

20 A What is the value of Q for the s waves or the p
21 waves? I am not --

22 Q Both.

23 A I have not physically measured the Q, nor do I
24 know of observations in Imperial Valley to measure Q. So
25 if I give you -- I mean, the way I would have to answer that



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1 question would have to be an indirect way of obtaining Q.
2 I have done calculations for waves in Imperial Valley,
3 and in order to proceed with those calculations I have
4 had to use the best judgment I can to get the best Qs I
5 can for that structure, and I can provide those for you.

6 Q So you have no empirical data that measures the
7 Q value for the p and the s waves in Imperial Valley, is
8 that correct?

9 A No. Conversely, that is what I am using, empirical
10 data. I have no physical data. I have only empirical
11 data that has been extrapolated.

12 Q Could you, for purposes of the record, define Q?

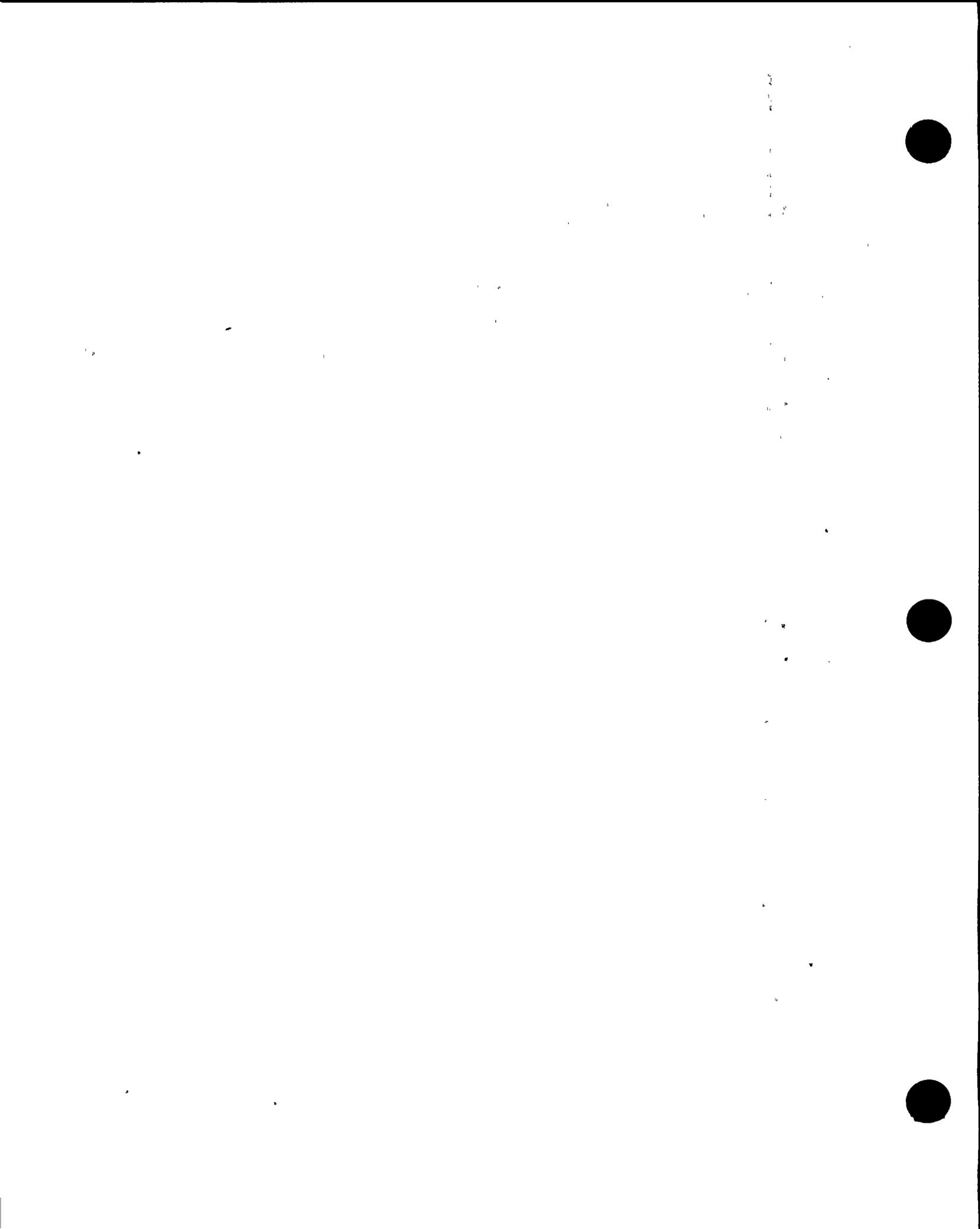
13 A As I recall, we went through this a year and
14 a half ago.

15 Q We don't have to do it unless the Board would
16 like it in the record at this point.

17 CHAIRMAN SALZMAN: Why don't you give us a
18 definition of Q?

19 WITNESS FRASER: First, Q is a quality factor
20 of the earth. The higher the Q, the higher the quality;
21 that is, the less the dissipation. The lower the Q, the
22 lower the quality; that is, the more the dissipation.

23 People -- I think most of the people in the room
24 are accustomed to the term percentage of critical damping.
25 We use that in structural engineering a lot. There is an



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approximate relationship between percentage of critical damping and Q. The relationship is that Q is approximately equal to one divided by twice the ratio of critical damping, so it is an inverse relationship with regard to critical damping.

BY MR. FLEISCHAKER: (Resuming)

Q Could you provide us the figures that you have derived for Q? You were about to do that.

A You are asking what Q did I use in my numerical calculations at Imperial Valley, is that the question?

Q That is the question.





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A I have used two different earth structures for Imperial Valley in order to get a sense of what range of values might I get within the range of uncertainty for that structure.

The preferred earth structure is the one at the top of my table two in my testimony. The results that appear in table two are a result of the preferred earth structure.

So I have done two different earth structural approximations for Imperial Valley.

Q Is this table 4-2?

A Yes.

Q Okay.

A Table 4-2.

.CHAIRMAN SALZMAN: That is on page 4-15 of your testimony, Mr. Fraser, your written testimony?

WITNESS FRASER: Yes.

CHAIRMAN SALZMAN: That is the page that has been revised?

WITNESS FRASER: That is according to the revision, yes.

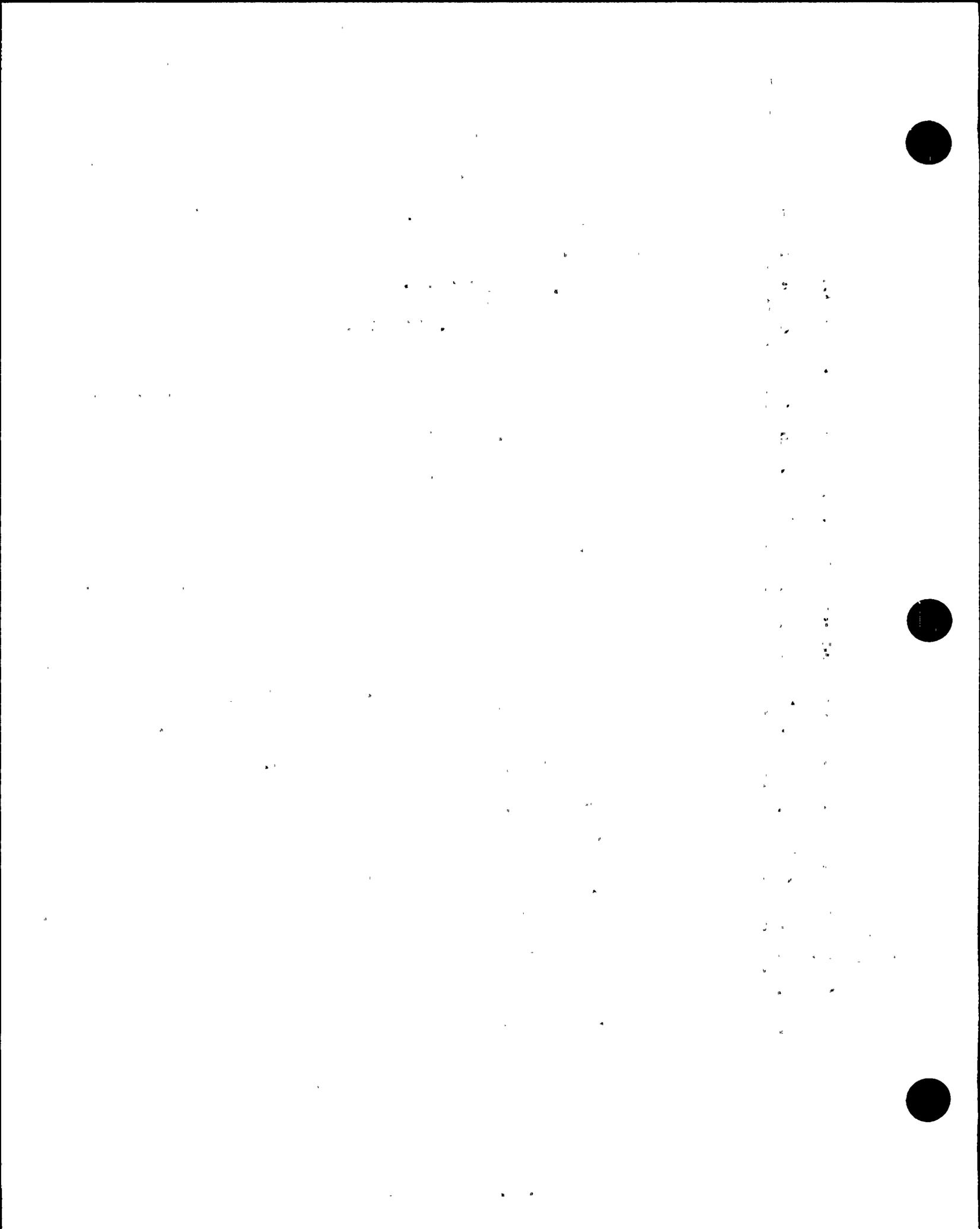
CHAIRMAN SALZMAN: Do you have the revised page, Mr. Felischaker?

MR. FLEISCHAKER: Yes.

WITNESS FRASER: Perhaps I can answer the question

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dsp4-2

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1 by explaining how I determined Q.

2 I have used in all my calculations that I have
3 done for the past four years an empirical relationship
4 that yields Q as a function of the shear wave velocity.

5 BY MR. FLEISCHAKER:

6 Q Can I ask you first, sir, to give us the numbers
7 and then the explanation?

8 A Okay. And what you would like is Q as a function
9 of depth in the Imperial Valley.

10 Q Correct.

11 A Okay.

12 (Pause)

13 MR. NORTON: Dr. Salzman, I just consulted with
14 Dr. Fraser to see how long this would take, and he said
15 we are talking about 15 depths, two Q values per depth.
16 It will take him 10 to 15 minutes to do the calculations.

17 WITNESS FRASER: The equation I am using, I
18 think is the question. There is no ambiguity, I think,
19 once I give the equation.

20 MR. NORTON: Dr. Salzman, I am going to make a
21 formal objection; I am not going to have a witness
22 spending 15 minutes to make calculations with paper and
23 pencil in response to a question. I don't think it is
24 proper.

25 CHAIRMAN SALZMAN: Just a moment, Mr. Norton.



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(Board conferring)

CHAIRMAN SALZMAN: Mr. Fleischaker, do you need the answer immediately to continue your questioning? If not, perhaps Dr. Fraser could calculate the answer for you and give it to you after lunch.

MR. NORTON: Excuse me, Dr. Salzman. Again, I kind of object to that procedure of Mr. Fleischaker asking questions and my witnesses having to do calculations during breaks and lunch hour for Mr. Fleischaker. They deserve breaks and lunches too.

CHAIRMAN SALZMAN: I understand, Mr. Norton. We all deserve a lot of things, and we don't always get them, sir. Mr. Fleischaker, I ask you a question.

MR. FLEISCHAKER: Can I consult with my advisers?

CHAIRMAN SALZMAN: Just a moment.

MR. NORTON: I do have the right to make an objection.

CHAIRMAN SALZMAN: Your objection is noted, Mr. Norton, and that is enough.

MR. NORTON: I have not had an opportunity to make it, Mr. Salzman, and I would like to finish my objection.

CHAIRMAN SALZMAN: State your objection for the record, Mr. Norton.

MR. NORTON: Thank you. Mr. Fleischaker has



dsp4-4

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A

1 consultants, has experts, and our witness is willing to
2 give him the formula and they can do the mathematical
3 calculations as easily as our expert can.

4 Again, I think it is improper for adverse
5 counsel to be sending off witnesses to do their homework
6 that they are capable of doing. That is my objection.

7 CHAIRMAN SALZMAN: Objection is noted. We will
8 rule on it in a moment.

9 MR. FLEISCHAKER: Let me suggest this: I can
10 continue with my cross examination, if Mr. Norton does
11 not have an objection. I can put Dr. Brune together
12 with Dr. Fraser, and we can determine what we might be
13 able to obtain through some discussions at a break.

14 CHAIRMAN SALZMAN: Mr. Fleischaker, Mr. Norton's
15 point is that if his witness gives you the equation, your
16 witness can -- your experts can simply come up with the
17 answer.

18 Is that correct, sir?

19 MR. FLEISCHAKER: It is my understanding that
20 it is a very -- that is not an easy thing to do, and he
21 may well have -- let me ask this a different way.

22 Dr. Fraser has provided a graph, figure 7-2 in
23 his testimony which sets out the Q value for Diablo Canyon.
24 If he has such a graph for Imperial Valley available, that
25 would cut down the time, and that would be sufficient for



dsp4-5

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our purposes.

CHAIRMAN SALZMAN: Dr. Fraser, do you have such a graph, sir?

WITNESS FRASER: I have such a graph in another report, but I do not know if it is in evidence or anything like that here. Yes, I do have it in a graph.

CHAIRMAN SALZMAN: Can you locate it promptly?

WITNESS FRASER: Yes.

CHAIRMAN SALZMAN: Would you, please.

(Pause)

MR. OLMSTEAD: I think we might have it right here if you want to take a look at it.

CHAIRMAN SALZMAN: Dr. Fraser, Mr. Olmstead has it. Would you look at his paper, sir?

MR. FLEISCHAKER: Excuse me, sir. Mr. Chairman, may we approach the bench very briefly? Would now be an appropriate time to take a break because I have some documents which I can mark now and have distributed for cross examination, and that would save us time.

CHAIRMAN SALZMAN: All right.

Gentlemen, we will recess for five minutes.

(Brief recess)

CHAIRMAN SALZMAN: Back on the record, please.

Mr. Fleischaker?

MR. FLEISCHAKER: Yes, sir?



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1 CHAIRMAN SALZMAN: We have pending before us
2 a motion to subpoena Mr. Boore. As far as I can see,
3 subpoenaing Mr. Boore would not result in his appearance
4 before this board this week. The record seems very clear
5 that you could have anticipated that you might need
6 Mr. Boore at this hearing beforehand. And offering the
7 subpoena at this time would be nothing but for purposes of
8 delay.

9 Al this information was available to you. The
10 motion for your subpoena will be denied.

11 MR. FLEISCHAKER: I would like to take exception
12 with the characterization of the purpose of the motion.

13 CHAIRMAN SALZMAN: Mr. Fleischaker, your
14 exceptions are noted in the record automatically, sir.
15 You may make them in your brief.

16 MR. FLEISCHAKER: Thank you.

17 MR. NORTON: Excuse me, Mr. Salzman. For
18 completeness of the record, I believe that the copy that
19 was marked in evidence of USGS circular 795 -- I think this
20 is in the record, but I just want to make sure it is --
21 the copy of 795 that has been admitted into the record and
22 marked as an exhibit has written on the top, "Should we
23 subpoena the author."

24 And I asked Mr. Fleischaker if that was part of
25 the original report or it was his writing, and he said that



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1 it was his writing.

2 MR. FLEISCHAKER: No, that is wrong.

3 CHAIRMAN SALZMAN: Let me interrupt. I am aware
4 of the writing; he said only that he was aware it was not
5 part of the report.

6 MR. FLEISCHAKER: For purposes of the record, I
7 did not write that on the report.

8 CHAIRMAN SALZMAN: All right. That is all right.

9 MR. FLEISCHAKER: I have distributed to --

10 CHAIRMAN SALZMAN: Mr. Fleischaker, before we
11 finish, we are left with the question of calculating Q.
12 Have your assistants and Dr. Fraser come to a conclusion
13 here?

14 MR. FLEISCHAKER: Let me consult briefly with
15 Dr. Brune. I was distributing the materials.

16 CHAIRMAN SALZMAN: Very briefly, Mr. Fleischaker,
17 please.

18 (Pause)

19 MR. FLEISCHAKER: Okay. We are ready to proceed,
20 sir.

21 CHAIRMAN SALZMAN: Has some arrangement been made
22 here about Q?

23 MR. FLEISCHAKER: We think we might be able to get
24 the values out of these reports, and I will question
25 Dr. Fraser on that.



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1 CHAIRMAN SALZMAN: All right. You are going to
2 drop te previous request that he calculate Q?

3 MR. FLEISCHAKER: That is correct, sir.

4 CHAIRMAN SALZMAN: Very well. Thank you very
5 much, gentlemen. Please continue. You might begin by
6 marking these exhibits for the reporter and for us, if you
7 intend to use them in the next few moments.

8 MR. FLEISCHAKER: Yes, sir.

9 I have distributed four documents. The first
10 is entitled "Simulation of Earthquake Ground Motions for
11 San Onofre Nuclear Generating Station Unit 1, Final
12 Report," by Delmar Technical Associates dated May 1978.

13 And I would like to have this marked as Joint
14 Intervenor's Exhibit R-6.

15 CHAIRMAN SALZMAN: For identification..

16 MR. FLEISCHAKER: For identification.

17 All of these are marked for purposes of
18 identification and all copies have been submitted to
19 counsel for the parties, three copies to the board, three
20 copies to the reporter.

21 The second document is supplement one to that
22 same report, which is dated July 1979, and I would like
23 to have that marked for identification as Joint Intervenors'
24 Exhibit R-7.

25 The third document is supplement two to that
report, and that is dated August 1980, and I would like to



sp4-9

1 have that marked for identification as Joint Intervenors'
2 Exhibit R-8.

3 And the final is supplement three; the final
4 document is supplement three to that report, and it is dated
5 August 1980. And it is -- should be marked for identification
6 as Joint Intervenors' Exhibit R-9.

7 CHAIRMAN SALZMAN: The reporter will please mark
8 the exhibits.

9 (The above-entitled documents
10 were marked Joint Intervenors'
11 Exhibits R-6, R-7, R-8, and
12 R-9 for identification.)

13 MR. NORTON: Mr. Salzman, before the questioning
14 begins, I have a preliminary matter on these documents. I
15 have looked at one, supplement III. Because of the date,
16 I started looking through it looking for Q values, and in
17 doing so, I have noted that there is a lot of writing --
18 not a lot -- there is writing in the report.

19 I think before we go further, I would like to
20 know if all of these reports have things written in them,
21 whether they are part of the original report, whether they
22 are part of Mr. Fleischaker's notes, his witness's notes,
23 or what.

24 I anticipate some real problems until we get that
25 question resolved.

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1 MR. FLEISCHAKER: Could you indicate to me --
 2 MR. NORTON: I am just leafing through it:
 3 III-4, for example, there are a number of numbers written
 4 in the extreme righthand column. I just turned the ears
 5 of some pages here where there are some things: IV-12,
 6 there are some numbers written in the righthand corner;
 7 IV-23, there are some curves with lines, question marks,
 8 and stuff written on them; V-5, there are some words --
 9 I am not sure I can read the words in the righthand
 10 column.

11 I am just leafing through this, but it bothers
 12 me that we have probably 500 or 600 pages or more here, and
 13 I have some problems with that. I would like to clear it
 14 up.

15 MR. FLEISCHAKER: There are some interlineations
 16 here. We tried to clean them up. They are in pencil. They
 17 are not part of the final report.

18 CHAIRMAN SALZMAN: It is only in effect the
 19 printed material.

20 MR. FLEISCHAKER: It is only the printed material.

21 CHAIRMAN SALZMAN: Does that satisfy you, Mr.
 22 Norton?

23 MR. NORTON: Yes. Perhaps, but I do not know --
 24 I have not had an opportunity to talk to Dr. Fraser, that
 25 he has not made some notations, and I would like to do that.



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1 CHAIRMAN SALZMAN: I don't follow you. Would
2 these be Dr. Fraser's notations?

3 MR. NORTON: Dr. Fraser wrote these reports.
4 These are his company's reports. Now, they may well have
5 made a notation after the final thing was printed because
6 a number was in error or something. I don't know. That is
7 what I am trying to find out.

8 MR. FLEISCHAKER: I believe almost all the
9 notations here are Dr. Brune's, but if we begin cross
10 examination here and it appears that there is something
11 other than printed matter which Dr. Fraser has added,
12 then he can certainly indicate that.

13 CHAIRMAN SALZMAN: Why don't we just leave it at
14 that and we will take a further look at them later on.
15 I think we can assume that if it not printed on the page
16 it is not part of the official report. And we will ignore
17 it unless we are asked to do otherwise, sir.

18 MR. NORTON: Thank you.

19 BY MR. FLEISCHAKER:

20 Q Now, Dr. Fraser, Mr. Norton just indicated you
21 were an author of this report, were you not?

22 A (Witness Fraser) I don't know which report you
23 are referring to, but I think the answer is yes.

24 Q The final report plus the three supplements, I, II,
25 and III.



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1 A Yes.

2 Q Okay. Could you please, sir, briefly describe
3 that report?

4 MR. NORTON: I am going to have to object to
5 that question as overly broad.

6 CHAIRMAN SALZMAN: Mr. Fleischaker, the report
7 says what it is on that first page. Be specific in
8 questions. You cannot ask a witness to please describe a
9 report if it is this long, sir.

10 BY MR. FLEISCHAKER:

11 Q Could you just describe the purpose of the report?

12 A May I speak of this as four reports?

13 Q Yes, sir.

14 A The purpose of the four reports are to develop
15 a method for computer simulations of earthquake ground
16 motions and to test the computer simulations against strong
17 motion records and some of the supplements are to make
18 improvements in that computer simulation of earthquake
19 processes.

20 Q Do you have -- when we broke off last, Dr. Fraser,
21 we were discussing the Q values in the Imperial Valley
22 which reduced the amplitudes -- excuse me -- affected the
23 s waves.

24 Is there a table in any of these four reports
25 which sets out the Q values that you used in your



sp4-13

1 calculations for the Imperial Valley?

2 A Yes.

3 Q Can you identify that table, please?

4 A Yes, but I want to be clear about this. In
5 table IV-2, page IV-15 of my testimony, the earth structure
6 labeled -- part of that table labeled "Imperial Valley
7 Results," that is the top -- there are three sections in
8 that table; the top section is labeled "Imperial Valley
9 Results."

10 The earth structure and the Q's that led to those
11 results are presented in supplement III; that is Joint
12 Intervenors' R-9, page III-4, a tabulation of the Q's, the
13 p wave and s wave Q's that were used for those calculations.

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1 Q Now I would like to show you a copy of the
2 supplement that I have here, so that we can make sure which
3 are the values.

4 CHAIRMAN SALZMAN: Show it to counsel, Mr.
5 Fleischaker.

6 Mr. Norton, would you look at that?

7 MR. NORTON: I have been furnished a copy by Mr.
8 Fleischaker.

9 Has the witness been furnished with a copy of
10 the exhibit?

11 WITNESS FRASER: I am using my own copy, so the
12 marking will be different.

13 CHAIRMAN SALZMAN: Would you be kind enough to
14 repeat the page number?

15 MR. FLEISCHMAKER: It is page 3-4.

16 MR. NORTON: Could we have an extra copy so that
17 the witness can have a copy of what you are reading from.

18 MR. FLEISCHAKER: For that purpose, can we borrow
19 a copy from the court reporter.

20 CHAIRMAN SALZMAN: Yes.

21 BY MR. FLEISCHAKER:

22 Q Mr. Fraser, we are just trying to clarify for the
23 record here, and we are looking at page 3-4, supplement 3
24 of what is marked --

25 CHAIRMAN SALZMAN: Did you say 3-4 or 2-4?





1 MR. FLEISCHAKER: Page 3-4 of Supplement 3, Joint
2 Intervenor's Exhibit R-9.

3 BY MR. FLEISCHAKER:

4 Q There are some pencil markings in the last
5 column, were those part of the report, sir?

6 A No.

7 Q You did not add those to this page?

8 A Pardon?

9 Q You did not add those pencil marks to this page?

10 A No.

11 Q Now, sir, about the Q values for the table
12 modified Imperial Valley results, do those appear in this
13 report?

14 A They do not.

15 Q Those do not appear in any of the four copies?

16 A No.

17 Q Do you have a graph or a table that contains
18 those values available?

19 A Yes, I do.

20 Q Can you obtain a copy of that during the lunch
21 recess?

22 MR. NORTON: You can obtain a copy of that after
23 the lunch recess. We will be happy to provide them, or to
24 have somebody make them during the lunch recess.

25 MR. FLEISCHAKER: Thank you.



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CHAIRMAN SALZMAN: Mr. Fleischaker, you are going to be finished here by 11:00, sir.

MR. FLEISCHAKER: I don't think that I need those values for purposes of my cross-examination, but rather for some rebuttal, or perhaps some other purpose.

CHAIRMAN SALZMAN: Thank you, sir.

BY MR. FLEISCHAKER:

Q Was it your testimony earlier this morning, sir, that the structural properties of Imperial Valley would lead to larger peak accelerations than one would predict for the Diablo Canyon site?

A I did not understand the question.

Q Was it your testimony, sir, that the properties of the so-called echo chamber effect of the Imperial Valley would result in higher peak accelerations both vertical and horizontal than predicted for the Diablo Canyon site?

A No.

Q Could you rephrase your testimony, or could you restate your testimony?

MR. NORTON: There is no question, when he says, can you restate your testimony.

CHAIRMAN SALZMAN: Objection sustained.

Mr. Fleischaker, ask the witness a question, and he will answer it.

--



1 BY MR. FLEISCHAKER:

2 Q What is your opinion with respect to predicted
3 peaks horizontal and vertical accelerations for Imperial
4 Valley versus Diablo Canyon?

5 A That Imperial Valley might be expected or should
6 expected to have larger horizontal to vertical ratios than
7 would be expected at Diablo Canyon. The reason for that
8 is the properties of the earth at Imperial Valley
9 principally.

10 Q Do you have an opinion, sir, as to the comparison
11 between peak horizontal accelerations predicted for
12 Imperial Valley versus those predicted for Diablo
13 Canyon?

14 A Yes.

15 Q What is that opinion?

16 A It is explained in my testimony under Question
17 7. There has been modeling -- computer modeling, as I
18 explained in those four reports, has been conducted
19 on hypothesized earthquakes off-shore Diablo, and from
20 those calculations we obtained synthetic ground motions
21 at Diablo, and those results are presented under my
22 testimony to Question 7.

23 The corresponding computer simulations at
24 Imperial Valley are contained in the report entitled,
25 Supplement 3, which is Joint Intervenor's Exhibit R-9.



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1 Q With respect to the properties of the geologic
2 structure alone, given the same magnitude event and the
3 same rupture mechanism, would you accept a predicted peak
4 accelerations at the Imperial Valley to be greater than or
5 less than those on rock sites?

6 MR. NORTON: Excuse me. May we have a clarifica-
7 tion of whether we are talking about vertical or
8 horizontal?

9 MR. FLEISCHAKER: That question was with
10 reference to horizontal accelerations.

11 WITNESS FRASER: I am going to have to clarify
12 a piece of the question. I don't understand when you say
13 with regard to earth structure. Let me attempt to answer
14 the question.

15 The calculations I just referred to indicate
16 larger horizontal accelerations at Diablo from the
17 corresponding calculations of accelerations at Imperial
18 Valley for the same distance range.

19 BY MR. FLEISCHAKER:

20 Q To what do you attribute the larger accelerations
21 predicted for Diablo Canyon?

22 A Principally earth structure.

23 Q What aspect of the earth structure?

24 A When I look at Imperial Valley, I note the two
25 compensating effects. One is that Imperial Valley, in the





1 absence of dissipation, elevates ground motions, both
2 vertical and horizontal. Dissipation does the opposite
3 effect. Dissipation at Imperial Valley is the compensating
4 effect.

5 So my conclusion is that for horizontal motions,
6 which are governed by sheer wave, the dissipation more
7 than compensates the effect of the echo chamber effect at
8 Imperial Valley. It approximately compensates, and perhaps
9 slightly over compensates.

10 Q To which model, sir, are you referring in that
11 response?

12 A All of the modeling work I am referring to is
13 the Table on page 3-4 of Supplement 3 Report, R-9.

14 CHAIRMAN SALZMAN: It is Joint Intervenor's
15 Exhibit R-9 for identification.

16 WITNESS FRASER: Yes.

17 BY MR. FLEISCHAKER:

18 Q Is that your revised Imperial Valley geologic
19 structure?

20 A Revised with respect to what? We used an
21 Imperial Valley earth structure two years ago that was
22 different from that.

23 Q Your answer now is Table 3-4 applies to the more
24 current Imperial Valley geologic structure?

25 A Yes, it is our best estimate of the generic





1 structure, or the general earth structure at Imperial
2 Valley, yes.

3 Q Now would you reach the same result with respect
4 to the Imperial Valley structure you used two years ago?

5 A The same results with respect to which aspect?

6 Q With regard to your estimation of the -- I am
7 trying to phrase this precisely. Would you reach the same
8 result with regard to the effect that increasing sheer
9 waves -- excuse me, decreasing the attenuation of sheer
10 waves at Diablo Canyon versus Imperial Valley would have
11 on horizontal acceleration at Diablo Canyon?

12 A Perhaps I can state the question.

13 Q Sure.

14 A I don't understand the question. It is very
15 complicated.

16 The last thing we were talking about was that
17 I said that I predict somewhat higher accelerations at
18 Diablo than I do at Imperial Valley. You are asking the
19 question perhaps that would the earth structure that I
20 used two years ago influence that conclusion.

21 Q That is correct.

22 A I don't know the answer to that. I suspect that
23 it would not reverse that conclusion. I am fairly sure
24 that it would not reverse it. I have not done the
25 comparison. I don't know.



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Q Thank you.

DR. JOHNSON: Dr. Fraser, may I ask a question?

The result you reached of higher values at Diablo than at Imperial Valley because of the effect of attenuation, is this a distance dependent result, or is it uniform?

You had data at various distances from the fault, is this result that you get independent of distance, or does it change with distance from the fault?

WITNESS FRASER: Let me substitute the word "dissipation" because, as you know, we use attenuation in multiple meanings.

DR. JOHNSON: Fine.

WITNESS FRASER: The properties of the earth vary with depth. The trend is that there is less dissipation in deeper depths. The result of that is that as you look in distance away from the causative rupture, the effect of dissipation is altered because the waves have found different paths to go from the source to the receiver.

So dissipation does have different effects at different distances. However, if the dissipation model is independent of distance, it is only a function of depth.

DR. JOHNSON: Thank you.

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BY MR. FLEISCHAKER:

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Q Dr. Fraser, I would like to direct your attention to page 4-5 of your pre-filed testimony at line 19.

3

A Yes.

4

CHAIRMAN SALZMAN: Pardon me, Mr. Fleischaker, this is the page where we have a number of corrections?

5

MR. FLEISCHAKER: That is correct, and I was going to ask him about one correction.

6

CHAIRMAN SALZMAN: Please go ahead, sir.

7

BY MR. FLEISCHAKER:

8

Q Dr. Fraser, the correction at line 19 is to change the words "from about 10 times" to "about three to 10 times." Is that correct?

9

A Yes.

10

Q What is the basis for that correction?

11

12

A We were attempting to understand some of the high verticals at Imperial Valley, and we had an earth structure to investigate what range of earth structure might explain unusual verticals, structure with low wave velocity near the surface yields the number 10. That is the vertical to horizontal ratio at Imperial Valley are 10 times higher than they are Diablo for similar calculations.

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However, the generic earth structure at Imperial Valley, the one on page 3-4 of Joint Intervenor's R-9

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1 yields three times higher vertical to horizontal ratios
2 at Imperial Valley than at Diablo.

3 Because stations are located on different earth
4 structures, it seemed reasonable to me to state that they
5 are three to 10 times different.

6 Q When you say, the vertical to horizontal ratio
7 is 10 times greater, it implies that we can the sheer
8 wave component at Imperial Valley and multiply it by 10
9 to obtain an equivalent component at Diablo Canyon.

10 A I don't understand on what basis one would do
11 that.

12 Q The answer is no?

13 A No. I don't understand.

14 Q Can you quantify the difference between the sheer
15 weight component at the Imperial Valley versus Diablo
16 Canyon?

17 DR. JOHNSON: May I interrupt, Mr. Fleischaker?

18 I don't know about any one else, but this Board
19 member does not know what you mean by sheer wave component.
20 Would you explain a little bit more?

21 MR. FLEISCHAKER: I will strike that line of
22 questioning, and leave it to the experts to address.

23 BY MR. FLEISCHAKER:

24 Q Dr. Fraser, your No. 3 times -- three to ten
25 times, your No. 3 comes from a generic Q factor; is that



1 correct?

2 A An earth structure that is more representative
3 of Imperial Valley as a whole, so I called it a generic
4 earth structure for Imperial Valley.

5 Q Is that directly related to the generic Q factor
6 that you used in your modeling?

7 A Q is part of the earth structure.

8 Q Have you considered, or are you considering
9 changing that generic Q factor as a result of comments on
10 the model that you received?

11 A No. I wish I had data to tell me Q better, but
12 I have no evidence now to tell me how to change the Q
13 factors. I don't know where to set them at, if I set them
14 different than where I have them now.

15 Q Thank you.

16 One more question on this, Dr. Fraser. You
17 indicate at page 4-2 of your testimony that for a typical
18 southern California earth structure this, is line 12,
19 quoting from your testimony, "the typical --

20 CHAIRMAN SALZMAN: Mr. Fleischaker, would you
21 give us the page?

22 MR.FLEISCHAKER: It is page 4-2.

23 CHAIRMAN SALZMAN: Thank you.

24 BY MR. FLEISCHAKER:

25 Q At line 12, sir, you say "The typical California



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1 earth structure is vertically polarized shear waves, and
2 not P waves, accounting for larger vertical accelerations.

3 At Diablo Canyon, do you predict that shear
4 waves or P waves will account for the vertical accelera-
5 tions?

6 A Vertically polarized shear waves.

7 Q Those vertically polarized shear waves arrive
8 in face with the horizontal polarized shear waves?

9 A Some of them certainly will.

10 Q Does that mean that at Diablo Canyon we can
11 expect the peak vertical, and the peak horizontal
12 accelerations to occur at the same time, or very near the
13 same time during the time history of an earthquake?

14 A That would be a conservative assumption.

15 MR. NORTON: I did not have a chance to object
16 to the question before it was answered, but I would like
17 a definition of very nearly at the same time. Mr. Fraser
18 may have something in his mind as to what that means, but
19 the reader of the record certainly doesn't, and I don't.

20 CHAIRMAN SALZMAN: The question has been asked
21 and answered, but Mr. Fleischaker, would you be kind
22 enough to state what you mean by very nearly the same
23 time for the record, sir?

24 MR. FLEISCHAKER: Let me ask Dr. Fraser.

25 CHAIRMAN SALZMAN: That is even better.



1 Dr. Fraser, what do you mean by very nearly the
2 same time in the answer that you gave a moment ago?

3 WITNESS FRASER: When I see seismogram, there
4 are wave packets, and to question whether the vertical
5 peaking might occur in the same wave packet as the
6 horizontal peaking, I think that that would be a conser-
7 vative assumption.

8 CHAIRMAN SALZMAN: I think that that is enough
9 for the record, thank you.

10 DR. JOHNSON: May I follow that up?

11 Dr. Fraser, do you mean that it would be
12 reasonable to assume that the high vertical and the high
13 horizontal arrive simulatneously?

14 WITNESS FRASER: No. That negates the -- It is
15 a complex problem. The higher verticals at Imperial
16 Valley are different mechanism. They are P waves, and
17 they occurred well before the high horizontals.

18 I think the fact that they are in the same wave
19 packet is going to restrict the verticals to be two-thirds
20 or the horizontals or less.

21 DR. JOHNSON: Thank you.

22 BY MR. FLEISCHAKER:

23 Q Dr. Fraser, returning again to your testimony,
24 your pre-filed testimony, at page 4-4, line 15, that
25 fourth sentence, "In the shallow sediments at Imperial



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1 Valley S waves above 10 herds can be attenuated by a factor
2 of 10 within one kilometer, while P waves above 10 herds
3 are attenuated only about 20 percent over the same
4 distance."

5 A Yes.

6 Q Have you done an analysis calculation for Diablo
7 Canyon?

8 A No. Not to paraphrase it in those simple terms,
9 I have not.

10 Q Would you care now to estimate the Diablo
11 Canyon analogous values that you presented in your
12 testimony here for Imperial Valley?

13 A I would want to go to the structure that was
14 determined for Diablo Canyon and deduce those numbers from
15 that.

16 Q Okay.

17 Dr. Fraser, I would like to address your atten-
18 tion to your testimony in Question 7.

19 DR. JOHNSON: Mr. Fleischaker, before we leave
20 Question 4, may I ask a question?

21 MR. FLEISCHAKER: Certainly.

22 MR. NORTON: Excuse me, Chairman Salman, I have
23 a question.

24 I believe Dr. Blume has testimony on Question 4.
25 I presume that Mr. Fleischaker, if he is going to leave





1 Question 4 now, he cannot come back later to Question 4
2 with Dr. Blume. Is that correct?

3 MR. FLEISCHAKER: I am passing my cross-examina-
4 tion of Dr. Blume.

5 MR. NORTON: Is that the procedure that we are
6 going to follow, if we move on to the next question, the
7 questioner cannot come back with another witness on an
8 earlier question?

9 CHAIRMAN SALZMAN: That is the way we intended
10 to proceed. But, of course, if there is a reason why
11 one must go back, we will endeavor to be reasonable about
12 it. I would prefer to move on because otherwise we will
13 never finish.

14 Thank you, Mr. Fleischaker.

15 Thank you, Mr. Norton.

16 DR. JOHNSON: Dr. Fraser, are you familiar with
17 the affidavit that was submitted by the Applicant in
18 connection with a motion to reopen, in which Dr. Blume
19 had two figures depicting the vertical and horizontal
20 accelerations at Imperial Valley as a function of distance
21 from the fault?

22 WITNESS FRASER: That was a plot of peak
23 verticals, and a plot of peak horizontals.

24 DR. JOHNSON: Observed peaks versus distance
25 and horizontal, and the observed vertical acceleration



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versus distance.

WITNESS FRASER: Yes, I have read that.

DR. JOHNSON: Those figures, if you observe the
tend line, appear to indicate that the vertical accelera-
tion was decreasing with a greater slope with the distance
than was the horizontal.

If you simply were guided by that data you
might obtain the opinion that perhaps in the near field
the vertical accelerations exceeded the horizontal
accelerations, and that the two-thirds ratio that people
had used in the past might not hold in the near field.

Now, you have given an explanation of why the
vertical acceleration at Imperial Valley may have been
higher relative to the observed horizontal. Are you of the
opinion that it would not be correct to attribute the
high vertical acceleration simply to the fact that you are
getting close to the fault, and we have never seen a great
deal of data close to the fault before?

WITNESS FRASER: No. The mechanistic basis
that I have used to study the vertical to horizontal
ratio at Imperial Valley do --

I believe that closer you are more likely to
larger vertical to horizontal ratio. Furthermore,
Imperial Valley is not the only data with large vertical
to horizontal ratios. But even at Imperial Valley, as you



1 go out in distance, the mechanism of what is creating the
2 verticals is changing the further out you go. There is a
3 trend, the close in the verticals are controlled by P waves,
4 as you go further out the verticals begin to become con-
5 trolled by SB waves, as I said earlier, I would expect at
6 Diablo.

7 So the mechanism is changing as a function of
8 distance.

9 DR. JOHNSON: In one of the records, I believe
10 it was the Iranian earthquake, but perhaps another of the
11 overseas earthquakes that was referred to in the earlier
12 testimony, the vertical accelerations in the near field was
13 higher than the horizontal. Do you have enough information
14 to know whether or not your mechanistic approach or calcula-
15 tion would explain that or not?

16 WITNESS FRASER: I believe that you may be
17 referring to Gosley in the Soviet Union.

18 DR. JOHNSON: Yes, I will take your word for that.

19 WITNESS FRASER: At Gosley, they have very large
20 vertical acceleration, approximately 1.3, which is consider-
21 ably larger. I have not studied that situation, and I cannot
22 comment on it.

23 It had a rupture at considerable depth, a little
24 deeper than we get ruptures in California, roughly right
25 under the station, about 25 kilometers, it ruptured toward



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1 the surface. It is not clear to me how close to the station
 2 the rupture came, but perhaps five kilometers. So there
 3 is a possibility that there may have been some unusual
 4 feature to the rupture coming toward the station that led
 5 to the large vertical. I don't know.

6 DR.. JOHNSON: Thank you, sir. That is all I have.

7 CHAIRMAN SALZMAN: Mr. Fleischaker.

8 BY MR. FLEISCHAKER:

9 Q Dr. Fraser, I would like to move on to Question
 10 7, and I would like to direct your attention first of all,
 11 sir, to your testimony at page 7-1, lines 20 through 23.
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1 There, sir, you state, as has been previously
2 discussed by Dr. Blume, the parameters of velocity and
3 displacement are outside the frequency range of primary
4 importance for the Diablo Canyon structures. Have you had
5 an opportunity to review Dr. Luco's testimony, Dr. Fraser?

6 A I have read it.

7 Q Okay. I would like to direct your attention to
8 pages II-6 and II-7 of that prefiled testimony.

9 DR. BUCK: Whose testimony is this?

10 MR. FLEISCHAKER: This is Dr. Luco's testimony.
11 I am on II-6 and II-7 of the bottom page, II-6.

12 BY MR. FLEISCHAKER: (Resuming)

13 Q Do you have that?

14 A I have page II-6 and page II-7 open right now.

15 Q At the bottom of the page there Dr. Luco states --
16 this is page II-6 of his prefiled testimony -- "It has
17 been mentioned (Blume affidavit, paragraph 9) that the
18 period range of interest for Diablo Canyon structures is
19 less than 0.5 seconds and that peak velocities and displace-
20 ments have no effect in that range. The turbine building,
21 however, has a period after modifications of 0.71 seconds,
22 which is in the region controlled by peak velocity (FSAR,
23 Amendment 50, DLL 42)."

24 Have you had an opportunity to review Dr. Luco's
25 testimony and discuss it with Dr. Blume to determine whether



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1 that is an accurate figure, 0.71 seconds is an accurate
 2 figure?
 3 A No.
 4 Q Assume that it is an accurate figure. Would it
 5 change the testimony that we previously read on page VII-1.
 6 MR. NORTON: Excuse me. I am not sure that Dr.
 7 Fraser is qualified to answer this question, but this
 8 question really deals with Dr. Blume's testimony in both
 9 instances.
 10 Dr. Fraser is citing Dr. Blume, and Dr. Luco is
 11 talking about Dr. Blume. I think the question should be
 12 better directed at Dr. Blume than Dr. Fraser.
 13 CHAIRMAN SALZMAN: Mr. Fleischaker, would you have
 14 any reason why Dr. Blume cannot answer that?
 15 MR. FLEISCHAKER: I am cross examining Dr. Fraser's
 16 testimony here at lines 21 through 23, and either we can
 17 obtain an answer from him, it seems to me, or strike the
 18 testimony.
 19 CHAIRMAN SALZMAN: We will allow the question at
 20 the moment.
 21 WITNESS FRASER: Yes. As you are pointing out,
 22 if I just take these two pieces of data, I have testimony
 23 from Dr. Blume that long periods are not of any design
 24 consideration or consequences for the structure. There is
 25 plenty of conservatism in high periods. It is only the



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1 high frequency that matters. And Dr. Luco cites a period
2 of the containment -- the turbine building and so what I
3 have, if I just go from those two pieces of evidence, or
4 I would take Dr. Blume's evidence from this point of view
5 just because there is a period below .5 seconds period
6 or longer period. Because there is a low frequency resonance
7 does not mean that there is excessive conservatisms in that
8 period range.

9 So I do not see directly here a contradiction.

10 BY MR. FLEISCHAKER: (Resuming)

11 Q So if we assume the turbine building has a period
12 after modification of 0.71 seconds, it is still your testi-
13 mony that the parameters of velocity and displacement are
14 outside the frequency range of primary importance for the
15 Diablo Canyon structures, is that correct?

16 A That is my understanding, yes.

17 Q Okay. I would like to direct your attention next,
18 sir, to page VII-4. There at the top of the page your
19 testimony states, "Recordings of the 1979 or Imperial Valley
20 earthquake provide further evidence on the limited effects
21 that rupture focusing has on increasing peak accelerations."

22 In reaching that conclusion do you imply that the
23 energy release on the IV '79 earthquake occurred along a
24 more or less continuous rupture?

25 A No.



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1 Q Have you made any assumption with respect to the
2 rupture mechanism to reach that conclusion?

3 A That conclusion is based on many things. The
4 way I have described it here is based on data, and in that
5 regard the answer would be no, not based on data. It does
6 not require an assumption about the rupture.

7 Q Would your conclusion change -- might your conclusion
8 change after study of the rupture mechanism of the earthquake?

9 A Not unless the data changed.

10 Q Okay. Have you examined the records from the
11 Imperial Valley earthquake, Dr. Fraser?

12 A Yes, to some degree.

13 Q Those records that are south of the U.S.-Mexican
14 international border are characterized by sharp velocity
15 and displacement components, are they not?

16 A Sharp relative to what? They are not unexpectedly
17 sharp.

18 Q Have you drawn any conclusions yourself, Dr. Fraser,
19 on the character of the rupture mechanism for the Imperial
20 Valley earthquake?

21 A Yes.

22 Q What are those conclusions?

23 A Basically that the epicenter was probably near
24 the border, the U.S.-Mexican border. The hypocenter was
25 probably at a depth of probably greater than 3 kilometers



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1 deep, and that the rupture spread principally to the north-
2 west for a length of rupture 30 kilometers, perhaps slightly
3 longer, distance.

4 Q Did you reach any conclusions regarding the release
5 of stress along that rupture? That is, whether it was equal
6 over the face or whether there were concentrated pockets.

7 MR. NORTON: Excuse me. May I have a clarification
8 of that question? I am not following it.

9 BY MR. FLEISCHAKER: (Resuming)

10 Q Dr. Fraser, did you understand my question?

11 A Yes, I think so.

12 Q Okay. Can I have an answer?

13 CHAIRMAN SALZMAN: Please answer.

14 WITNESS FRASER: Okay. There are data -- let me
15 try to answer your question as directly as I can. I do not
16 know. There are compensating effects. There are stations
17 that measured high accelerations, and there are stations
18 that measured low accelerations, relatively low, both of
19 which were very close to the rupture.

20 From that one might conclude that there were
21 regions of high energy release compared to other regions
22 of lower energy release from the low energy surface. On
23 the other hand, there seemed to be some correlations between
24 the stations that measured high accelerations during the
25 main earthquake of October 15, 1979, that those stations



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1 tended to measure also high accelerations and aftershocks
2 in different directions. So perhaps it is a local station
3 correction, so it is very difficult. So the answer is no,
4 I have not drawn such a conclusion.

5 BY MR. FLEISCHAKER: (Resuming)

6 Q Is the reason you have not drawn such a conclusion
7 because the data does not permit a conclusion or because you
8 are in the preliminary stages of your analysis or some
9 other reason?

10 A Of course I wish there were more data. I think,
11 though, that there probably is enough data for this earth-
12 quake that after it is studied sufficiently that we will
13 learn the answer to that question to some degree of accuracy.
14 I mean more than what we know now. I think in a couple of
15 years we probably will learn whether or not there is strong
16 evidence that small localized sections released higher --
17 or produced more severe ground shaking or energy that produces
18 ground shaking than other regions of the fault. We will
19 learn whether that happened or not.

20 Q Have you personally -- how much time have you
21 personally spent trying to discover the rupture mechanism
22 the IV '79 earthquake?

23 A Boy, that is a difficult question. When one is
24 looking at records to try to -- like we have done computer
25 simulations of that earthquake, and in looking at our



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1 synthetic results against the records and trying to under-
2 stand the physics, I am not clear whether that time is
3 being spent trying to learn about the rupture mechanism. It
4 is a gray area. Probably several weeks.

5 Q Okay.

6 A Perhaps months.

7 MR. FLEISCHAKER: Mr. Chairman, it is two minutes
8 before 11:00. I am going to run over my estimate of 11:00.

9 CHAIRMAN SALZMAN: Please finish.

10 MR. FLEISCHAKER: I have some exhibits. If you
11 want to take a break while we mark them.

12 CHAIRMAN SALZMAN: In addition to the ones we
13 have already marked.

14 DR. BUCK: Are you finished with Dr. Fraser on
15 this particular point?

16 MR. FLEISCHAKER: Yes.

17 DR. BUCK: Dr. Fraser, this is perhaps an impossible
18 question for you to answer. You are now hinting at a
19 possible type of fracture for intermittent high in some
20 places, low and then high again and so on. Is there enough
21 data on other earthquakes in the past to say whether this
22 is a typical earthquake, or is it something that you suspect
23 is likely to occur on only rare occasions because of the
24 particular situation at Imperial Valley?

25 WITNESS FRASER: I think you may have been led



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to a misunderstanding based on the nature of the questions that were occurring. I have not drawn conclusions that that earthquake did stop, lurch, proceed.

DR. BUCK: I said you implied there was a possible conclusion.

WITNESS FRASER: That is a possibility, yes. Several aspects of that earthquake were as simple or simpler than what we have seen in the past, so I do not think it is unusual in terms of its lurching properties, its unusual stopping, starting sort of things. It is not particularly unusual. The velocity records, lower frequency are fairly simple and rather simple models seem to be able to explain some of the major features observed at lower frequencies like velocity and displacement.

DR. BUCK: I guess your answer is this is more or less typical.

WITNESS FRASER: Yes, I think so.

DR. BUCK: Okay. Thank you.

CHAIRMAN SALZMAN: Mr. Fleischaker, we will recess for five minutes, and then after that do you think you will be able to complete it in 15 more minutes?

MR. FLEISCHAKER: No, sir. I think it is more like 30.

CHAIRMAN SALZMAN: When we resume we will allow you until 11:30, but that is enough, sir.

(Recess.)



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CHAIRMAN SALZMAN: The proceeding will come to order. We will resume.

Mr. Fleischaker, you have until 11:30, sir.

MR. NORTON: Excuse me. My understanding was Mr. Fleischaker was going to have exhibits marked. Did he do that? If he did, we did not get any.

MR. FLEISCHAKER: I put an exhibit on your table, and I was going to mark it now.

CHAIRMAN SALZMAN: You did not -- did you give us any, sir?

MR. FLEISCHAKER: Yes, sir. I put three on your table and three with the Reporter. It is a map.

Let's mark the exhibit. The exhibit that I have here was previously admitted in testimony as part of the Applicant's original testimony submitted on geology. I had copies of it xeroxed. This is Figure 35 from the Applicant's --

CHAIRMAN SALZMAN: Is there any objection to referring to it in this proceeding as Joint Intervenors' Exhibit R-10?

MR. NORTON: I much prefer that.

CHAIRMAN SALZMAN: Mr. Fleischaker, will that be all right? The record shows where it comes from, but it will make life easier if we just call it your exhibit R-10, and we will note it is already in evidence. You will



1 not have to offer it.

2 MR. FLEISCHAKER: Thank you.

3 CHAIRMAN SALZMAN: The Reporter will mark this
4 Joint Intervenors' Exhibit R-10 for identification.

5 (The document referred to was
6 marked Joint Intervenors'
7 Exhibit R-10 for identification.)

8 MR. NORTON: Excuse me. I just noticed this one
9 has numbers written on it, too:

10 MR. FLEISCHAKER: I wrote these numbers on it.
11 When we come to the discussion of this I will --

12 CHAIRMAN SALZMAN: Just one moment, please. I
13 don't have any numbers on mine.

14 MR. NORTON: All right.

15 CHAIRMAN SALZMAN: Oh, I see. Allright.

16 MR. FLEISCHAKER: Mr. Norton makes a good point,
17 and it is that I may have to introduce this into evidence
18 after I cross examine Dr. Fraser on it.

19 CHAIRMAN SALZMAN: I think I had best do that.

20 MR. NORTON: I would just like the record clear
21 that this is a modified figure.

22 CHAIRMAN SALZMAN: It is not in evidence, Mr.
23 Reporter, and Mr. Fleischaker will offer it if he chooses
24 after he has cross examined.

25 Please continue, sir.

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1 MR. FLEISCHAKER: Thank you.

2 BY MR. FLEISCHAKER: (Resuming)

3 Q Mr. Fraser, is it your testimony, sir, that the
4 focusing effects from earthquakes tend to have a subdued
5 nature on the high frequencies, the amplitudes of strong
6 ground motions in the high frequency range?

7 A Yes.

8 Q I would like to direct your attention, sir, to
9 Supplement 1 of the report that we were previously discussing,
10 and let me get you -- this is Joint Intervenors' Exhibit
11 R-7.

12 I would like to direct your attention to page
13 VI-1.

14 MR. OLMSTEAD: Excuse me, Mr. Chairman. Ms.
15 Nordlinger does not have a copy of the exhibit. Could we
16 have another copy?

17 MR. FLEISCHAKER: I provided them a copy.

18 CHAIRMAN SALZMAN: Yes. Were you referring to
19 a page which is marked Section 6.0, Sensitivity Studies?

20 MR. FLEISCHAKER: That is correct, sir.

21 CHAIRMAN SALZMAN: Thank you, sir.

22 Does the witness have the page?

23 WITNESS FRASER: Yes.

24 CHAIRMAN SALZMAN: Thank you. Please go ahead.

25



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1 BY MR. FLEISCHAKER: (Resuming)

2 Q The last full paragraph states as follows:

3 "Figures VI-2 through VI-4 illustrate the way in which
4 fault location and rupture direction influences response
5 spectra. Clearly, focusing due to rupture direction is
6 significant as demonstrated by the relative amplitudes
7 created by earthquakes A and G, which differ only in terms
8 of the direction of rupture with respect to the site. The
9 rupture direction is from north to south, and the earthquake
10 g response is much less than the other responses as the
11 rupture does not focus toward the sites."

12 Now, I would like to direct your attention, sir,
13 to Figures VI-2 and VI-4 and ask you, sir, as we compare
14 the response spectra throughout the amplitudes of motion
15 in these response spectra throughout the frequency ranges
16 depicted, and we compare earthquakes A through F through
17 G, isn't it true that the increase in the amplitudes of
18 motion due to focusing is about the same throughout the
19 frequency range?

20 (Pause.)

21 A That will take me just a second to look at.

22 (Pause.)

23 I can state that from these figures certainly
24 earthquake G is lower than the other synthetics over the
25 entire frequency band by roughly the same amount.



Vertical text or markings on the right side of the page, possibly bleed-through from the reverse side.

1 Q Thank you. I would like to return to your pre-
2 filed testimony, Figure VII-4 and Figure VII-5. Now, there,
3 sir, you have compared mean spectra derived from strike slip
4 rupture sequences A through G to the Newmark mean plus one
5 standard deviation spectra.

6 CHAIRMAN SALZMAN: Just one moment.

7 Dr. Fraser, do you have that page?

8 WITNESS FRASER: Yes.

9 BY MR. FLEISCHAKER: (Resuming)

10 Q And I will ask you, sir, why did you not compare
11 a mean plus one standard deviation for the strike slip
12 rupture sequences A through G with the Newmark mean plus
13 one standard deviation spectra?

14 A I need to define what a mean plus one standard
15 deviation is for my computer modeling in order to answer
16 that question.

17 Q Fine.

18 CHAIRMAN SALZMAN: Can you do that?

19 WITNESS FRASER: I think so, yes.

20 CHAIRMAN SALZMAN: How long would it take you?

21 WITNESS FRASER: Not very long. I am just trying
22 to say I am not evading the answer. It is going to take
23 me a couple or two sentences to define it. ...

24 CHAIRMAN SALZMAN: Surely.

25 WITNESS FRASER: There are some aspects of the

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1 rupture process that we do not know precisely, and so we have
2 entered into our computer modeling perturbations in the
3 rupture process. The process is allowed to stop and lurch
4 ahead, and even the orientations of the little segments of
5 rupture are allowed to vary in orientation, vary in depth.

6 The slip factor on the rupture surface, for example,
7 if it is a strike slip earthquake instead of being strictly
8 horizontal there are perturbations placed on that. So to
9 get an answer out, we have to perform a simulation of an
10 earthquake several times. These were performed I believe
11 several times to estimate a mean.

12 The mean plus one sigma from those random per-
13 turbations in the rupture mechanism is approximately 10 to
14 15 percent higher than the mean. So it is the mean that
15 seems to me is more relevant here. It is the mean that
16 we have compared and validated the model against.

17 The mean plus one sigma is only a measure of
18 what effects of uncertainty in a rupture process have on
19 potential output. It is not intended to be a mean plus
20 one sigma in the same sense that this design spectrum
21 mean plus one sigma indicates.

22 BY MR. FLEISCHAKER: (Resuming)

23 Q This uncertainty that you have quantified would
24 result in curves at a range between 10 and 15 percent
25 above the curves that you depicted here.



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1 A Yes.

2 MR. NORTON: Excuse me. While Mr. Fleischaker
3 is thumbing through for his next question, I notice perhaps
4 a typographical error on Figure -- excuse me -- Figure
5 Fraser VII-5, which is the second of the two figures.
6 It says "corresponding results to Figure VII- blank" and
7 perhaps Dr. Fraser, that is -- a blank should have a number
8 there, and perhaps we could correct the record at this
9 point.

10 CHAIRMAN SALZMAN: Dr. Fraser, can you fill in
11 the blank for us, sir?

12 WITNESS FRASER: I think I can. One moment,
13 please.

14 (Pause.)

15 I believe that should be Figure VII-4, the preced-
16 ing figure.

17 CHAIRMAN SALZMAN: Thank you, Dr. Fraser.

18 BY MR. FLEISCHAKER: (Resuming)

19 Q Dr. Fraser, I would like to direct your attention
20 to page VII-5 of your testimony.

21 A Yes.

22 Q There starting at line 15 you state, "As described
23 below, site specific simulations have been performed at
24 Diablo Canyon to examine effects of rupture along the
25 Hosgri fault focused toward the site in a manner consistent



1 with geologic data."

2 And I turn to the map of the geologic data which
3 appears at page VII-16.

4 A Could you give me the page again that you are
5 reading from?

6 Q VII-5.

7 A Okay.

8 Q Now, turn to VII -- the map which is on VII-15.
9 Is this the map that you used in order to construct the
10 model of the geologic -- strike that.

11 Is this the map that you used to obtain the
12 geologic structure configuration for your model?

13 A No, that is not determined from a fault map.

14 Q How is that determined?

15 A From field investigations of the properties
16 of the earth at various steps.

17 Q I would like to direct your attention to Joint
18 Intervenors' Exhibit --

19 MR. NORTON: Excuse me. I think maybe we just
20 had some miscommunication. Mr. Fleischaker was talking
21 about a map, but he said page VII-15, and then he asked
22 some questions, and I think Dr. Fraser was looking at VII-15,
23 and I think Mr. Fleischaker was looking at the map on the
24 next page.

25 I may be wrong, but I think they were both talking

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1 about different pages.

2 MR. FLEISCHAKER: That is correct. Let me start
3 that line of cross examination over.

4 BY MR. FLEISCHAKER: (Resuming)

5 Q Looking at the map on VII-16 --

6 MR. OLMSTEAD: What figure number are you looking
7 at?

8 MR. FLEISCHAKER: Figure VII-1.

9 CHAIRMAN SALZMAN: It follows immediately the
10 page we are looking at.

11 BY MR. FLEISCHAKER: (Resuming)

12 Q Are we together?

13 A Yes.

14 Q Was this the map that you used to obtain a
15 configuration of the geologic structure for your computer
16 model of the Hogri fault?

17 A I think the ambiguity that may have been was the
18 use of the word "geologic structure." I meant the word
19 "geologic" in the way I have been using it in my testimony
20 so far, geologic structure to mean the properties of the
21 materials versus depth, and I think you are using the
22 word differently.

23 Q That is correct. The configuration of the fault.

24 A Yes. Principally this is the map.

25 Q I would like to --

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A There are other things that went into making up our considerations of where the rupture might go.

Q I would like to direct your attention to what has been marked as Joint Intervenors' Exhibit R-10, which is taken from the Applicant's testimony.

A Are you referring to Figure 35?

Q That is correct. There have been some additions to this. This was Plate 2N in the FSAR, Section 2.5E. This is a blowup of a segment of that larger map. It is different from the map originally submitted with the Applicant's testimony in that some numbers have been added here to characterize distance from Diablo Canyon to points on the fault which is traced there.

Why didn't you use this characterization of the fault for determining the configuration for your earthquake model?

MR. NORTON: Object. Assumes facts not in evidence.

MR. FLEISCHAKER: It seems to me it is a straightforward question. He can say I did or didn't.

MR. NORTON: He asked him why he did not. He asked him why he did not.

CHAIRMAN SALZMAN: Ask him if he used it, sir.

BY MR. FLEISCHAKER: (Resuming)

Q Did you consider this?



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1 A Indirectly, yes.

2 Q What do you mean "indirectly?"

3 A I consulted with the people that drew this map
4 in assisting me to know which maps were appropriate, which
5 rupture sequences and so forth would be appropriate. So
6 this map was taken into consideration.

7 Q Well, there is a strand on this map that points
8 directly at the site itself.

9 CHAIRMAN SALZMAN: Mr. Fleischaker, I have two
10 maps in front of me. Please tell me which one you are
11 looking at.

12 MR. FLEISCHAKER: The map marked Joint Intervenors
13 R-10.

14 CHAIRMAN SALZMAN: That is the way you say there
15 was a strand on that points at the Diablo site?

16 MR. FLEISCHAKER: Right.

17 CHAIRMAN SALZMAN: Thank you.

18 BY MR. FLEISCHAKER: (Resuming)

19 Q Did you consider that particular consideration
20 in your model?

21 MR. NORTON: Object. Which strand?

22 CHAIRMAN SALZMAN: Can you specify it? I am
23 having trouble finding it.

24 MR. FLEISCHAKER: The strand that I am talking
25 about is the one from which an arrow is drawn to the number



1 5.8 kilometers.

2 MR. NORTON: All right. I would object to a mis-
3 characterization of the exhibit. Mr. Fleischaker wears
4 glasses and I don't. That means he may see better than
5 I do, but I do not see that strand pointing directly at
6 the site.

7 CHAIRMAN SALZMAN: Just one moment.

8 Dr. Fraser, do you see the strand to which he
9 is referring?

10 WITNESS FRASER: I believe so. It is a dashed
11 line. It is the tail of the arrow.

12 MR. FLEISCHAKER: Correct.

13 BY MR. FLEISCHAKER: (Resuming)

14 Q Did you consider that in your modeling?

15 CHAIRMAN SALZMAN: Did you?

16 WITNESS FRASER: Yes.

17 BY MR. FLEISCHAKER: (Resuming)

18 Q How did you consider it in your modeling?

19 A I considered it in terms of setting up the
20 modeling, and I considered it in terms of its relevance
21 to ground motion that was determined from the model.

22 DR. JOHNSON: May I interrupt, please, Mr.
23 Fleischaker?

24 MR. FLEISCHAKER: Yes, sir.

25 DR. JOHNSON: Dr. Fraser, if the strand that we

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1 are talking about is one that ends just above a letter
2 A2, and I realize there are many letters A2 on that figure,
3 what does that represent in geological terms that the line
4 on the drawing -- the strand does not mean anything to me.

5 WITNESS FRASER: I am fairly -- I used my knowledge
6 in a wide range of areas, but you are beyond me on that.
7 That is a geologic question.

8 MR. NORTON: Dr. Johnson, the author of this map
9 is here. He is on one of the upcoming panels, but he is
10 here right now if you want him to address the question at
11 this moment. That is up to the Board, of course.

12 DR. JOHNSON: I am a little confused. Dr. Fraser
13 said he used it in preparing his computer model, and if
14 he does not know exactly what it is, how was he able, at
15 least indirectly, to include it in the modeling process?

16 WITNESS FRASER: Perhaps I can answer your question.
17 I believe I was a little intimidated by the words "geologic
18 notation" and so forth. I am not a geologist. I think
19 the dashed line represents some sort of discontinuity in
20 the ocean floor in the rocks.

21 DR. BUCK: But not necessarily a fault, is that
22 what you mean?

23 WITNESS FRASER: I would not qualify it neces-
24 sarily as a fault. It is some sort of discontinuity that
25 has been mapped, and I am not qualified, I don't think, to



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argue the subtle differences between them.

DR. JOHNSON: Well, I think perhaps when the person who drew the map is on the stand we will get to that question.

MR. NORTON: He is here right now, if it would save time, which it well might, rather than coming back to this at that time.

DR. BUCK: I would like to ask Dr. Fraser first of all, did you consider it in your computations in your model as a fault?

WITNESS FRASER: Yes. Let me be clear on that.

DR. BUCK: Okay.

WITNESS FRASER: In modeling earthquakes there are many things about earthquakes that are not precisely placed in the model. The computer simulation method is an effort to calculate ground motion from first principles, but it does not entirely do that. To a great degree it is an extrapolation method. We take past data. We do the best we can in terms of the physics, and we calibrate the model.

Those calibrations have included the effect of how these kinds splays or joints in the rocks, how they might have influenced past data, and in that sense it is a part of the model to that degree.

DR. BUCK: When you say consider them do you mean



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1 to say you have considered them as supposing it did rupture
2 on that particular line. You have considered that effect
3 on the Hosgri.

4 WITNESS FRASER: No, I have not done computer
5 simulations with rupture proceeding down that splay. No,
6 I have not done that.

7 DR. BUCK: How have you used it in your model?

8 WITNESS FRASER: The question I was asked, did
9 I consider it, and definitely I did consider it both in
10 the input and the output. It is to the degree I just
11 described, to some degree in the modeling in that past
12 earthquakes have splays or joints in the rock like this,
13 and so when I modeled a past earthquake to test the validity
14 of my computational schemes, then whatever effect these
15 joints might have in how earthquakes might proceed, to
16 that degree it has been included.

17 DR. BUCK: Maybe I don't quite follow you. You
18 are considering what might happen on an earthquake in the
19 Hosgri, what would occur along these splays, is that
20 correct, or might occur along the splays?

21 WITNESS FRASER: I am not sure I have exactly
22 what the question was.

23 DR. BUCK: You have something here that has a
24 disturbance, shall we say, in the rock formation. You
25 don't know whether it is a fault or not, but it is obvious



1 or apparent from this map there is a splay or could be a
2 splay of the Hosgri.

3 What I am asking is if you did have an earthquake,
4 a motion on the Hosgri, you have looked at the effect of
5 that on the splays or the effect of that splay on the
6 focusing towards Hosgri or not?

7 WITNESS FRASER: I have not ruptured down that
8 splay. The ruptures that I have done precisely are described
9 in my testimony, and they do not include rupture going down
10 that splay. But it is my judgment that indirectly some
11 aspects of the fact that there is a joint in the rock there
12 has been considered in that there are similar features going
13 on in probably essentially all large earthquakes.

14 DR. BUCK: I guess my problem is how have you
15 considered the splay then? You say you considered the splay
16 to some extent. What is the extent of it?

17 WITNESS FRASER: By tying to the physical data
18 recorded in past earthquakes which also have joints in rocks
19 connecting into the main fault or into the main rupture
20 zone.

21 DR. BUCK: All right. Let's go back to the past
22 earthquakes of similar splays. What has occurred on those
23 splays that you find of interest in this particular thing?

24 WITNESS FRASER: The rupture that takes place in
25 last earthquakes by and large is beneath the surface where

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1 I cannot see what is going on. There appears to be evidence,
2 though, that in past earthquakes the rupture zone is not
3 perfectly aligned along a straight line as geologists draw
4 maps, and we see that in aftershocks and where we can locate
5 the earthquakes, and there are other evidences of that.

6 As the rupture proceeds it probably hopscotches
7 around a little bit as it proceeds down basically the main
8 trend of the fault. In that sense the little hopscotching
9 around that depth which is not visible to the observer at
10 the surface, to that degree in calibrating my model and
11 testing my model against past earthquake data, the possibility
12 of some jumping around of the rupture as it proceeds down
13 a major fault, which I assume a large magnitude earthquake
14 would be a major fault, not a small fault, and to that
15 degree any hopscotching around or jumping that the rupture
16 may do due to the presence of discontinuities in joints in
17 the rocks adjacent to the fault has been tested and
18 included in the modeling to that degree.

19 DR. BUCK: All right. Maybe I can understand
20 now. What you are saying is you have looked at, shall we
21 say, the hopscotching of an earthquake down a major fault,
22 and you have looked at what happens at some of the splay
23 joints as a result of that, is that correct?

24 WITNESS FRASER: I have looked at what it does
25 in terms of producing strong ground motion at a particular

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1 station.

2 DR. BUCK: Okay. So then you have used that
3 consideration by analogy on the splay that is marked here
4 as just above the A2 situation.

5 WITNESS FRASER: That is one of the considerations,
6 yes.

7 DR. BUCK: What are the other considerations?

8 WITNESS FRASER: The capability of having rupture
9 go down such a splay was considered not by me but was con-
10 sidered in judgments as to whether these types of splays are
11 any different than what we see in past earthquakes, that
12 sort of analysis.

13 DR. BUCK: And are they generally capable of sus-
14 taining -- producing earthquakes or not in the past experi-
15 ence?

16 WITNESS FRASER: My suspicion is that these splays
17 would probably be capable of generating maybe magnitude three
18 or maybe slightly larger earthquakes. I would expect it we
19 are talking about a magnitude 7 1/2 earthquake, I am going
20 to look for a major fault to put that earthquake on and not
21 on some tangent.

22 DR. BUCK: All right. That is the point I wanted
23 to get at. This is a limited amount of earthquake motion
24 that you might get on a splay such as this, at least based
25 on past experience.

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1 WITNESS FRASER: Yes.

2 MR. FLEISCHAKER: I have a couple of clarifying
3 questions, and that is the end of my cross examination
4 related to Dr. Buck's questions.

5 CHAIRMAN SALZMAN: Just one moment. We are having
6 a little problem because the gentleman who drew this map is
7 in the room, I understand.

8 Would you have any objection to having the gentle-
9 man sworn as a witness now just for the purpose of explaining
10 what this line is?

11 MR. FLEISCHAKER: I think it is probably Dr.
12 Hamilton. I believe he has prefiled testimony. I would
13 just as soon examine him when he takes the stand in order,
14 Mr. Chairman.

15 MR. OLMSTEAD: Mr. Chairman, one of the purposes
16 of this hearing is so that the Board gets information in
17 a manner in which it can understand it, and it seems to me
18 that if the witness is here and there is a point of contention,
19 and we have two witnesses who have two different maps, that
20 we ought to get them on the stand and hear what they have
21 to say and explain the discrepancy. We are not playing cat
22 and mouse games here.

23 MR. FLEISCHAKER: That is right, but I also -- excuse
24 me, I would like to reply to that, please.

25 There are -- if this is going to be testimony and

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1 Dr. Hamilton is going to take the stand, I would like to
2 have time to prepare. There are other maps, the Buchanan
3 and Banks map, which also gives a different characterization
4 of the fault, and I do not have that map with me right now.

5 I take that back. I have it here, but I haven't
6 studied it, so if he takes the stand now, I am quite frankly
7 not prepared to cross him. So if he wants to take the stand
8 now and if I have an opportunity to cross examine him
9 tomorrow, that would be fine.

10 CHAIRMAN SALZMAN: All right, Mr. Fleischaker. You
11 have offered and you have been cross examining on a map
12 which was drawn by someone who is in the room, and we would
13 like the gentleman who drew the map to take the stand and
14 be sworn solely to answer Dr. Johnson's questions about
15 what the map means.

16 If you have any questions in light of what Dr.
17 Johnson says, of course you will be asked to -- given the
18 opportunity to address it, and that will be all we want
19 to hear about it. We just want to understand the map, sir.

20 Mr. Norton, which witness is that?

21 MR. NORTON: It is Douglas Hamilton right here
22 on the left walking up to the stand.

23 CHAIRMAN SALZMAN: Mr. Hamilton --

24 MR. NORTON: Perhaps he could change places with
25 Dr. Seed or Dr. Smith at the moment. Do you want to remain

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1 standing?

2 CHAIRMAN SALZMAN: Would you state your full name
3 for the record, sir?

4 MR. HAMILTON: My name is Douglas Holmes Hamilton.

5 CHAIRMAN SALZMAN: Thank you, Dr. Hamilton.

6 Would you raise your right hand?

7 Whereupon,

8 DOUGLAS HOLMES HAMILTON

9 was called as a witness by the Board and, having been first
10 duly sworn by the Chairman, was examined and testified as
11 follows:

12 CHAIRMAN SALZMAN: Please be seated. Dr. Johnson
13 wishes to ask you a question at this time just related to
14 Joint Intervenors' R-10 for identification. Do you have that
15 in front of you, sir?

16 WITNESS HAMILTON: Yes, sir, I do.

17 BOARD EXAMINATION

18 BY DR. JOHNSON:

19 Q Dr. Hamilton, do you understand the line segment
20 that we have been talking about displayed on that map?

21 A Yes. Dr. Fraser has pointed that out to me.

22 Q Could you tell us what that line segment represents?

23 A Yes. That line segment is one of a series that
24 were interpreted as being faults of small displacement
25 within the rock and that lies along the east side of the



1 Hosgri fault on the basis of the seismic reflection line,
2 so in the subsurface structure that we interpreted to develop
3 this map.

4 Q What role would such a feature play in the event
5 of a major rupture on the Hosgri fault in that vicinity?

6 MR. FLEISCHAKER: I object to this question as
7 being beyond the scope of this witness' expertise. He is a
8 geologist, not a seismologist or a geophysicist.

9 MR. NORTON: If Dr. Hamilton cannot answer that
10 question, I am sure he will say, and Dr. Smith who is
11 the seismologist who is sitting right next to him can answer
12 it.

13 CHAIRMAN SALZMAN: Dr. Hamilton, can you answer
14 that?

15 WITNESS HAMILTON: Can I answer it in terms of
16 our geologic interpretation of the structure?

17 CHAIRMAN SALZMAN: Yes, sir.

18 WITNESS HAMILTON: Is that a satisfactory --

19 CHAIRMAN SALZMAN: One moment.

20 Please go ahead.

21 WITNESS HAMILTON: In terms of our geologic
22 interpretation we consider the fault along the trend of
23 the splays under discussion, as well as other smaller faults
24 indicated also in that same kind of line weight of that
25 same orientation, and the other symbols that indicate fold

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1 structures to be part of the general structure of the rock
2 that lies along the east side of the Hosgri fault. And it
3 is our interpretation of the evidence we can see in the
4 subsurface that the Hosgri fault has a truncating relationship
5 to elements of structure like that such that we would expect
6 that large movements taking place along the Hosgri fault
7 would be associated with an earthquake on it, would essentially
8 move along past elements or structure like this.

9 We think that these features do not have large
10 amounts of movement shown on them. They are essentially
11 fairly minor faults that lie within the ground on the east
12 side of the Hosgri, and they do not show the kind of structural
13 evidence or evidence in the sea floor that would suggest to
14 us that they would actually participate in any significant
15 way in a major earthquake generating movement on the Hosgri.

16 CHAIRMAN SALZMAN: Is that what you intended to
17 indicate by the fact that the line is dotted on your map,
18 sir?

19 WITNESS HAMILTON: No, sir. The dashed line is
20 meant to indicate a more approximate kind of degree of
21 certainty with respect to identifying and locating the
22 feature. The Hosgri fault is much more clearly defined.
23 It has much better evidence. And we are looking for more
24 subtle kinds of evidence for these smaller breaks such as
25 the one under discussion. And so we cannot be as confident



1 that we are really seeing a fault or exactly how we are
2 locating it.

3 CHAIRMAN SALZMAN: Thank you.

4 DR. JOHNSON: Thank you.

5 CHAIRMAN SALZMAN: Mr. Fleischaker.

6 MR. FLEISCHAKER: I have a couple of followup
7 questions.

8 CROSS ON BOARD EXAMINATION

9 BY MR. FLEISCHAKER:

10 Q Dr. Hamilton, on the basis of your examination of
11 this fault you have determined that it does not display a
12 major offset, is that correct?

13 A Yes, sir.

14 Q Now, how can you take that data and -- can you
15 as a geologist take that data and predict that that splay
16 will not be the site of some major rupture at a future date?

17 A Well, we are basing it on both the evidence of
18 its past movement, which is quite small, and I think also
19 contrasting it with the kind of movement that we see on the
20 Hosgri fault which is very much larger and is clearly more
21 continuous in the area from some miles north to some miles
22 south of the site along the Hosgri trend itself.

23 Q Is it the case that by looking at the ruptures
24 that we can observe at the surface in the fault we can
25 predict how that fault will rupture in the future?

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1 A I think that is certainly a very good guide to
2 it. All our experience seems to tell us that breaks that
3 have not experienced very much movement in the past, that
4 lie within an area of complexly deformed rock such as we
5 see here are much less likely to sustain any kind of a
6 future earthquake movement than a larger, more active fault
7 that has a record of repeated movements over a long period
8 of time and some known earthquake history.

9 (Pause.)

10 O Sir, this strand of fault in here, is this the
11 strand -- were you able to date the last movement of faulting?

12 A As is the case with most of the faulting that we
13 see in the offshore region, the only date that we have on
14 this is that it lies within rocks that are many millions
15 of years old, and it does not break the sea floor. So that
16 our latest time line on it is that it is older than about
17 17,000 years.

18 Q Is that characterized as Holocene movement?

19 A 17,000 years would be late Pleistocene. Holocene
20 we take to be the last 10,000 or 11,000 years.

21 Q Are you aware as to whether the USGS has mapped
22 on MF 910, Buchanan and Banks map, a splay similar to this
23 in which they indicate Holocene movement?

24 MR. NORTON: Object as to what do you mean by a
25 splay similar to this? Where are we talking about, in

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1 Turkey or where?

2 CHAIRMAN SALZMAN: I think the question was clear,
3 Mr. Norton. He was talking about, Mr. Fleischaker, as I
4 understand it, a map essentially like this where the faults
5 run in the same area. Is that your point?

6 MR. FLEISCHAKER: That is correct.

7 MR. NORTON: Excuse me, Mr. Salzman. I don't know
8 that. I don't see the map, and I would think first he
9 would ask if he is familiar with the map, because I do not
10 know what map he is talking about.

11 CHAIRMAN SALZMAN: All right. Mr. Norton's point
12 is well-taken. Please be a little more specific for the
13 purpose of the witness. Ask him if he is aware of the maps,
14 and if he is, then show it to him.

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MR. FLEISCHAKER: May I mark this as an Exhibit?

CHAIRMAN SALZMAN: Surely.

The reporter will mark this map as Joint
Intervenor's Exhibit R-11.

(The above referred document was
marked for identification as
Joint Intervenor's Exhibit
R-11 and R-11A.)

MR. FLEISCHAKER: I would like to note that Joint
Intervenor's Exhibit R-11 is a Xerox of a portion of
Buchanan and Banks MF 910, a USGS map. I am going to give
the map itself to the witness, so he can determine that this
is a portion of this map.

CHAIRMAN SALZMAN: Mr. Norton, do you want to look
at it also?

MR. OLMSTEAD: Mr. Chairman.

CHAIRMAN SALZMAN: Mr. Olmstead.

MR. OLMSTEAD: Before we proceed further on this
line of questioning, I might note that I have not interposed
an objection on relevance grounds because I assume that we
are going to tie this back to Question 7 of the Board, which
deals with focusing. But we are starting to get away from
that.

CHAIRMAN SALZMAN: I am not sure what we are doing
here, Mr. Olmstead. As I understand this point, he is



1 suggesting that this is the fault at Diablo Canyon, and that
2 you get focusing on it. The waves indicate whether there is
3 such a fault.

4 I am going to let him go on for a while, sir.

5 MR. NORTON: Mr. Fleischaker, this appears to be
6 Sheet 2 of 3. Does Sheet 1 have perhaps more language
7 which describes what the numbers mean and that sort of
8 thing?

9 I would ask that that be put in evidence also. I
10 am now looking at sheet one, and half of the map is writing
11 which explains the symbols, etc. I don't see how you can
12 use just the Joint Intervenor's Exhibit R-11 without the
13 key to what all of the various numbers mean.

14 CHAIRMAN SALZMAN: Would it be possible, Mr.
15 Fleischaker to have the key to the map, the legend xeroxed
16 and used as an adjunct to this exhibit. You could do that
17 after lunch?

18 MR. FLEISCHAKER: No problem.

19 CHAIRMAN SALZMAN: We will do that, and we will
20 append that key as a second page of your Exhibit R-11, sir.

21 MR. FLEISCHAKER: Thank you.

22 CHAIRMAN SALZMAN: Mr. Hamilton, have you had a
23 moment to examine that?

24 WITNESS HAMILTON: Yes, I have.

25 CHAIRMAN SALZMAN: Mr. Norton?



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1 MR. NORTON: I assume that you are going to ask
2 him whether he is prepared to answer the question.

3 As I see this exhibit, and as I am sure the Board
4 can see, there are many little teeny lines on it. I am not
5 sure which one he is talking about. Is he talking --

6 Is the question, is there a line on here which
7 shows holocene movement?

8 MR. FLEISCHAKER: I think that it will be easier
9 if I start with the cross-examination.

10 CHAIRMAN SALZMAN: Let him ask the question.

11 BY MR. FLEISCHAKER:

12 Q This is a USGS Map, is that not correct?

13 A Yes.

14 Q Are you familiar with this map?

15 A Relatively, yes.

16 Q I would like to direct your attention to R-11 and
17 just off-shore where it says, "Bouchon," there is a circle
18 drawn around a strand. That circle is not part of the
19 original map, but it has been put on there to identify
20 the strand that we will be talking about.

21 A Yes, I see that area.

22 Q That triangle there, what does that mean
23 according to the legend?

24 A If I might refer to the control symbols part of
25 the legend, and simply read what it says. There is a



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1 triangle that looks like the one on the map, and it is
2 identified as indicating "geomorphic features formed by
3 fault movement, latest fault movement inferred from type
4 of features," then they add "see footnote 3 and 5 to age
5 age range chart."

6 Q Is that your complete answer?

7 A Could you restate the question, and let me see
8 if I failed to complete it.

9 Q I would like to know what that triangle with the
10 one in it indicates in terms of the estimate of movement
11 on that fault.

12 A I believe that the triangle indicates the
13 geomorphic features, which suggests a young age, and the
14 number one indicates, according to this fairly complex way
15 of indicating things, that the age holocene.

16 Q How did they describe holocene in terms --

17 A Holocene lies within the bracket in the age
18 range, and lies between zero and 10,000 years.

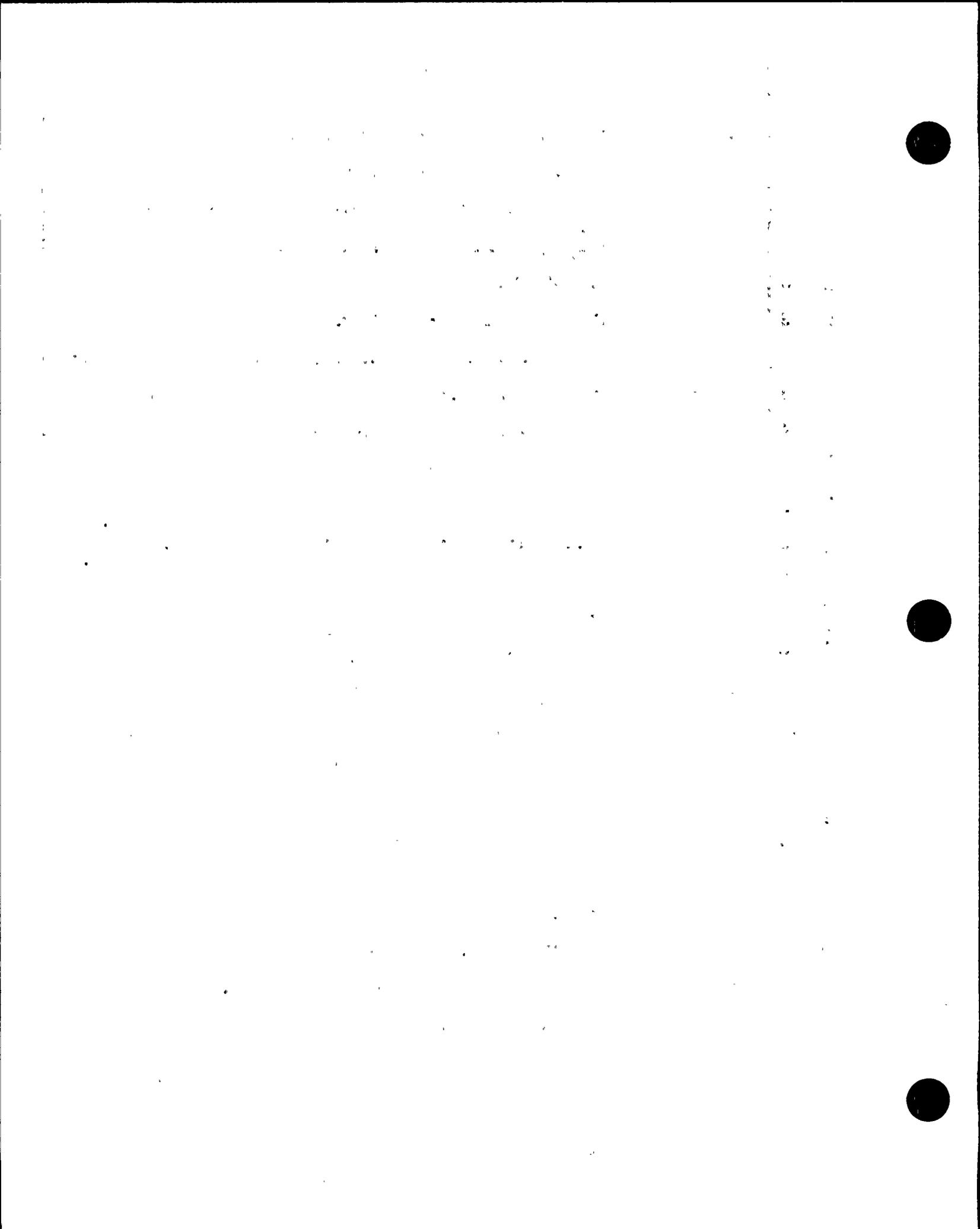
19 MR. FLEISCHAKER: I have no further questions,
20 sir.

21 DR. BUCK: Is there any way of knowing where
22 Diablo Canyon is on this map?

23 MR. FLEISCHAKER: That is a good question.

24 DR. BUCK: You put it in.

25 MR. NORTON: May we also a couple of questions,





1 I guess that would be redirect, although there has not been
2 any direct, simply on this exhibit?

3 CHAIRMAN SALZMAN: I take it that you want to
4 ask one or two questions to clear something up.

5 MR. NORTON: Yes.

6 CHAIRMAN SALZMAN: All right, make it brief.

7 MR. NORTON: I don't have the large map in front
8 of me because there is only one, nor do I have a small one.
9 The triangle that was referred to, is that on the short
10 little splay, or is that the major Hosgri fault?

11 WITNESS HAMILTON: I think the way this map is
12 drawn, the placement of the triangle is ambiguous. However,
13 if one follows the splay or strand that is circled north-
14 westerly, one comes to another point, which is a number 3
15 in a square box, and the triangle, if one follows the fault
16 that is located farther to the south, then you find no
17 other symbols. So it might be inferred that the triangle
18 is on the shorter north of the fault segment that extends
19 from the circled area.

20 MR. FLEISCHAKER: May I ask, Dr. Hamilton, if
21 you can estimate from that map the distance from that track
22 and go Diablo Canyon?

23 CHAIRMAN SALZMAN: That does not show the Diablo
24 Canyon site. I don't see how he could do it.

25 MR. FLEISCHAKER: He may know where it is. He



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1 could plot it easily.

2 WITNESS HAMILTON: You are asking for the distance
3 from the triangle that lies at the southeasterly end of
4 the circled area to Diablo Canyon on this map.

5 MR. FLEISCHAKER: Correct.

6 WITNESS HAMILTON: If the Board would like, I can
7 sketch it off on the map that is in front of me, which I
8 think does have a scale on it.

9 MR. FLEISCHAKER: I think that it would be useful
10 information.

11 MR. BROWN: While this is being done, perhaps I
12 could ask a question.

13 I am not familiar with the procedure in my
14 experience of redirect, as Mr. Norton put it in the middle
15 of Cross-examination.

16 CHAIRMAN SALZMAN: It is simply to clarify with
17 Dr. Hamilton.

18 MR. BROWN: I am not objecting to it. I want to
19 be sure that I am not barred from engaging in cross-
20 examination of Mr. Hamilton.

21 CHAIRMAN SALZMAN: No, sir.

22 WITNESS HAMILTON: From the original version of
23 this map, I have scaled the distance to about 7.6
24 kilometers.

25 MR. FLEISCHAKER: Thank you. I have no further



1 questions.

2 I have one question of Dr. Fraser.

3 BY MR. FLEISCHAKER:

4 Q When you talk of this hop-scotching which you
5 take into account in your modeling, is that hop-scotching
6 taken into account in the parameters that you call spatial
7 variations or randomness?

8 A No. It is taken into account from the simply the
9 fact that we have models of strong motion data. If there
10 were no randomness in the model, it would still be taken
11 into account.

12 MR.FLEISCHAKER: Thank you.

13 I have no further questions.

14 CHAIRMAN SALZMAN: Does the Board have any further
15 questions?

16 Dr. Johnson?

17 DR. JOHNSON: No.

18 CHAIRMAN SALZMAN: Dr. Buck?

19 DR. BUCK: No.

20 CHAIRMAN SALZMAN: Mr. Lanpher, are you prepared
21 to go ahead?

22 MR. LANPHER: Yes, sir.

23 CHAIRMAN SALZMAN: Let's take a five minute break
24 and then we will begin.

25 (Whereupon, a short recess was taken.)



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Q That was the first viewgraph?

A Yes.

Q On that exhibit you have two side locations, one labeled "far field site," and the other "near source site." Would you please define for me what distance range you consider in your a near source site to the surface rupture trace?

A There are two different scales of importance in defining a near field, and a far field. One is the distance with respect to the fault dimension, and the other scale is that of the wave length of waves that one is concerned with.

Generally speaking, we use the term somewhat of a combination of these. So a near field site is typically within 5 to 10 kilometers to a fault.

Q To the surface rupture or the surface trace?

A Of the rupture.

Q I would like to address your attention, Dr. Smith, to 1.1 of Dr. Trifunac's testimony. Do you have that, Dr. Smith?

A Yes.

Q In some of the examination yesterday there was discussion regarding the surface trace of the IV-79 earthquake, and where possibly the zone of primary energy release took place.





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My question is whether you were conducting studies or analyses to determine where the zone of primary energy release took place during that earthquake?

A No.

Q Would anyone else on the panel like to respond to that question?

In other words, have any of you performed such analyses?

A (Witness Fraser) I have been involved in a computer simulation of that particular earthquake, and comparing synthetic ground motion with those observed in the field.

Indirectly there is some study of that subject, and that question, but no specific study to determine whether the principal zone of energy release was around Bond's Corner, or whether it was uniform along the fault.

I would word it the other way around. I see no evidence for localized high zones of energy release.



arker 10
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dsp10-1

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1 Q Dr. Blume, I would like to direct your attention
2 to the figures on your item one or question one testimony.
3 I would to look first at figure I-1. It follows page I-7.

4 A (Witness Blume) I have it now.

5 Q I want to be clear in my own mind how this is the
6 SAM-V curves on this exhibit -- this figure are plotted.
7 Is it correct that you solved the SAM-V equations using
8 hypocentral distance, but plotted the equations on this
9 graph as a function of fault distance?

10 A No, that is not exactly correct. I derived
11 SAM-V as an equation using basically hypocentral distances,
12 determined from United States Earthquake reports.

13 Once having the equation, I then applied it in
14 this case by assuming that the hypocentral distance was
15 in fact a slant distance or the normal distance down to the
16 center of energy release at the Imperial Valley earthquake.

17 Q Did you assume that the center of energy release
18 for that earthquake was uniform all the way along the
19 fault?

20 A Yes, I assumed that it might be anywhere opposite
21 each station normal to the fault.

22 MR. NORTON: Excuse me, Mr. Salzman. While they
23 are conferring for a moment, I have a feeling we have
24 another very minor correction to make, but I am not sure,
25 and I guess I should ask --



sp10-2

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CHAIRMAN SALZMAN: In Dr. Blume's testimony?

MR. NORTON: Yes, it is the figure we are referring to. If you will recall on page I-3 of the testimony Dr. Blume changed one minor thing which is the very last line, line 26. I guess that b bar is supposed to be rho equals 1.51.

Perhaps I am wrong, but if he did, if you go to Blume figure I-1 it shows rho equals 2.05 which was the original value on Blume I-3. So I wonder if the other engineers who might be computing numbers or something, if they were just using the table and did not pick up the text change, that indeed the figure is supposed to be changed in the text, and then we ought to make that change now.

That is a question to Dr. Blume. I am not sure it should be changed in both places, but I do note it was changed in the text.

WITNESS BLUME: Thank you, Mr. Norton. It should be changed in both places to the value 1.51. We are talking about -- and also I see another problem with the typing.

BY MR. LANPHER:

Q Could we finish on the first correction first On page I-3, in the foot note, that is a "b", isn't it, or has that been changed to rho?



sp10-3

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1 A That should be a rho, and the line 25 of page
2 I-3, it reads PV_S . It should be rho V_S .

3 Q And on your figure I-1, Dr. Blume, the rho should
4 be 1.51 instead of 2.05; is that correct?

5 A The number should be changed to 1.51. But the
6 rho should be changed to b bar.

7 Q Right.

8 MR. FLEISCHAKER: I am confused. I thought we
9 just changed on page I-3 a b bar to a rho.

10 WITNESS BLUME: No, no. The b bar on line 26
11 remains the same, equal to 1.51. But in the line above,
12 line 25, it reads PV_S . It should be rho V_S .

13 MR. NORTON: Now, would you go to figure I-1 and
14 give that the way it should be.

15 WITNESS BLUME: On figure I-1, in the middle of
16 the page, it now reads "rho equals 2.05." That should be
17 crossed out and substitute "b bar equals 1.51."

18 BY MR. LANPHER:

19 Q Dr. Blume, how does this correction on your
20 figure I-1 change the plotting of the SAM-V curves, if at
21 all?

22 A I do not believe it changes the plotting at all.
23 I think this is a typo.

24 Q So they were plotted correctly? This is just --
25 they were plotted using b bar 1.51?



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spl0-4

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1 A Yes.

2 Q Could you maybe just check that during the
3 lunch hour just to confirm it?

4 A All right. Yes.

5 Q Thank you.

6 I would like you to turn your attention to
7 Blume figure I-5, please. This figure in your testimony,
8 I believe, is the same as figure four, D-LL11B, except for
9 the addition of the IV '79 data.

10 A That is correct.

11 Q And in solving the SAM-V equation, did you use
12 the same slant distance as you previously described with
13 respect to figure I-1 for distance to the fault. Excuse
14 me.

15 A Yes. These curves were drawn a long time ago,
16 but as I recall they were done in the same way that we did
17 for Imperial Valley. The magnitude, however, is 7 here
18 and ρV_s is 2000 feet per second.

19 Q Thank you. In attempting to extrapolate the
20 mean line on figure I-5 for the SAM-V equation, I get
21 around .6 or .65g at the left vertical axis at zero
22 distance.

23 Is that approximately correct?

24 A Let me try it for a moment.

25 (Pause)



isp10-5

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1 As near as I can scale roughly here it would be
2 about .55 to .60g.

3 MR. OLMSTEAD: Mr. Chairman, just to clarify the
4 record, as I understand this log curve chart, there is
5 no zero distance on it. It should be one kilometer at
6 the edge.

7 MR. LANPHER: That is my understanding.

8 BY MR. LANPHER:

9 Q That is my understanding. Is that correct?

10 A That is correct. It should be one.

11 MR. NORTON: I have a question about that, however
12 If you go backwards from 10, how far back does it go?

13 WITNESS BLUME: It goes a full unit, a full
14 magnitude.

15 MR. NORTON: But I take it there is a dashed
16 line for two missing on log scale.

17 WITNESS BLUME: Yes, there is a two missing.

18 MR. NORTON: Okay.

19 BY MR. LANPHER:

20 Q In this figure, the slant distance to the fault
21 is assumed to be 10 kilometers; is that correct?

22 A I am not sure. You mean the focal depth at the
23 fault?

24 Q Yes.

25 A I am not sure from looking at this figure. As I



dsp10-6

1 say, this was done a long time ago. What was used, it is
2 hard to say without going back to the derivation of all of
3 these curves.

4 I can say that for Diablo Canyon we assumed
5 five kilometers as the focal depth for the purpose of
6 calculation.

7 Q Directing your attention to the horizontal axis,
8 the distance is set forth down there; what distance
9 parameter is that with respect to the SAM-V curves?

10 A Well, that would have to be the same distance
11 that was on the original figure. I believe it came from
12 795. I presume that is the normal fault distance, but I
13 think it should be checked.

14 Q You mean normal horizontal distance to the fault
15 at the surface?

16 A I believe that was what was used in the original
17 drawing. This was originally a USGS drawing. The
18 major points here are by USGS. The lines were added by
19 me and the Imperial Valley 1979 data were added by me.
20 So we could go back to the USGS report and verify that if
21 you want.

22 My colleague tells me it is the closest distance
23 to the fault.

24 Q Could you please tell me, Dr. Blume, why you have
25 extended the SAM-V curves on figure I-5 inside 10 kilometers?

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isp10-7

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1 Isn't it true that when you solve the SAM-V equation using
2 the slant distance -- and I believe that we were assuming
3 a 10 kilometer focal depth -- but if we could assume that
4 just for the moment --

5 A Yes.

6 Q -- that the SAM-V curves become essentially
7 horizontal inside a 10 kilometer distance to the fault,
8 normal distance to the fault?

9 A They become quite flat; not exactly horizontal,
10 but quite flat as you approach zero distance. I think
11 perhaps there is confusion developing between the derivation
12 of the equation and the application in this case. The
13 application here is normal log distance, which would be
14 a surface horizontal measurement.

15 Whereas, in the derivation of the equation,
16 hypocentral distances were used.

17 MR. LANPHER: Mr. Salzman, I would like marked
18 as Governor Brown Exhibit R-1 for identification a
19 reproduction of figure I-5 where we have replotted the
20 SAM curve.

21 I would like Dr. Blume to take a look at it, and
22 then I will ask some questions about it.

23 (The above-mentioned document
24 was marked Governor Brown
25 Exhibit R-1 for identification.)

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1

BY MR. LANPHER:

2

Q Are you ready, Dr. Blume?

3

A Yes, I think so.

4

5

Q In response to one of my earlier questions you said that inside 10 kilometers the SAM-V curves plot almost horizontal. Is that what is depicted on Governor Brown's Exhibit R-1?

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7

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A Yes.

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Q And is it -- do you agree that Governor Brown's Exhibit R-1 without having checked the actual equations themselves generally represents the shape of the SAM-V curves when plotted against a fault distance for a magnitude of 7 earthquake using the factors that you have on this graph?

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MR. NORTON: May we have a clarification? Are we talking about local magnitude or surface wave magnitude?

CHAIRMAN SALZMAN: Can you answer, sir?

MR. LANPHER: We used the same magnitude as indicated on this graph, M equals 7.

MR. NORTON: I am asking whether this is surface or local magnitude. This is a production from Governor Brown, not from Dr. Blume. And they are asking him to accept it. And I am asking what magnitude they used.

CHAIRMAN SALZMAN: Can you tell him?

MR. LANPHER: We used in the equation the number



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1 7 for magnitude; we did not differentiate between MS
2 or ML. And it is our understanding in the derivation of
3 the equation that Dr. Blume did not either.

4 BY MR. LANPHER:

5 Q But I would like Dr. Blume maybe first to clarify
6 whether he did differentiate in the equation.

7 A In the derivation of the equation, we simply
8 used whatever magnitude was published in the United States
9 earthquakes, which I believe in the early years was mostly
10 MS and possibly towards the later years it may have become
11 some ML.

12 Q I believe I had a pending question. Would you
13 like me to repeat it?

14 A Would you repeat it, please?

15 Q Certainly. I had asked you -- you had testified
16 earlier that inside a fault distance of 10 kilometers the
17 SAM-V curves when plotted against fault distance becomes
18 nearly horizontal.

19 I don't mean to characterize exactly what your
20 words were.

21 Looking at Governor Brown's Exhibit R-1, does
22 this represent what you were describing before?

23 A Yes, these curves are nearly horizontal.

24 Q And is this a proper way to plot the SAM-V
25 curve as a function of fault distance?



dsp10-10

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A Well, I cannot answer that without checking these calculations, but I will put it this way, that many, many of the plots do come out with that type of shape, yes.

Q And when the SAM-V curve is plotted in this way as a function of fault distance and the IV '79 data are also plotted as a function of fault distance, that brings the SAM-V curves down relative to those data points; isn't that correct?

A Apparently so on this drawing, but as I said before, I would have to check the calculations.

Now, there is a lot involved in what is used for the value of R close in. I might inquire before I can answer your question correctly or directly as to what the value of R was used, for example, at a distance of one kilometer.

Q We are going to check on that. We can return to it.

DR. JOHNSON: Mr. Lanpher, can I ask a question? Would you explain for my benefit the difference between your figure, Governor Brown's Exhibit R-1, and Dr. Blume's figure 1.1?

MR. OLMSTEAD: Mr. Chairman, I like the question, but I would object to counsel answering it. I think counsel ought to identify who did the adjustment on the chart and what the basis for the adjustment was.



dsp10-11

1 DR. JOHNSON: I had no one else to ask. I do
2 not think it would be fair to ask Dr. Blume what the
3 difference is. I think he knows what figure I-1 is.

4 MR. OLMSTEAD: I agree with that. I think that
5 counsel for the state ought to identify who made the
6 adjustments to the chart and what the basis for it was.

7 CHAIRMAN SALZMAN: Would you do that, please,
8 sir?

9 MR. LANPHER: Certainly. Let me first answer
10 Dr. Blume's question.

11 We used a value for R of 10, a focal depth of
12 10 throughout. So R would vary for the near field. The
13 person who made these adjustments on this chart, Dr.
14 Johnson, was Dr. Young, who will be a witness for Governor
15 Brown later.

16 If you would like me to respond further to
17 questions about it, I would be happy to, or when Dr. Young
18 takes the stand you can certainly question him.

19 DR. JOHNSON: We are dealing with the two figures
20 now. Are there some things that appear to be obviously
21 different? I just wonder if the parameters that were used
22 for R-1 and the parameters that were used in Blume
23 figure I-1 could be compared?

24 MR. LANPHER: The answer is no. We are not
25 attempting to compare the parameters from figure I-1 to

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I-5, as Dr. Blume testified I think in response to Mr. Fleischaker. They are different parameters. I-5 was produced and prepared with different parameters.

DR. JOHNSON: Well, specifically, Dr. Blume's figure I-1 accelerations are plotted against distance through the fault, and that is the same abscissa that is used in Governor Brown's Exhibit R-1; is that correct?

MR. LANPHER: Yes, sir.

DR. JOHNSON: Okay, I will ask Mr. Young later.

end 10

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BY MR. LANPHER:

Q Dr. Blume, I would like to return to your figure I-1 just briefly. You have testified to your belief that the SAM-V curve, the mean curve for SAM-V -- well, it is not the mean curve. But -- no, it is the mean curve -- properly fits the data for IV '79; is that correct?

A That is correct, based upon the assumptions that were made as to distances.

Q Do you have a copy of Joint Intervenors' Exhibit R-5?

A No, I do not, but there may be one at the table here.

Q It is the -- to help you, it is the redraft of a figure by Dr. Seed or by Dr. Seed's colleagues, but it was provided to us by Dr. Seed.

A To make sure I have the right document, this is not marked R-5. The title reads, "Regression Analysis of the Peak Accelerations Recorded during the October 15, 1979 Imperial Valley Earthquake."

Q That has been marked for identification.

CHAIRMAN SALZMAN: I believe that has been admitted as R-5, Joint Exhibit R-5.

BY MR. LANPHER:

Q We are talking about the same document, Dr. Blume.



dsp11-2

1 CHAIRMAN SALZMAN: That is what I understand
2 to be Joint Intervenors' R-5. Do you have the same
3 understanding, sir?

4 MR. LANPHER: Yes.

5 BY MR. LANPHER:

6 Q When I compare your figure I-1 with Joint
7 Intervenors' Exhibit R-5, I find that the SAM curve predicts
8 at zero distance approximately .37 -- .35 --

9 MR. NORTON: Excuse me. May we find out which
10 one you are referring to when you say what SAM predicts
11 at zero distance.

12 MR. LANPHER: Blume figure I-1.

13 MR. NORTON: I just did not see the line going
14 into the zero.

15 MR. LANPHER: At the vertical axis; if you
16 extrapolate just a little bit over, it comes out just
17 below 0.4, I think at around 0.37.

18 BY MR. LANPHER:

19 Q Is that correct?

20 A That is correct.

21 Q I believe Dr. Seed yesterday testified that on
22 his Joint Intervenor Exhibit R-5 his mean curve for the
23 IV '79 data meets the vertical axis at about .53g. Do
24 you recall that testimony?

25 A No, but I see it on this diagram R-5.

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dsp11-3

1 Q Can you explain the difference between the
2 prediction in the SAM curve and the mean which Dr. Seed
3 has derived?

4 A Well, there could be many reasons. He may have
5 been actually fitting the data with regression lines. I
6 do not know. If that is the case, it is entirely -- an
7 entirely different situation than mine where I was
8 merely comparing an existing attenuation law with data
9 points.

10 Q Dr. Seed, could you clarify for us?

11 A (Witness Seed) R-5 simply shows regression lines
12 fitting to the data.

13 Q In your opinion, do those regression lines
14 depict the mean of those data that you have plotted on
15 Joint Intervenors' R-5?

16 A The line labeled the median is pretty close to
17 the mean.

18 Q So the mean of your regression line meets --
19 or the median that is labeled on there meets the vertical
20 axis at about .53?

21 A Right.

22 A (Witness Blume) I suspect another difference
23 may be we have a different number of data points. I don't
24 know whether Dr. Seed included the Mexican stations in
25 his or not.

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1 Q I would like to ask Dr. Seed that: did you
2 include the Mexican stations, Dr. Seed?

3 A (Witness Seed) I cannot answer that; the
4 drawing was done by colleagues. I will find out at
5 lunchtime and answer you this afternoon.

6 A (Witness Blume) I can see by looking at one
7 kilometer that he has only four data points whereas I
8 have one, two, three, four, five, six, seven, eight, nine,
9 10, 11, within one kilometer.

10 So I suspect that the Mexican data are not in
11 his.

12 Q Dr. Seed, when you are checking with your
13 colleagues, I would appreciate it if you could also check
14 whether there are other data points which were not plotted,
15 for instance, beyond the trace of the fault to the north-
16 west.

17 I can return to this after lunch.

18 Dr. Blume, I would like you to turn to page 1 --

19 MR. NORTON: Excuse me. Before we leave this
20 subject, I think there is again some miscommunication.

21 CHAIRMAN SALZMAN: I did not hear you, sir.

22 MR. NORTON: Before we leave the subject and
23 come back to it after lunch and people go off doing things
24 over the lunch hour, I think there is some miscommunication.
25 Joint Intervenors' Exhibit R-5 says it is a regression



dsp11-5

1 analysis of the peak accelerations. Figure I-1 deals
2 with all of the data points and so it is apples and
3 oranges.

4 In other words, R-5 is only the peak. I mean,
5 that is what it says.

6 CHAIRMAN SALZMAN: Well, Mr. Lanpher, that is
7 indeed what it says.

8 If it will not take but a moment for him to
9 ask his colleagues, he can answer.

10 MR. NORTON: My question was -- and I don't
11 know but that the colleagues may be in Berkeley and he
12 is going to lose half his noon hour trying to get ahold of
13 people in Berkeley and so on. If it is not necessary, I
14 want to avoid it.

15 You know, just looking at the labels of the two
16 documents on their face, they are different data.

17 WITNESS BLUME: And they have different purposes,
18 I might add. One is regression. The other is merely
19 plotting a curve that is already existing.

20 MR. LANPHER: I am merely, Mr. Salzman, trying
21 to find out why we are ending up with a different
22 prediction for these two curves. And it may be the
23 data points that are plotted. I would be delighted for
24 the witnesses to tell me.

25 CHAIRMAN SALZMAN: Dr. Seed, would it be very

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dspl1-6

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1 difficult for you to get the information that Mr. Lanpher
2 would like to have?

3 WITNESS SEED: No, as far as I know the data
4 points plotted are the peak accelerations for two
5 components for each station. Not all the stations that
6 Dr. Bloom has shown may be shown on this particular plot.
7 I can find out at lunch hour.

8 WITNESS BLUME: May I try to clarify the
9 situation? The regression analysis is a fit to actual
10 data points, whatever those points on. On figure I-1,
11 I did not attempt to fit these points at all. I just
12 merely drew the curves the way the equation had previously
13 been derived.

14 The mere fact that they happen to fit fairly
15 well is either luck or coincidence or good fortune. But
16 regression analysis is by no means the same thing as
17 merely comparing curves and data points.

18 I would be surprised if they were the same.

19 CHAIRMAN SALZMAN: Dr. Blume, just a moment.

20 Mr. Norton, the witness has indicated it will
21 take him but a moment, that it will not be difficult
22 to do. With your indulgence, we will let him do it, sir.

23 Please continue, Mr. Lanpher.

24 DR. JOHNSON: I have a question. From your
25 questions, Mr. Lanpher, I am not sure you did previously



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the surface. It is not clear to me how close to the station the rupture came, but perhaps five kilometers. So there is a possibility that there may have been some unusual feature to the rupture coming toward the station that led to the large vertical. I don't know.

DR. JOHNSON: Thank you, sir. That is all I have.

CHAIRMAN SALZMAN: Mr. Fleischaker.

BY MR. FLEISCHAKER:

Q Dr. Fraser, I would like to move on to Question 7, and I would like to direct your attention first of all, sir, to your testimony at page 7-1, lines 20 through 23.



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1 There, sir, you state, as has been previously
2 discussed by Dr. Blume, the parameters of velocity and
3 displacement are outside the frequency range of primary
4 importance for the Diablo Canyon structures. Have you had
5 an opportunity to review Dr. Luco's testimony, Dr. Fraser?

6 A I have read it.

7 Q Okay. I would like to direct your attention to
8 pages II-6 and II-7 of that prefiled testimony.

9 DR. BUCK: Whose testimony is this?

10 MR. FLEISCHAKER: This is Dr. Luco's testimony.
11 I am on II-6 and II-7 of the bottom page, II-6.

12 BY MR. FLEISCHAKER: (Resuming)

13 Q Do you have that?

14 A I have page II-6 and page II-7 open right now.

15 Q At the bottom of the page there Dr. Luco states --
16 this is page II-6 of his prefiled testimony -- "It has
17 been mentioned (Blume affidavit, paragraph 9) that the
18 period range of interest for Diablo Canyon structures is
19 less than 0.5 seconds and that peak velocities and displace-
20 ments have no effect in that range. The turbine building,
21 however, has a period after modifications of 0.71 seconds,
22 which is in the region controlled by peak velocity (FSAR,
23 Amendment 50, DLL 42)."

24 Have you had an opportunity to review Dr. Luco's
25 testimony and discuss it with Dr. Blume to determine whether



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1 that is an accurate figure, 0.71 seconds is an accurate
2 figure?

3 A No.

4 Q Assume that it is an accurate figure. Would it
5 change the testimony that we previously read on page VII-1.

6 MR. NORTON: Excuse me. I am not sure that Dr.
7 Fraser is qualified to answer this question, but this
8 question really deals with Dr. Blume's testimony in both
9 instances.

10 Dr. Fraser is citing Dr. Blume, and Dr. Luco is
11 talking about Dr. Blume. I think the question should be
12 better directed at Dr. Blume than Dr. Fraser.

13 CHAIRMAN SALZMAN: Mr. Fleischaker, would you have
14 any reason why Dr. Blume cannot answer that?

15 MR. FLEISCHAKER: I am cross examining Dr. Fraser's
16 testimony here at lines 21 through 23, and either we can
17 obtain an answer from him, it seems to me, or strike the
18 testimony.

19 CHAIRMAN SALZMAN: We will allow the question at
20 the moment.

21 WITNESS FRASER: Yes. As you are pointing out,
22 if I just take these two pieces of data, I have testimony
23 from Dr. Blume that long periods are not of any design
24 consideration or consequences for the structure. There is
25 plenty of conservatism in high periods. It is only the



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1 high frequency that matters. And Dr. Luco cites a period
2 of the containment -- the turbine building and so what I
3 have, if I just go from those two pieces of evidence, or
4 I would take Dr. Blume's evidence from this point of view
5 just because there is a period below .5 seconds period
6 or longer period. Because there is a low frequency resonance
7 does not mean that there is excessive conservatisms in that
8 period range.

9 So I do not see directly here a contradiction.

10 BY MR. FLEISCHAKER: (Resuming)

11 Q So if we assume the turbine building has a period
12 after modification of 0.71 seconds, it is still your testi-
13 mony that the parameters of velocity and displacement are
14 outside the frequency range of primary importance for the
15 Diablo Canyon structures, is that correct?

16 A That is my understanding, yes.

17 Q Okay. I would like to direct your attention next,
18 sir, to page VII-4. There at the top of the page your
19 testimony states, "Recordings of the 1979 or Imperial Valley
20 earthquake provide further evidence on the limited effects
21 that rupture focusing has on increasing peak accelerations."

22 In reaching that conclusion do you imply that the
23 energy release on the IV '79 earthquake occurred along a
24 more or less continuous rupture?

25 A No.



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1 Q Have you made any assumption with respect to the
2 rupture mechanism to reach that conclusion?

3 A That conclusion is based on many things. The
4 way I have described it here is based on data, and in that
5 regard the answer would be no, not based on data. It does
6 not require an assumption about the rupture.

7 Q Would your conclusion change -- might your conclusion
8 change after study of the rupture mechanism of the earthquake?

9 A Not unless the data changed.

10 Q Okay. Have you examined the records from the
11 Imperial Valley earthquake, Dr. Fraser?

12 A Yes, to some degree.

13 Q Those records that are south of the U.S.-Mexican
14 international border are characterized by sharp velocity
15 and displacement components, are they not?

16 A Sharp relative to what? They are not unexpectedly
17 sharp.

18 Q Have you drawn any conclusions yourself, Dr. Fraser,
19 on the character of the rupture mechanism for the Imperial
20 Valley earthquake?

21 A Yes.

22 Q What are those conclusions?

23 A Basically that the epicenter was probably near
24 the border, the U.S.-Mexican border. The hypocenter was
25 probably at a depth of probably greater than 3 kilometers



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1 deep, and that the rupture spread principally to the north-
2 west for a length of rupture 30 kilometers, perhaps slightly
3 longer, distance.

4 Q Did you reach any conclusions regarding the release
5 of stress along that rupture? That is, whether it was equal
6 over the face or whether there were concentrated pockets.

7 MR. NORTON: Excuse me. May I have a clarification
8 of that question? I am not following it.

9 BY MR. FLEISCHAKER: (Resuming)

10 Q Dr. Fraser, did you understand my question?

11 A Yes, I think so.

12 Q Okay. Can I have an answer?

13 CHAIRMAN SALZMAN: Please answer.

14 WITNESS FRASER: Okay. There are data -- let me
15 try to answer your question as directly as I can. I do not
16 know. There are compensating effects. There are stations
17 that measured high accelerations, and there are stations
18 that measured low accelerations, relatively low, both of
19 which were very close to the rupture.

20 From that one might conclude that there were
21 regions of high energy release compared to other regions
22 of lower energy release from the low energy surface. On
23 the other hand, there seemed to be some correlations between
24 the stations that measured high accelerations during the
25 main earthquake of October 15, 1979, that those stations



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1 tended to measure also high accelerations and aftershocks
2 in different directions. So perhaps it is a local station
3 correction, so it is very difficult. So the answer is no,
4 I have not drawn such a conclusion.

5 BY MR. FLEISCHAKER: (Resuming)

6 Q Is the reason you have not drawn such a conclusion
7 because the data does not permit a conclusion or because you
8 are in the preliminary stages of your analysis or some
9 other reason?

10 A Of course I wish there were more data. I think,
11 though, that there probably is enough data for this earth-
12 quake that after it is studied sufficiently that we will
13 learn the answer to that question to some degree of accuracy.
14 I mean more than what we know now. I think in a couple of
15 years we probably will learn whether or not there is strong
16 evidence that small localized sections released higher --
17 or produced more severe ground shaking or energy that produces
18 ground shaking than other regions of the fault. We will
19 learn whether that happened or not.

20 Q Have you personally -- how much time have you
21 personally spent trying to discover the rupture mechanism
22 the IV '79 earthquake?

23 A Boy, that is a difficult question. When one is
24 looking at records to try to -- like we have done computer
25 simulations of that earthquake, and in looking at our



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1 synthetic results against the records and trying to under-
2 stand the physics, I am not clear whether that time is
3 being spent trying to learn about the rupture mechanism. It
4 is a gray area. Probably several weeks.

5 Q Okay.

6 A Perhaps months.

7 MR. FLEISCHAKER: Mr. Chairman, it is two minutes
8 before 11:00. I am going to run over my estimate of 11:00.

9 CHAIRMAN SALZMAN: Please finish.

10 MR. FLEISCHAKER: I have some exhibits. If you
11 want to take a break while we mark them.

12 CHAIRMAN SALZMAN: In addition to the ones we
13 have already marked.

14 DR. BUCK: Are you finished with Dr. Fraser on
15 this particular point?

16 MR. FLEISCHAKER: Yes.

17 DR. BUCK: Dr. Fraser, this is perhaps an impossible
18 question for you to answer. You are now hinting at a
19 possible type of fracture for intermittent high in some
20 places, low and then high again and so on. Is there enough
21 data on other earthquakes in the past to say whether this
22 is a typical earthquake, or is it something that you suspect
23 is likely to occur on only rare occasions because of the
24 particular situation at Imperial Valley?

25 WITNESS FRASER: I think you may have been led



1 to a misunderstanding based on the nature of the questions
2 that were occurring. I have not drawn conclusions that
3 that earthquake did stop, lurch, proceed.

4 DR. BUCK: I said you implied there was a possible
5 conclusion.

6 WITNESS FRASER: That is a possibility, yes.
7 Several aspects of that earthquake were as simple or simpler
8 than what we have seen in the past, so I do not think it is
9 unusual in terms of its lurching properties, its unusual
10 stopping, starting sort of things. It is not particularly
11 unusual. The velocity records, lower frequency are fairly
12 simple and rather simple models seem to be able to explain
13 some of the major features observed at lower frequencies
14 like velocity and displacement.

15 DR. BUCK: I guess your answer is this is more
16 or less typical.

17 WITNESS FRASER: Yes, I think so.

18 DR. BUCK: Okay. Thank you.

19 CHAIRMAN SALZMAN: Mr. Fleischaker, we will recess
20 for five minutes, and then after that do you think you will
21 be able to complete it in 15 more minutes?

22 MR. FLEISCHAKER: No, sir. I think it is more
23 like 30.

24 CHAIRMAN SALZMAN: When we resume we will allow
25 you until 11:30, but that is enough, sir.

(Recess.)

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1 CHAIRMAN SALZMAN: The proceeding will come to
2 order. We will resume.

3 Mr. Fleischaker, you have until 11:30, sir.

4 MR. NORTON: Excuse me. My understanding was
5 Mr. Fleischaker was going to have exhibits marked. Did he
6 do that? If he did, we did not get any.

7 MR. FLEISCHAKER: I put an exhibit on your table,
8 and I was going to mark it now.

9 CHAIRMAN SALZMAN: You did not -- did you give us
10 any, sir?

11 MR. FLEISCHAKER: Yes, sir. I put three on your
12 table and three with the Reporter. It is a map.

13 Let's mark the exhibit. The exhibit that I have
14 here was previously admitted in testimony as part of the
15 Applicant's original testimony submitted on geology. I
16 had copies of it xeroxed. This is Figure 35 from the
17 Applicant's --

18 CHAIRMAN SALZMAN: Is there any objection to
19 referring to it in this proceeding as Joint Intervenors'
20 Exhibit R-10?

21 MR. NORTON: I much prefer that.

22 CHAIRMAN SALZMAN: Mr. Fleischaker, will that
23 be all right? The record shows where it comes from, but
24 it will make life easier if we just call it your exhibit
25 R-10, and we will note it is already in evidence. You will



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1 not have to offer it.

2 MR. FLEISCHAKER: Thank you.

3 CHAIRMAN SALZMAN: The Reporter will mark this
4 Joint Intervenors' Exhibit R-10 for identification.

5 (The document referred to was
6 marked Joint Intervenors'
7 Exhibit R-10 for identification.)

8 MR. NORTON: Excuse me. I just noticed this one
9 has numbers written on it, too.

10 MR. FLEISCHAKER: I wrote these numbers on it.
11 When we come to the discussion of this I will --

12 CHAIRMAN SALZMAN: Just one moment, please. I
13 don't have any numbers on mine.

14 MR. NORTON: All right.

15 CHAIRMAN SALZMAN: Oh, I see. Allright.

16 MR. FLEISCHAKER: Mr. Norton makes a good point,
17 and it is that I may have to introduce this into evidence
18 after I cross examine Dr. Fraser on it.

19 CHAIRMAN SALZMAN: I think I had best do that.

20 MR. NORTON: I would just like the record clear
21 that this is a modified figure.

22 CHAIRMAN SALZMAN: It is not in evidence, Mr.
23 Reporter, and Mr. Fleischaker will offer it if he chooses
24 after he has cross examined.

25 Please continue, sir.



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1 MR. FLEISCHAKER: Thank you.

2 BY MR. FLEISCHAKER: (Resuming)

3 Q Mr. Fraser, is it your testimony, sir, that the
4 focusing effects from earthquakes tend to have a subdued
5 nature on the high frequencies, the amplitudes of strong
6 ground motions in the high frequency range?

7 A Yes.

8 Q I would like to direct your attention, sir, to
9 Supplement 1 of the report that we were previously discussing,
10 and let me get you -- this is Joint Intervenors' Exhibit
11 R-7.

12 I would like to direct your attention to page
13 VI-1.

14 MR. OLMSTEAD: Excuse me, Mr. Chairman. Ms.
15 Nordlinger does not have a copy of the exhibit. Could we
16 have another copy?

17 MR. FLEISCHAKER: I provided them a copy.

18 CHAIRMAN SALZMAN: Yes. Were you referring to
19 a page which is marked Section 6.0, Sensitivity Studies?

20 MR. FLEISCHAKER: That is correct, sir.

21 CHAIRMAN SALZMAN: Thank you, sir.

22 Does the witness have the page?

23 WITNESS FRASER: Yes.

24 CHAIRMAN SALZMAN: Thank you. Please go ahead.

25



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1 BY MR. FLEISCHAKER: (Resuming)

2 Q The last full paragraph states as follows:
3 "Figures VI-2 through VI-4 illustrate the way in which
4 fault location and rupture direction influences response
5 spectra. Clearly, focusing due to rupture direction is
6 significant as demonstrated by the relative amplitudes
7 created by earthquakes A and G, which differ only in terms
8 of the direction of rupture with respect to the site. The
9 rupture direction is from north to south, and the earthquake
10 g response is much less than the other responses as the
11 rupture does not focus toward the sites."

12 Now, I would like to direct your attention, sir,
13 to Figures VI-2 and VI-4 and ask you, sir, as we compare
14 the response spectra throughout the amplitudes of motion
15 in these response spectra throughout the frequency ranges
16 depicted, and we compare earthquakes A through F through
17 G, isn't it true that the increase in the amplitudes of
18 motion due to focusing is about the same throughout the
19 frequency range?

20 (Pause.)

21 A That will take me just a second to look at.

22 (Pause.)

23 I can state that from these figures certainly
24 earthquake G is lower than the other synthetics over the
25 entire frequency band by roughly the same amount.



1 Q Thank you. I would like to return to your pre-
2 filed testimony, Figure VII-4 and Figure VII-5. Now, there,
3 sir, you have compared mean spectra derived from strike slip
4 rupture sequences A through G to the Newmark mean plus one
5 standard deviation spectra.

6 CHAIRMAN SALZMAN: Just one moment.

7 Dr. Fraser, do you have that page?

8 WITNESS FRASER: Yes.

9 BY MR. FLEISCHAKER: (Resuming)

10 Q And I will ask you, sir, why did you not compare
11 a mean plus one standard deviation for the strike slip
12 rupture sequences A through G with the Newmark mean plus
13 one standard deviation spectra?

14 A I need to define what a mean plus one standard
15 deviation is for my computer modeling in order to answer
16 that question.

17 Q Fine.

18 CHAIRMAN SALZMAN: Can you do that?

19 WITNESS FRASER: I think so, yes.

20 CHAIRMAN SALZMAN: How long would it take you?

21 WITNESS FRASER: Not very long. I am just trying
22 to say I am not evading the answer. It is going to take
23 me a couple or two sentences to define it. ...

24 CHAIRMAN SALZMAN: Surely.

25 WITNESS FRASER: There are some aspects of the

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1 rupture process that we do not know precisely, and so we have
2 entered into our computer modeling perturbations in the
3 rupture process. The process is allowed to stop and lurch
4 ahead, and even the orientations of the little segments of
5 rupture are allowed to vary in orientation, vary in depth.

6 The slip factor on the rupture surface, for example,
7 if it is a strike slip earthquake instead of being strictly
8 horizontal there are perturbations placed on that. So to
9 get an answer out, we have to perform a simulation of an
10 earthquake several times. These were performed I believe
11 several times to estimate a mean.

12 The mean plus one sigma from those random per-
13 turbations in the rupture mechanism is approximately 10 to
14 15 percent higher than the mean. So it is the mean that
15 seems to me is more relevant here. It is the mean that
16 we have compared and validated the model against.

17 The mean plus one sigma is only a measure of
18 what effects of uncertainty in a rupture process have on
19 potential output. It is not intended to be a mean plus
20 one sigma in the same sense that this design spectrum
21 mean plus one sigma indicates.

22 BY MR. FLEISCHAKER: (Resuming)

23 Q This uncertainty that you have quantified would
24 result in curves at a range between 10 and 15 percent
25 above the curves that you depicted here.

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1 A Yes.

2 MR. NORTON: Excuse me. While Mr. Fleischaker
3 is thumbing through for his next question, I notice perhaps
4 a typographical error on Figure -- excuse me -- Figure
5 Fraser VII-5, which is the second of the two figures.
6 It says "corresponding results to Figure VII- blank" and
7 perhaps Dr. Fraser, that is -- a blank should have a number
8 there, and perhaps we could correct the record at this
9 point.

10 CHAIRMAN SALZMAN: Dr. Fraser, can you fill in
11 the blank for us, sir?

12 WITNESS FRASER: I think I can. One moment,
13 please.

14 (Pause.)

15 I believe that should be Figure VII-4, the preced-
16 ing figure.

17 CHAIRMAN SALZMAN: Thank you, Dr. Fraser.

18 BY MR. FLEISCHAKER: (Resuming)

19 Q Dr. Fraser, I would like to direct your attention
20 to page VII-5 of your testimony.

21 A Yes.

22 Q There starting at line 15 you state, "As described
23 below, site specific simulations have been performed at
24 Diablo Canyon to examine effects of rupture along the
25 Hosgri fault focused toward the site in a manner consistent

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1 with geologic data."

2 And I turn to the map of the geologic data which
3 appears at page VII-16.

4 A Could you give me the page again that you are
5 reading from?

6 Q VII-5.

7 A Okay.

8 Q Now, turn to VII -- the map which is on VII-15.
9 Is this the map that you used in order to construct the
10 model of the geologic -- strike that.

11 Is this the map that you used to obtain the
12 geologic structure configuration for your model?

13 A No, that is not determined from a fault map.

14 Q How is that determined?

15 A From field investigations of the properties
16 of the earth at various steps.

17 Q I would like to direct your attention to Joint
18 Intervenors' Exhibit --

19 MR. NORTON: Excuse me. I think maybe we just
20 had some miscommunication. Mr. Fleischaker was talking
21 about a map, but he said page VII-15, and then he asked
22 some questions, and I think Dr. Fraser was looking at VII-15,
23 and I think Mr. Fleischaker was looking at the map on the
24 next page.

25 I may be wrong, but I think they were both talking



1 about different pages.

2 MR. FLEISCHAKER: That is correct. Let me start
3 that line of cross examination over.

4 BY MR. FLEISCHAKER: (Resuming)

5 Q Looking at the map on VII-16 --

6 MR. OLMSTEAD: What figure number are you looking
7 at?

8 MR. FLEISCHAKER: Figure VII-1.

9 CHAIRMAN SALZMAN: It follows immediately the
10 page we are looking at.

11 BY MR. FLEISCHAKER: (Resuming)

12 Q Are we together?

13 A Yes.

14 Q Was this the map that you used to obtain a
15 configuration of the geologic structure for your computer
16 model of the Hogri fault?

17 A I think the ambiguity that may have been was the
18 use of the word "geologic structure." I meant the word
19 "geologic" in the way I have been using it in my testimony
20 so far, geologic structure to mean the properties of the
21 materials versus depth, and I think you are using the
22 word differently.

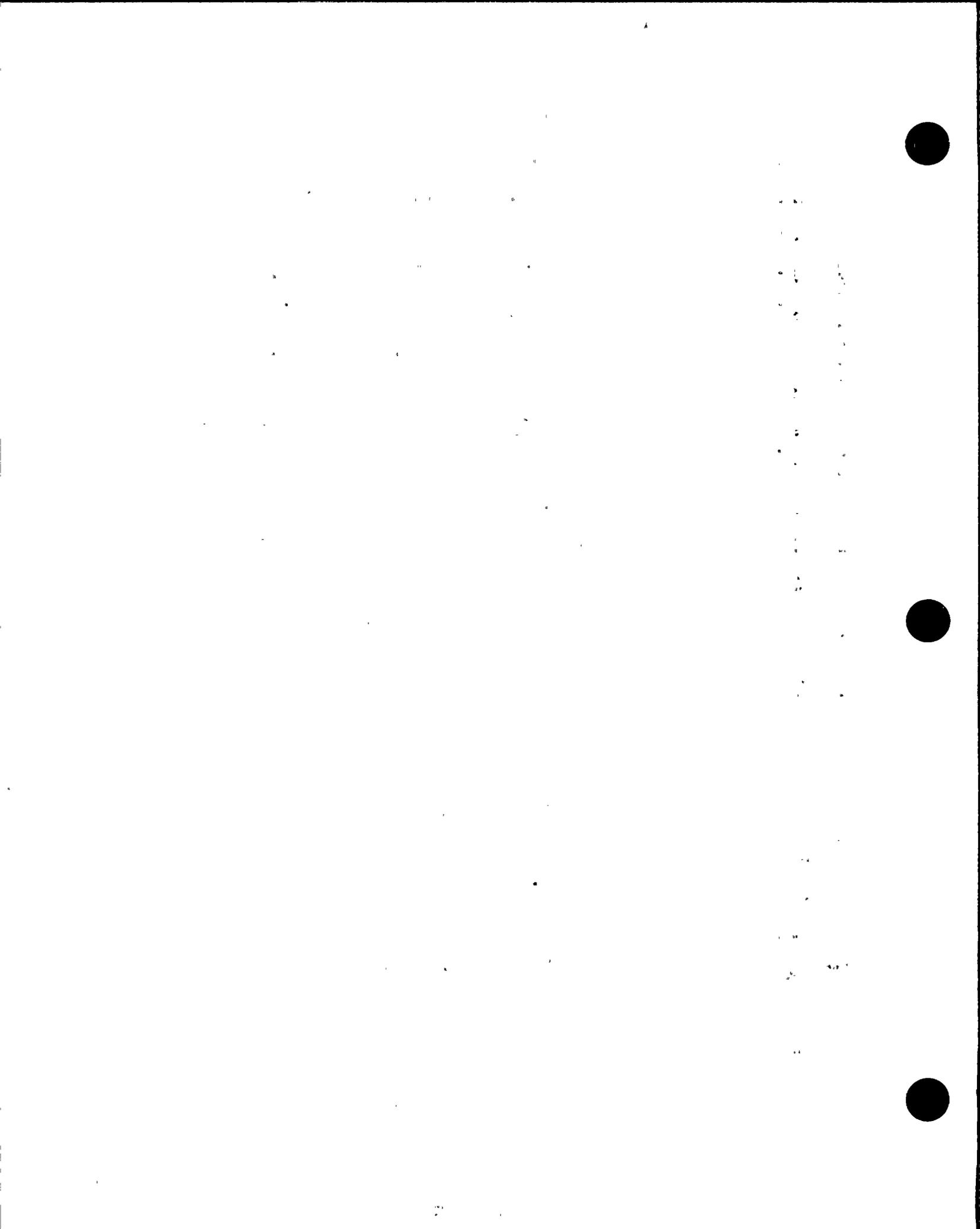
23 Q That is correct. The configuration of the fault.

24 A Yes. Principally this is the map.

25 Q I would like to --

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1 A There are other things that went into making
2 up our considerations of where the rupture might go.

3 Q I would like to direct your attention to what
4 has been marked as Joint Intervenors' Exhibit R-10, which
5 is taken from the Applicant's testimony.

6 A Are you referring to Figure 35?

7 Q That is correct. There have been some additions
8 to this. This was Plate 2N in the FSAR, Section 2.5E.
9 This is a blowup of a segment of that larger map. It is
10 different from the map originally submitted with the
11 Applicant's testimony in that some numbers have been added
12 here to characterize distance from Diablo Canyon to points
13 on the fault which is traced there.

14 Why didn't you use this characterization of the
15 fault for determining the configuration for your earth-
16 quake model?

17 MR. NORTON: Object. Assumes facts not in
18 evidence.

19 MR. FLEISCHAKER: It seems to me it is a straight-
20 forward question. He can say I did or didn't.

21 MR. NORTON: He asked him why he did not. He
22 asked him why he did not.

23 CHAIRMAN SALZMAN: Ask him if he used it, sir.

24 BY MR. FLEISCHAKER: (Resuming)

25 Q Did you consider this?



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1 A Indirectly, yes.

2 Q What do you mean "indirectly?"

3 A I consulted with the people that drew this map
4 in assisting me to know which maps were appropriate, which
5 rupture sequences and so forth would be appropriate. So
6 this map was taken into consideration.

7 Q Well, there is a strand on this map that points
8 directly at the site itself.

9 CHAIRMAN SALZMAN: Mr. Fleischaker, I have two
10 maps in front of me. Please tell me which one you are
11 looking at.

12 MR. FLEISCHAKER: The map marked Joint Intervenors
13 R-10.

14 CHAIRMAN SALZMAN: That is the way you say there
15 was a strand on that points at the Diablo site?

16 MR. FLEISCHAKER: Right.

17 CHAIRMAN SALZMAN: Thank you.

18 BY MR. FLEISCHAKER: (Resuming)

19 Q Did you consider that particular consideration
20 in your model?

21 MR. NORTON: Object. Which strand?

22 CHAIRMAN SALZMAN: Can you specify it? I am
23 having trouble finding it.

24 MR. FLEISCHAKER: The strand that I am talking
25 about is the one from which an arrow is drawn to the number



5.8 kilometers.

1
2 MR. NORTON: All right. I would object to a mis-
3 characterization of the exhibit. Mr. Fleischaker wears
4 glasses and I don't. That means he may see better than
5 I do, but I do not see that strand pointing directly at
6 the site.

7 CHAIRMAN SALZMAN: Just one moment.

8 Dr. Fraser, do you see the strand to which he
9 is referring?

10 WITNESS FRASER: I believe so. It is a dashed
11 line. It is the tail of the arrow.

12 MR. FLEISCHAKER: Correct.

13 BY MR. FLEISCHAKER: (Resuming)

14 Q Did you consider that in your modeling?

15 CHAIRMAN SALZMAN: Did you?

16 WITNESS FRASER: Yes.

17 BY MR. FLEISCHAKER: (Resuming)

18 Q How did you consider it in your modeling?

19 A I considered it in terms of setting up the
20 modeling, and I considered it in terms of its relevance
21 to ground motion that was determined from the model.

22 DR. JOHNSON: May I interrupt, please, Mr.
23 Fleischaker?

24 MR. FLEISCHAKER: Yes, sir.

25 DR. JOHNSON: Dr. Fraser, if the strand that we

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1 are talking about is one that ends just above a letter
2 A2, and I realize there are many letters A2 on that figure,
3 what does that represent in geological terms that the line
4 on the drawing -- the strand does not mean anything to me.

5 WITNESS FRASER: I am fairly -- I used my knowledge
6 in a wide range of areas, but you are beyond me on that.
7 That is a geologic question.

8 MR. NORTON: Dr. Johnson, the author of this map
9 is here. He is on one of the upcoming panels, but he is
10 here right now if you want him to address the question at
11 this moment. That is up to the Board, of course.

12 DR. JOHNSON: I am a little confused. Dr. Fraser
13 said he used it in preparing his computer model, and if
14 he does not know exactly what it is, how was he able, at
15 least indirectly, to include it in the modeling process?

16 WITNESS FRASER: Perhaps I can answer your question.
17 I believe I was a little intimidated by the words "geologic
18 notation" and so forth. I am not a geologist. I think
19 the dashed line represents some sort of discontinuity in
20 the ocean floor in the rocks.

21 DR. BUCK: But not necessarily a fault, is that
22 what you mean?

23 WITNESS FRASER: I would not qualify it neces-
24 sarily as a fault. It is some sort of discontinuity that
25 has been mapped, and I am not qualified, I don't think, to



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1 argue the subtle differences between them.

2 DR. JOHNSON: Well, I think perhaps when the
3 person who drew the map is on the stand we will get to that
4 question.

5 MR. NORTON: He is here right now, if it would
6 save time, which it well might, rather than coming back to
7 this at that time.

8 DR. BUCK: I would like to ask Dr. Fraser first
9 of all, did you consider it in your computations in your
10 model as a fault?

11 WITNESS FRASER: Yes. Let me be clear on that.

12 DR. BUCK: Okay.

13 WITNESS FRASER: In modeling earthquakes there
14 are many things about earthquakes that are not precisely
15 placed in the model. The computer simulation method is
16 an effort to calculate ground motion from first principles,
17 but it does not entirely do that. To a great degree it is
18 an extrapolation method. We take past data. We do the
19 best we can in terms of the physics, and we calibrate
20 the model.

21 Those calibrations have included the effect of
22 how these kinds splays or joints in the rocks, how they
23 might have influenced past data, and in that sense it is
24 a part of the model to that degree.

25 DR. BUCK: When you say consider them do you mean

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1 to say you have considered them as supposing it did rupture
2 on that particular line. You have considered that effect
3 on the Hosgri.

4 WITNESS FRASER: No, I have not done computer
5 simulations with rupture proceeding down that splay. No,
6 I have not done that.

7 DR. BUCK: How have you used it in your model?

8 WITNESS FRASER: The question I was asked, did
9 I consider it, and definitely I did consider it both in
10 the input and the output. It is to the degree I just
11 described, to some degree in the modeling in that past
12 earthquakes have splays or joints in the rock like this,
13 and so when I modeled a past earthquake to test the validity
14 of my computational schemes, then whatever effect these
15 joints might have in how earthquakes might proceed, to
16 that degree it has been included.

17 DR. BUCK: Maybe I don't quite follow you. You
18 are considering what might happen on an earthquake in the
19 Hosgri, what would occur along these splays, is that
20 correct, or might occur along the splays?

21 WITNESS FRASER: I am not sure I have exactly
22 what the question was.

23 DR. BUCK: You have something here that has a
24 disturbance, shall we say, in the rock formation. You
25 don't know whether it is a fault or not, but it is obvious

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1 or apparent from this map there is a splay or could be a
2 splay of the Hosgri.

3 What I am asking is if you did have an earthquake,
4 a motion on the Hosgri, you have looked at the effect of
5 that on the splays or the effect of that splay on the
6 focusing towards Hosgri or not?

7 WITNESS FRASER: I have not ruptured down that
8 splay. The ruptures that I have done precisely are described
9 in my testimony, and they do not include rupture going down
10 that splay. But it is my judgment that indirectly some
11 aspects of the fact that there is a joint in the rock there
12 has been considered in that there are similar features going
13 on in probably essentially all large earthquakes.

14 DR. BUCK: I guess my problem is how have you
15 considered the splay then? You say you considered the splay
16 to some extent. What is the extent of it?

17 WITNESS FRASER: By tying to the physical data
18 recorded in past earthquakes which also have joints in rocks
19 connecting into the main fault or into the main rupture
20 zone.

21 DR. BUCK: All right. Let's go back to the past
22 earthquakes of similar splays. What has occurred on those
23 splays that you find of interest in this particular thing?

24 WITNESS FRASER: The rupture that takes place in
25 last earthquakes by and large is beneath the surface where



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1 I cannot see what is going on. There appears to be evidence,
2 though, that in past earthquakes the rupture zone is not
3 perfectly aligned along a straight line as geologists draw
4 maps, and we see that in aftershocks and where we can locate
5 the earthquakes, and there are other evidences of that.

6 As the rupture proceeds it probably hopscotches
7 around a little bit as it proceeds down basically the main
8 trend of the fault. In that sense the little hopscotching
9 around that depth which is not visible to the observer at
10 the surface, to that degree in calibrating my model and
11 testing my model against past earthquake data, the possibility
12 of some jumping around of the rupture as it proceeds down
13 a major fault, which I assume a large magnitude earthquake
14 would be a major fault, not a small fault, and to that
15 degree any hopscotching around or jumping that the rupture
16 may do due to the presence of discontinuities in joints in
17 the rocks adjacent to the fault has been tested and
18 included in the modeling to that degree.

19 DR. BUCK: All right. Maybe I can understand
20 now. What you are saying is you have looked at, shall we
21 say, the hopscotching of an earthquake down a major fault,
22 and you have looked at what happens at some of the splay
23 joints as a result of that, is that correct?

24 WITNESS FRASER: I have looked at what it does
25 in terms of producing strong ground motion at a particular



1 station.

2 DR. BUCK: Okay. So then you have used that
3 consideration by analogy on the splay that is marked here
4 as just above the A2 situation.

5 WITNESS FRASER: That is one of the considerations,
6 yes.

7 DR. BUCK: What are the other considerations?

8 WITNESS FRASER: The capability of having rupture
9 go down such a splay was considered not by me but was con-
10 sidered in judgments as to whether these types of splays are
11 any different than what we see in past earthquakes, that
12 sort of analysis.

13 DR. BUCK: And are they generally capable of sus-
14 taining -- producing earthquakes or not in the past experi-
15 ence?

16 WITNESS FRASER: My suspicion is that these splays
17 would probably be capable of generating maybe magnitude three
18 or maybe slightly larger earthquakes. I would expect it we
19 are talking about a magnitude 7 1/2 earthquake, I am going
20 to look for a major fault to put that earthquake on and not
21 on some tangent.

22 DR. BUCK: All right. That is the point I wanted
23 to get at. This is a limited amount of earthquake motion
24 that you might get on a splay such as this, at least based
25 on past experience.

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1 WITNESS FRASER: Yes.

2 MR. FLEISCHAKER: I have a couple of clarifying
3 questions, and that is the end of my cross examination
4 related to Dr. Buck's questions.

5 CHAIRMAN SALZMAN: Just one moment. We are having
6 a little problem because the gentleman who drew this map is
7 in the room, I understand.

8 Would you have any objection to having the gentle-
9 man sworn as a witness now just for the purpose of explaining
10 what this line is?

11 MR. FLEISCHAKER: I think it is probably Dr.
12 Hamilton. I believe he has prefiled testimony. I would
13 just as soon examine him when he takes the stand in order,
14 Mr. Chairman.

15 MR. OLMSTEAD: Mr. Chairman, one of the purposes
16 of this hearing is so that the Board gets information in
17 a manner in which it can understand it, and it seems to me
18 that if the witness is here and there is a point of contention,
19 and we have two witnesses who have two different maps, that
20 we ought to get them on the stand and hear what they have
21 to say and explain the discrepancy. We are not playing cat
22 and mouse games here.

23 MR. FLEISCHAKER: That is right, but I also -- excuse
24 me, I would like to reply to that, please.

25 There are -- if this is going to be testimony and

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1 Dr. Hamilton is going to take the stand, I would like to
2 have time to prepare. There are other maps, the Buchanan
3 and Banks map, which also gives a different characterization
4 of the fault, and I do not have that map with me right now.

5 I take that back. I have it here, but I haven't
6 studied it, so if he takes the stand now, I am quite frankly
7 not prepared to cross him. So if he wants to take the stand
8 now and if I have an opportunity to cross examine him
9 tomorrow, that would be fine.

10 CHAIRMAN SALZMAN: All right, Mr. Fleischaker. You
11 have offered and you have been cross examining on a map
12 which was drawn by someone who is in the room, and we would
13 like the gentleman who drew the map to take the stand and
14 be sworn solely to answer Dr. Johnson's questions about
15 what the map means.

16 If you have any questions in light of what Dr.
17 Johnson says, of course you will be asked to -- given the
18 opportunity to address it, and that will be all we want
19 to hear about it. We just want to understand the map, sir.

20 Mr. Norton, which witness is that?

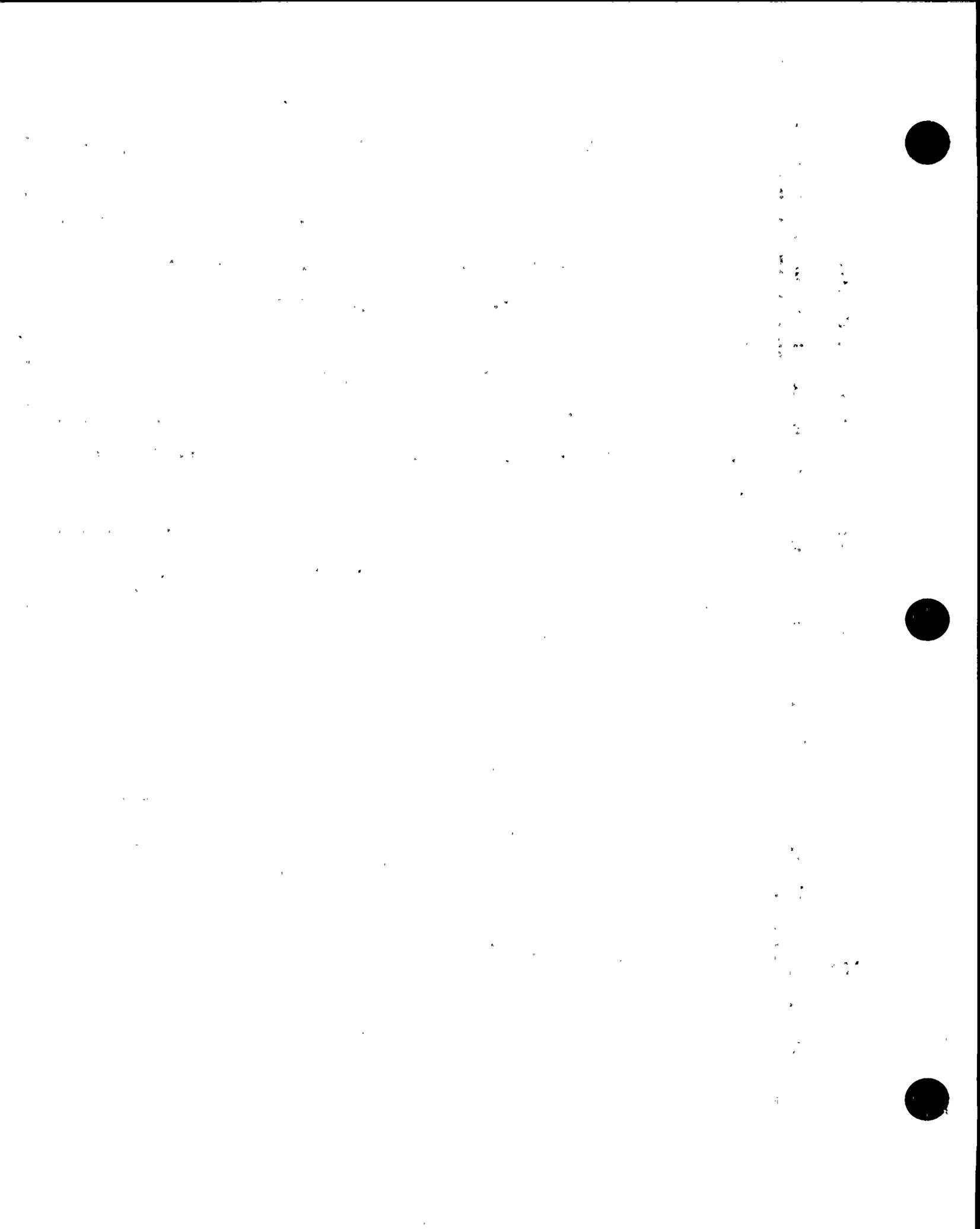
21 MR. NORTON: It is Douglas Hamilton right here
22 on the left walking up to the stand.

23 CHAIRMAN SALZMAN: Mr. Hamilton --

24 MR. NORTON: Perhaps he could change places with
25 Dr. Seed or Dr. Smith at the moment. Do you want to remain

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1 standing?

2 CHAIRMAN SALZMAN: Would you state your full name
3 for the record, sir?

4 MR. HAMILTON: My name is Douglas Holmes Hamilton.

5 CHAIRMAN SALZMAN: Thank you, Dr. Hamilton.

6 Would you raise your right hand?

7 Whereupon,

8 DOUGLAS HOLMES HAMILTON

9 was called as a witness by the Board and, having been first
10 duly sworn by the Chairman, was examined and testified as
11 follows:

12 CHAIRMAN SALZMAN: Please be seated. Dr. Johnson
13 wishes to ask you a question at this time just related to
14 Joint Intervenors' R-10 for identification. Do you have that
15 in front of you, sir?

16 WITNESS HAMILTON: Yes, sir, I do.

17 BOARD EXAMINATION

18 BY DR. JOHNSON:

19 Q Dr. Hamilton, do you understand the line segment
20 that we have been talking about displayed on that map?

21 A Yes. Dr. Fraser has pointed that out to me.

22 Q Could you tell us what that line segment represents?

23 A Yes. That line segment is one of a series that
24 were interpreted as being faults of small displacement
25 within the rock and that lies along the east side of the

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1 Hosgri fault on the basis of the seismic reflection line,
2 so in the subsurface structure that we interpreted to develop
3 this map.

4 Q What role would such a feature play in the event
5 of a major rupture on the Hosgri fault in that vicinity?

6 MR. FLEISCHAKER: I object to this question as
7 being beyond the scope of this witness' expertise. He is a
8 geologist, not a seismologist or a geophysicist.

9 MR. NORTON: If Dr. Hamilton cannot answer that
10 question, I am sure he will say, and Dr. Smith who is
11 the seismologist who is sitting right next to him can answer
12 it.

13 CHAIRMAN SALZMAN: Dr. Hamilton, can you answer
14 that?

15 WITNESS HAMILTON: Can I answer it in terms of
16 our geologic interpretation of the structure?

17 CHAIRMAN SALZMAN: Yes, sir.

18 WITNESS HAMILTON: Is that a satisfactory --

19 CHAIRMAN SALZMAN: One moment.

20 Please go ahead.

21 WITNESS HAMILTON: In terms of our geologic
22 interpretation we consider the fault along the trend of
23 the splays under discussion, as well as other smaller faults
24 indicated also in that same kind of line weight of that
25 same orientation, and the other symbols that indicate fold

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1 structures to be part of the general structure of the rock
2 that lies along the east side of the Hosgri fault. And it
3 is our interpretation of the evidence we can see in the
4 subsurface that the Hosgri fault has a truncating relationship
5 to elements of structure like that such that we would expect
6 that large movements taking place along the Hosgri fault
7 would be associated with an earthquake on it, would essentially
8 move along past elements or structure like this.

9 We think that these features do not have large
10 amounts of movement shown on them. They are essentially
11 fairly minor faults that lie within the ground on the east
12 side of the Hosgri, and they do not show the kind of structural
13 evidence or evidence in the sea floor that would suggest to
14 us that they would actually participate in any significant
15 way in a major earthquake generating movement on the Hosgri.

16 CHAIRMAN SALZMAN: Is that what you intended to
17 indicate by the fact that the line is dotted on your map,
18 sir?

19 WITNESS HAMILTON: No, sir. The dashed line is
20 meant to indicate a more approximate kind of degree of
21 certainty with respect to identifying and locating the
22 feature. The Hosgri fault is much more clearly defined.
23 It has much better evidence. And we are looking for more
24 subtle kinds of evidence for these smaller breaks such as
25 the one under discussion. And so we cannot be as confident



1 that we are really seeing a fault or exactly how we are
2 locating it.

3 CHAIRMAN SALZMAN: Thank you.

4 DR. JOHNSON: Thank you.

5 CHAIRMAN SALZMAN: Mr. Fleischaker.

6 MR. FLEISCHAKER: I have a couple of followup
7 questions.

8 CROSS ON BOARD EXAMINATION

9 BY MR. FLEISCHAKER:

10 Q Dr. Hamilton, on the basis of your examination of
11 this fault you have determined that it does not display a
12 major offset, is that correct?

13 A Yes, sir.

14 Q Now, how can you take that data and -- can you
15 as a geologist take that data and predict that that solav
16 will not be the site of some major rupture at a future date?

17 A Well, we are basing it on both the evidence of
18 its past movement, which is quite small, and I think also
19 contrasting it with the kind of movement that we see on the
20 Hosgri fault which is very much larger and is clearly more
21 continuous in the area from some miles north to some miles
22 south of the site along the Hosgri trend itself.

23 Q Is it the case that by looking at the ruptures
24 that we can observe at the surface in the fault we can
25 predict how that fault will rupture in the future?

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1 A I think that is certainly a very good guide to
2 it. All our experience seems to tell us that breaks that
3 have not experienced very much movement in the past, that
4 lie within an area of complexly deformed rock such as we
5 see here are much less likely to sustain any kind of a
6 future earthquake movement than a larger, more active fault
7 that has a record of repeated movements over a long period
8 of time and some known earthquake history.

9 (Pause.)

10 O Sir, this strand of fault in here, is this the
11 strand -- were you able to date the last movement of faulting?

12 A As is the case with most of the faulting that we
13 see in the offshore region, the only date that we have on
14 this is that it lies within rocks that are many millions
15 of years old, and it does not break the sea floor. So that
16 our latest time line on it is that it is older than about
17 17,000 years.

18 Q Is that characterized as Holocene movement?

19 A 17,000 years would be late Pleistocene. Holocene
20 we take to be the last 10,000 or 11,000 years.

21 Q Are you aware as to whether the USGS has mapped
22 on MF 910, Buchanan and Banks map, a splay similar to this
23 in which they indicate Holocene movement?

24 MR. NORTON: Object as to what do you mean by a
25 splay similar to this? Where are we talking about, in



1 Turkey or where?

2 CHAIRMAN SALZMAN: I think the question was clear,
3 Mr. Norton. He was talking about, Mr. Fleischaker, as I
4 understand it, a map essentially like this where the faults
5 run in the same area. Is that your point?

6 MR. FLEISCHAKER: That is correct.

7 MR. NORTON: Excuse me, Mr. Salzman. I don't know
8 that. I don't see the map, and I would think first he
9 would ask if he is familiar with the map, because I do not
10 know what map he is talking about.

11 CHAIRMAN SALZMAN: All right. Mr. Norton's point
12 is well-taken. Please be a little more specific for the
13 purpose of the witness. Ask him if he is aware of the maps,
14 and if he is, then show it to him.

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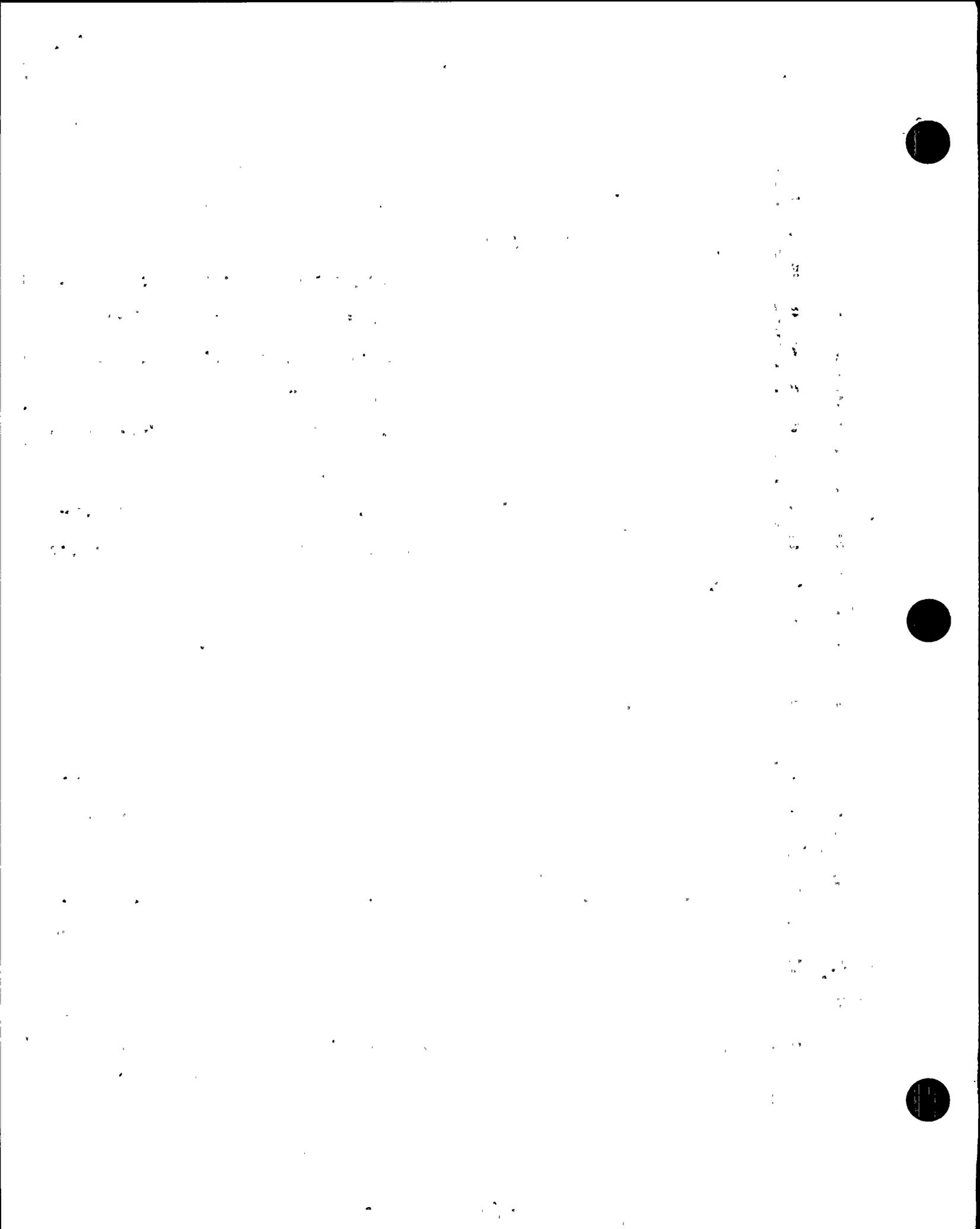
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MR. FLEISCHAKER: May I mark this as an Exhibit?

CHAIRMAN SALZMAN: Surely.

The reporter will mark this map as Joint
Intervenor's Exhibit R-11.

(The above referred document was
marked for identification as
Joint Intervenor's Exhibit
R-11 and R-11A.)

MR. FLEISCHAKER: I would like to note that Joint
Intervenor's Exhibit R-11 is a Xerox of a portion of
Buchanan and Banks MF 910, a USGS map. I am going to give
the map itself to the witness, so he can determine that this
is a portion of this map.

CHAIRMAN SALZMAN: Mr. Norton, do you want to look
at it also?

MR. OLMSTEAD: Mr. Chairman.

CHAIRMAN SALZMAN: Mr. Olmstead.

MR. OLMSTEAD: Before we proceed further on this
line of questioning, I might note that I have not interposed
an objection on relevance grounds because I assume that we
are going to tie this back to Question 7 of the Board, which
deals with focusing. But we are starting to get away from
that.

CHAIRMAN SALZMAN: I am not sure what we are doing
here, Mr. Olmstead. As I understand this point, he is

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1 suggesting that this is the fault at Diablo Canyon, and that
2 you get focusing on it. The waves indicate whether there is
3 such a fault.

4 I am going to let him go on for a while, sir.

5 MR. NORTON: Mr. Fleischaker, this appears to be
6 Sheet 2 of 3. Does Sheet 1 have perhaps more language
7 which describes what the numbers mean and that sort of
8 thing?

9 I would ask that that be put in evidence also. I
10 am now looking at sheet one, and half of the map is writing
11 which explains the symbols, etc. I don't see how you can
12 use just the Joint Intervenor's Exhibit R-11 without the
13 key to what all of the various numbers mean.

14 CHAIRMAN SALZMAN: Would it be possible, Mr.
15 Fleischaker to have the key to the map, the legend xeroxed
16 and used as an adjunct to this exhibit. You could do that
17 after lunch?

18 MR. FLEISCHAKER: No problem.

19 CHAIRMAN SALZMAN: We will do that, and we will
20 append that key as a second page of your Exhibit R-11, sir.

21 MR. FLEISCHAKER: Thank you.

22 CHAIRMAN SALZMAN: Mr. Hamilton, have you had a
23 moment to examine that?

24 WITNESS HAMILTON: Yes, I have.

25 CHAIRMAN SALZMAN: Mr. Norton?



1 MR. NORTON: I assume that you are going to ask
2 him whether he is prepared to answer the question.

3 As I see this exhibit, and as I am sure the Board
4 can see, there are many little teeny lines on it. I am not
5 sure which one he is talking about. Is he talking --

6 Is the question, is there a line on here which
7 shows holocene movement?

8 MR. FLEISCHAKER: I think that it will be easier
9 if I start with the cross-examination.

10 CHAIRMAN SALZMAN: Let him ask the question.

11 BY MR. FLEISCHAKER:

12 Q This is a USGS Map, is that not correct?

13 A Yes.

14 Q Are you familiar with this map?

15 A Relatively, yes.

16 Q I would like to direct your attention to R-11 and
17 just off-shore where it says, "Bouchon," there is a circle
18 drawn around a strand. That circle is not part of the
19 original map, but it has been put on there to identify
20 the strand that we will be talking about.

21 A Yes, I see that area.

22 Q That triangle there, what does that mean
23 according to the legend?

24 A If I might refer to the control symbols part of
25 the legend, and simply read what it says. There is a



1 triangle that looks like the one on the map, and it is
2 identified as indicating "geomorphic features formed by
3 fault movement, latest fault movement inferred from type
4 of features," then they add "see footnote 3 and 5 to age
5 age range chart."

6 Q Is that your complete answer?

7 A Could you restate the question, and let me see
8 if I failed to complete it.

9 Q I would like to know what that triangle with the
10 one in it indicates in terms of the estimate of movement
11 on that fault.

12 A I believe that the triangle indicates the
13 geomorphic features, which suggests a young age, and the
14 number one indicates, according to this fairly complex way
15 of indicating things, that the age holocene.

16 Q How did they describe holocene in terms --

17 A Holocene lies within the bracket in the age
18 range, and lies between zero and 10,000 years.

19 MR. FLEISCHAKER: I have no further questions,
20 sir.

21 DR. BUCK: Is there any way of knowing where
22 Diablo Canyon is on this map?

23 MR. FLEISCHAKER: That is a good question.

24 DR. BUCK: You put it in.

25 MR. NORTON: May we also a couple of questions,



1 I guess that would be redirect, although there has not been
2 any direct, simply on this exhibit?

3 CHAIRMAN SALZMAN: I take it that you want to
4 ask one or two questions to clear something up.

5 MR. NORTON: Yes.

6 CHAIRMAN SALZMAN: All right, make it brief.

7 MR. NORTON: I don't have the large map in front
8 of me because there is only one, nor do I have a small one.
9 The triangle that was referred to, is that on the short
10 little splay, or is that the major Hosgri fault?

11 WITNESS HAMILTON: I think the way this map is
12 drawn, the placement of the triangle is ambiguous. However,
13 if one follows the splay or strand that is circled north-
14 westerly, one comes to another point, which is a number 3
15 in a square box, and the triangle, if one follows the fault
16 that is located farther to the south, then you find no
17 other symbols. So it might be inferred that the triangle
18 is on the shorter north of the fault segment that extends
19 from the circled area.

20 MR. FLEISCHAKER: May I ask, Dr. Hamilton, if
21 you can estimate from that map the distance from that track
22 and go Diablo Canyon?

23 CHAIRMAN SALZMAN: That does not show the Diablo
24 Canyon site. I don't see how he could do it.

25 MR. FLEISCHAKER: He may know where it is. He

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1 could plot it easily.

2 WITNESS HAMILTON: You are asking for the distance
3 from the triangle that lies at the southeasterly end of
4 the circled area to Diablo Canyon on this map.

5 MR. FLEISCHAKER: Correct.

6 WITNESS HAMILTON: If the Board would like, I can
7 sketch it off on the map that is in front of me, which I
8 think does have a scale on it.

9 MR. FLEISCHAKER: I think that it would be useful
10 information.

11 MR. BROWN: While this is being done, perhaps I
12 could ask a question.

13 I am not familiar with the procedure in my
14 experience of redirect, as Mr. Norton put it in the middle
15 of Cross-examination.

16 CHAIRMAN SALZMAN: It is simply to clarify with
17 Dr. Hamilton.

18 MR. BROWN: I am not objecting to it. I want to
19 be sure that I am not barred from engaging in cross-
20 examination of Mr. Hamilton.

21 CHAIRMAN SALZMAN: No, sir.

22 WITNESS HAMILTON: From the original version of
23 this map, I have scaled the distance to about 7.6
24 kilometers.

25 MR. FLEISCHAKER: Thank you. I have no further



1 questions.

2 I have one question of Dr. Fraser.

3 BY MR. FLEISCHAKER:

4 Q When you talk of this hop-scotching which you
5 take into account in your modeling, is that hop-scotching
6 taken into account in the parameters that you call spatial
7 variations or randomness?

8 A No. It is taken into account from the simply the
9 fact that we have models of strong motion data. If there
10 were no randomness in the model, it would still be taken
11 into account.

12 MR.FLEISCHAKER: Thank you.

13 I have no further questions.

14 CHAIRMAN SALZMAN: Does the Board have any further
15 questions?

16 Dr. Johnson?

17 DR. JOHNSON: No.

18 CHAIRMAN SALZMAN: Dr. Buck?

19 DR. BUCK: No.

20 CHAIRMAN SALZMAN: Mr. Lanpher, are you prepared
21 to go ahead?

22 MR. LANPHER: Yes, sir.

23 CHAIRMAN SALZMAN: Let's take a five minute break
24 and then we will begin.

25 (Whereupon, a short recess was taken.)



1 CHAIRMAN SALZMAN: Before I turn to the Governor's
2 cross-examination of Applicant's witness, Mr. Fleischaker,
3 I have a question of you, sir.

4 According to my records, I presume you did not
5 intend to offer Joint Intervenor's Exhibits R-6 through 11
6 into evidence, because you did not offer them.

7 MR. FLEISCHAKER: Can I consider that over the
8 lunch period because I need to look at those again. Perhaps
9 I could offer them after lunch.

10 CHAIRMAN SALZMAN: Hearing no objection, I don't
11 see why you cannot consider them until after lunch.

12 Mr. Lanpher.

13 MR. LANPHER: Just as a preliminary matter for
14 the Board's information, I am going to be handling the
15 examination of the panel on Questions 1 through 4, and my
16 colleague Mr. Brown will handle the questions on Question
17 7.

18 CHAIRMAN SALZMAN: It is perfectly acceptable.

19 BY MR. LANPHER:

20 Q I would first like to go over a few things that
21 have been discussed in response to Mr. Fleischaker's
22 questions.

23 Dr. Smith, do you have a copy of Applicant's
24 Exhibit R-1, that was the first viewgraph that you used?

25 A (Witness Smith) Yes.



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1 Q That was the first viewgraph?

2 A Yes.

3 Q On that exhibit you have two side locations, one
4 labeled "far field site," and the other "near source site."
5 Would you please define for me what distance range you
6 consider in your a near source site to the surface rupture
7 trace?

8 A There are two different scales of importance in
9 defining a near field, and a far field. One is the distance
10 with respect to the fault dimension, and the other scale is
11 that of the wave length of waves that one is concerned
12 with.

13 Generally speaking, we use the term somewhat of
14 a combination of these. So a near field site is typically
15 within 5 to 10 kilometers to a fault.

16 Q To the surface rupture or the surface trace?

17 A Of the rupture.

18 Q I would like to address your attention, Dr.
19 Smith, to 1.1 of Dr. Trifunac's testimony. Do you have
20 that, Dr. Smith?

21 A Yes.

22 Q In some of the examination yesterday there was
23 discussion regarding the surface trace of the IV-79
24 earthquake, and where possibly the zone of primary energy
25 release took place.



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My question is whether you were conducting studies or analyses to determine where the zone of primary energy release took place during that earthquake?

A No.

Q Would anyone else on the panel like to respond to that question?

In other words, have any of you performed such analyses?

A (Witness Fraser) I have been involved in a computer simulation of that particular earthquake, and comparing synthetic ground motion with those observed in the field.

Indirectly there is some study of that subject, and that question, but no specific study to determine whether the principal zone of energy release was around Bond's Corner, or whether it was uniform along the fault.

I would word it the other way around. I see no evidence for localized high zones of energy release.





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dspl0-1

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1 Q Dr. Blume, I would like to direct your attention
2 to the figures on your item one or question one testimony.
3 I would to look first at figure I-1. It follows page I-7.

4 A (Witness Blume) I have it now.

5 Q I want to be clear in my own mind how this is the
6 SAM-V curves on this exhibit -- this figure are plotted.
7 Is it correct that you solved the SAM-V equations using
8 hypocentral distance, but plotted the equations on this
9 graph as a function of fault distance?

10 A No, that is not exactly correct. I derived
11 SAM-V as an equation using basically hypocentral distances,
12 determined from United States Earthquake reports.

13 Once having the equation, I then applied it in
14 this case by assuming that the hypocentral distance was
15 in fact a slant distance or the normal distance down to the
16 center of energy release at the Imperial Valley earthquake.

17 Q Did you assume that the center of energy release
18 for that earthquake was uniform all the way along the
19 fault?

20 A Yes, I assumed that it might be anywhere opposite
21 each station normal to the fault.

22 MR. NORTON: Excuse me, Mr. Salzman. While they
23 are conferring for a moment, I have a feeling we have
24 another very minor correction to make, but I am not sure,
25 and I guess I should ask --



dsp10-2

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1 CHAIRMAN SALZMAN: In Dr. Blume's testimony?

2 MR. NORTON: Yes, it is the figure we are referring
3 to. If you will recall on page I-3 of the testimony
4 Dr. Blume changed one minor thing which is the very last
5 line, line 26. I guess that b bar is supposed to be rho
6 equals 1.51.

7 Perhaps I am wrong, but if he did, if you go to
8 Blume figure I-1 it shows rho equals 2.05 which was the
9 original value on Blume I-3. So I wonder if the other
10 engineers who might be computing numbers or something,
11 if they were just using the table and did not pick up the
12 text change, that indeed the figure is supposed to be
13 changed in the text, and then we ought to make that change
14 now.

15 That is a question to Dr. Blume. I am not sure
16 it should be changed in both places, but I do note it was
17 changed in the text.

18 WITNESS BLUME: Thank you, Mr. Norton. It should
19 be changed in both places to the value 1.51. We are
20 talking about -- and also I see another problem with the
21 typing.

22 BY MR. LANPHER:

23 Q Could we finish on the first correction first
24 On page I-3, in the foot note, that is a "b", isn't it,
25 or has that been changed to rho?



dsp10-3

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1 A That should be a rho, and the line 25 of page
2 I-3, it reads PV_S . It should be rho V_S .

3 Q And on your figure I-1, Dr. Blume, the rho should
4 be 1.51 instead of 2.05; is that correct?

5 A The number should be changed to 1.51. But the
6 rho should be changed to b bar.

7 Q Right.

8 MR. FLEISCHAKER: I am confused. I thought we
9 just changed on page I-3 a b bar to a rho.

10 WITNESS BLUME: No, no. The b bar on line 26
11 remains the same, equal to 1.51. But in the line above,
12 line 25, it reads PV_S . It should be rho V_S .

13 MR. NORTON: Now, would you go to figure I-1 and
14 give that the way it should be.

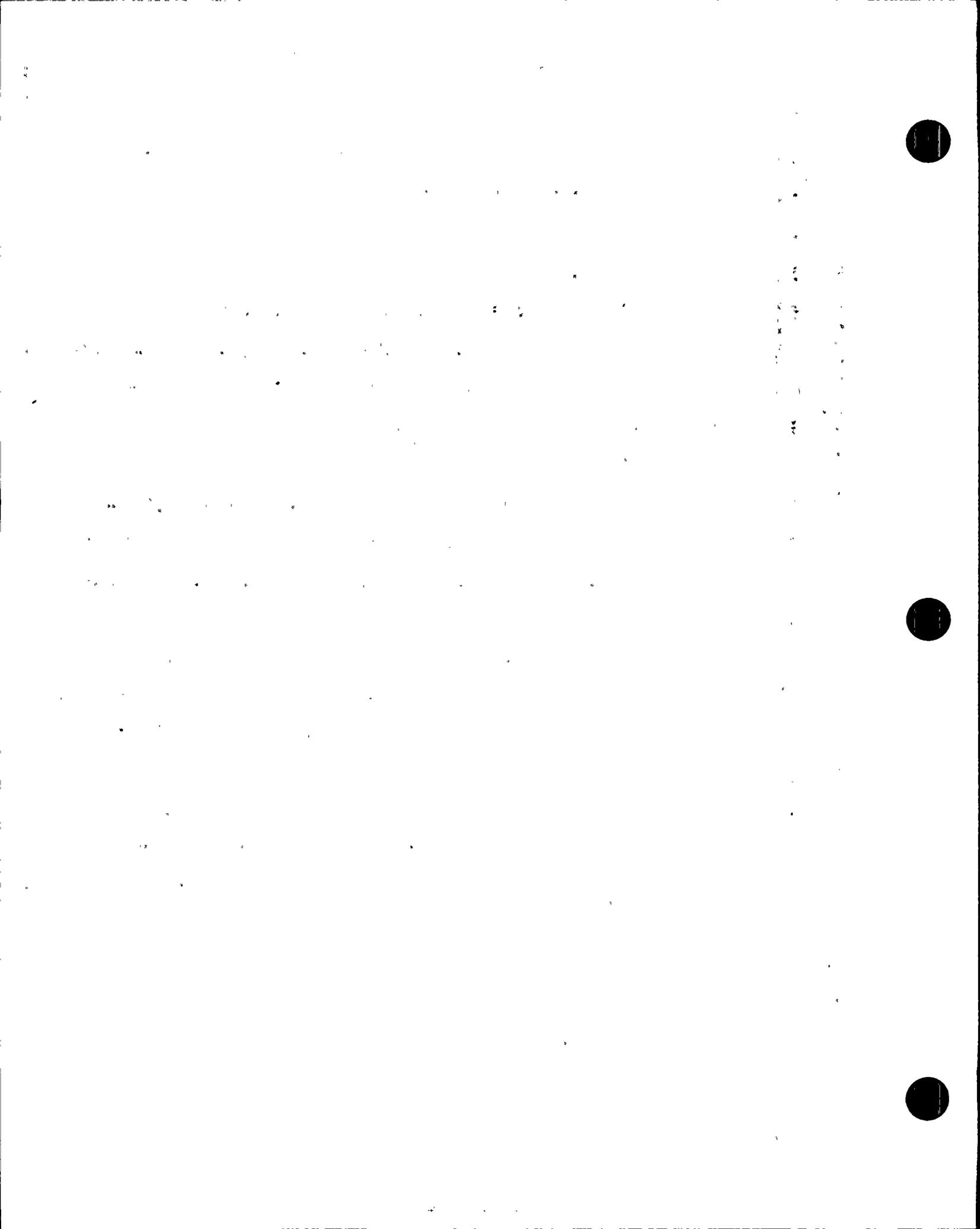
15 WITNESS BLUME: On figure I-1, in the middle of
16 the page, it now reads "rho equals 2.05." That should be
17 crossed out and substitute "b bar equals 1.51."

18 BY MR. LANPHER:

19 Q Dr. Blume, how does this correction on your
20 figure I-1 change the plotting of the SAM-V curves, if at
21 all?

22 A I do not believe it changes the plotting at all.
23 I think this is a typo.

24 Q So they were plotted correctly? This is just --
25 they were plotted using b bar 1.51?



dspl0-4

1 A Yes.

2 Q Could you maybe just check that during the
3 lunch hour just to confirm it?

4 A All right. Yes.

5 Q Thank you.

6 I would like you to turn you attention to
7 Blume figure I-5, please. This figure in your testimony,
8 I believe, is the same as figure four, D-LL11B, except for
9 the addition of the IV '79 data.

10 A That is correct.

11 Q And in solving the SAM-V equation, did you use
12 the same slant distance as you previously described with
13 respect to figure I-1 for distance to the fault. Excuse
14 me.

15 A Yes. These curves were drawn a long time ago,
16 but as I recall they were done in the same way that we did
17 for Imperial Valley. The magnitude, however, is 7 here
18 and rho V_s is 2000 feet per second.

19 Q Thank you. In attempting to extrapolate the
20 mean line on figure I-5 for the SAM-V equation, I get
21 around .6 or .65g at the left vertical axis at zero
22 distance.

23 Is that approximately correct?

24 A Let me try it for a moment.

25 (Pause)

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dsp10-5

1 As near as I can scale roughly here it would be
2 about .55 to .60g.

3 MR. OLMSTEAD: Mr. Chairman, just to clarify the
4 record, as I understand this log curve chart, there is
5 no zero distance on it. It should be one kilometer at
6 the edge.

7 MR. LANPHER: That is my understanding.

8 BY MR. LANPHER:

9 Q That is my understanding. Is that correct?

10 A That is correct. It should be one.

11 MR. NORTON: I have a question about that, however.
12 If you go backwards from 10, how far back does it go?

13 WITNESS BLUME: It goes a full unit, a full
14 magnitude.

15 MR. NORTON: But I take it there is a dashed
16 line for two missing on log scale.

17 WITNESS BLUME: Yes, there is a two missing.

18 MR. NORTON: Okay.

19 BY MR. LANPHER:

20 Q In this figure, the slant distance to the fault
21 is assumed to be 10 kilometers; is that correct?

22 A I am not sure. You mean the focal depth at the
23 fault?

24 Q Yes.

25 A I am not sure from looking at this figure. As I

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1 say, this was done a long time ago. What was used, it is
2 hard to say without going back to the derivation of all of
3 these curves.

4 I can say that for Diablo Canyon we assumed
5 five kilometers as the focal depth for the purpose of
6 calculation.

7 Q Directing your attention to the horizontal axis,
8 the distance is set forth down there; what distance
9 parameter is that with respect to the SAM-V curves?

10 A Well, that would have to be the same distance
11 that was on the original figure. I believe it came from
12 795. I presume that is the normal fault distance, but I
13 think it should be checked.

14 Q You mean normal horizontal distance to the fault
15 at the surface?

16 A I believe that was what was used in the original
17 drawing. This was originally a USGS drawing. The
18 major points here are by USGS. The lines were added by
19 me and the Imperial Valley 1979 data were added by me.
20 So we could go back to the USGS report and verify that if
21 you want.

22 My colleague tells me it is the closest distance
23 to the fault.

24 Q Could you please tell me, Dr. Blume, why you have
25 extended the SAM-V curves on figure I-5 inside 10 kilometers?



dsp10-7

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1 Isn't it true that when you solve the SAM-V equation using
2 the slant distance -- and I believe that we were assuming
3 a 10 kilometer focal depth -- but if we could assume that
4 just for the moment --

5 A Yes.

6 Q -- that the SAM-V curves become essentially
7 horizontal inside a 10 kilometer distance to the fault,
8 normal distance to the fault?

9 A They become quite flat; not exactly horizontal,
10 but quite flat as you approach zero distance. I think
11 perhaps there is confusion developing between the derivation
12 of the equation and the application in this case. The
13 application here is normal log distance, which would be
14 a surface horizontal measurement.

15 Whereas, in the derivation of the equation,
16 hypocentral distances were used.

17 MR. LANPHER: Mr. Salzman, I would like marked
18 as Governor Brown Exhibit R-1 for identification a
19 reproduction of figure I-5 where we have replotted the
20 SAM curve.

21 I would like Dr. Blume to take a look at it, and
22 then I will ask some questions about it.

23 (The above-mentioned document
24 was marked Governor Brown
25 Exhibit R-1 for identification.)

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BY MR. LANPHER:

Q Are you ready, Dr. Blume?

A Yes, I think so.

Q In response to one of my earlier questions you said that inside 10 kilometers the SAM-V curves plot almost horizontal. Is that what is depicted on Governor Brown's Exhibit R-1?

A Yes.

Q And is it -- do you agree that Governor Brown's Exhibit R-1 without having checked the actual equations themselves generally represents the shape of the SAM-V curves when plotted against a fault distance for a magnitude of 7 earthquake using the factors that you have on this graph?

MR. NORTON: May we have a clarification? Are we talking about local magnitude or surface wave magnitude?

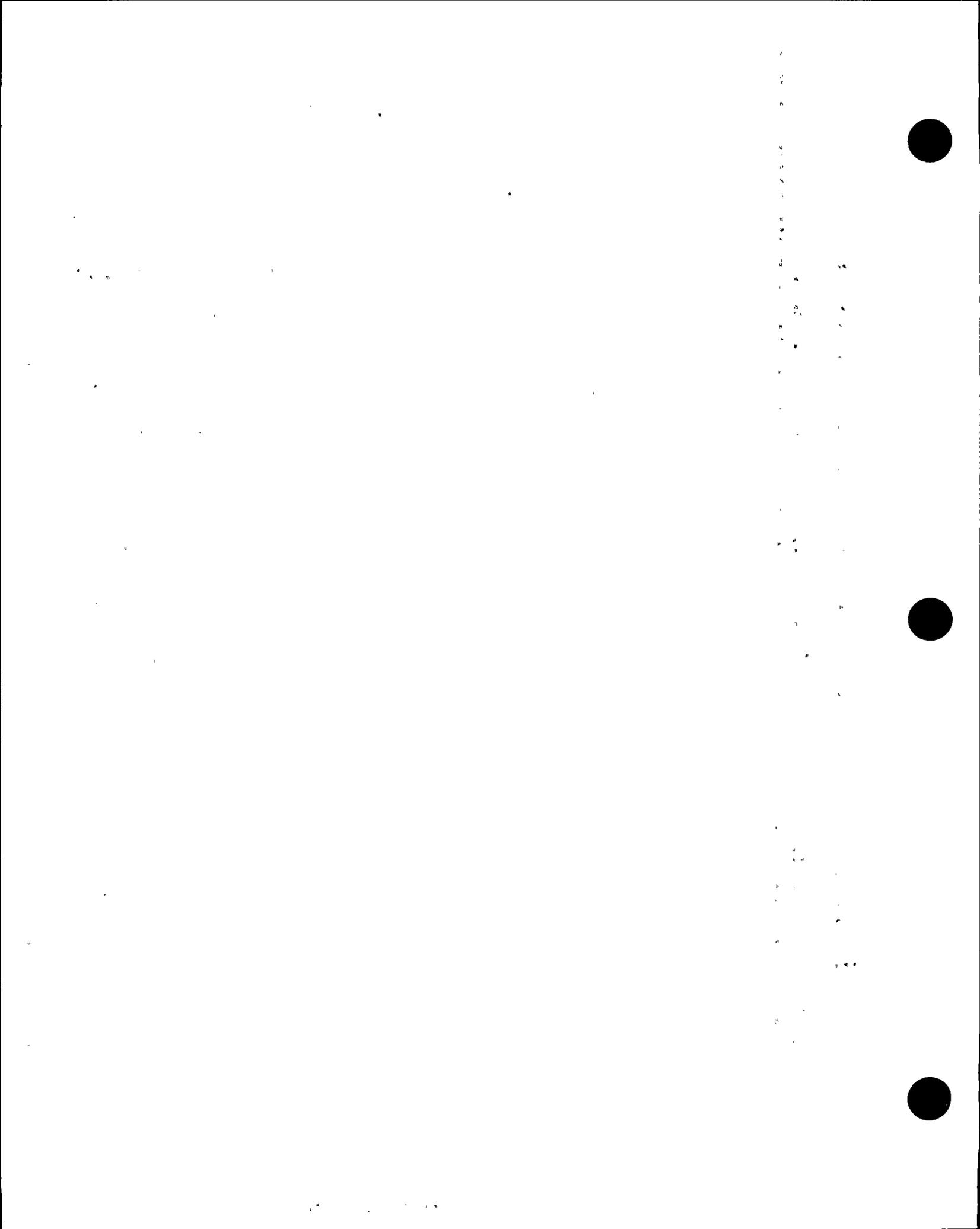
CHAIRMAN SALZMAN: Can you answer, sir?

MR. LANPHER: We used the same magnitude as indicated on this graph, M equals 7.

MR. NORTON: I am asking whether this is surface or local magnitude. This is a production from Governor Brown, not from Dr. Blume. And they are asking him to accept it. And I am asking what magnitude they used.

CHAIRMAN SALZMAN: Can you tell him?

MR. LANPHER: We used in the equation the number



dsp10-9

1 7 for magnitude; we did not differentiate between MS
2 or ML. And it is our understanding in the derivation of
3 the equation that Dr. Blume did not either.

4 BY MR. LANPHER:

5 Q But I would like Dr. Blume maybe first to clarify
6 whether he did differentiate in the equation.

7 A In the derivation of the equation, we simply
8 used whatever magnitude was published in the United States
9 earthquakes, which I believe in the early years was mostly
10 MS and possibly towards the later years it may have become
11 some ML.

12 Q I believe I had a pending question. Would you
13 like me to repeat it?

14 A Would you repeat it, please?

15 Q Certainly. I had asked you -- you had testified
16 earlier that inside a fault distance of 10 kilometers the
17 SAM-V curves when plotted against fault distance becomes
18 nearly horizontal.

19 I don't mean to characterize exactly what your
20 words were.

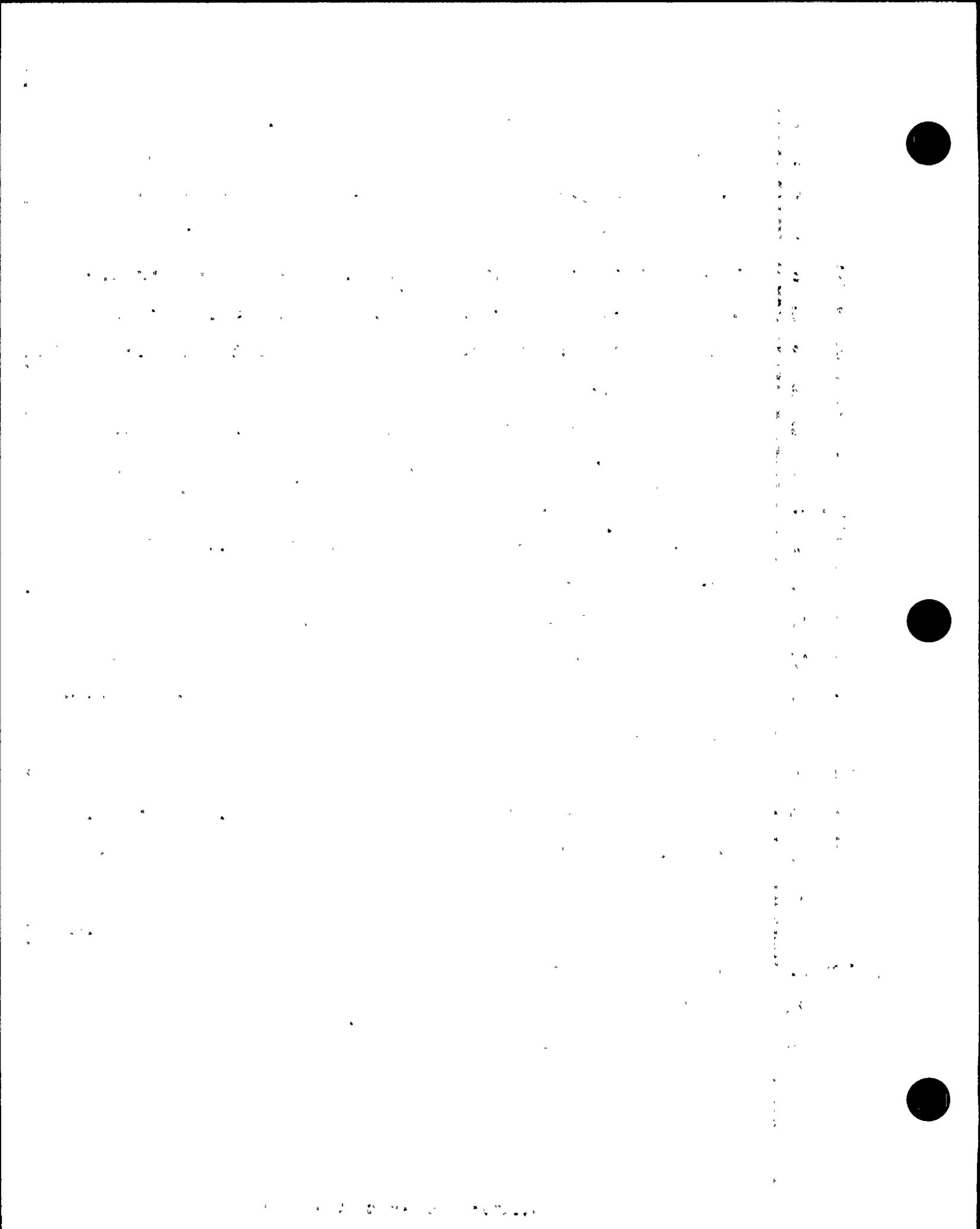
21 Looking at Governor Brown's Exhibit R-1, does
22 this represent what you were describing before?

23 A Yes, these curves are nearly horizontal.

24 Q And is this a proper way to plot the SAM-V
25 curve as a function of fault distance?

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dsp10-10

1 A Well, I cannot answer that without checking
2 these calculations, but I will put it this way, that many,
3 many of the plots do come out with that type of shape, yes.

4 Q And when the SAM-V curve is plotted in this way
5 as a function of fault distance and the IV '79 data are
6 also plotted as a function of fault distance, that brings
7 the SAM-V curves down relative to those data points; isn't
8 that correct?

9 A Apparently so on this drawing, but as I said
10 before, I would have to check the calculations.

11 Now, there is a lot involved in what is used for
12 the value of R close in. I might inquire before I can
13 answer your question correctly or directly as to what
14 the value of R was used, for example, at a distance of
15 one kilometer.

16 Q We are going to check on that. We can return to
17 it.

18 DR. JOHNSON: Mr. Lanpher, can I ask a question?
19 Would you explain for my benefit the difference between
20 your figure, Governor Brown's Exhibit R-1, and Dr. Blume's
21 figure 1.1?

22 MR. OLMSTEAD: Mr. Chairman, I like the question,
23 but I would object to counsel answering it. I think
24 counsel ought to identify who did the adjustment on the
25 chart and what the basis for the adjustment was.

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dsp10-11

1 DR. JOHNSON: I had no one else to ask. I do
2 not think it would be fair to ask Dr. Blume what the
3 difference is. I think he knows what figure I-1 is.

4 MR. OLMSTEAD: I agree with that. I think that
5 counsel for the state ought to identify who made the
6 adjustments to the chart and what the basis for it was.

7 CHAIRMAN SALZMAN: Would you do that, please,
8 sir?

9 MR. LANPHER: Certainly. Let me first answer
10 Dr. Blume's question.

11 We used a value for R of 10, a focal depth of
12 10 throughout. So R would vary for the near field. The
13 person who made these adjustments on this chart, Dr.
14 Johnson, was Dr. Young, who will be a witness for Governor
15 Brown later.

16 If you would like me to respond further to
17 questions about it, I would be happy to, or when Dr. Young
18 takes the stand you can certainly question him.

19 DR. JOHNSON: We are dealing with the two figures
20 now. Are there some things that appear to be obviously
21 different? I just wonder if the parameters that were used
22 for R-1 and the parameters that were used in Blume
23 figure I-1 could be compared?

24 MR. LANPHER: The answer is no. We are not
25 attempting to compare the parameters from figure I-1 to

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I-5, as Dr. Blume testified I think in response to Mr. Fleischaker. They are different parameters. I-5 was produced and prepared with different parameters.

DR. JOHNSON: Well, specifically, Dr. Blume's figure I-1 accelerations are plotted against distance through the fault, and that is the same abscissa that is used in Governor Brown's Exhibit R-1; is that correct?

MR. LANPHER: Yes, sir.

DR. JOHNSON: Okay, I will ask Mr. Young later.

end 10

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BY MR. LANPHER:

Q Dr. Blume, I would like to return to your figure I-1 just briefly. You have testified to your belief that the SAM-V curve, the mean curve for SAM-V -- well, it is not the mean curve. But -- no, it is the mean curve -- properly fits the data for IV '79; is that correct?

A That is correct, based upon the assumptions that were made as to distances.

Q Do you have a copy of Joint Intervenors' Exhibit R-5?

A No, I do not, but there may be one at the table here.

Q It is the -- to help you, it is the redraft of a figure by Dr. Seed or by Dr. Seed's colleagues, but it was provided to us by Dr. Seed.

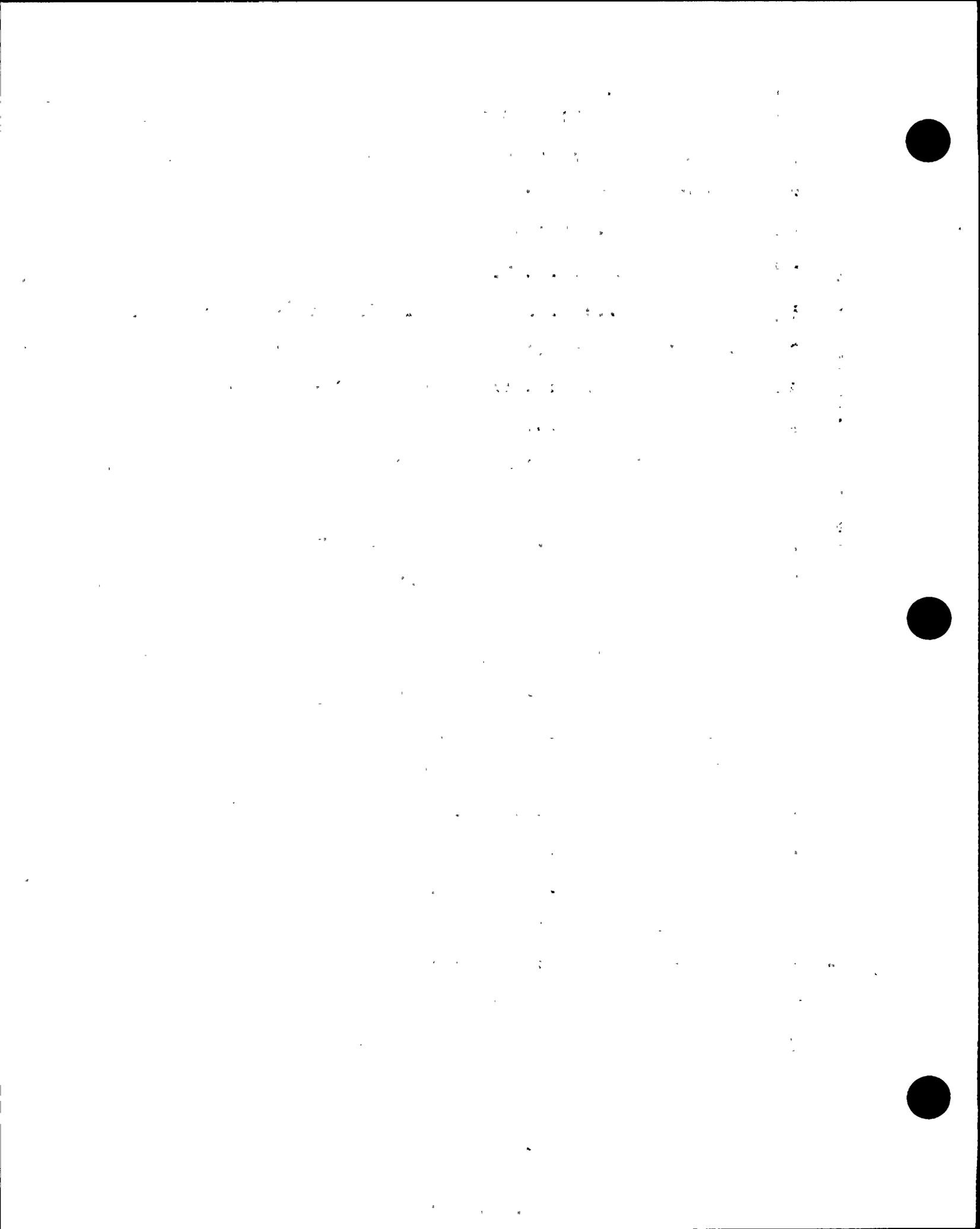
A To make sure I have the right document, this is not marked R-5. The title reads, "Regression Analysis of the Peak Accelerations Recorded during the October 15, 1979 Imperial Valley Earthquake."

Q That has been marked for identification.

CHAIRMAN SALZMAN: I believe that has been admitted as R-5, Joint Exhibit R-5.

BY MR. LANPHER:

Q We are talking about the same document, Dr. Blume.



dsp11-2

1 CHAIRMAN SALZMAN: That is what I understand
2 to be Joint Intervenors' R-5. Do you have the same
3 understanding, sir?

4 MR. LANPHER: Yes.

5 BY MR. LANPHER:

6 Q When I compare your figure I-1 with Joint
7 Intervenors' Exhibit R-5, I find that the SAM curve predicts
8 at zero distance approximately .37 -- .35 --

9 MR. NORTON: Excuse me. May we find out which
10 one you are referring to when you say what SAM predicts
11 at zero distance.

12 MR. LANPHER: Blume figure I-1.

13 MR. NORTON: I just did not see the line going
14 into the zero.

15 MR. LANPHER: At the vertical axis; if you
16 extrapolate just a little bit over, it comes out just
17 below 0.4, I think at around 0.37.

18 BY MR. LANPHER:

19 Q Is that correct?

20 A That is correct.

21 Q I believe Dr. Seed yesterday testified that on
22 his Joint Intervenor Exhibit R-5 his mean curve for the
23 IV '79 data meets the vertical axis at about .53g. Do
24 you recall that testimony?

25 A No, but I see it on this diagram R-5.

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dsp11-3

1 Q Can you explain the difference between the
2 prediction in the SAM curve and the mean which Dr. Seed
3 has derived?

4 A Well, there could be many reasons. He may have
5 been actually fitting the data with regression lines. I
6 do not know. If that is the case, it is entirely -- an
7 entirely different situation than mine where I was
8 merely comparing an existing attenuation law with data
9 points.

10 Q Dr. Seed, could you clarify for us?

11 A (Witness Seed) R-5 simply shows regression lines
12 fitting to the data.

13 Q In your opinion, do those regression lines
14 depict the mean of those data that you have plotted on
15 Joint Intervenors' R-5?

16 A The line labeled the median is pretty close to
17 the mean.

18 Q So the mean of your regression line meets --
19 or the median that is labeled on there meets the vertical
20 axis at about .53?

21 A Right.

22 A (Witness Blume) I suspect another difference
23 may be we have a different number of data points. I don't
24 know whether Dr. Seed included the Mexican stations in
25 his or not.

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dsp11-4

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1 Q I would like to ask Dr. Seed that: did you
2 include the Mexican stations, Dr. Seed?

3 A (Witness Seed) I cannot answer that; the
4 drawing was done by colleagues. I will find out at
5 lunchtime and answer you this afternoon.

6 A (Witness Blume) I can see by looking at one
7 kilometer that he has only four data points whereas I
8 have one, two, three, four, five, six, seven, eight, nine,
9 10, 11, within one kilometer.

10 So I suspect that the Mexican data are not in
11 his.

12 Q Dr. Seed, when you are checking with your
13 colleagues, I would appreciate it if you could also check
14 whether there are other data points which were not plotted,
15 for instance, beyond the trace of the fault to the north-
16 west.

17 I can return to this after lunch.

18 Dr. Blume, I would like you to turn to page 1 --

19 MR. NORTON: Excuse me. Before we leave this
20 subject, I think there is again some miscommunication.

21 CHAIRMAN SALZMAN: I did not hear you, sir.

22 MR. NORTON: Before we leave the subject and
23 come back to it after lunch and people go off doing things
24 over the lunch hour, I think there is some miscommunication.
25 Joint Intervenors' Exhibit R-5 says it is a regression



dspl1-5

1 analysis of the peak accelerations. Figure I-1 deals
2 with all of the data points and so it is apples and
3 oranges.

4 In other words, R-5 is only the peak. I mean,
5 that is what it says.

6 CHAIRMAN SALZMAN: Well, Mr. Lanpher, that is
7 indeed what it says.

8 If it will not take but a moment for him to
9 ask his colleagues, he can answer.

10 MR. NORTON: My question was -- and I don't
11 know but that the colleagues may be in Berkeley and he
12 is going to lose half his noon hour trying to get ahold of
13 people in Berkeley and so on. If it is not necessary, I
14 want to avoid it.

15 You know, just looking at the labels of the two
16 documents on their face, they are different data.

17 WITNESS BLUME: And they have different purposes,
18 I might add. One is regression. The other is merely
19 plotting a curve that is already existing.

20 MR. LANPHER: I am merely, Mr. Salzman, trying
21 to find out why we are ending up with a different
22 prediction for these two curves. And it may be the
23 data points that are plotted. I would be delighted for
24 the witnesses to tell me.

25 CHAIRMAN SALZMAN: Dr. Seed, would it be very

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dspl1-6

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difficult for you to get the information that Mr. Lanpher would like to have?

WITNESS SEED: No, as far as I know the data points plotted are the peak accelerations for two components for each station. Not all the stations that Dr. Bloom has shown may be shown on this particular plot. I can find out at lunch hour.

WITNESS BLUME: May I try to clarify the situation? The regression analysis is a fit to actual data points, whatever those points on. On figure I-1, I did not attempt to fit these points at all. I just merely drew the curves the way the equation had previously been derived.

The mere fact that they happen to fit fairly well is either luck or coincidence or good fortune. But regression analysis is by no means the same thing as merely comparing curves and data points.

I would be surprised if they were the same.

CHAIRMAN SALZMAN: Dr. Blume, just a moment.

Mr. Norton, the witness has indicated it will take him but a moment, that it will not be difficult to do. With your indulgence, we will let him do it, sir.

Please continue, Mr. Lanpher.

DR. JOHNSON: I have a question. From your questions, Mr. Lanpher, I am not sure you did previously



dsp11-7

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1 understand the distinction that Dr. Blume just made, and
2 that on the one hand we have Dr. Seed's fit to the data;
3 on the other hand we have Dr. Blume's calculation for a
4 6.6 magnitude earthquake on which are displayed the data.
5 But it is perfectly reasonable to assume that they would
6 not exactly correspond to one another.

7 MR. LANPHER: I understand that. I am trying
8 to find out why they do not correspond. I believe one
9 of the reasons is that they have taken different data
10 points also, Dr. Johnson.

11 DR. JOHNSON: Dr. Blume's calculation using
12 SAM-V does not use any data points from the Imperial
13 valley earthquake. That is the point. He has an
14 equation that he dreamed up using data, and he calculated
15 what the ground acceleration for a 6.6 magnitude earthquake
16 would be.

17 And then he compared the measured values from
18 Imperial Valley with it. That is what figure I-1 is.

19 MR. LANPHER: I understand that; I misspoke
20 before, Dr. Johnson.

21 DR. JOHNSON: Excuse me.

22 MR. LANPHER: He also has testified that he
23 believe his mean SAM curve is depicted on that exhibit,
24 Exhibit I-5 accurately -- that it accurately matches the
25 data he has plotted on there.



dspl1-8

1 I am not saying that that is the mean of that data,
2 that he has even attempted to plot the mean of that data.
3 That is the SAM curve prediction.

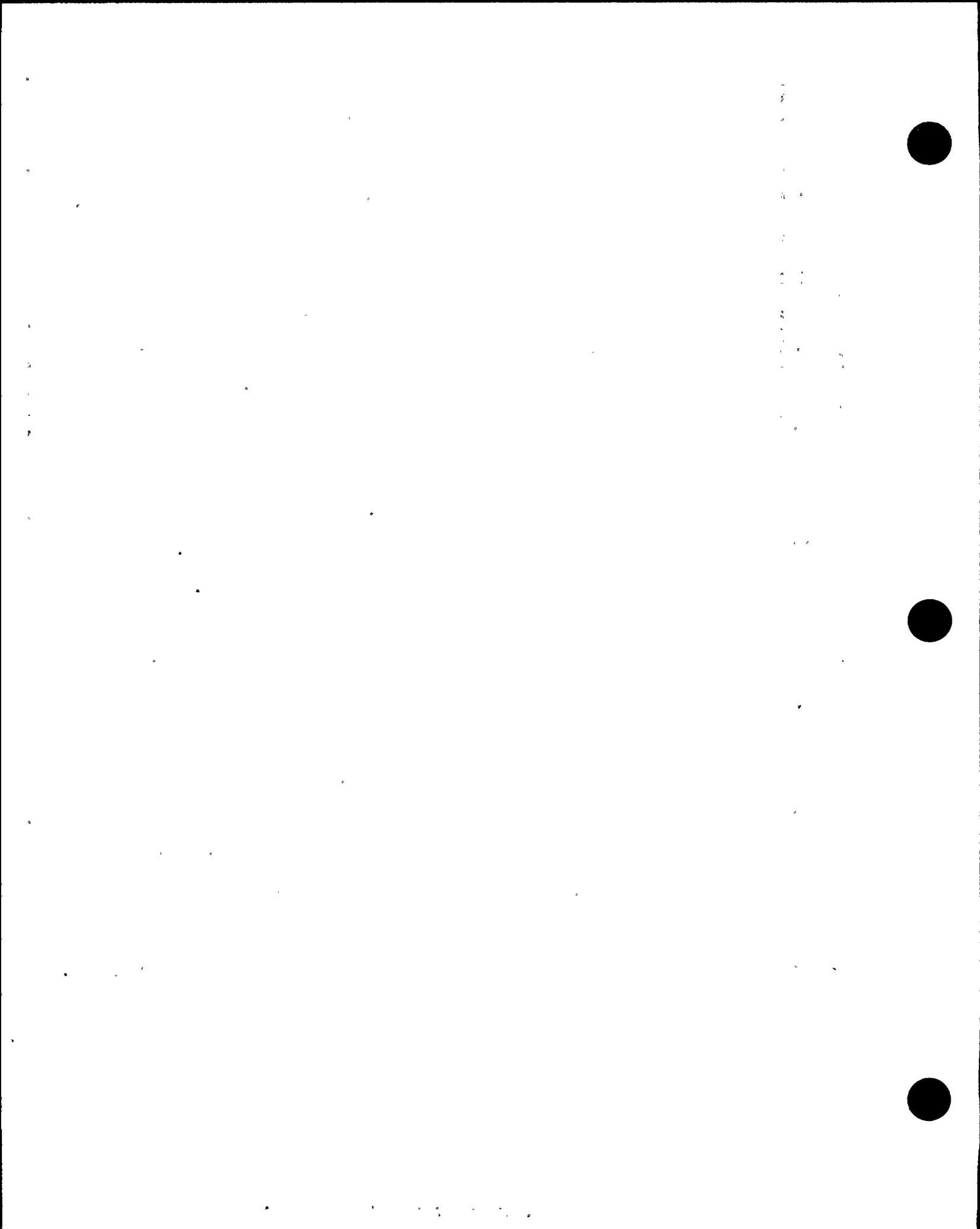
4 MR. OLMSTEAD: If that is the case, I have an
5 objection. If that is what we are trying to get at with
6 this testimony, I have to point out that yesterday we
7 went over the same point and it was pointed out that all
8 he did was do what the board told him to do in the question.
9 So I would view it as cumulative and repetitive at this
10 point.

11 CHAIRMAN SALZMAN: I think at this point I am
12 prepared to adjourn for lunch, but I would ask this,
13 Mr. Lanpher. I too have concerned that we are going over
14 ground that has been thoroughly plowed, and I suggest that
15 while Dr. Seed will get you this information, I would
16 like you when we return from lunch to tell us precisely
17 where you are going to go and what point in the matter
18 has not been drawn out by Mr. Fleischaker's cross
19 examination.

20 With that, gentlemen, I would appreciate it if
21 we could recess for lunch, Mr. Lanpher, and reconvene at
22 2:15.

23 (Thereupon, at 12:55 p.m., the hearing in the
24 above-entitled matter was recessed to reconvene at 2:15 p.m.
25 that same day.)

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CHAIRMAN SALZMAN: On the record, please. We will reconvene the hearing.

Mr. Fleischaker has handed out to all who should have it a Xerox copy of the Preliminary Maps Showing Recency of Faulting in Coastal South-Central California. This will be part of Joint Intervenor's Exhibit R-11 for identification. We will refer to it as R-11 part 1.

MR FLEISCHAKER: For purposes of information, this is only the legend from the USGS map.

CHAIRMAN SALZMAN: I am sure the transcript will be clear as to what we are trying to get at.

MR. FLEISCHAKER: I would like to bring up one other matter which we discussed prior to the noon break. I would like to offer in evidence the following exhibits.

CHAIRMAN SALZMAN: If you will just wait one moment, I wouldlike the reporter to mark this as Joint Intervenor's Exhibit R-11, part 2.

I am going to ask Mr. Fleischaker if he is going to offer these exhibits in evidence?

MR. FLEISCHAKER: Thank you, Mr. Chairman.

I would like to offer into evidence Joint Intervenor's Exhibits R-6 through R-9, which include a final report entitled, "Determination of Ground Motion at Regenerating Station Unit," and Supplements 1 through 3.

In addition: -- Perhaps we should stay with those





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1 first.

2 CHAIRMAN SALZMAN: Let's deal with those first.

3 Mr. Norton, do you have any objection?

4 MR. NORTON: We are now talking about the reports
5 and the supplements. I have no objection.

6 CHAIRMAN SALZMAN: Mr. Lanpher?

7 MR. LANPHER: I have no objection.

8 CHAIRMAN SALZMAN: Mr. Olmstead.

9 MR. OLMSTEAD: Mr. Chairman, I do have an objection
10 I guess. I don't quite know what we are doing with the San
11 Onofre information in this case. The particular chart
12 which is referred to, I have no objection to, and I don't
13 question the authenticity of the document.

14 I certainly don't want to be acceding to a line
15 of examination on why the San Onofre work was done one way,
16 and the Diablo work was done in another way, and the myriad
17 comparisons back and forth that we can get into, when the
18 purpose that we had this examination was to look at the
19 Board's question on focusing

20 CHAIRMAN SALZMAN: Mr. Fleischaker, could you
21 specify the specific portions that are relevant to your
22 cross-examination that you wish us to examine?

23 Most of these are very large documents, and most
24 of them we did not make any particular reference to, sir.

25 MR. FLEISCHAKER: I am trying to recall now, sir.



1 There was reference to tables, and I cannot recall, unless
2 I go back and check it out.

3 Let me respond to the staff's point. First of
4 all, the only matter in which that material would be
5 considered by the Board, or any reviewing body, would be to
6 the specific pages that were discussed in the testimony.

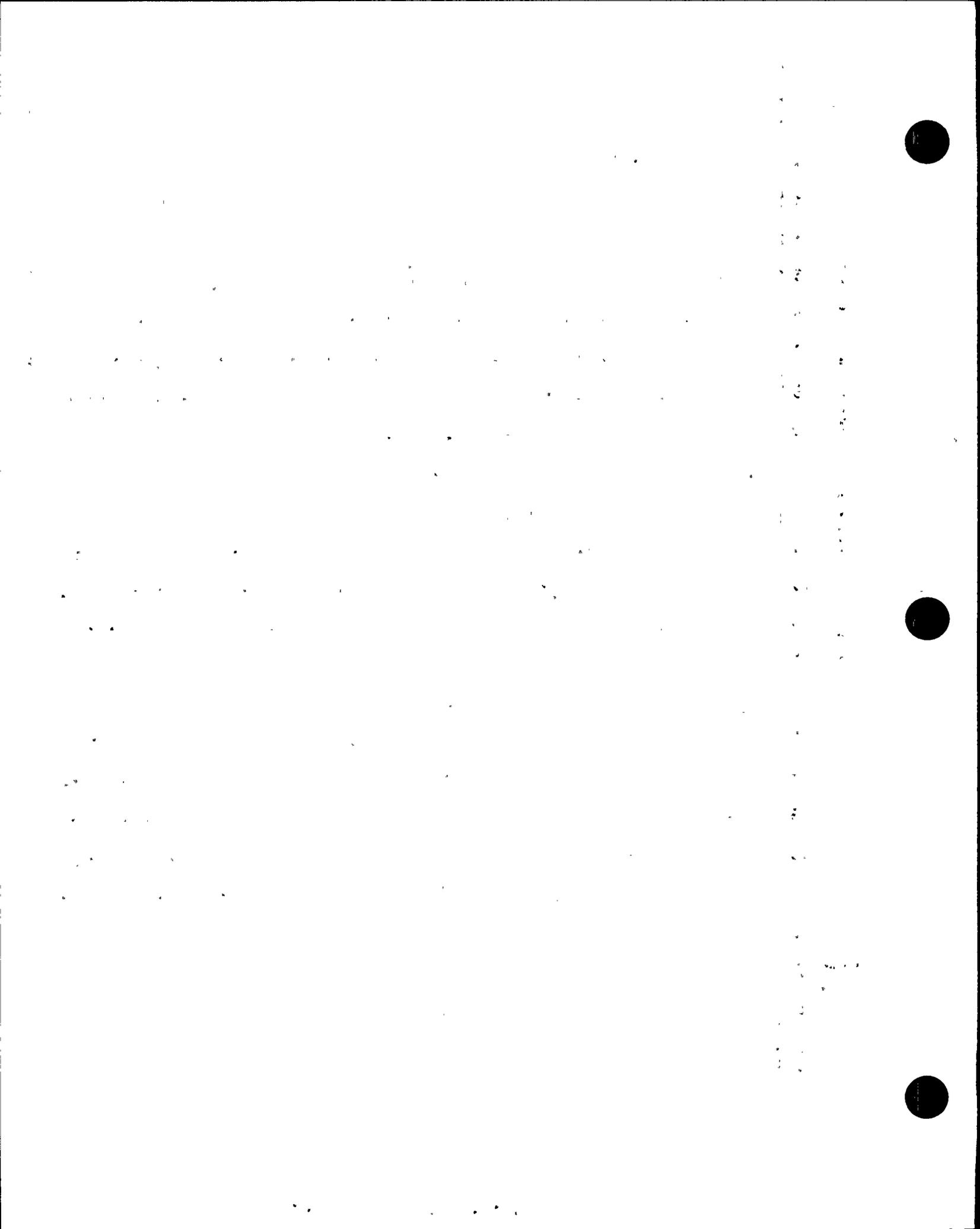
7 Secondly, there may well be additional cross-
8 examination in this proceeding with respect to that report.
9 At that time, the Board will have to determine whether it is
10 relevant or not.

11 I would suggest, contrary to staff counsel's
12 position, that it is very relevant, because I think it will
13 be shown that the computer model that was used at San
14 Onofree is very much the same computer model that was used
15 for Diablo Canyon.

16 CHAIRMAN SALZMAN: Yes, Mr. Norton.

17 MR. NORTON: I have no real problem with it, with
18 one minor exception. As this Board noted in one of its
19 appellate decisions, in reprimanding the Licensing Board for
20 not having reviewed the entire record below, if this 6,000 or
21 7,000 page document is in the record, then this Board would,
22 I guess, under ruling be compelled to read from page 1 to
23 page whatever.

24 I do think that that is a little extraordinary when,
25 in fact, it is not by and large relevant. . To date, one page



1 has been referred to, one table only, I believe. To put the
2 whole thing in evidence does require this Board, of course,
3 to read it.

4 CHAIRMAN SALZMAN: Mr. Lanpher?

5 MR. LANPHER: My colleague, Mr. Brown, when he
6 will cross-examine on Question 7 is planning to refer to
7 the report for San Onofree. So maybe we ought to defer
8 consideration of this until we see how much has been raised.

9 CHAIRMAN SALZMAN: Gentlemen, wait just one
10 moment.

11 (Discussion off the record.)

12 CHAIRMAN SALZMAN: As is not uncommon, everybody's
13 remarks are valuable. We will reserve ruling on whether we
14 will take all or part of this until we see what Mr. Brown
15 is going to use in his cross-examination. Meanwhile, I
16 will ask you to identify specifically what pages you wish
17 to put in evidence, and we will accept into the record the
18 relevant pages that you used, Governor Brown's counsel uses,
19 and anyone else who finds it necessary to cross-examine or
20 to refer to those. That will save us the necessity of reading
21 the entire document for fear of criticism by the Appeal Board.

22 Mr. Fleischaker?

23 MR. FLEISCHAKER: There are two other exhibits.

24 CHAIRMAN SALZMAN: You are quite right, sir.

25 MR. FLEISCHAKER: Joint Intervenor's Exhibit R-10



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1 and Joint Intervenor's Exhibit R-11, and R-11, part 2.

2 I would like to offer those into evidence at this time.

3 CHAIRMAN SALZMAN: Mr. Norton?

4 MR. NORTON: We have no objection to R-11, or
5 R-11, part 2. We do object to Exhibit R-10 at this point
6 in time because there are additional drawings on it with
7 numbers. We don't know who did that. We don't know what
8 they mean, what they purport to mean, or anything of that
9 nature. So we very much object to that?

10 CHAIRMAN SALZMAN: Let me ask Mr. Fleischaker?

11 Is it possible that you and Mr. Norton can get
12 together and come up with a map without extraneous material
13 on it, and then we can accept that?

14 I can understand his concern, sir, and I think you
15 can, too.

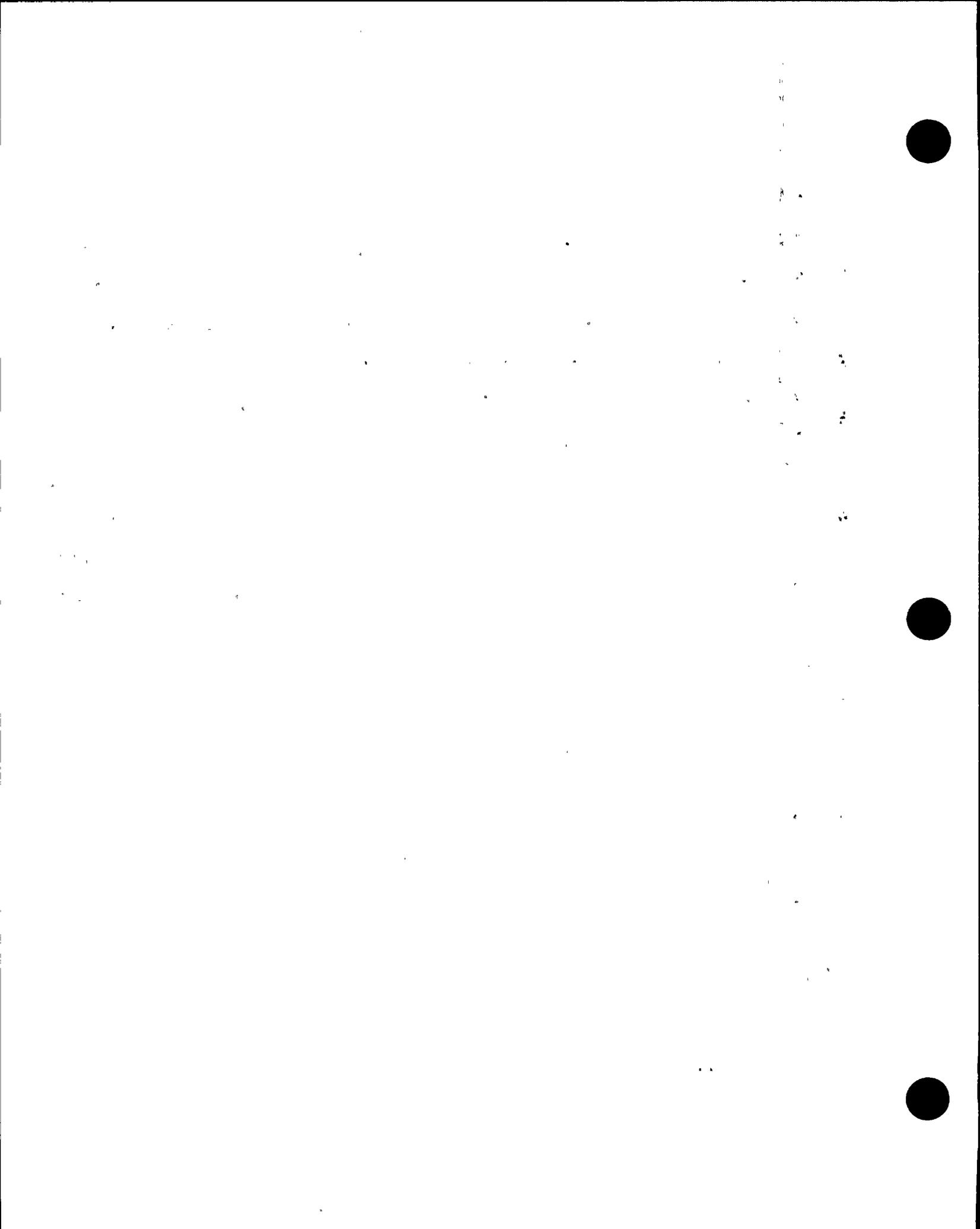
16 MR. NORTON: Excuse me, the map without this
17 writing on it is, indeed, already in evidence. I have
18 obviously no basis to object to something that is already in
19 evidence. But this I do strongly object to.

20 CHAIRMAN SALZMAN: Which part of this?

21 MR. NORTON: The lines with the numbers on them,
22 distances, I suppose, 12.5 kilometers, and so on.

23 CHAIRMAN SALZMAN: There is no evidence explaining
24 precisely what those meant, sir.

25 MR. FLEISCHAKER: That is one that I am prepared to



1 rest with. The map in evidence is a satisfactory substitute
2 for my purposes.

3 CHAIRMAN SALZMAN: That solves the problem.

4 We will reserve the ruling on the specific portion
5 of Joint Intervenor's Exhibit R-9 pending our being told
6 just what pages we want. Joint Intervenor's Exhibit R-11,
7 parts 1 and 2, will be admitted in evidence. Joint
8 Intervenor's Exhibit R-10, it is my understanding that it is
9 not being offered.

XXXX

10 ((The documents previously marked
11 or identification as Joint
12 Intervenor's Exhibit R-11, and
13 R-11, Part 2, were received in
14 evidence.)

15 CHAIRMAN SALZMAN: I think that we can now turn to
16 Mr. Lanpher.

17 MR. LANPHER: Thank you.

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1 Whereupon,

2 GERALD FRASER
3 H. BOLTON SEED
4 STEWART SMITH
5 JOHN BLUME
6 ROBERT EDWARDS

7 the witnesses on the stand at the time of recess, resume
8 the stand, and testified as follows:

9 CROSS-EXAMINATION (resumed)

10 BY MR. LANPHER:

11 Q I think just a couple of questions will clear up
12 the line of examination that I was following earlier.

13 Dr. Seed, did you have an opportunity during the
14 lunch break to determine which IV-79 data points are plotted
15 on Joint Intervenor's Exhibit R-5?

16 A Yes. As far as I can find out, all the stations
17 that were in the United States were plotted. Stations that
18 are missing and different from Dr. Blume's plots are the
19 Mexican stations. That was because they were not available
20 at the time this was first plotted, and then we have had some
21 uncertainty about the distances at which to plot. So this
22 does not show any Mexican stations.

23 Q This plot, then, does include stations beyond the
24 El Centro Ray to the northwest like parachute test
25 facility?



1 A Yes, I believe so.

2 Q Dr. Blume, you were asked questions with regard
3 to the Hanks and Johnson article, Joint Intervenor's Exhibit
4 R-2. You were asked whether you knew if Hanks and Johnson
5 had plotted vertical peak accelerations as well as horizontal.
6 You said yesterday, I believe, that you just did not recall
7 whether they had or had not.

8 Have you had an opportunity to refresh your
9 memory on that?

10 A I have not had any contact, but my colleague, Dr.
11 Smith, informs me that they did plot verticals.

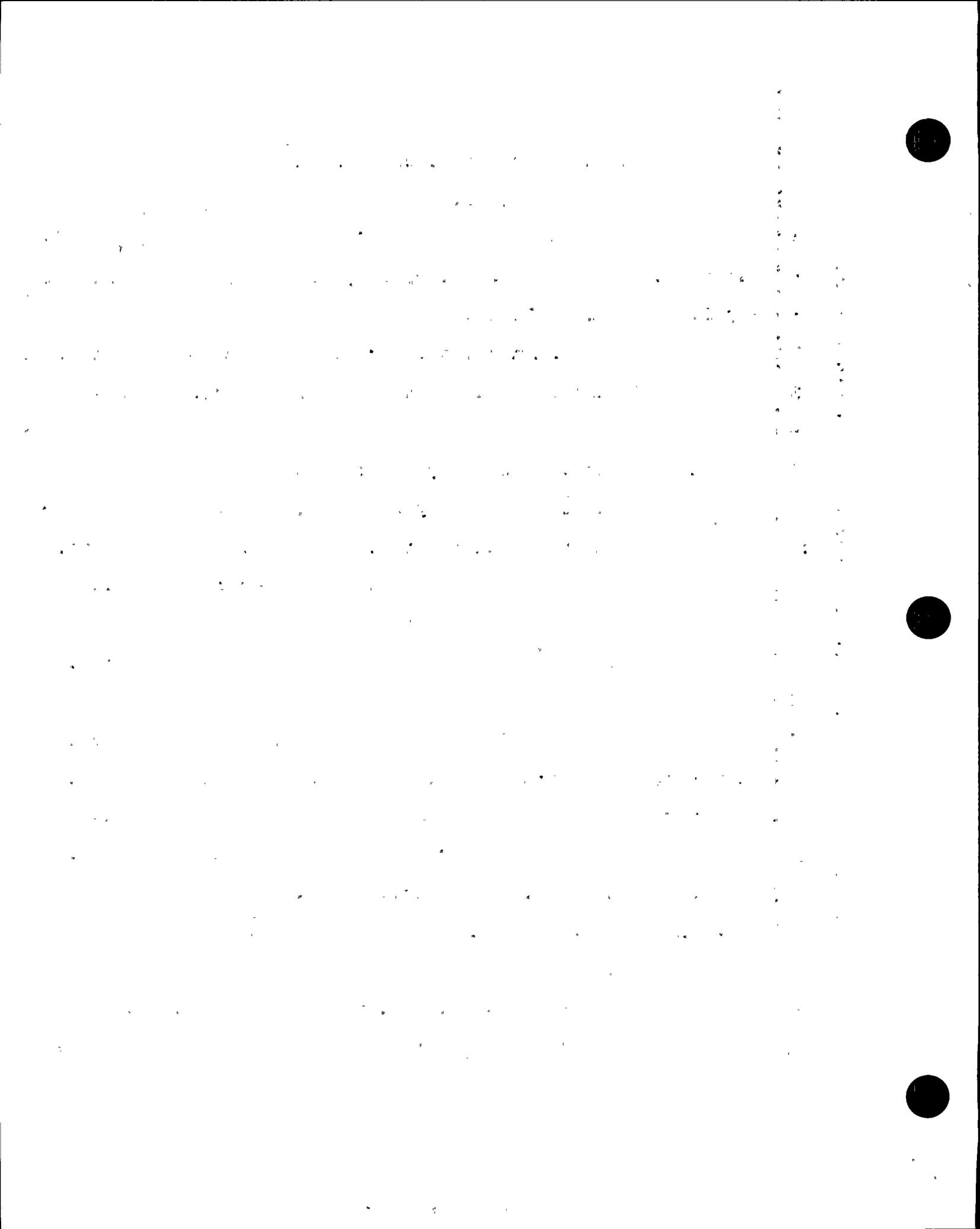
12 Q I believe that is correct. At the bottom of page
13 960 and 961, they make the point that they took the highest
14 plot of the three records, the two horizontals and the one
15 vertical.

16 In your figure I-10, however, you did not plot any
17 verticals. Is that correct?

18 A Only the horizontals.

19 Q If that figure were replotted in the same manner
20 that Hanks and Johnson plotted their data, you would have
21 to extend the Imperial Valley 1979 data up to include the
22 high vertical accelerations which are recorded. Is that not
23 correct?

24 A Yes. We might also have to extend it downward to
25 take care of the low verticals. I don't know. We show the



1 range.

2 Q You show the range of horizontal?

3 A That is correct.

4 Q Dr, Blume, in your SAM 5 equation, or in the deri-
5 vation of your SAM 5 equation, in your SAM 4, did you include
6 any San Fernando 1971 data?

7 A No, I did not include that. I went up to that time

8 Q Is there a reason why you did not include those
9 data?

10 A There are actually two reasons. At the time they
11 were not available officially when I derived the equation.
12 The second reason was that I felt even if they were available,
13 it would be such a mess of data from one earthquake that it
14 would unduly bias the data population.

15 Q Would you need to include all the data from that
16 earthquake?

17 A No. It could have been screened. There could have
18 been a filtering procedure set up to select portions of it.
19 But it was not available to me at the time I derived the
20 equation, neither, of course, was Imperial Valley 1979, so
21 I intended to revise the equations again one of these days.
22 We will probably have SAM 6 and 7.

23 Q Dr. Blume, could you please turn to page 1-5 of
24 your testimony? At lines 11 through 14, you state that it is
25 your long-held opinion that the near field magnitude becomes



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1 much less relative to local shaking value of 7.5 and
2 approximately 7M. If that was your opinion, Dr. Blume, why
3 did you derive the SAM 5 equation which is specifically for
4 the larger magnitudes?

5 A Actually I derived SAM 4 and SAM 5 simultaneously,
6 and SAM 4 takes care of the smaller magnitudes, and SAM 5
7 the larger ones. I was hoping at the time that I had enough
8 data points to break into three or more equations because
9 actually the difference between SAM 4 and SAM 5 does represent
10 the start of saturation effects.

11 Q Notwithstanding this belief which you express at
12 this page, I believe you testified yesterday of going from
13 6.6 to 7.6. Your SAM 5 equation predicts an increase in
14 acceleration of about 50 percent. Is that correct?

15 A I believe that was correct for the hypothetical
16 case going a full magnitude difference.

17 Q Dr. Seed, I would like to ask the next questions
18 of you.

19 If I could turn your attention to Intervenor's
20 Exhibit R-4, which is your 1976 article in relationship to
21 maximum acceleration, etc.

22 A Yes.

23 Q I would like you to turn to Table 2 of that
24 article, which starts at page 1328.

25 A Yes.



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1 Q There is a column in that article entitled,
2 "Approximate Source Distance."

3 A That is right.

4 Q Approximate source distance in kilometers.

5 A Yes.

6 Q Approximately what distance are you measuring
7 there?

8 A The horizontal distance from the recording station,
9 or what I call the zone of energy release, which is very
10 often the causative fault.

11 Q By causative fault, do you mean the surface
12 expression of the fault, or the epicenter or something else?

13 A It would be the surface expression that if we had
14 a very steeply inclined slope such as 45 degrees, such as
15 we had in San Fernando, then it would be an ellipse in plan
16 which would denote in plan view on a map the area equivalent
17 to where the energy was coming from in that particular
18 earthquake, representing the fault plane in a three-
19 dimensional picture. It is the closest distance to that
20 zone.

21 Q Why did you choose that zone as opposed to the
22 surface of expression for your distance parameter?

23 A Because in some earthquakes not all the energy
24 comes from the near surface expression of the fault. In the
25 San Fernando earthquake, for example, I believe most of the



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1 energy came from the deeper part of the fault, and not much
2 came from the upper magnitude of the rupture of the ground.

3 The rupture at stronger depth, or when they
4 fracture down there, they release more energy, and the
5 surface expression of the fault is not necessarily where the
6 maximum energy would be coming from.

7 Q Is it your belief, then Dr. Seed, that it is a more
8 reliable indication of measuring the strength of an earthquake
9 to measure to the zone of primary or greatest energy release
10 rather than the surface fault expression?

11 MR. NORTON: Excuse me. I would like a clarifica-
12 tion on the question of what is meant by the strength of an
13 earthquake. This is a term I had not heard before.

14 MR. LANPHER: Acceleration.

15 WITNESS SEED: Yes, I would say so.

16 BY MR. LANPHER:

17 Q Are you aware that in USGS 795, they use the
18 fault distance measurement for, for instance, the San
19 Fernando Valley earthquake?

20 A Yes.

21 Q Do you agree with the use of that as a measurement?

22 A What I believe is that three different people have
23 used different distances as we have heard testified very
24 often in this hearing, each person who uses a different
25 distance tends to develop his own law using his distance.



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1 I believe that each person who does that is familiar with the
 2 data on the basis of the distances that he uses, and his
 3 hands it becomes a viable tool. It does not make it neces-
 4 sarily a good tool in everybody else's hands.

5 Dr. Trifunac using his tools and his law, his
 6 distances, and trying to use my laws with my distances. We
 7 all use something a little bit different, and I think that
 8 it is perfectly normal. There are many ways of expressing
 9 the distance from the source.

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1 I would also point out that since most of us are
2 dealing with relatively far field data until the Imperial
3 Valley earthquake that a change in the distance of four or
4 five kilometers would not seriously affect the plotting
5 of the data on the graphs we use because they are plotted
6 semilogarithmically, and by the time you get to 25 kilometers,
7 if you go a little five extra, it runs to 30, and you don't
8 cover much part of the paper, the paper on which you are
9 plotting.

10 Q Would it be correct, however, that when you get
11 closer to the fault -- the faulting, you could get more
12 dramatic impacts if -- depending on which measurement you
13 chose?

14 A It would make some difference but since the
15 attenuation laws mostly are quite flat in that area, again
16 an error of 1 or 2 kilometers would not seriously change
17 the plotting of the data.

18 (Pause.)

19 Q Depending upon which fault distance you chose,
20 the surface fault or to the zone of energy release, it would
21 make a difference in terms of the data plotted above or
22 below one's curve -- isn't that true? I believe this is
23 what Dr. Smith was testifying about really at the start
24 of the hearing, that you have to be careful about which
25 distance parameter you are using.



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1 A Yes, you do have to be quite careful about which
2 distance parameter you use, but I do not think an error of
3 one, or two, or three kilometers makes that much difference
4 except -- in any case I would say not much difference.

5 I can give you a good example of that if you like.

6 Q I was going to ask you an example, but go ahead.

7 A Thank you. If you would refer to my own Figure I-2
8 in my own testimony in answer to question one, there are
9 seven data points plotted at a distance of 1 kilometer from
10 the fault. If I had chosen to plot those data points at
11 a distance of three kilometers, it would be three times
12 as far, and it wouldn't have changed anything on the plot.
13 So an error of two kilometers in that case in the near field
14 would not make any significant difference.

15 If I now looked at the point -- two points at a
16 distance of about 11 kilometers from the fault, the accelera-
17 tion is about .3 g and .2 g or thereabouts, and if they
18 were plotted as 13 kilometers, they would move a very short
19 distance to the right, and it would not make an awful lot
20 of difference again. So 2 kilometers is really not very
21 significant in plotting this data because of the semi-
22 logarithmic nature of the plots and because of the relatively
23 horizontal lines that we have in the very near field.

24 Q Would a distance like 13 kilometers make any
25 difference?



1 A It depends on what distance. Thirteen kilometers
2 from one would surely make a difference.

3 Q A difference between, say, 7 1/2 kilometers and
4 20 kilometers in terms of plotting?

5 A Yes. That would make some difference.

6 Q The example which I was going to give you, and
7 we can draw it out of the various data -- I don't want
8 to pursue this point much further, but in your article in
9 the table for 8244 Orion --

10 MR. NORTON: In the article?

11 MR. LANPHER: In the table. It should be under
12 "Deep Soil Portion." It is on page XIII-32, the first
13 station under San Fernando.

14 WITNESS SEED: Table 2?

15 CHAIRMAN SALZMAN: Refer to the exhibit number.

16 MR. LANPHER: Excuse me. This is Joint Inter-
17 venors' Exhibit R-4.

18 WITNESS SEED: Yes.

19 MR. LANPHER: I have lost my page.

20 BY MR. LANPHER: (Resuming)

21 Q You list a fault distance of --

22 A Which page, please?

23 Q XIII-32.

24 A Fine. And which?

25 Q The station is 8244 Orion Boulevard.

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1 A Okay.

2 Q You list a distance of 20 kilometers.

3 A Yes.

4 Q And USGS --

5 MR. NORTON: If we are going to quote from
6 another document I would like to see a copy of it and have
7 it marked for identification, please.

8 MR. LANPHER: Let me finish the question, please.

9 MR. NORTON: I don't want the record --

10 CHAIRMAN SALZMAN: Are you going to quote from
11 another document?

12 MR. LANPHER: I am going to quote from a document
13 already admitted in evidence.

14 CHAIRMAN SALZMAN: Please tell Mr. Norton what
15 document you are referring to, and then we won't have any
16 problem.

17 MR. LANPHER: It is USGS Circular 795.

18 CHAIRMAN SALZMAN: Thank you, Mr. Lanpher.

19 MR. LANPHER: It is Joint Intervenors' Exhibit
20 R-1.

21 BY MR. LANPHER: (Resuming)

22 Q If you look at page 38 you will see 8244 Orion,
23 which is listed at a distance of 7.7 kilometers.

24 A Yes.

25 MR. NORTON: Excuse me. I have no found that yet.

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1 MR. LANPHER: Did you find that, Mr. Norton?

2 MR. NORTON: Yes.

3 BY MR. LANPHER: (Resuming)

4 Q Given the distance differences such as 8244 Orion
5 it would make a difference in terms of plotting versus a
6 curve, is that not correct?

7 A Yes.

8 Q Dr. Smith, in the TERA report you used -- it is
9 my understanding that you used --

10 CHAIRMAN SALZMAN: I am losing you again. Where
11 in the TERA report?

12 MR. LANPHER: Appendix B to the TERA report.

13 CHAIRMAN SALZMAN: Is this in evidence?

14 MR. LANPHER: Yes, it is. The TERA report is
15 Exhibit 1 to the PG&E testimony.

16 CHAIRMAN SALZMAN: Thank you.

17 MR. OLMSTEAD: Excuse me, Mr. Chairman. I just
18 want to correct one thing. He said it is in evidence. I
19 do not think it is in evidence yet. It has been filed as
20 part of the testimony in these proceedings.

21 MR. NORTON: I believe it was in evidence.

22 CHAIRMAN SALZMAN: All the testimony is in
23 evidence.

24 MR. OLMSTEAD: Okay.

25 CHAIRMAN SALZMAN: Can you tell me which exhibit

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1 it is? I am swimming in a sea of paper.

2 MR. LANPHER: It is exhibit --

3 CHAIRMAN SALZMAN: I have this one somewhere.

4 MR. LANPHER: I believe --

5 (Pause.)

6 CHAIRMAN SALZMAN: I found it.

7 BY MR. LANPHER: (Resuming)

8 Q Dr. Smith, with respect to the San Fernando
9 Valley data which is listed -- well it is Table B to
10 Exhibit 1 of the PG&E testimony -- the San Fernando Valley
11 data is generally consistent from a distance point of view
12 with the distances set forth in USGS Circular 795, is that
13 correct?

14 A (Witness Smith) Yes.

15 Q Was the reason that you chose those distances
16 which generally speaking the surface distances to the fault
17 rather than --

18 A No, that is not correct.

19 Q Okay. Correct me. How did you choose your
20 distance parameter for the study?

21 A We chose our distance parameter in what we hope
22 to be a very consistent and precisely defined fashion just
23 to avoid these kinds of problems. The distance to the
24 closest point of rupture on the fault surface.

25 Q So it would not necessarily be perpendicular



1 distance to the fault. You would have to be to the rupture
2 surface, is that the distinction?

3 A Yes. It is hard to explain all the possible vari-
4 ations of geometry and so forth. If you simply stick
5 with that definition you will always get the same number
6 we did.

7 Q With respect to the San Fernando Valley data,
8 that resulted, did it not, in distances substantially less
9 than the distances set forth by Dr. Seed in his article
10 that we have been talking about.

11 A I am not sure.

12 Q Well, the record will speak for itself on that.

13 (Pause.)

14 Dr. Smith?

15 CHAIRMAN SALZMAN: Dr. Smith, are you ready?

16 WITNESS SMITH: Yes. I am listening.

17 BY MR. LANPHER: (Resuming)

18 Q Referring your attention again to Table B-1, B-1,
19 and this time the Imperial Valley 1979 data that is on
20 the second and third page of that table -- it is my under-
21 standing that some of the data here are plotted to the
22 nearest rupture on the Brawley fault rather than on the
23 Imperial Valley fault, is that correct?

24 A That is correct.

25 Q Why did you choose to plot to the Brawley fault

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1 rupture?

2 A We examined it both ways and found that the
3 statistical correlation was much superior using the
4 Brawley fault. We took this to mean that in fact our
5 proper distance as defined back to the point of closest
6 rupture to the fault should be in fact to the Brawley.

7 Q Does that mean you determined that the peak
8 accelerations at those stations which are listed in your
9 table, at least to the extent of your statistical study,
10 resulted from the rupture on the Brawley fault as opposed
11 to the rupture on the Imperial Valley fault?

12 A That is the statistical inference, yes.

13 (Pause.)

14 Q If you had chosen to plot your distances to
15 the rupture on the Imperial Valley fault for those stations
16 which are noted in Table B-1, would the distances have
17 increased or decreased?

18 A The distances would have increased in some cases
19 and decreased in others. My colleague, Dr. Frazier, reminds
20 me perhaps they always would have increased.

21 A (Witness Frazier) No, I think that the data to
22 the west of the fault would have had no change. The only
23 possible change could have been the data on the northeast
24 side of the fault, and that could have decreased somewhat.

25 A (Witness Smith) We are talking about a statistical

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1 study of hundreds of data points and the inference being
2 that your question leads one to think perhaps this would
3 change the result. I can assure you it would not change
4 the result.

5 Q I am just trying to understand, you know, the
6 various distances, how they were plotted with respect to the
7 TERA report.

8 A There was a slight statistical preference for
9 four of the stations to use the distance to the Brawley
10 fault.

11 Q I think if you will look at the table, there are
12 five stations marked with that footnote 2.

13 A Yes, that is correct. Five.

14 (Pause.)

15 DR. JOHNSON: May I interject something here,
16 please?

17 Dr. Smith, you said that there was a statistical
18 inference that there was rupture along the Brawley fault
19 during IV '79. Is there any other data which tends to
20 indicate there was motion along the Brawley fault?

21 WITNESS SMITH: Yes. There was surface rupture.

22 MR. NORTON: Excuse me, Dr. Johnson. I believe
23 you misquoted Dr. Smith. He did not say there was
24 statistical data to infer rupture along the fault. That
25 was a question in regard to peak accelerations at the



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1 stations as coming from the Brawley fault as opposed to
2 the Imperial Valley fault, and there is a significant
3 difference in that in the way you rephrased the testimony.

4 DR. JOHNSON: Okay.

5 WITNESS SMITH: But that fault did rupture,
6 clearly.

7 DR. JOHNSON: There is definite information, data
8 physical information that says that that fault ruptured
9 as well.

10 WITNESS SMITH: Yes, yes.

11 DR. JOHNSON: That is all I have, Mr. Lanpher.

12 BY MR. LANPHER: (Resuming)

13 Q Dr. Smith, I would like to direct your attention
14 again to the TERA report which is Exhibit 1 to the PG&E
15 testimony, specifically to page IV-4 of that report. Could
16 you please briefly describe the four models which are
17 depicted in this table? Well, maybe there are two models,
18 but there are some different parameters which are used.

19 A Yes. The basic question being examined here is
20 what is the nature of the attenuation curve at short
21 distance. It has only been in recent years where there
22 has been very much data in that range, and we examined
23 several different hypotheses as to how the curve might
24 behave.

25 I think there are really only two significant ones



1 here that we should discuss: that which is called the
2 physical model and the statistical fit. Since the others
3 are discarded as viable alternatives, I think it is not
4 necessary to go into any details there.

5 Q I would like you to describe the physical and
6 statistical models but also the ones labeled "C equals
7 constant" and "log linear," at least briefly.

8 A All right. It has been conjectured on a theoretical
9 and experimental basis by such people as Hanks and others
10 that in the near field the peak acceleration is independent
11 of magnitude. That means that the slope of the curve
12 should be flat, should be absolutely flat as you go to
13 zero distance.

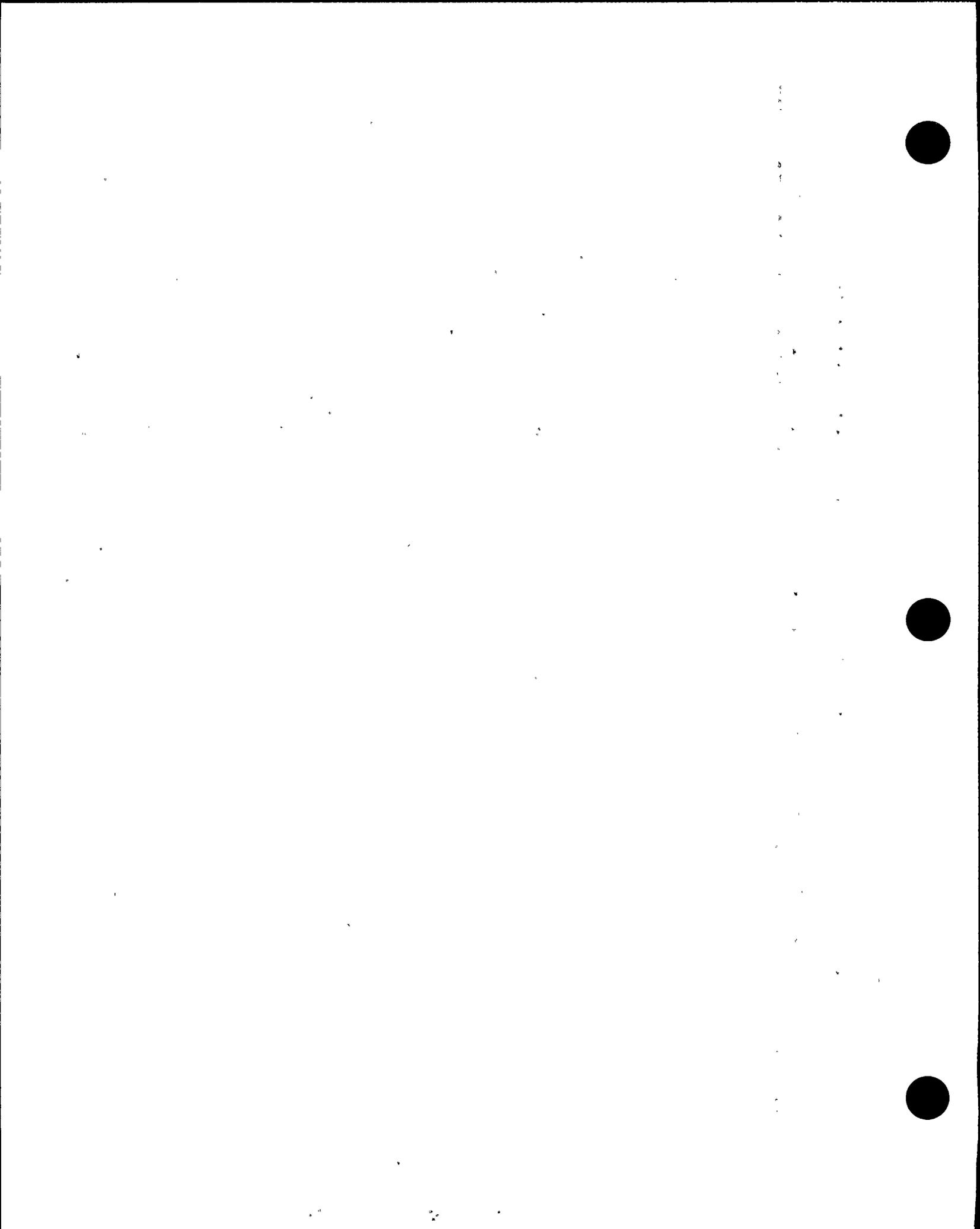
14 In the regression analysis when we constrained
15 these solutions to follow that physical log, namely they
16 must be flat, we call that the physical model. We do not
17 specify what the acceleration need be, but only that the
18 curve approach zero distance and be flat.

19 The statistical fit, the curve which is the
20 parameter which describes the rollover of this curve is
21 called C. In the statistical fit we simply let the data
22 determine what the optimal value for that constant should
23 be.

24 In the C equals constant model we examined the
25 possibility of forcing the constant C to be in fact a

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1 universal constant for all earthquakes and all magnitudes,
2 and based on the statistical results we discarded that
3 hypothesis.

4 In the log linear model that is simply an assump-
5 tion that the acceleration would follow a log linear log,
6 and we also discarded that hypothesis.

7 Q Why did you discard those latter two hypotheses?

8 A It was my judgment.

9 Q Could you explain that, the factors that entered
10 into your judgment?

11 A Primarily how well the models fit the data. We
12 were attempting to be able to learn something about the
13 general behavior of ground motion from earthquakes from a
14 lot of data from all over the world. And so if you
15 choose a lot of different models to try to see how best
16 to represent the data, then we would naturally try to
17 choose the one we felt was best and that seemed to have
18 the best predictive value, the best fit to the overall
19 data.

20 Q Based upon your Table IV-1 and the worldwide
21 data base weighted under your physical model in going
22 from a 6.5 to 7.5 magnitude earthquake, you go from .32 g
23 predicted to .41 g predicted as the main peak acceleration,
24 is that correct?

25 A Yes.





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1 Q I calculated that out as being a 29 percent increase
2 in peak acceleration in going from 6.5 to 7.5. Does that
3 appear approximately correct to you?

4 A It is about 20 percent, yes.

5 Q I said 29 percent.

6 A My eyeball tells me it is a little less. It is
7 9 parts out of 30, 27 percent.

8 Q For the statistical model in going from 6.5 to
9 7.5 I come up with an increase in predicted mean peak accelera-
10 tion of a little over 50 percent.

11 A That is correct.

12 CHAIRMAN SALZMAN: Mr. Lanpher, before you continue
13 this line I would like to know what you are driving at here,
14 what is the line of cross examination?

15 MR. LANPHER: I am about to leave this. I think
16 we just established that they predicted --

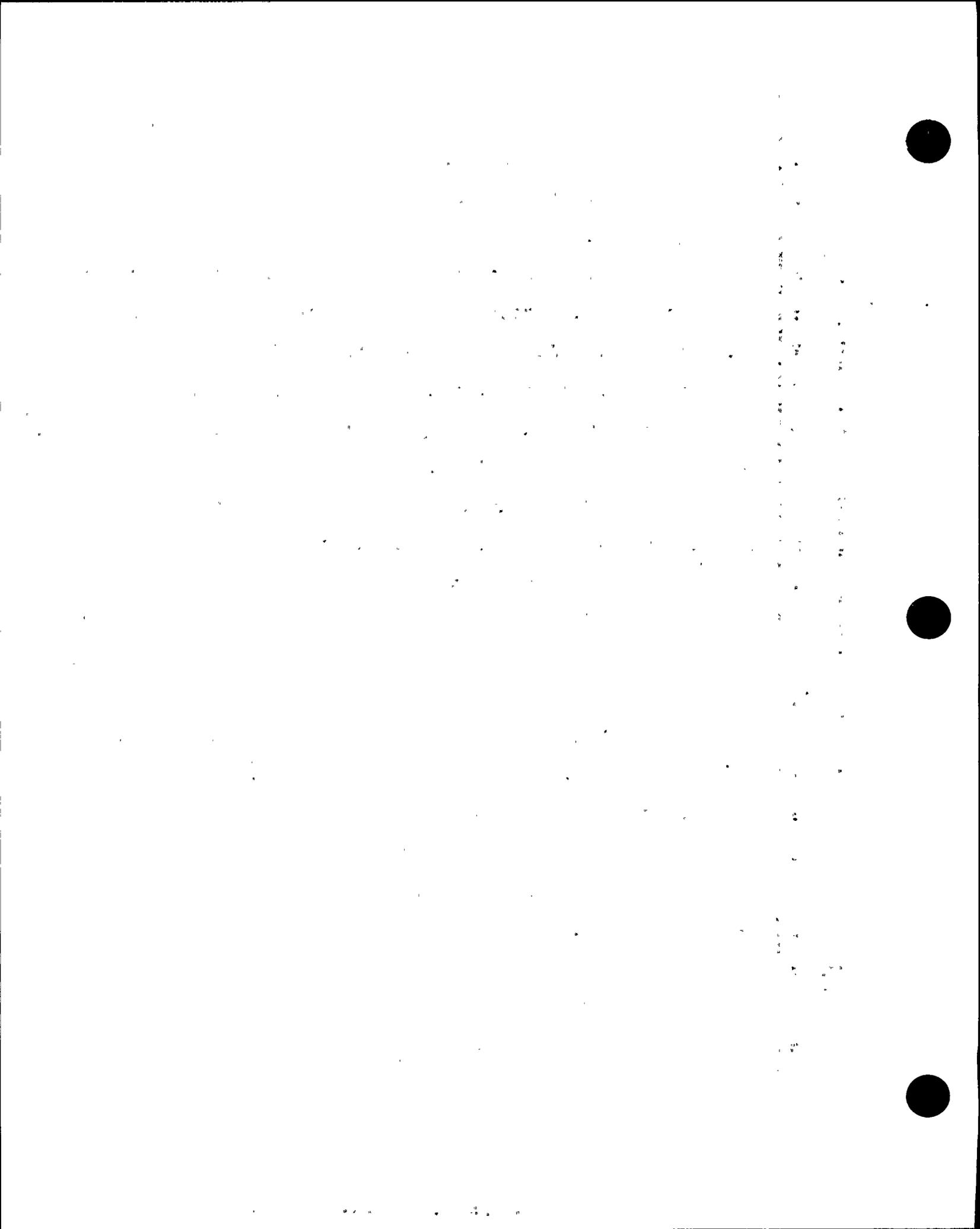
17 CHAIRMAN SALZMAN: If you are about to leave it
18 then my question is irrelevant. Please continue. Please do
19 so then.

20 (Laughter.)

21 Mr. Lanpher, if you have one more question, please,
22 I did not mean to cut you off like that.

23 (Pause.)

24 DR. JOHNSON: Dr. Smith, while we are waiting here
25 could you just tell me what the parameter R^2 refers to in



1 Table IV-1?

2 WITNESS SMITH: The correlation.

3 DR. JOHNSON: Correlation.

4 (Pause.)

5 Well, if I may continue just one second, looking
6 at the correlation coefficients and the column labeled
7 "Median Plus One Sigma Over Median," it does not appear that
8 the two models which you discarded are significantly differ-
9 ent from the two that you kept on the basis of standard
10 deviation and the correlation coefficient.

11 And I thought that you indicated that the degree
12 to which these models were able to predict or to reproduce
13 the data, or the degree to which they were not able to
14 reproduce the data were the basis for your rejecting them.

15 It does not show here as to why you would discard
16 them on this table.

17 WITNESS SMITH: Yes. There were other elements
18 of judgment entering into this. I might also point out in
19 terms of the predicted mean value, it makes little difference,
20 but I must admit there was some personal judgment having
21 to do with my understanding of the physical aspects of the
22 earthquake process leads me to, for example, discard the
23 C equals constant model, for example, as being inconsistent
24 with our understanding of the physical process.

25 So there is some other bias, you might call it, or

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1 judgment, whatever, built in here. But I think the importance
2 of showing all the different models is to illustrate the
3 relative insensitivity of the final result to the assumptions
4 that might go into the analysis.

5 DR. JOHNSON: Okay. Thank you.

6 BY MR. LANPHER: (Resuming)

7 Q In your data, Dr. Smith, for the TERA report you
8 included some non-North American data and you refer to that
9 in your prepared testimony at page I-2, lines 19 and 20,
10 as having doubtful quality and not a great deal of information
11 about it. Why were these data included then?

12 A Well, there are very few data points close in to
13 very large earthquakes, and I felt it would be irresponsible
14 to do a statistical analysis without considering what the
15 impact of some of these very important earthquakes might be.

16 Q So these are included because of the lack of
17 large magnitude near field records to use for this study.

18 A Yes.

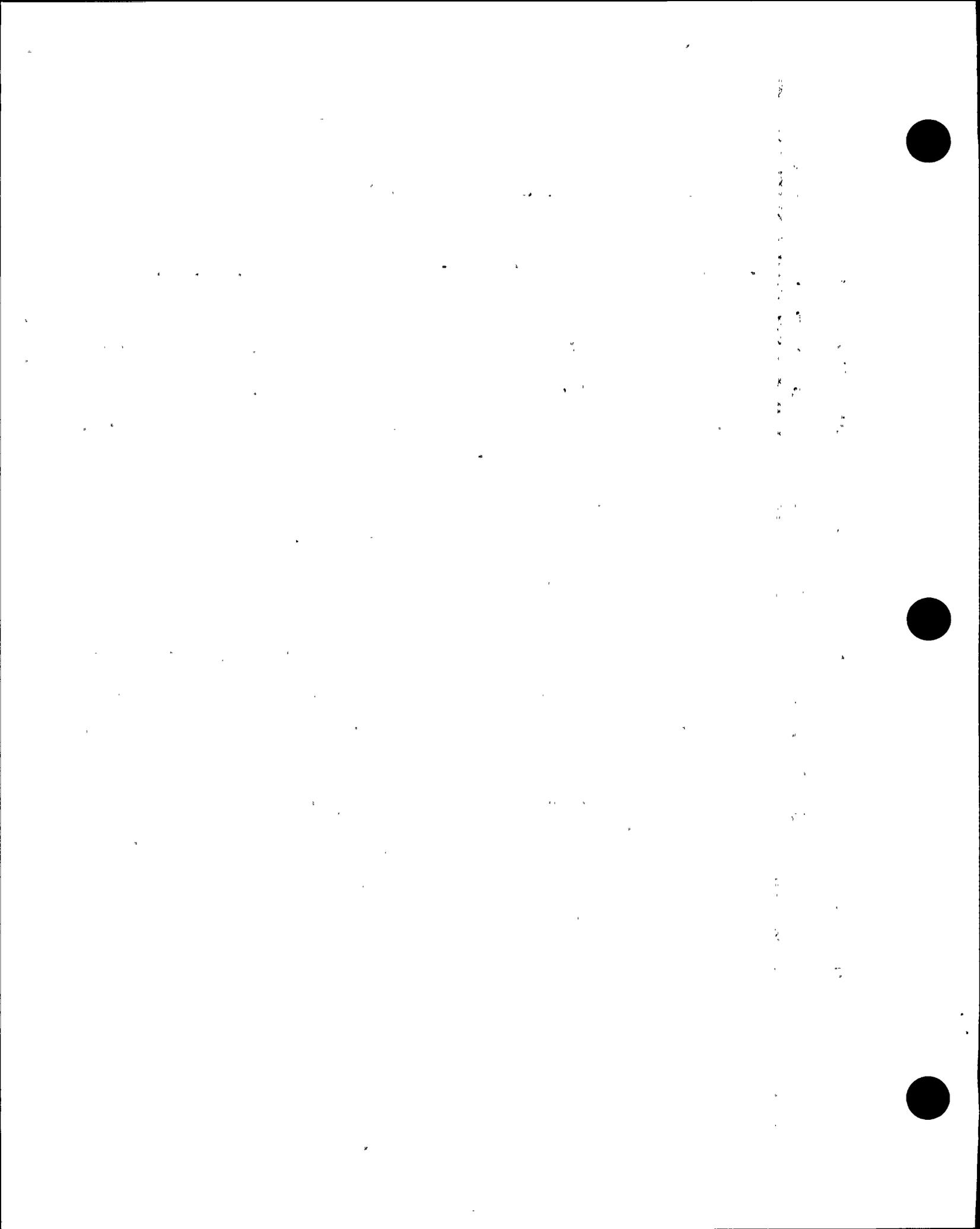
19 Q Could you please turn to page I-5 of the TERA
20 report, and Figure I-1 on that page, you have plotted the
21 non-North American data which to my view all lies above
22 the mean line and most of it up above the mean plus sigma,
23 is that correct?

24 A Yes.

25 Q If you drew a mean line through the non-North

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14-



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1 American data, it would come out around 1 g, wouldn't it?

2 A No.

3 Q Have you drawn such a line?

4 A Yes. There are several examples of the sensitivity
5 of the statistical analysis to include or not include the
6 data points.

7 Q If you tried to derive the mean of the non --

8 A Excuse me. By your question do you mean draw a
9 mean line through the eight points on that curve that are
10 non-North American data?

11 Q Yes, I did.

12 A That would be an absurd procedure.

13 Q Why would it be?

14 A Because, yes, there is one at 2 kilometers and
15 one at 30 kilometers, and one would have to include some other
16 earthquakes. The only reason these special ones were
17 included is because they were very large and very important.

18 (Pause.)

19 DR. JOHNSON: Dr. Smith, it's me again up here.
20 That figure says that these data were normalized to MS 7.5.
21 By what procedure do you normalize acceleration data?

22 WITNESS SMITH: This is a multiple regression,
23 so magnitude is a parameter in the determination of the
24 curve.

25 DR. JOHNSON: But are the individual data points



1 displayed also normalized to 7.5?

2 WITNESS SMITH: There are several different dis-
3 plays here, some of which the data points have shifted, so
4 they would appear as if their magnitude were 7.5. And other
5 displays show the raw data plotted exactly where it lies.

6 DR. JOHNSON: Well, I am having specific reference
7 to your Figure I-1 on page I-5, and there it says the data
8 are normalized to 7.5. I took that to mean that the indi-
9 vidual data points were normalized to magnitude 7.5, and
10 my question to you is how do you normalize a data point
11 recorded for an earthquake of magnitude 6.6 to magnitude
12 7.5?

13 WITNESS SMITH: Using the coefficients developed
14 in the multiple regression equation, which are given in
15 the report.

16 DR. JOHNSON: Would you like to give me a
17 reference to those coefficients?

18 WITNESS SMITH: Yes. For example, on page III-2,
19 two equations are given with the coefficients determined
20 from the multiple regressions.

21 Now, one would -- one would take a value of
22 recorded peak ground acceleration at a particular magnitude,
23 use these coefficients and substitute for some other
24 magnitude you wish to normalize to and calculate what that
25 normalized PGA would be.

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1 DR. JOHNSON: Do you recall for near field data
2 what the correction from 6.6 to 7.5 might be?

3 WITNESS SMITH: Yes. That is illustrated in
4 some of the tables here which are all calculated for a near
5 field distance, 5.8 kilometers. For example, the table
6 we looked at before on page IV-4.

7 DR. JOHNSON: So that 30 percent that was quoted
8 a few minutes ago would be the typical value of this
9 correction factor, at 5.8.

10 WITNESS SMITH: That is correct. I think the
11 factor would be 1.3, so it makes it 30 percent. These factors
12 will of course be different at different distances.

13 DR. JOHNSON: Not for the physically determined --

14 WITNESS SMITH: That is correct, yes.

15 DR. JOHNSON: How would the physically determined
16 model -- out to what distance do you assume that the
17 magnitude is flat?

18 WITNESS SMITH: The physical model, it must have
19 a zero slip at zero distance only.

20 DR. JOHNSON: Oh, okay.

21 Mr. Lanpher, I am finished. Thank you.

22 BY MR. LANPHER: (Resuming)

23 Q Dr. Smith, I would like you to direct your
24 attention to page II-4 of the TERA report. In the section
25 on site geology about halfway down that paragraph you state



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1 that, "Shallow soils -- sites underlined by shallow soil
2 deposits were not included in the data set for this report."

3 A That is correct.

4 Q How do you define a shallow soil deposit, Dr. Smith?

5 A Typically less than 10 meters.

6 Q The Diablo Canyon site, as I understand it, has
7 about 15 feet of sand around it, is that your understanding?

8 A I would rather not --

9 MR. NORTON: May we have the question rephrased a
10 little? I guess he cleaned it up a bit at the end by
11 saying is that your understanding. I guess the foundation
12 should be does he know what --

13 CHAIRMAN SALZMAN: Yes. Mr. Lanpher, would you
14 please restate the question?

15 BY MR. LANPHER: (Resuming)

16 Q Do you know how much soil there is at the Diablo
17 Canyon site?

18 A My understanding is this is a rock site. The
19 foundation is on rock.

20 MR. NORTON: Excuse me. I would like to interject
21 something to my witnesses here, an instruction to the
22 witnesses regarding answering the question. I don't believe
23 that was responsive to the question. The question was
24 do you know. The answer is yes or no, and after that
25 answer then the next question comes, and you can give the



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1 answer you just gave.

2 CHAIRMAN SALZMAN: I think the witness responded
3 to your satisfaction, Mr. Norton.

4 MR. FLEISCHAKER: I do not think so.

5 BY MR. LANPHER: (Resuming)

6 Q I would like to avoid introducing a document if
7 I can and just direct one question to Dr. Seed.

8 Dr. Seed, it is my understanding you performed
9 a soil structure interaction study which is referenced in
10 your testimony under question 6. We will get to that a
11 little later. But in that study you describe, I believe,
12 the site as being overlaid by 15 feet or so of sand, is that
13 correct?

14 A (Witness Seed) That is right.

15 Q Dr. Smith --

16 A May I clarify that? And the structures are
17 founded on rock.

18 Q They are -- I believe that study says they are
19 embedded in rock to approximately 8 feet.

20 A When Dr. Smith considers the site to be rocky
21 is really making the right statement, except we are
22 excavating through the sand.

23 Q So, Dr. Smith, in your shallow soil site, Diablo
24 would not be one of those because the structure is embedded
25 in the rock, is that right?



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1 A (Witness Smith) Yes.

2 Q Dr. Smith, at page II-5 of the TERA report you
3 indicate that to avoid the possible biases associated with
4 large fillings, you used the USGS data for the San Fernando
5 1971 earthquake. Did you use all of the data from the
6 San Fernando earthquake that are reported in that circular?

7 A Yes. -- well, no.

8 CHAIRMAN SALZMAN: I am sorry, Mr. Lanpher.

9 WITNESS SMITH: The answer was no. I was mis-
10 taken.

11 MR. LANPHER: I was going to correct him because
12 I did not think he understood my question or whatever.

13 I would like to have marked as Governor Brown's
14 Exhibit R-2 a table which we prepared. It is really hope-
15 fully to be helpful so that we do not have to go to a lot
16 of different documents, but I believe this table lists
17 on the lefthand side the San Fernando stations from USGS
18 795 which were not included in the TERA report.

19 CHAIRMAN SALZMAN: Mr. Lanpher, the Reporter is
20 instructed to mark the document as Governor Brown's Exhibit
21 R-2, and in order to give the other parties a chance to
22 look at the document, we will take a five minute interruption
23 right here, sir.

24 We will be recessed for five minutes, Mr. Reporter.

25



1 (The document referred to was
2 marked Governor Brown's
3 Exhibit R-2 for identification.)

4 (Recess.)

5 MR. LANPHER: I would like to identify three
6 different exhibits. First, Governor Brown's Exhibit R-2,
7 which is entitled, "Table Showing Building Heights, Site
8 Conditions, and Fault Distances for 1971 San Fernando
9 Earthquake Stations Listed in USGS Circular 795 with
10 Fault Distances Less Than 50 Kilometers." As Governor
11 Brown's Exhibit R-3 for identification a table entitled
12 "USGS Circular 795 Data From 1971 San Fernando Earthquake
13 With Fault Distance Less than 50 Kilometers Not Included
14 in TERA Report of August 1980."

15 CHAIRMAN SALZMAN: I'm sorry. Does that appear
16 on the front of the exhibit somewhere? I have an exhibit
17 marked -- I am sorry. I thought that was R-2. Is that
18 correct?

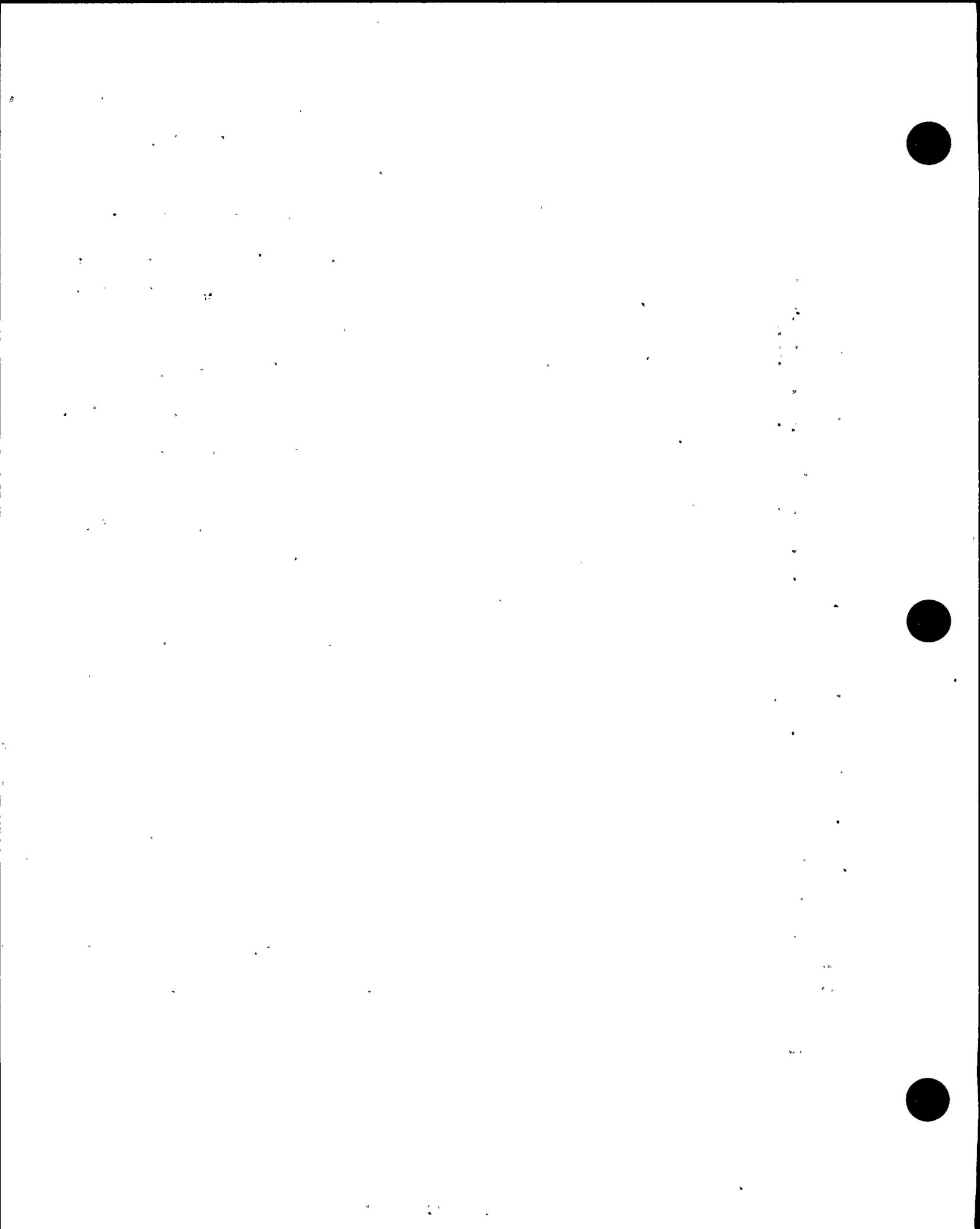
19 MR. LANPHER: No. I was just describing R-3,
20 Mr. Salzman.

21 CHAIRMAN SALZMAN: No one gave me a copy of R-2.
22 I'm sorry. Someone did give me a copy of R-2. I have it
23 correct now. Please go ahead.

24 MR. LANPHER: Finally, as Governor Brown's
25 Exhibit R-4 for identification is the cover sheet and table

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1 2 from a United States Department of Commerce study entitled
2 "San Fernando, California Earthquake of February 9, 1971."

3 (The documents referred to were
4 marked Governor Brown's
5 Exhibits R-3 and R-4, respec-
6 tively, for identification.)

7 MR. LANPHER: And for your information, in the
8 two previous tables which are marked for identification,
9 Exhibits R-2 and R-3, the NOAA data which are listed come
10 from Governor Brown's Exhibit R-4. We have included this
11 exhibit so people have access to those data.

12 MR. NORTON: Excuse me, Mr. Salzman. I don't
13 know who to voir dire about these exhibits that are
14 being marked, but I presume they are being marked for the
15 purposes of asking questions of Dr. Smith et al., and I have
16 some questions about them that I would like to ask before
17 those questions are asked of my witnesses.

18 CHAIRMAN SALZMAN: Do you wish to ask Mr. Lanpher?

19 MR. NORTON: It is very difficult to voir dire
20 Mr. Lanpher, of course, because he is not under oath.

21 CHAIRMAN SALZMAN: He may be able to make some
22 representations that will solve our problems.

23 MR. NORTON: First, where is the rest of this
24 three-volume work called the "San Fernando, California
25 Earthquake of February 9, 1971?" That is my first question.

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1 Is it available?

2 MR. LANPHER: We have it available. I did not
3 think we wanted to copy the whole of it.

4 MR. NORTON: There may be explanations and qualifi-
5 cations, etcetera, etcetera, around these tables.

6 CHAIRMAN SALZMAN: By having it available, Mr.
7 Lanpher, do you mean it is in the room?

8 MR. LANPHER: The volume that this table came from
9 is in this room and the rest is in the trunk of a car outside.

10 CHAIRMAN SALZMAN: Okay. That is close enough.

11 MR. NORTON: The second question I have: was this
12 cited by any witness in prefiled testimony?

13 MR. LANPHER: What do you refer to as "this?"

14 MR. NORTON: Brown's Exhibit R-4, what we are
15 talking about.

16 MR. LANPHER: I do not know the answer to that
17 right now, Mr. Norton. I am not sure that I know the
18 relevance of the question either.

19 MR. NORTON: It is very relevant. If this is not
20 cited, it is a three-volume work, and to take a table out
21 of it and mark only that table and give it and cross examine
22 on it without other parties having an opportunity to see
23 the document -- if it had been cited I would say it is
24 incumbent upon us to dig it out and look at it and see
25 what it says. If it was not cited, we certainly -- it is not



1 incumbent upon us to make a search of the world literature
2 and review it all and bring it all to this hearing on the
3 happenstance that Mr. Brown might offer it.

4 CHAIRMAN SALZMAN: Mr. Lanpher, can you respond?

5 MR. LANPHER: We are utilizing this work for a
6 very limited purpose, Mr. Salzman. Just -- well, for the
7 cross examination that is going to go forward next just
8 to identify the second acceleration level for the very
9 stations from IV -- from San Fernando 1971 which were not
10 used by the TERA report.

11 One of the acceleration levels -- I am referring,
12 by the way, to our exhibit R-3 for identification. One of
13 the levels was included in USGS Circular 795, so we had that
14 those data. We are just using it to provide the other
15 acceleration level.

16 CHAIRMAN SALZMAN: Mr. Olmstead, do you have any
17 comment to offer?

18 MR. OLMSTEAD: Well, before I got beat to the
19 punch this time by counsel for the Applicant I was going to
20 lodge a similar objection. I was going to add one other
21 part to it, and that was that we are here supposedly focusing
22 on some Appeal Board questions which deal with the Imperial
23 Valley earthquake and how that data works with the different
24 theories that were presented to the Licensing Board below.

25 We are now off on the 1971 San Fernando, California

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1 earthquake which I do not view as directly relevant to the
2 Appeal Board's questions. But I am willing to hear where
3 we are going for a few minutes.

4 CHAIRMAN SALZMAN: Mr. Lanpher, I think I would
5 like to hear where we are going for a few minutes, too,
6 please.

7 MR. FLEISCHAKER: Can I say something?

8 CHAIRMAN SALZMAN: I am sorry, Mr. Fleischaker.
9 I did not mean to overlook you, sir.

10 MR. FLEISCHAKER: First, on the question of
11 relevance that has been raised, I support Mr. Lanpher's
12 efforts to use these documents. First, with respect to the
13 question of relevance, we have before us in testimony a
14 study done by TERA Delta which purports to provide reliable
15 information to this Board regarding the mean --

16 CHAIRMAN SALZMAN: Just a moment. The exhibit is
17 being offered for cross examination by Mr. Lanpher, and the
18 other two parties are objecting to it. And I would like
19 to hear why Mr. Lanpher feels it is relevant. You are
20 not offering the exhibit, sir.

21 Mr. Lanpher, will you please tell us where you are
22 going and why you wish to engage in this cross examination
23 with these exhibits?

24 MR. LANPHER: I want to engage in this cross
25 examination, Mr. Salzman, because they have stated that they

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1 have the most complete data set put together to date by which
2 to predict peak ground accelerations. That data set includes
3 the San Fernando Valley earthquake or certain recordings
4 from it. I believe the recordings which they omitted from
5 that TERA report, as I will show in my subsequent cross
6 examination, all have accelerations which would fall near or
7 above the mean of their statistical model. I think it is
8 relevant to show that.

9 CHAIRMAN SALZMAN: Mr. Norton, you had one further
10 comment.

11 MR. NORTON: None of that goes to my objection.
12 My objection is very narrow. I did not object on the
13 basis of relevancy at all. That was Mr. Olmstead's objection,
14 and no one has answered my objection which is was this
15 three-volume work or the one volume out of the three that
16 this is taken from cited or referenced by any witness to
17 this proceeding so that anybody had any notice?

18 If it was not, to take three pages or four, five,
19 whatever there are, out of a three-volume work and attempt
20 to put them in evidence and use them for cross examination
21 is totally improper. We don't know what the text says
22 surrounding these tables or anything else.

23 -- I am not -- I for one -- my witnesses may even
24 know. They may have read it. But I for one as the lawyer
25 have not, and I object strenuously to its being used if it



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1 was not referenced.

2 CHAIRMAN SALZMAN: Mr. Lanpher, was it referenced?

3 MR. LANPHER: I don't believe -- I don't believe
4 it was.

5 CHAIRMAN SALZMAN: One moment, please.

6 (Board conferring.)

7 DR. JOHNSON: Mr. Lanpher, the volume or the portion
8 of the three-volume set that you gave us, do you know
9 whether this is the type of document that a geologist or
10 seismologist looking for data on earthquakes, historical
11 earthquakes would go to to seek information?

12 We have heard several documents or sources, data
13 sources referred to today. I do not recall this one
14 being mentioned or NOAA being mentioned. What I am getting
15 to is the obscurity factor that might be associated with
16 this document, or is it one that your technical advisor
17 feels that every geologist ought to be familiar with?

18 (Board conferring.)

19 MR. NORTON: Excuse me, Mr. Salzman.

20 CHAIRMAN SALZMAN: Yes, Mr. Norton.

21 MR. NORTON: I don't want to keep this going, but
22 the problem is this is a 1971 document. 795 was a 1978
23 document. It was cited in various witnesses' testimony.
24 We knew -- we reasonably expected to be cross examined
25 on it. Our witnesses therefore made an effort to get the



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1 authors' followup papers; you know, the followed it up
2 with two paper which are now in evidence in this hearing.
3 For all I know this thing, which is a date of 1973, may
4 have one, two, three, four, five followups behind it. I
5 do not know that. I do not know that it does or does not.

6 The problem is I do not have the opportunity to
7 find out, and while this may say one thing, the followup
8 documents may say something totally different, and that
9 is the heart of the problem.

10 DR. JOHNSON: May I maybe try to solve this
11 problem?

12 Mr. Lanpher, looking at your R-3, the exhibit,
13 it would seem to me that you could use column 2, which is
14 fault distance from USGS 795, and the accelerations which
15 appear under the USGS 795 column and make your point.

16 You look down the column there. The USGS 795
17 accelerations are in virtually ever case either equivalent
18 to or higher than the NOAA accelerations. And if you want
19 to ask the witnesses for the Applicant why they haven't
20 included these points, you can base your question on 795
21 and finish the NOAA document without disturbing the point
22 that I thought you wanted to make.

23 MR. LANPHER: Mr. Johnson, I would be willing to
24 do that. The reason we put that column in that exhibit is
25 so it would be complete, since the TERA report when it



1 plotted data plotted two recordings of data. And so we
2 did not want to misrepresent by only having the higher
3 recording which was reported in 795. We were trying to
4 be complete.

5 DR. JOHNSON: I think everyone here is aware that
6 in 795 only the high data points were plotted, so I think
7 the witnesses know the basis upon which 795 was drawn.
8 They probably -- period.

9 CHAIRMAN SALZMAN: Mr. Lanpher, do I understand
10 you to say that you would be able to make your point without
11 offering R-4 or not?

12 One of the problems Mr. Norton raises goes to the
13 point of how much this exhibit is worth when he has not
14 had the opportunity to find out if there are any contra-
15 dictions or revisions.

16 MR. LANPHER: Dr. Johnson, with respect to
17 Exhibit R-3, yes, I think I can make the points without
18 extended additional cross examination, even without the
19 NOAA document which has been marked as our Exhibit R-4.

20 With respect to Exhibit R-2, I may have to ask
21 considerable additional questions to bring out the points
22 which I think I would would want to, for instance, regarding
23 building size and -- site and building size without
24 that document. But I am willing to do that if you sustain
25 the objection.

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1 CHAIRMAN SALZMAN: The Board will sustain the
2 objection for the use of Governor Brown's Exhibit R-4.
3 Please make your cross examination based on R-3 and R-2.

4 MR. NORTON: Excuse me, Mr. Salzman. My objection
5 also goes to R-2 and R-3 insofar as they reference document
6 R-4 which they clearly do.

7 CHAIRMAN SALZMAN: Well, Mr. Lanpher, we do have
8 a problem, and the problem is essentially -- it is a real
9 one. It is not a formal one. That is, I mean, what use
10 can we make of this sort of information if we don't know
11 whether the information has been followed up, and how much
12 is it worth even were we to pay any attention to it to let
13 it in.

14 We are not trying to -- I hope I have made it
15 clear. Mr. Norton's point I think is well taken. It is
16 not a procedural matter. It is a matter how reliable is
17 this sort of evidence.

18 MR. LANPHER: The sort of evidence -- I don't mean
19 to argue about your ruling, but since you raise it, the
20 sort of evidence, Pacoima Dam, the recording site, a small
21 building I don't think that changed, that is not the kind
22 of thing that is going to change on subsequent investigation.
23 I am referring to Exhibit R-2. So I do not think we
24 seriously have a problem of unreliable information, though
25 that is what it has been portrayed as.

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I think this Board can take official notice of the government document, but I am willing to go ahead.

CHAIRMAN SALZMAN: Even if we were to take official notice of the document, we could not do so without giving the other side opportunity to look at the document and to object or to explain it away with additional testimony. That does not solve the problem, sir.

All right. The Board ruling will stand. We will not permit any reference to Governor's Exhibit R-4.

Please continue your cross examination.



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BY MR. LANPHER:

Q Dr. Smith, with reference to Governor's Exhibit R-3, there are 10 reporting stations listed in the left-hand column, the Pacoima Dam Lake Hughes No. 12, Lake Hughes No. 4, Lake Hughes No. 9, Castaic, Glendale, Fairmont, Pear Blossom, Puddingstone, and Oso Pump Plant.

Were any of those reporting stations -- Was the information from any of these stations included in the TERA report?

A No.

Q I would like to refer your attention to the right hand column of that exhibit. Have you had an opportunity to review the accelerations listed therein are in fact the accelerations set forth in the USGS Circular 795?

A They would be appear to be, correct.

Q Looking at the second column from the left of that exhibit, the fault distance column. Have you had a chance to review that and see whether that accurately depicts the fault distances set out in the USGS Circular 795 for these 10 stations?

A Yes.

Q I would like you to turn your attention to TERA Report Figure 5-1A, page 5-3. The Pacoima Dam.

CHAIRMAN SALZMAN: What page was that?

MR. LANPHER: I mispoke, I think. Page 5-3.



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1 BY MR. LANPHER:

2 Q Dr. Smith, if the Pacoima Dam were plotted on
3 Figure 5-1A, would that plot above or below the mean?

4 A Above.

5 Q It would plot above the mean plus a sigma or two.

6 A That is right.

7 Q If the Lake Hughes No. 12 data were plotted, would
8 it plot above or below the mean?

9 A Lake Hughes 12?

10 Q Yes.

11 A If we are going to do much more of this, I will
12 get a scale and a sharp pencil.

13 Q I have a plotting of the data points. This
14 plotting, however, also includes the Noah plotting from the
15 third plotting of Governor's Exhibit R-3. I am not using
16 it purposefully.

17 CHAIRMAN SALZMAN: I don't see how you could be.

18 Do you want to introduce that? WE will close our
19 eyes to the Noah data.

20 MR. NORTON: Why go through the exercise of asking
21 a witness of plotting every one of them as opposed to having
22 their witness say, "Yes, I plotted them and they are all
23 above the mean." I would be willing to stipulate to that.
24 This is absurd.

25 CHAIRMAN SALZMAN: Are you willing to stipulate



1 to the matter, then?

2 WITNESS SMITH: I assume that they are able to
3 plot as well as I.

4 MR. LANPHER: There are two points that plot above
5 the mean, and one point that plots above the mean.

6 CHAIRMAN SALZMAN: Mr. Lanpher and Mr. Norton, this
7 is unnecessary, and it is mildly silly in a crowded hearing.
8 Would the two gentlemen please at the next break get
9 together and agree as to which ones are below or above the
10 mean, and stipulate to them. I am sure you will be able to
11 agree and have the information.

12 Then let's move on with questions of these gentle-
13 men, other than where the points lie.

14 Mr. Norton, are you prepared to do that?

15 MR. NORTON: Absolutely.

16 CHAIRMAN SALZMAN: Mr. Olmstead and Mr. Fleischaker.
17 Mr. Lanpher, please continue.

18 BY MR. LANPHER:

19 Q Dr. Smith, could you tell me why these ten records
20 were not included in the TERA data report, except for the
21 Pacoima Dam, which is set forth specifically in the report
22 and we can all refer to that.

23 Starting with Lake Hughes No. 12, why was that
24 not included?

25 A Lake Hughes No. 12 was classified as a shallow soil



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1 site by geologists based on a field inspection.

2 Q Lake Hughes No. 4, and Lake Hughes No. 9, do they
3 fall in the same category?

4 A That is correct.

5 Q Was Castaic classified as a shallow site?

6 A Yes, based on a visit by geologists.

7 Q Could you continue down the list?

8 A Glendale was eliminated as a result of a detailed
9 investigation reported in a graduate student dissertation,
10 Mr. Barrow. Apparently there was some interference because
11 of closely spaced buildings knocking against each other.

12 Fairmont was classified as a shallow soil site.
13 Pear Blossom was classified as a shallow soil site. Pudding-
14 stone failed to meet the distance criteria based on our
15 measurement and our criterion for distance. OsoPump Plant
16 failed to meet failed to meet the distance criteria of being
17 greater than 50 kilometers based on our independent measure
18 of distance to the rupture source.

19 Q Rupture source or surface?

20 A Are you still uncertain of my definition of
21 insignificant distance?

22 Q I thought that it was rupture surface?

23 A You misunderstand the word surface. Rupture
24 surface is that portion of the fault which ruptures. It has
25 nothing to do with the surface of the earth.



5

1 Q Thank you.

2 Dr. Smith, could you please turn to page 5-11. On
3 that Figure 5-6, you have plotted, I believe, the mean and
4 mean plus sigma of the TERA statistical model. Is that
5 correct?

6 A That is what the figure caption indicates.

7 Q Could you please compare that plotting with the
8 plotting on Figure 5-4 two pages earlier?

9 My question is, just by eyeballing the two, by
10 holding them up to the light, it seems as if the plotting
11 on 5-4 is higher than the plotting on figure 5-6. I am
12 inquiring whether there is a mistake in or the other figure?

13 A Have you held them up to the light?

14 Q I did.

15 A I can tear mine out and do that if you would like.

16 Q I can give you mine if you would like, Dr.
17 Smith?

18 A I think that the figure caption is mislabeled.

19 Q Fine. I am ready to go on to some other testimony,
20 if you would like to check that out. Once you have done your
21 checking, perhaps you could advise us whether or not there
22 is a mistake.

23 A My impression is that the points are plotted
24 correctly. There is a slight difference. It appears to me
25 that perhaps exactly the same case in terms of the model was

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1 not plotted, so the figure caption may be in error.

2 Q If you could just take that out, and analyze this
3 later, if you will.

4 A Read me the figures and numbers again?

5 Q They are 5-4 and 5-6.

6 Dr. Blume, I want to address my next questions to
7 your testimony on Question 2.

8 MR. NORTON: Are we done with Question No. 1?

9 MR. LANPHER: Yes, except for the clarification
10 from Dr. Smith, after he has had a chance to review that.

11 CHAIRMAN SALZMAN: Then you are going to stipulate
12 are you not?

13 MR. LANPHER: Yes.

14 CHAIRMAN SALZMAN: That you can do at your leisure.

15 MR. NORTON: To facilitate that, if they would
16 give us the stations which they say are above the mean, and
17 the stations which they say are below the mean.

18 CHAIRMAN SALZMAN: The two of you can discuss it
19 and take care of it.

20 BY MR. LANPHER:

21 Q Dr. Blume, I would like you to turn your attention
22 to 2-2.

23 A Yes, I have it.

24 Q On that figure you have drawn your Blume Hosgri
25 design spectrum. Is that a mean plus sigma?

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1 A Approximately. It may be a little less in some
2 places and a little more in some places. It was a matter of
3 smoothing peaks and valleys. It is approximately one sigma
4 or standard deviation above the mean.

5 There were adjustments made later on in the early
6 hearings, so that probably forced it up even greater than
7 one sigma in certain places, in.. certain places, especially
8 the long periods.

9 Q Yesterday, Mr. Fleischaker asked Dr. Seed some
10 questions regarding Dr. Luco's figure 2-1.

11 A Yes, I have it here.

12 Q Figure 2-1, I would like to ask whether you agree
13 with the figure as portrayed by Dr. Luco with respect to his
14 mean plus one standard deviation for the IV-79 data
15 normlaized to 0.75 G?

16 A No, I do not agree with that figure.

17 Q Could you explain your disagreement please?

18 A The result is that the figure is too high in my
19 opinion. I have done a similar one which is much lower.

20 MR. OLMSTEAD: Mr. Chairman, this disagreement was
21 addressed yesterday.

22 CHAIRMAN SALZMAN: Mr. Lanpher, you do have a
23 problem when you come second, there is a tendency to be
24 asking questions that have been asked before.

25 MR. LANPHER: I believe, Mr. Salzman, that those



1 questions were all asked of Dr. Seed with respect to this
2 figure.

3 CHAIRMAN SALZMAN: I thought that they were asked
4 of the panel.

5 We will let you continue for a moment, but much
6 of this information is already in the record.

7 MR. LANPHER: If he agrees with Dr. Seed's statement,
8 if he recalls them.

9 CHAIRMAN SALZMAN: That would be a little hard, sir.
10 We will let you pursue this line of questioning a little
11 longer, about five minutes, and I think that it will be
12 enough.

13 MR. LANPHER: Maybe I can shorten this.

14 BY MR. LANPHER:

15 Q Will you please turn to page 2-3 of Luco's testi-
16 mony. There are some assumptions there.

17 A Yes.

18 Q Could you please go through the assumptions one
19 through five, and tell me which ones you agree with, and
20 which you disagree with. If you disagree, would you please
21 state why.

22 A I disagree with number one, because .75 G I do
23 not consider an appropriate value for the mean expected
24 accelerated based upon the great value earthquake. I think
25 that it is much too high.

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1 Do you want me to continue on with the others?

2 Q Yes, please.

3 A I would not agree with 2 because he has scaled the
4 average spectrum to .75 G, so I could not agree with that
5 either.

6 No. 3 I cannot agree with because he has assumed
7 the standard deviation for structural amplitude corresponds
8 to the same factor as for peak acceleration. I happen to
9 know from studies we have made and published that that is
10 not the case.

11 Q What number would you feel more comfortable with?

12 A It varies with the period, and with the type of
13 soil. I have worked it out with values as low as 20 percent
14 at very short periods of up to as high as 40 or 45 percent in
15 very long periods.

16 Q Would it differ for a rock site, for instance,
17 like Diablo Canyon?

18 A The short period portion would not differ, but
19 the long period would. I would expect it to differ, yes.

20 Q Would you continue with numbers 4 and 5.

21 A All right. Four is a byproduct of 3. It multi-
22 plies the results by 1.5 to get a one standard deviation
23 above the mean. I cannot agree with this for two reasons.
24 One is that I don't agree with the 1.5, as I previously
25 noted under item 3. In the second place, I believe in



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1 looking at the figure that he has scaled all the way down
 2 to zero period. That I cannot agree with because the zero
 3 period in scaling down and make amplification, it does not
 4 matter whether your are one standard deviation, or two or
 5 three, or even 10. You can't get any other number than
 6 zero period acceleration by definition.

7 If that is a little complicated, I would like to
 8 go further.

9 Q That is all right.

10 A By definition, zero period means infinite
 11 rigidity, and if a thing is infinitely rigid, no matter
 12 what the deviations are from the mean, you can't get a
 13 response greater than ground motion. That is basic physics.

14 Q What would the amplification factor be at, for
 15 instance, .03 seconds?

16 A I have that in our publication for AEC many years
 17 ago. It is a little bit over one, not much. It almost
 18 one at .03 seconds.

19 Q Dr. Blume, if I could interrupt, were you referring
 20 to your November 1973 article, Seismic Design Spectra for
 21 Nuclear Power Plants, which you co-authored with Dr.
 22 Newmark and Mr. Kaphur?

23 A No. It is related to that, but I was referring to
 24 our WASH reports published by AEC, which is referred to in
 25 the same document, which you have.







1 In our WAS report, we gave amplification factors
2 for all damping, for all sigma values above the mean, and
3 for the entire across the spectral shape.

4 Q I do not have that WAS Report, but I do have your
5 1973 article, which I would like to have marked for
6 identification as Governor Brown's Exhibit R-5. To repeat,
7 it is a 1973 article entitled, "Seismic Design Spectra of
8 a Nuclear Power Plant."

9 Dr. Blume, do you have a copy of that article in
10 front of you?

11 A Yes, sir, I do.

12 Q You were talking about the amplification factor.
13 I would like you to turn your attention to page 292, and
14 Table 2 on that page which sets forth your recommended
15 amplification factors. Is that correct?

16 A These are the jointly determined amplification
17 factors between the Newmark Associations, the Blume
18 Associates, and the Atomic Energy Commission.

19 It so happens that I believe in the high frequency
20 range. They do correspond to our report, but this was a
21 joint paper, and a joint effort.

22 Q I would like you to turn your attention to page
23 288 of that article, figure 2. Could you please describe
24 the amplification factors for points B and C on Figure 2
25 of that article, both the mean and the mean plus sigma?



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1 A Do you want me to quantify them?

2 Q Can they be derived from that table that we
3 were previously looking at?

4 A Yes. That might be easier than reading the
5 diagram. Points B and C in figure 2 are obviously corner
6 points on 97.7 probably level, which is like two standard
7 deviations above the mean.

8 If we go to the Table 2 which you previously
9 recommended, I can see that we only go to one standard
10 deviation above the mean.

11 Q Reading from Figure 2, the middle more or less
12 horizontal line that would be the mean plus sigma response
13 spectrum. Is that correct?

14 A You are looking now at which figure?

15 Q Figure 2.,

16 A Figure 2, the middle line is 84.1, which would
17 be one standard deviation.

18 Q You have amplification factors for there?

19 A Yes. You drop the points B and C down under that
20 curve, and I will try to read them. At what damping are
21 you interested?

22 Q Seven percent would be fine.

23 A At seven percent, point A has a factor of 1.0
24 and that is at a period of .032 seconds. Point B is at a
25 period of .111 second, and has an amplification factor of



1 2.2. Point C is at a period of .35 seconds, and has an
2 amplification of 2.6.

3 The ABC's can be visualized in the figure 2 as
4 the corner points of the linear plotting.

5 Q Could you please explain again why at point A
6 there is no amplification factor?

7 A Yes. By definition point A is, in this case,
8 so close to zero period that it is close to being an
9 infinitely rigid body. By definition an infinitely rigid
10 body cannot have dynamic amplification. It is a solid
11 block. So naturally, the DAF work, or the dynamic
12 amplification factor for zero period, and going on out to
13 0.31 and .032 in this case, there is 1.0. There is no
14 amplification regardless of the standard deviation.

15 Q Dr. Blume, in the derivation of your amplification
16 factor, did you take into account the variation and
17 distance of the source from the recording station.

18 MR. NORTON: May I ask for a clarification of
19 which amplification factor we are talking about?

20 MR. LANPHER: The amplification factors in the
21 Exhibit R-5.

22 BY MR. LANPHER:

23 Q Were the source distances taken into account in
24 deriving those amplification factors?

25 A We considered the source and distance from the



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1 source, rather. But there were not enough data points, nor
2 enough variations to make it essential to break down into
3 categories for different distances. The source is not a
4 specific parameter here.

5 Q Dr. Blume, isn't it true that the high frequency
6 waves get more dissipated at a far distance from the source,
7 than low frequency waves?

8 A Yes, they do, and we covered that in Reg Guide
9 161. I believe in this paper as well. These particular
10 factors are recommended for typical site and for deep soft
11 sites. The shape of the spectrum would have to be changed
12 to allow for site amplification beyond what is shown here.
13 It is a footnote in Reg Guide 161. I believe that it is in
14 this paper, too, for a long period motion beyond half a
15 second.

16 DR. JOHNSON: Mr. Lanpher, what you are asking
17 questions on right now appears to be the design spectra of
18 Dr. Blume, and that was presented at the previous hearing,
19 and it was subject to extensive cross-examination and
20 discussion at that time.

21 In the last 10 or 15 minutes, you have, as far as
22 I know, dealt with the question that the Board addressed,
23 and was the basis for reopening the case, the effect of
24 Imperial Valley.

25 Now, Dr. Luco's figure has some information on



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1 Imperial Valley. But you have not addressed it in your
 2 most recent questions. So I think that you had better get
 3 the line of cross-examination back to the issue or the
 4 matters at stake, unless you can show some connection
 5 between what you are asking him and the Imperial Valley
 6 data.

7 MR. LANPHER: That completed my questions with
 8 respect to the article, Dr. Johnson.

9 If I could take a few moments, I think that I
 10 would like to go through my next line of questioning
 11 because I think I am ready to move to Item 3. I am trying
 12 to determine what has been crossed and what has not been.

13 CHAIRMAN SALZMAN: We will take a recess of five
 14 minutes.

15 (Recess.)

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CHAIRMAN SALZMAN: Would you go ahead, please, sir.

BY MR.LANPHER:

Q Dr. Blume, I would like to turn now to your testimony on item four. I have no questions on item three.

Dr. Blume, on page 1 of your item four testimony at line 16 you speak of the considerable strength of structures to resist vertical earthquake forces.

And on page 2 of this testimony at line 7 you state that, "The Diablo Canyon structures are in fact capable of accommodating far more than a two-thirds ratio."

When you use the term, "structures," what are you referring to?

A (Witness Blume) I am referring to the containment structures, the auxiliary building, the turbine building, the tanks; in fact, all of the equipment and piping because as we demonstrated later in reply to this question, there is more than a two-thirds force implicit in the actual design.

Q You are referring in that reference to your table on page IV-3, is that correct?

A Yes, I am referring to that and also to some further thinking we have done on the same subject, which would increase those factors.



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1 Q Those factors are the tau factors which we will
2 be discussing later.

3 If it were not -- tau is one of the issues in
4 this case, of course. Absent the tau factor, would you
5 have designed beyond the two-thirds level for Diablo
6 Canyon?

7 A Yes.

8 MR. NORTON: Excuse me, Dr. Blume, before you
9 answer that question, I think we have to be very careful
10 of the words. And the witness, I think, understands
11 what he means. But again, the future reader of the
12 record might not.

13 We have to distinguish between the design and
14 the Hosgri re-analysis. And the question used the
15 word "design."

16 This information that they are obviously talking
17 about is the Hosgri re-analysis. Mr. Lanpher used the
18 word "redesign."

19 I am sure Dr. Blume knew what he meant, but that
20 is not correct in the record.

21 CHAIRMAN SALZMAN: Mr. Lanpher, is that what
22 you meant, the Hosgri re-analysis?

23 MR. LANPHER: Yes, it is.

24 CHAIRMAN SALZMAN: Thank you for your help,
25 Mr. Norton. Thank you, Mr. Lanpher. The witness, I take



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1 it, understands that.

2 WITNESS BLUME: Yes, and I agree.

3 CHAIRMAN SALZMAN: Fine, Dr. Blume. Please go
4 ahead, sir.

5 BY MR. LANPHER:

6 Q You said, "yes, and I agree." What were you
7 agreeing with?

8 A To Mr. Norton's statement.

9 CHAIRMAN SALZMAN: I thought you agreed with it
10 too, Mr. Lanpher, but I take it the point -- all his point
11 is, as I understand it, the information here is relevant
12 to the redesign, the re-analysis. That is all, which I
13 might add, I presume you meant, too, but perhaps the
14 future reader of these transcripts, whoever that might
15 be, might not.

16 BY MR. LANPHER:

17 Q Dr. Blume, in your testimony with respect to
18 question two, you took a number of stations from the IV '79
19 records and computed it at mean design spectrum and a
20 mean -- and then you scaled that for the horizontal
21 accelerations.

22 Have you done a similar spectrum for the vertical
23 accelerations?

24 A No. We have made studies of the relative amount
25 of vertical to horizontal. That was actually provided in
the structure. but I have not plotted a spectrum of that.



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1 I am not sure that on your previous question whether you --
2 I understood you correctly. I am looking back on it.

3 Q Let me make it more precise.

4 A The question having to do with two-thirds design;
5 I was talking about two-thirds capacity, not design. In
6 other words, the capacity of the structure in the system
7 is far greater than two-thirds.

8 Q Is that because of some residual strength and the
9 ability to deform, or is this -- are you staying
10 entirely in the elastic range?

11 A It is due not only to the residual strength and
12 other factors, but basically to the manner in which the
13 design coefficients can be computed.

14 Now on the table on page IV-3 of my testimony it
15 shows factors that range of .67 to 1.0 because the tau
16 effect was ignored in the vertical design. Now, we have
17 done some work since, some thinking since that involves the
18 thought that we consider .75g anchor point as a mean
19 plus one standard deviation.

20 And if we reduce that to a mean for this purpose,
21 these factors would increase from .67 to 1 and the top
22 one from one to 1.52.

23 So what I am saying is we feel the real capacity
24 of the system and the structures for vertical motion ranges
25 from a ratio of one vertical to horizontal up to one and a



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half.

Q Do you believe it is conservative to design the vertical to be at least equal to the horizontal in the near field for a location like Diablo?

A Well, this is an argment of point. I imagine you are well familiar with the reg guide specification that did require going to one at one time in the certain range.

But I believe now the tendency is to go back to the two-thirds rule.

Q My question is whether you agree with that when you are designing a structure such as Diablo Canyon, a facility such as Diablo Canyon in the near field?

A I believe that and I have believed all my life that two-thirds was an adequate design in view of El Centro or in view of Imperial Valley. It might be that we should reconsider for similar sites in the near field.

DR. JOHNSON: May I clear something up. By "similar sites," Dr. Blume, do you mean deep soil sites?

WITNESS BLUME: Deep soil sites, cohesionless soil, yes, where it may amplify vertically.

DR. JOHNSON: Then do I gather that your belief is that two-thirds ratio is adequate for rock sites? Is that correct?

WITNESS BLUME: Yes, that is my opinion, although





sp17-6

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1 I believe we have a capacity much more than that.

2 DR. JOHNSON: Thank you, sir.

3 BY MR. LANPHER:

4 Q Dr. Blume, let me go back to an earlier question.

5 I may have confused you with what I had asked. Under your
6 item two testimony, you took 24 horizontal records within
7 11 kilometers of the Imperial Valley Fault and prepared a
8 response spectrum for those records.

9 Have you prepared a vertical response spectrum for
10 those same stations? I guess there would be 12 vertical
11 records from those 12 stations?

12 A No.

13 Q Do you know whether such a spectrum, if it were
14 constructed would be bounded by the vertical response
15 spectrum for Diablo Canyon?

16 A No, I cannot say that I do know that.

17 Q I would like you to turn your attention to page
18 IV-4 of your testimony, the paragraph starting at line 14.
19 My first question with respect to that paragraph: is
20 your statement that ".34 instrumental when factored by the
21 ratio .75 to 1.15 would become 0.29 g," is that an error
22 or should -- when we factored it we came out with .22g.

23 A Well, I will try it again right here now.

24 Q Fine.

25 (Pause)



asp17-7

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1 A My colleague just got .22g.

2 Q So that should be .22?

3 A Apparently.

4 Q All right. Does that mean it is even further
5 below?

6 A Yes.

7 Q Why did you factor the IV '79 data by that ratio
8 of .75 to 1.15 in view of the fact that the IV '79 sites
9 are very different from the Pocomo Dam record which is
10 reflected by that factoring ratio?

11 A I don't think --

12 MR. NORTON: Excuse me, Dr. Blume. That just
13 assumed -- that question assumes a fact not in evidence,
14 that the .75/1.15 is the Pocomo Dam ratio. That fact is
15 simply not in evidence..

16 MR. LANPHER: Let me rephrase it.

17 BY MR. LANPHER:

18 Q How did you choose that ratio?

19 A This ratio happens to be the ratio of ratio of
20 effective design acceleration for the horizontal motion
21 at the plant to the instrumental horizontal acceleration
22 which was derived by many considerations, including, perhaps,
23 the Pocomo Dam, but there are many, many considerations
24 involved.

25 In using it here, I considered it only logical to



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1 apply the same ratio as for the horizontal.

2 Q Without trying to argue with you, Dr. Blume,
3 would it not be perhaps more correct to first determine
4 whether the peak instrumental accelerations in the so-called
5 effective accelerations for IV '79 actually differ?

6 A I don't think that would be the controlling factor.
7 It would be a consideration, of course, but the derivation
8 of the coefficient that reduces instrumental to effective
9 involves a great many things besides considering one
10 earthquake in a soft -- in especially a soft alluvial
11 valley. So I do not think it would enter in the decision.
12 It would be considered, but it would not be a big factor
13 in the decision.

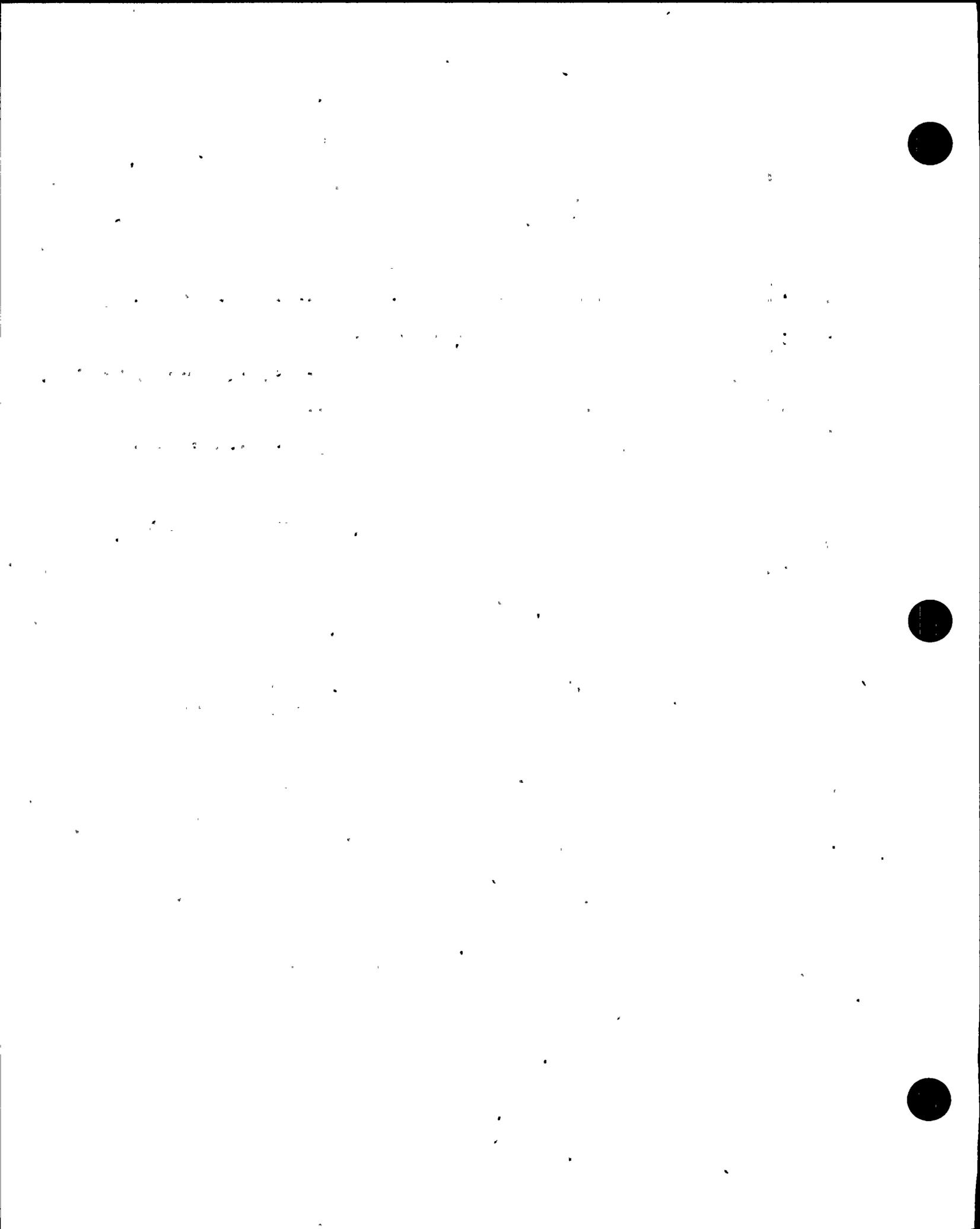
14 Q How would it be considered?

15 A Well, as a matter of interest, one would
16 naturally look at it, but the site conditions are so
17 different and there are so many factors involved in the
18 selection of this effective acceleration besides the
19 Imperial Valley or any other one earthquake, that it would
20 be insignificant in the decision process.

21 Q Now, that ratio, the .75 to 1.15 is the ratio
22 used for the Hosgri re-analysis of Diablo Canyon. Correct?

23 A Yes, in a horizontal direction.

24 Q In a horizontal direction for a rock site. I
25 believe you testified just a moment ago that IV '79 is very



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1 different as a deepsoil site, et cetera.

2 So my question is: why would you use this
3 same ratio, given the differences in sites?

4 A Well, we did not actually use this ratio. You
5 will notice the sentence on line 17 starts out, "If this
6 factor were figured by 75 over 115."

7 MR. NORTON: Excuse me. Dr. Blume, you misread
8 that. You interpolated a couple of words.

9 WITNESS BLUME: "If this figure were factored
10 by 0.75 over 1.15, it would become 0.22."

11 It was a hypothetical situation. We are not
12 saying that we used it.

13 BY MR. LANPHER:

14 Q You used it in your testimony.

15 A Yes.

16 Q I know you did not use it for the design of
17 Diablo.

18 A That is right. It is used in the testimony.

19 Q So my question is: why did you use that figure
20 given the differences in the sites?

21 A Because I considered the ratio .75 over 1.15 as
22 very conservative, and I certainly would not want to go
23 any higher than that. And I thought I was being very
24 generous to use that factor for the vertical here. I
25 think with study I could demonstrate how even a lower number



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1 might be used, a lower ratio.

2 Q Could you please expand upon that? How would you
3 justify a lower ratio?

4 A Well, there are a great many factors that are
5 involved in this decision as to how you change a peak
6 instrumental reading down to a design level..

7 Prior testimony of two years ago is replete with
8 this type of information. Very briefly, you consider such
9 factors as the actual strength of the materials compared
10 to their specified strengths; you consider the conservatisms
11 in the fact that you consider the analysis completely
12 inelastic when we know that even at low amplitudes concrete
13 is not completely linear; and the way test data are
14 reduced to working stress data in codes is another
15 conservatism.

16 They used the outlier instead of the median. I
17 listed about 10 or 15 of these factors in my testimony
18 two years ago.

19 (Pause)

20 Q Dr. Blume, on page IV-5, line 3, you refer to
21 the "tombstone effect." Could you please define it.

22 A Well, in the early days of earthquake engineering
23 going way back several people used to try estimate earthquake
24 acceleration without the aid of instruments by computing
25 the overturning moment required to turn a tombstone over in



spl7-11

1 an earthquake.

2 And they simply treated it as a static problem,
3 lateral force by Newton's Second Law where force equals
4 mass times acceleration.

5 And this of course completely overlooks the
6 truth problem, which is one in soil dynamics and true
7 dynamics.

8 And they got some answers that were no doubt far
9 from the truth. I might add that tombstones usually occur
10 in soft ground; it is easy to dig. It is a real soil
11 spring problem.

12 Q Farther down in that same paragraph, lines
13 5 and 6, you state that most if not all vertical recordings
14 are too high.

15 What is the basis for that statement?

16 A That is my opinion when it comes to vertical
17 recordings as applied to building design. I do not argue
18 with free field measurements far from any structure. But
19 I believe that pads of concrete or floor slabs used as a
20 base for instruments, even though anchored, do not reflect
21 the true motion that drives the foundations of building
22 vertically, the reason being that the foundation soil
23 material underneath the foundations is compressed under
24 rather high pressures and has different characteristics than
25 the free field soil would have in a vertical direction.

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1 Q Then it is your testimony that the free
2 field recordings for verticals may likely be accurate, but
3 it is the ones from buildings that you are concerned about?

4 A No. That is not exactly what I said. I am saying
5 that even in buildings if the instrument is located on a
6 floor slab in a building, the pressure under that floor
7 slab is minor compared to the pressure under the foundations.

8 So whether it is free field or in a building
9 slab, I do not think that the vertical motion measured
10 is a true indicator of the driving force that affects the
11 buildings vertically.

12 Now, even some free field measurements may be
13 suspect because there may be very loose soil near the
14 top.

15 I would frankly prefer the instrument be buried
16 two or three feet at least into the soil.

17 Q Have you ever spoken with the USGS or other
18 persons about this problem to try to get them to correct
19 their records?

20 A Well, I don't know whether they would agree with
21 the word "correct" or not, but I have spoken with several
22 of them, yes.

23 Q Did they share you concern?

24 A Some of them did, yes.

25 MR. OLMSTEAD: Mr. Chairman, that question was



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1 interesting, but once again I am not sure where we are
2 going.

3 CHAIRMAN SALZMAN: I would think without asking
4 Mr. Lanpher to respond that he is questioning Mr. Blume --
5 Dr. Blume on some statements that he made, and I do not
6 think he is going to press it any further.

7 Are you?

8 MR. LANPHER: I am not sure, but I think it is
9 clearly relevant when he says that he believes that all
10 vertical records are too high. I have a right to inquire
11 into that.

12 CHAIRMAN SALZMAN: I think so.

13 MR. OLMSTEAD: That was not the question I
14 was objectin to.

15 CHAIRMAN SALZMAN: I am sorry.

16 MR. OLMSTEAD: The last series of questions where
17 we started talking about whether he had made recommendations
18 to USGS or not, et cetera, et cetera. I did not think
19 they were leading us anywhere.

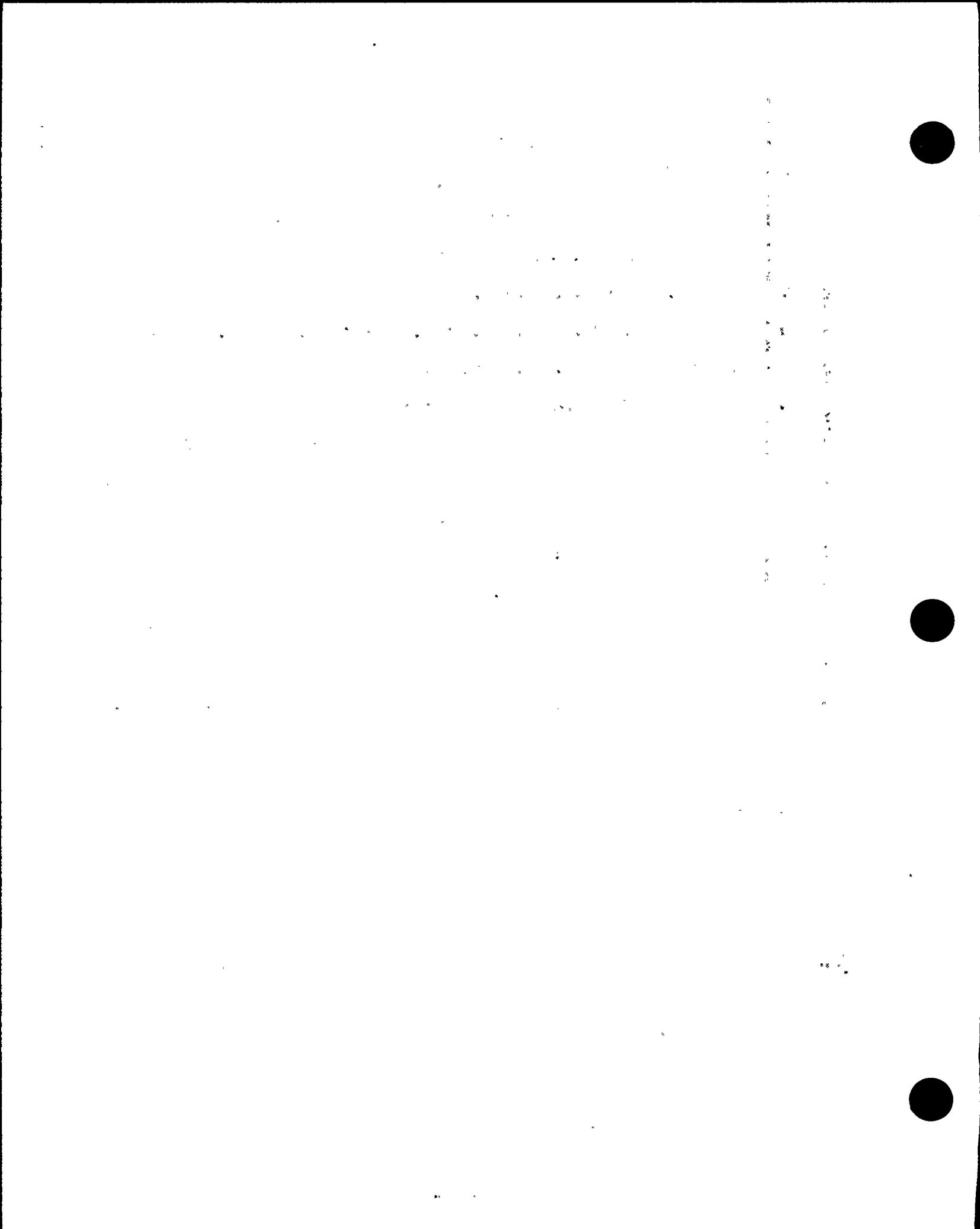
20 CHAIRMAN SALZMAN: Those are the questions, I
21 think, that were asked, answered, and now over, Mr. Olmstead.

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BY MR. LANPHER:

Q Your statement that we have been referring to about vertical recordings being too high, you did not qualify that in terms of any distance from the source or near field or far field.

Do you believe that the vertical recordings in the near field are all too high?

A I believe that any --

MR. NORTON: Excuse me. Again, that is a misstatement of the testimony which is written; it says most if not all vertical recordings are too high. I appreciate that that is a subtle difference, but that is not saying that all recordings are too high.

MR. LANPHER: Fine. Let me rephrase the question.

BY MR. LANPHER:

Q Do you believe that near field recordings are too high, Dr. Blume, most of them?

A I believe that they are not too high in the sense of measuring motion, but too high to use directly in designing for vertical motion of buildings.

Q You studied near field data to come up with that conclusion, or --

A I have considered near field and far field and also the records taken right in the first floors and basements of buildings.



spl8-2

1 Q Dr. Blume, I am going to ask you some questions
2 about your testimony on page IV-6 about peak clipping of
3 your testimony.

4 You state starting at line 6 that all of the
5 peak accelerations, both negative and positive, in a time
6 history can be reduced approximately 30 percent with only
7 a few percent, say 5 percent, decrease in spectral
8 response.

9 Does that statement -- when you use the term
10 "5 percent" in that statement --

11 DR. BUCK: Mr. Lanpher, would you repeat the
12 whole question, please.

13 MR. LANPHER: All I did was quote that sentence.
14 Would you like me to repeat that sentence?

15 DR. BUCK: I got lost.

16 MR. LANPHER: I have not asked a question. I
17 was drawing his attention to that sentence, Dr. Buck.

18 BY MR. LANPHER:

19 Q My question is whether the 5 percent figure that
20 you are referring to is an overall average 5 percent
21 reduction for the entire response spectrum or whether --
22 well, that is all.

23 A No, it is a little more than that. The 5 percent
24 reduction referred to here is the reduction of two different
25 categories. The first would be the reduction of the peak

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1 values of the spectrum, not the valleys. The valleys hardly
2 change, but the peaks.

3 The second element would be the reduction of the
4 integration of the area under the curve, the spectral
5 curve.

6 And in both cases we found after considerable
7 research with many, many records that we could clip as
8 much as 30 percent off of all the peaks of the acceleration
9 time histories and reduce the peak spectral acceleration
10 either by area or by peak period only about 5 percent on
11 the average, which is another way of saying that spikes or
12 peaks on an acceleration record are not very meaningful in
13 structural response.

14 Q If you had a spike or a peak, to use your
15 terms, for instance, at 10 hertz and you kept that, could
16 that affect a piece of equipment that has a natural
17 frequency of 10 hertz if such a peak should occur?

18 A If there were such a situation and we clipped
19 the time history 30 percent, the effect on the equipment
20 would be only roughly about 5 percent.

21 Q Could you explain that, please.

22 A I can explain it in this way: that I do not
23 consider acceleration itself as a meaningful index of damage
24 or response of structures. It is useful, but it is not
25 a meaningful index.



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1 Much more important to me is the spectral diagram
2 or -- usually a spectral diagram with damping, which really
3 represents the way the structure responds. So when I say
4 here that we can clip a great deal, as much as 30 or
5 40 percent off of the time history and still have very minor
6 effects on structural response, I am saying that those
7 spikes are so narrow and sharp usually on these records that
8 they have very little energy content in them and are not
9 therefore effective in driving the structure.

10 MR. LANPHER: Just one moment. I am ready to
11 turn to Dr. Frazier's testimony.

12 (Pause)

13 BY MR. LANPHER:

14 Q Dr. Frazier, my first question is going to relate
15 to your figure IV-3 and your testimony at page IV-3.

16 Now, you refer to the echo chamber effect in that
17 figure, and on page IV-3, starting at line 18 and going
18 through line 23, can you estimate this effect if the energy
19 released is at a depth of six to 10 kilometers, rather than
20 at three kilometers?

21 MR. NORTON: May I have that question read again?
22 I know you are reading it off a written piece of paper, so
23 it should not be hard.

24 CHAIRMAN SALZMAN: Mr. Lanpher, would you please
25 read the question again?



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1 BY MR. LANPHER:

2 Q Yes. Dr. Frazier, you refer both in figure
3 IV-3 and on page IV-3 to the echo chamber effect. Can you
4 estimate this effect if the energy release is at a depth of
5 six to 10 kilometers rather than at three kilometers?

6 MR. NORTON: Okay. My problem is could I have
7 a moment to look at the figures that the questioner is
8 talking about because it is the "rather than at three
9 kilometers" that triggers something I want to look at.
10 What was the figure number again?

11 MR. LANPHER: IV-3.

12 MR. NORTON: IV-3.

13 (Pause)

14 MR. OLMSTEAD: Mr. Chairman, while we are at
15 this -- while he is looking that up, there is a point that
16 I would like to make that we made in a filing earlier in
17 this proceeding, and I don't think it is going to be a
18 problem.

19 But Dr. Brune is now advising the State in their
20 cross examination here. He was earlier advising Mothers
21 for Peace in their cross examination. I just want to preserve
22 the point for later.

23 CHAIRMAN SALZMAN: I think everybody knows that.

24 MR. OLMSTEAD: I understand that.

25 CHAIRMAN SALZMAN: Fine. Your point is not that



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1 he is giving the state different advice than he gave
2 Mr. Fleischaker.

3 MR. OLMSTEAD: No. Not at all.

4 (Laughter)

5 MR. FLEISCHAKER: I do not know what he is
6 telling them.

7 MR. NORTON: Excuse me. I would like to correct
8 Mr. Olmstead. Nobody here is representing the state. They
9 are representing Governor Brown.

10 CHAIRMAN SALZMAN: We understood that,
11 Mr. Norton.

12 MR. BROWN: I do want to elaborate --

13 CHAIRMAN SALZMAN: Gentlemen, gentlemen, please,
14 this is irrelevant. No further elaboration.

15 (Pause)

16 BY MR. LANPHER:

17 Q Dr. Frazier, let me clarify if you cannot come
18 up with a percentage figure, would it be more or less --

19 A I am sorry. I did not know that it was my turn
20 to answer a question.

21 CHAIRMAN SALZMAN: Neither did I, Mr. Lanpher. I
22 thought Mr. Norton had requested a delay.

23 MR. LANPHER: I was trying to --

24 CHAIRMAN SALZMAN: Just one moment. Mr. Norton,
25 are you ready to proceed? You had a question of some sort.



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1 MR. NORTON: Would you again read the last
2 clause of your question, just the last five or six words,
3 please.

4 MR. LANPHER: "Rather than at three kilometers."

5 MR. NORTON: No objection.

6 CHAIRMAN SALZMAN: Fine.. Now, does the witness
7 remember the question?

8 WITNESS FRAZIER: I think there is enough of the
9 author left in the question that I understand what the
10 author was intending to ask.

11 CHAIRMAN SALZMAN: If you are prepared to answer,
12 please go ahead, sir.

13 WITNESS FRAZIER: You said I used the echo
14 chamber; I don't have the actual words in figure IV-3,
15 so I would like to correct that just slightly. I did not
16 call that an echo chamber effect. Yes, the echo chamber
17 effect that I was referring to on page IV-3 is by and
18 large and in fact essentially due to sources in the settlements
19 that is, at depths shallower than six kilometers.

20 At deeper depths, there are other effects, but
21 they are not referred to as the echo chamber effect.

22 DR. JOHNSON: Dr. Frazier, maybe Mr. Lanpher got
23 the answer, but I did not. I thought he asked if you used
24 a deeper depth would more or less of the energy be
25 dissipated into the lower strata. And I do not believe you



spl8-8

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answered that.

WITNESS FRAZIER: I am willing to answer that. I did not hear that as a question.

DR. JOHNSON: You used three kilometers.

WITNESS FRAZIER: Yes.

DR. JOHNSON: And yet I think that we are agreeing that the depth of the rupture was somewhere between six and 10.

WITNESS FRAZIER: No. I mean that the rupture is visible at the earth's surface.

DR. JOHNSON: Okay.

MR. NORTON: Excuse me. That was the gist of my objection. The epicenter -- excuse me, the hypocenter may have been six to 10 kilometers, but you have a rupture that goes 30 kilometers, and you have rupture at the surface. So, obviously, there is rupture going on in a lot more than one finite space in the earth.

DR. JOHNSON: I appreciate that.

MR. NORTON: That is why I was getting ready to object. But I thought the question was broad enough that it did not, you know, preclude that.

DR. JOHNSON: There is energy released at a spectrum of depth --

WITNESS FRAZIER: Yes.

DR. JOHNSON: -- for energy release at six





dspl8-9

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1 kilometers, would more or less of it be lost to the
2 lower depths?

3 WITNESS FRAZIER: I did not hear the last word.
4 Would more or less be lost due to what?

5 DR. JOHNSON: Well, you say for three kilometers
6 90 percent of the energy emerges at the earth's surface
7 within 20 kilometers of the release. What would happen
8 to energy released at six kilometers? Would -- where
9 would -- what effect would that have on where the energy
10 is released?

11 WITNESS FRAZIER: Okay, I think I understand. I
12 think you have to read what I have said very carefully, that
13 what I have said here, that only if a rupture at about
14 three kilometers deep, only about 10 percent of that
15 energy, high frequency energy makes it into the underlying
16 bedrock at a depth of six kilometers or deeper.

17 The rest of it gets trapped in those sediments
18 and comes out. So if you have a source that is six
19 kilometers deep or deeper, than 100 percent of it is in
20 bedrock or is in rock, anyway. I assume that is bedrock
21 that is six kilometers deep.

22 DR. JOHNSON: So that a smaller fraction of that
23 would emerge on the surface?

24 WITNESS FRAZIER: Just because it emerges on rock
25 does not mean it comes up to the surface; I did not mean to



sp18-10

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1 imply that. For a source that is three kilometers deep,
2 if the energy, seismic energy does not make it to bedrock,
3 it comes up ver, very near to where that source is located
4 within about 20 kilometers.

5 If it does make it to bedrock, some of that comes
6 up at about 20 kilometers also, but it comes up at
7 varying distances. It is spread out a bit more, so if it
8 makes it to bedrock, you don't necessarily lose it. Some
9 of it goes to China, but some of it still comes up in the
10 near field.

11 DR. JOHNSON: So within 20 kilometers, that
12 phrase, that is what is important here, then; the fraction
13 that comes up within the area, within plus or minus 20
14 kilometers. That is important.

15 WITNESS FRAZIER: Yes. I think that is a proper
16 characterization, yes.

17 DR. JOHNSON: Mr. Lanpher, you may want to ask
18 your question now. I may have messed it up for you.

19 MR. LANPHER: No. Thank you for your clarification.

20 BY MR. LANPHER:

21 Q I would like you to turn to table IV-2. That
22 is at page IV-15.

23 A Yes.

24 Q My question goes to comparing the Imperial Valley
25 results with the modified Imperial Valley results. Now,



spl8-11

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1 does the difference in the vertical-horizontal ratios
2 for those two tables represent any uncertainty in the ratios?

3 A To some degree, yes.

4 Q Does a similar uncertainty exist with respect to
5 Diablo Canyon?

6 A No. There are uncertainties at Diablo, but not
7 a similar uncertainty, no.

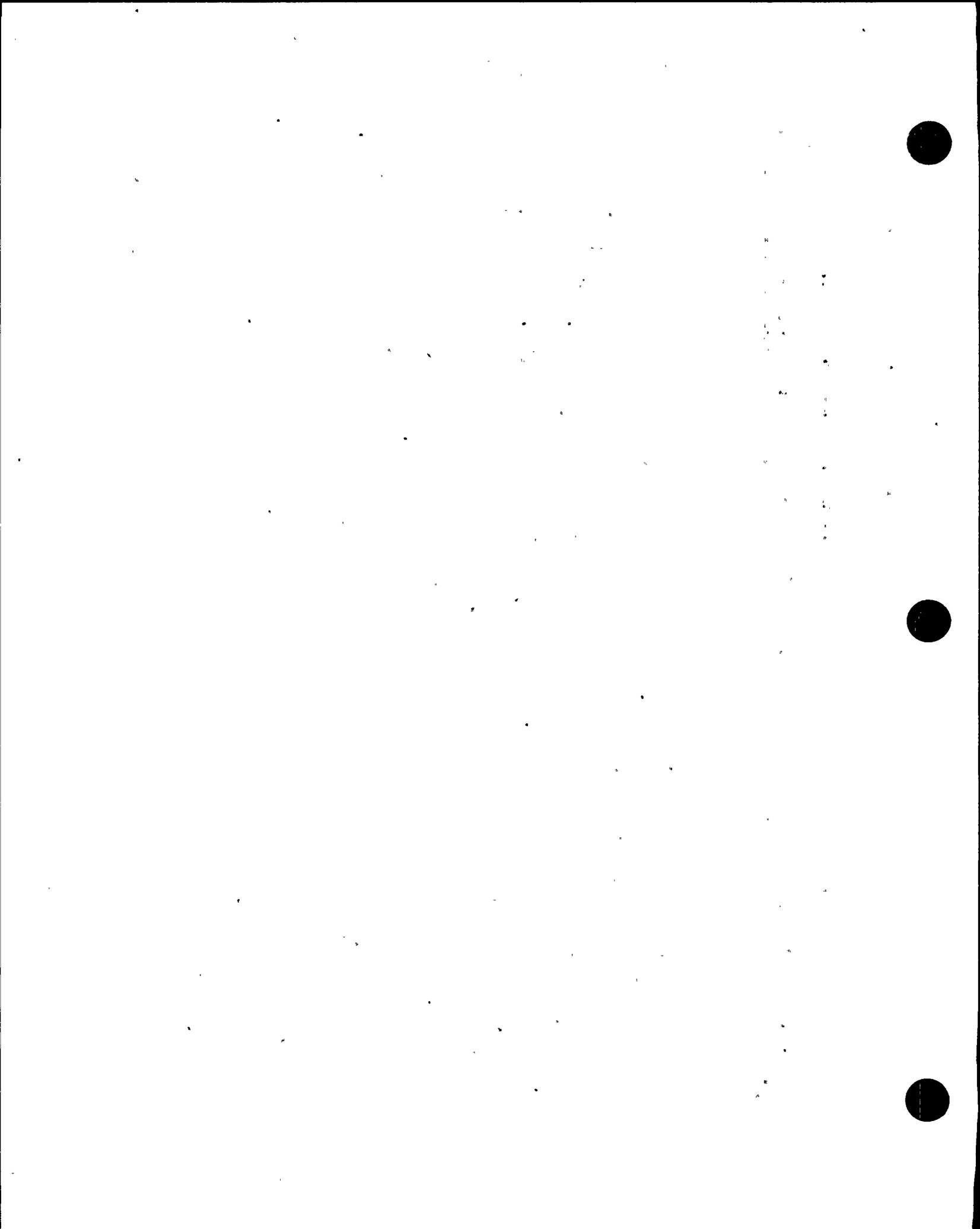
8 Q Could we go back, then, and could we please
9 describe the uncertainty with respect to the Imperial
10 Valley results?

11 A Yes. The earth structure that was used for the --
12 part of the table labeled "Imperial Valley Results" was an
13 earth structure that was appropriate for the entire
14 Imperial Valley region.

15 The earth structure that was used to obtain
16 modified Imperial Valley results was an earth structure
17 that was tested in an effort to find a mechanism to explain
18 particular verticals such as that at station six, which
19 had a very high vertical.

20 The difference in the two structures is
21 predominantly an upper kilometer with the modified Imperial
22 Valley earth structure having modified shear wave velocities
23 than the earth structure that was used for Imperial Valley
24 results.

25 MR. FLEISCHAKER: Excuse me. Could you repeat that



sp18-12

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1 again. The modified -- could I ask you to repeat that.

2 MR. NORTON: Why doesn't the court reporter
3 read the answer back?

4 CHAIRMAN SALZMAN: The court reporter will read
5 back the last three sentences, please.

6 (The reporter read the as requested.)

7 MR. FLESICHAKE: Excuse me, Mr. Chairman. Was
8 the word there "modified shear wave velocities"? Is that
9 the word he used?

10 CHAIRMAN SALZMAN: You did not catch it again?

11 MR. FLESICHAKE: The first time I thought he
12 said "lower." I heard the reporter read "modified" back.

13 MR. NORTON: I agree that --

14 CHAIRMAN SALZMAN: Would the witness please tell
15 me if he used modified or lower or which he means.

16 WITNESS FRAZIER: In the last sentence there were
17 two uses of the word "modified" as read back. The second
18 word "modified" should have been "reduced."

19 MR. FLEISCHAKER: Thank you, Mr. Chairman.

20 BY MR. LANPHER:

21 Q Dr Frazier, earlier you said -- I believe that
22 you stated there were uncertainties at Diablo, but they
23 were not similar to those at Imperial Valley.

24 A That is correct.

25 Q Could you please describe those uncertainties at



dsp18-13

1 Diablo?

2 A Am I taking too much latitude to explain my
3 statement about why the uncertainties at Diablo are
4 much lower than at Imperial Valley? You are asking a
5 different question from that or --

6 Q No. Please explain that.

7 A At Imperial Valley we did not attempt to develop
8 an earth structure precisely for a given station; that is,
9 we did not go out to a given station and measure earth
10 properties underneath a station at varying depths and then
11 use those in a computer model.

12 At Diablo that was done. We know the earth
13 properties right at Diablo and so we have site specific
14 earth properties. In Imperial Valley we do not have site
15 specific earth properties, number one.

16 Number two, uncertainties in the dissipation
17 properties of the material are more consequential at
18 Imperial Valley than they are at Diablo Canyon. Uncertainties
19 at Diablo Canyon, the dissipation properties are less
20 consequential because they have less influence on how
21 the waves get from the source to the receiver. In Imperial
22 Valley they have a substantial effect on how the waves get
23 from the source to the receiver.

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1 Q Dr. Frazier, I would like you now to refer to
2 page IV-5 of your testimony.

3 A Yes.

4 Q And I would like -- my concern is with the
5 last two sentences. The last sentence, in particular,
6 says, "These results" -- which I believe refers to the
7 previous statement. "The results indicate the trend to
8 be expected in actual earthquake motions, namely, considerably
9 reduced vertical accelerations at Diablo Canyon as compared
10 to vertical accelerations recorded for the Imperial Valley
11 earthquake."

12 In this statement are you referring to a given
13 source mechanism; for example, a given source mechanism,
14 the vertical accelerations at Diablo Canyon can be
15 expected to be greater or less?

16 A The sentence before says that vertical to
17 horizontal ratios at Diablo were expected to be less than
18 were recorded at Imperial Valley.

19 Q But if the source mechanism were different,
20 would that lead to a different result?

21 MR. NORTON: Object. Source mechanism different
22 than what source mechanism or different than what?

23 MR. LANPHER: I am sorry.

24 BY MR. LANPHER:

25 Q Are you assuming the same source mechanisms at



dsp19-2

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1 both locations?

2 A Table IV-2 has both strike and dip slip source
3 mechanisms at several distances. It was based on all of
4 the results in table IV-2 that draws this conclusion for
5 me. So it is pervasive as a function of dip as a function
6 of source mechanism and distance.

7 It is a pervasive conclusion.

8 Q Can you give an estimate on how much of the
9 difference is due to attenuation and how much is due to
10 the velocity structure?

11 A No, because as I stated this morning they are
12 compensating effects; if you do away with one -- like if
13 I do away with dissipation, the effect is -- no, I cannot
14 do that at this time. I have not done the calculations, but
15 they are compensating. So I am not sure what the question
16 really means also.

17 MR. LANPHER: That is all the question we have
18 on this item. So we are ready to turn it over to Mr.
19 Brown.

20 CHAIRMAN SALZMAN: Mr. Brown, let me ask you this:
21 how long do you expect to take? We had tentatively planned
22 to close the hearing at quarter of 6:00 -- I mean 6:00,
23 rather.

24 It is now quarter of 6:00. How long do you expect
25 to be? I assume 15 minutes is not the answer that I will



spl9-3

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1 get, sir.

2 MR. BROWN: I can break things up, perhaps in
3 a reasonably easy way for us. We can certainly finish
4 Mr. Edwards in that time, and we can ask Mr. Frazier for
5 some data. And if that data is supplied to us, that will
6 result in us saving considerable time tomorrow. So one
7 expeditious motion might meet that proposal.

8 CHAIRMAN SALZMAN: Fine. Please go ahead,
9 Mr. Brown.

10 MR. BROWN: One moment. I am sorry. Could we
11 have just one or two minutes to straighten up and move around
12 the table here.

13 CHAIRMAN SALZMAN: Yes, sir. Just two minutes
14 because we will complete this at about 6:00 -- I am
15 sorry. 6:30 is what I said. It is my mistake.

16 In those circumstances, let's take a five minute
17 break.

18 (Recess)

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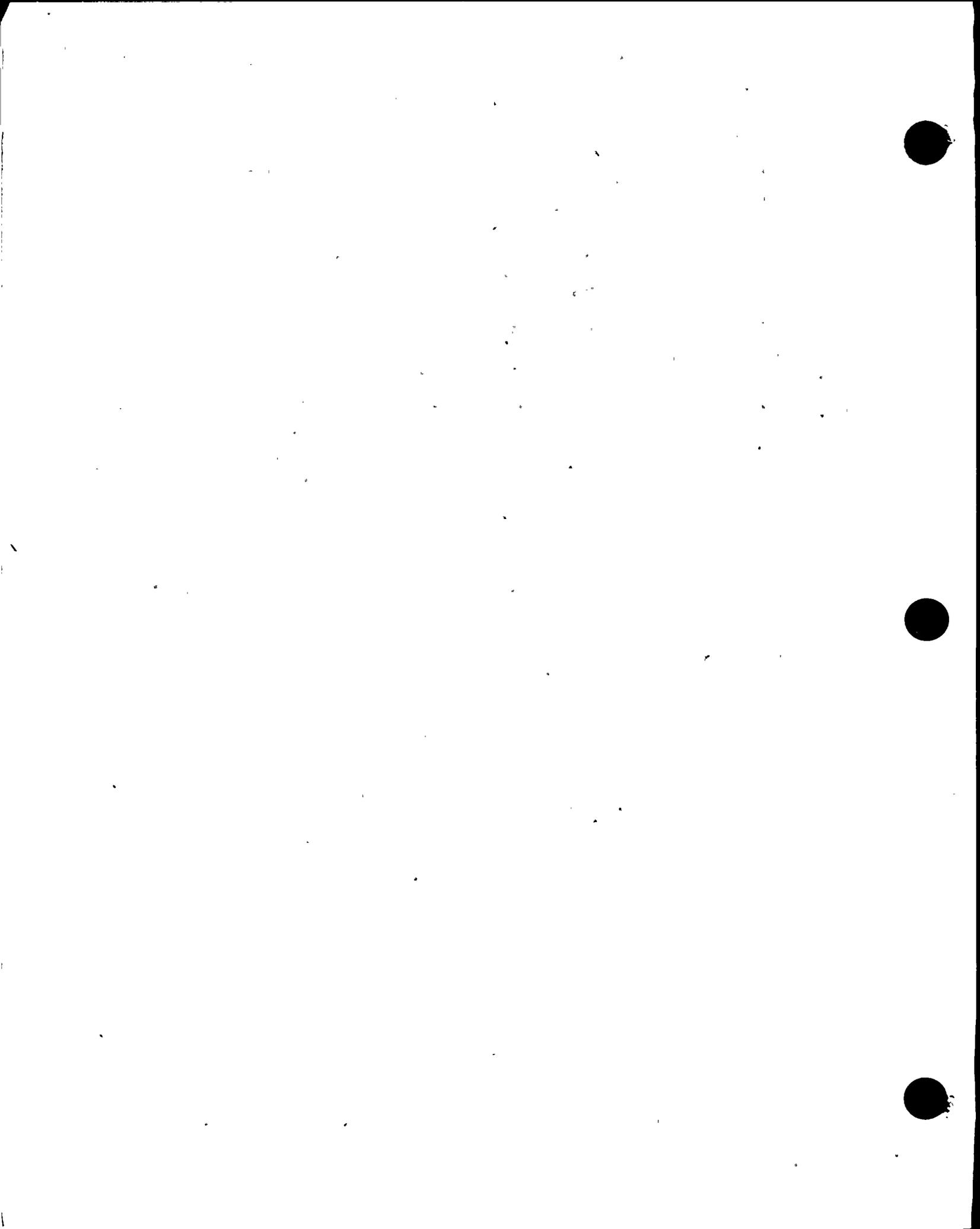
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CHAIRMAN SALZMAN: We will go on the record.

BY MR. BROWN:

Q Dr. Edwards, I have a few brief questions for you. Could you please refer to page 7-2 of your testimony, lines 1 through 6.

A I have them.

Q At lines 2 and 3 you refer to Dr. James Brune stating at the earlier hearing about the simple theoretical

--

CHAIRMAN SALZMAN: Mr. Brown, can you speak up. I cannot hear you, sir?

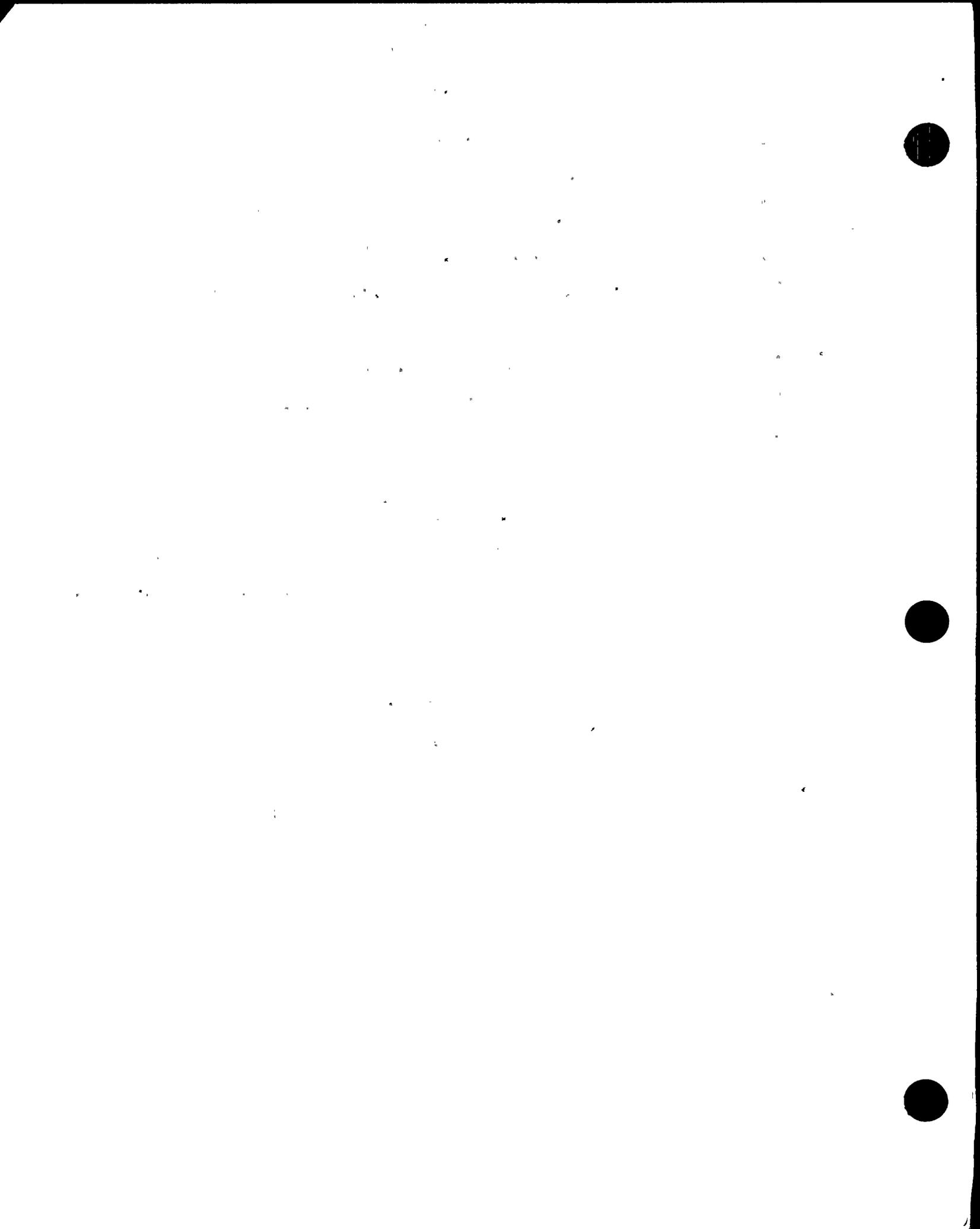
BY MR. BROWN:

Q Perhaps you can read with me so that there is no confusion. "The simplest theoretical representation of the phenomena of rupture focusing suggests that high frequency accelerations might be produced in a narrow beam plus or minus in the direction of rupture propagation under special conditions."

Do you consider, Mr. Edwards, what you referred to as Dr. Brune's simplest theoretical representation to be an accurate theoretical representation?

A I am not sure I understand your question.

Q Is what you cite in lines one through 6, or do you believe that his representations to which you refer are accurate?



1 Are simplest theoretical representations that you
2 refer to here -- those are your words -- accurate?

3 A If I understand the question correctly, it is
4 my belief that there should be enhanced high frequency
5 motion in a narrow beam, as azimuth beam around a rupturing
6 fault.

7 Are you asking me whether I agree with that
8 concept? Do I agree that that concept is theoretically
9 correct?

10 Q I am citing what you have here. There was a
11 Seismic Hearing which occurred, and Dr. Brune testified, of
12 which we are well aware, and that he made a statement which
13 you here characterize as a simplest theoretical representa-
14 tions of focusing, and so on.

15 I am asking, are his representation which you
16 have modified with the two other words, simplest theoretical,
17 accurate? Is he accurately doing what you say he is doing
18 or are you arguing with him?

19 A I am referring to a specific letter which was
20 addressed to Mort Labakin on 3 November 1976 by Dr. Brune.
21 Actually the simplest theoretical is part of the quote. I
22 was trying to avoid directly quoting Dr. Brune.

23 Q This was in earlier testimony, sir?

24 A This is the letter that was sent to the Executive
25 Director of the Advisory Commission on Reactor Safety in



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1 March 1976.

2 MR. NORTON: For clarification of the record,
3 this was an exhibit in evidence at the hearing.

4 BY MR. BROWN:

5 Q Dr. Edwards, are you familiar with the transcript
6 of the Seismic Hearing to which you refer in line one. By
7 the transcript, I mean the record which was made, such as
8 is being produced by this young lady at the table in front
9 of us.

10 A What I was referring to in line one was the
11 letter which was sent to the Executive Director on the 3rd
12 of November 1976. My reference is strictly to that letter,
13 and not the body of the ASLB testimony of which it may have
14 been a part.

15 I was attempting to arrive at some sort of
16 criterion by which I could take a look at whether there was
17 evidence for rupture focus, or azimuth beam around the point.
18 It was suggested and I agreed that I might use Dr. Brune's
19 definition as a starting point.

20 Q Therefore, when you are referring to the hearing,
21 you are referring to that letter?

22 A Yes.

23 Q Please elaborate. What do you mean by theoretical?
24 Why is this a theoretical representation that you are

25



4

1 addressing rather than some other kind of representation?

2 A This is in effect what one should postulate should
3 exist in the nature on the basis of known phenomena such
4 Data focusing is common analogy.

5 I think on the previous page I also refer to the
6 phenomena of activity, which also bears on the question --

7 Q Is there a distinction between the two in your
8 mind?

9 A Yes, there is.

10 Q Could you please tell the Board?

11 A To me rupture focusing represents an ensemble of
12 effects which tend to result in an increase in amplitude
13 and motion, and a relatively narrow beam. Let me strike
14 narrow beam for the moment. This results in an increase
15 of amplitude of motion in the direction of the rupture
16 propagation and a tendency toward decreased motion in the
17 opposite direction.

18 This effect, as I understand it, tends to be
19 highest at azimuth, very close to the fault plane, and
20 decreases with increasing azimuth and grow away from the
21 fault, and having no effect approximately right angles to
22 the fault plane.

23 Q You are still addressing this in the theoretical
24 sense?

25 A Yes, I am. I was attempting to determine whether

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1 there was any evidence from the peak ground for such an
2 effect.

3 MR. NORTON: Excuse me, Mr. Salzman. I want to
4 clarify something about the letter to make the record
5 clear.

6 The letter is, indeed, in the testimony at the ASLB
7 Seismic Hearing of Dr. Brune. It is Dr. Brune's written
8 testimony at the ASLB hearing, and inserted following
9 transcript 7940 in the very last two pages of that written
10 testimony are indeed the letter of November 3rd, 1976,
11 where the language that is set in Mr. Edwards' testimony
12 is directly taken from that letter.

13 So it was in the hearing. It is Appendix 3 to
14 Mr. Brune's written testimony.

15 CHAIRMAN SALZMAN: We understand where it is, and
16 we will be able to look at it.

17 BY MR. BROWN:

18 Q Mr. Edwards, I think that you answered with half
19 of the answer to my question. I asked you to address
20 rupture focusing and directivity. You addressed rupture
21 focusing, but not directivity. Would you do that for us
22 now?

23 A My concept of the term directivity has to do
24 with the radiation pattern which is associated with the
25 .4 observed at a considerable distance. In other words,





1 I am almost using the term as a totality here. But I am
2 far enough away from the source to be able to regard it as
3 a point source. Then I am describing the radiation pattern
4 associated with the point source under the assumption that
5 there is a propagation that is the source of the motion.

6 Q Then your characterization of a theoretical
7 representation here in the first three lines, page 2, are
8 you alluding to any theoretical solution?

9 A I am not alluding to anyone's particular
10 theoretical solution.

11 Q Are you referencing the construct of motion?

12 A No.

13 DR. BUCK: I don't know what you mean by the
14 solution. What is the solution to it?

15 MR. BROWN: One of the theoretical bases of
16 focusing is referred to as the construct solution.
17 Apparently, it is a formula. It is called a solution because
18 it solves something from what I have been told.

19 DR. BUCK: What does it solve, do you know?

20 MR. BROWN: I don't know.

21 DR. BUCK: Are you familiar with the so-called
22 solution?

23 WITNESS EDWARDS: I am familiar with the term
24 of construct solution more from the other day and from
25 some prior reading, but I don't feel qualified to describe



1 it in detail, either its derivation or many of its
2 implications.

3 MR. NORTON: Dr. Frazier certainly is. Perhaps
4 he could answer Dr. Buck's question.

5 WITNESS FRAZIER: There are not many solutions
6 to a problem, a growing crack problem in a stress media.
7 There is a solution, one of the few solutions we have,
8 analytic solutions is idealized because the math is very
9 difficult, but one of the few solutions we have is a
10 solution developed by a very prominent theoretical
11 geophysist Castroff, and we refer to that as the Castroff
12 solution.

13 DR. BUCK: I could not figure out what the solu-
14 tion was. I am sorry, I just did not understand what was
15 meant by that.

16 BY MR. BROWN:

17 Q Mr. Edwards, could you now please turn to the
18 bottom of page 3, lines 23 through 26, and then at the
19 top of page 7-4 of your testimony, the first four lines.

20 A Yes, I have them here.

21 Q Have you just reviewed them?

22 A Yes.

23 Q Is it correct that you are using the plus or
24 minus figure on line 26, in the context of that sentence, to
25 be in reference to Dr. Brune's theoretical representation

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1 of rupture focusing, which we just alluded to a moment ago?

2 A I am using it in the context of a narrow beam,
3 an azimuth beam, about a fault, which in this particular
4 case would be somehow pointed at the site at some distance.
5 I am alluding to it in that context.

6 Q You continue in your testimony to be referring
7 to this as a theoretical matter, I take it. Is that
8 correct?

9 A Theoretical to a degree. As far as I am concerned
10 the data at Imperial Valley did not show any evidence of
11 horizontal acceleration of any significant increase in the
12 plus or minus five degree beams.

13 Q Let me just ask you a simple question. You begin
14 by referring to Dr. Brune's theoretical representation, and
15 I would like to know if the final sentence continues to
16 refer to the theoretical representation?

17 A Mr. Brown, I am really having a lot of diffi-
18 culty understanding how you are tying the words theoretical
19 representation to what you want for an answer. Are you
20 talking about a specific model that Dr. Brune has proposed
21 which predicts specifically that there should be amplified
22 motion within plus or minus five degrees?

23 Q No, sir. I am just referring to your words. I
24 am not trying to be difficult. I don't want to be the
25 one testifying. As I read this, you began your description



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1 on page 2 of a theoretical representation and that theme
2 remained throughout this.

3 I thought that perhaps I would get a simple yes
4 or no answer. I would like to ask, is your testimony
5 dealing with that motif throughout?

6 A My last eight sentence attempt to refer to the
7 fact that in my estimation the source propagating at fault
8 which somehow is aimed at Diablo Canyon, a distance of
9 approximately 27 kilometers, would not give significantly
10 increased motion in a narrow beam specifically characterized
11 here as plus or minus five degrees just for the sake of
12 description at the site for the reasons I alluded to.

13 Q Those reasons are?

14 A That I expect that those distances, there would
15 be a considerable decrease in the high frequency forecast
16 of any increased energy due to concentrations of wave
17 scattering and inelastic attenuation.

18 Q Where do you see that here?

19 A I believe that in the last sentence on page 4, I
20 refer to that material damping of high frequency radiation
21 as the primary factor which would reduce any high frequency
22 motions used at such a distance from the site as they were
23 focused at the site.

24 Q I guess that this still does not go to my
25 question.



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1 My question is, there is no place that I can
2 determine, if you can show me where, I would like you to
3 please, that your initial observation in the context of
4 your testimony which theoretical becomes appropriate for
5 a conclusion that would not be a theoretical conclusion.

6 Would you show me where you change? I don't
7 see any reference here that would cause your allusion to
8 theoretical matters to become practical matters if you are
9 drawing conclusions about the Diablo Canyon site as opposed
10 to the theoretical representations which you depicted at
11 the beginning of page 2.

12 MR. NORTON: Mr. Salzman, I am going to object.
13 He is becoming argumentative. The testimony is very clear.
14 He is quoting Dr. Brune. Dr. Brune stated the simplest
15 theoretical representation. These are Dr. Brune's words,
16 and not the witness's words. Then he used that representa-
17 tion for his own analysis.

18 The question has been asked over and over, and
19 we are going no where.

20 CHAIRMAN SALZMAN: Mr. Brown, I think that the
21 witness's testimony speaks for itself. You asked him to
22 amplify and he told you what he meant by his words. It
23 may be a good answer, or it may not be a good answer. But
24 if you don't take it, he is just going to say it again.

25 MR. BROWN: I think that these are all the



1 questions I am going to have for you, Mr. Edwards.

2 MR. BROWN: I have some questions now for Dr.
3 Frazier.

4 BY MR. BROWN:

5 Q First, we would like to ask -- this will make
6 things really easier tomorrow if we could get these data
7 now, Mr. Chairman.

8 I wonder Dr. Frazier, if I could just list these
9 now. Because of the questions that we are going to be asking
10 of you, I think that it will expedite things eventually.

11 Could you refer to several documents, the first
12 is in the supplement 3 to the modeling you did on San
13 Onofree, which is Joint Intervenor's Exhibit R-9.

14 CHAIRMAN SALZMAN: What portion of Exhibit R-9
15 are you referring to, Mr. Brown?

16 MR. BROWN: First, we would like Table 3-2.

17 BY MR. BROWN:

18 Q If you would refer to Table 3-2, Dr. Frazier,
19 do you have that?

20 A Yes.

21 Q We would like to have the corresponding data for
22 the model that you performed on the Diablo Canyon site, if
23 we could, and if possible with a format of this table 3-2.

24 MR. NORTON: Excuse me. Dr. Frazier not going to
25 stay up all night making up tables. If he has the information

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1 here, if he has it available, we will be happy to supply
2 it. But Dr. Frazier is not going to be staying up all night
3 making up tables.

4 BY MR. BROWN:

5 Q Do you have that information, Dr. Frazier?

6 A If I understand the question you are asking me,
7 do I have a tabular listing of the earth properties used
8 or structure used to model the ground motions at Diablo
9 Canyon.

10 Q We are really interested in that, and particularly
11 in the values for Q?

12 A Yes, I do have it here. I have the numbers to
13 provide something similar to what you are pointing out
14 here.

15 MR. BROWN: What I would propose, Mr. Chairman,
16 if it is all right with you, is that we would ask Dr.
17 Frazier for three more items of data, if he has all those,
18 and they could provide them and perhaps that could be done
19 at the close of this hearing, which is in about eight
20 minutes.

21 MR. NORTON: When he says he has the numbers, I
22 don't know if he means he has that here. He may have them
23 in San Luis Obispo. Some of it may well be in his room.
24 We also want to make copies of it for us.

25 CHAIRMAN SALZMAN: Gentlemen, this does not seem



13

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1 like an unsurmountable problem. If he has the material here
2 and can get it and make it readily available, I prefer that
3 he do so. I don't see that we get anywhere by squabbling
4 hearing time about it.

5 Can we take one minute, and have the two gentleman
6 discuss with the witness what he has, and whether he can
7 make it available tonight, and let me know.

8 MR. NORTON: I would just as soon that Mr. Brown
9 put on the record what he wants. I would like to have a
10 record of that.

11 CHAIRMAN SALZMAN: Mr. Brown, would you just
12 state for the record what you want?

13 MR. BROWN: I would like to ask Dr. Frazier. The
14 second data that we would like, Dr. Frazier --

15 DR. BUCK: It is only the Q data that you want?

16 MR. BROWN: We asked for the table on October 3rd,
17 and we would still like to have that, sir.

18 DR. BUCK: You wanted the Q data. I am asking
19 if that is all you want, or do you want the whole table?

20 MR. BROWN: We would like the whole table.

21 BY MR. BROWN:

22 Q Dr. Frazier, we would like, if you will look at
23 Table 5-1 also of the same exhibit, apparently it is on
24 page 5-8.

25 A I have it.





1 Q If possible, we would like the data in the format
2 provided on this table, because that is the way we had
3 asked for it.

4 The other two are in supplement 1, Joint
5 Intervenor's Exhibit R-7. There we would like the data
6 in comparable form for the Diablo Canyon study that is in
7 Table 5-3. It is page 5-8.

8 There is one more that we would like, and that
9 is Table 4-1 of the same exhibit, Joint Intervenor's
10 Exhibit R-7, page 4-5.

11 A Yes.

12 Q Dr. Frazier, we are prepared to stay after the
13 hearing breaks, which I think is in about 8 minutes, if
14 you would provide that directly to Dr. Brune.

15 CHAIRMAN SALZMAN: Dr. Johnson has a question.

16 DR. JOHNSON: I just wondered to what purpose
17 you are making this request. A great deal of data.

18 MR. OLMSTEAD: Before you do that, I would like
19 to put something on the record.

20 One of the points that I have been making over
21 the past two days in a series of objections to new
22 analyses that don't have anything to do with Imperial
23 Valley, which I don't believe ought to be injected into
24 the Diablo Canyon proceeding. I objected earlier on to
25 the TERA modeling studies, because it is new information



1 related to the analysis that the licensing board went into,
2 and that is based on data that has nothing to do with
3 Imperial Valley.

4 We are going to get into this more and more
5 tomorrow because there are other events, and agendas around
6 the room concerning some of the other evaluations that have
7 been done as part of that effort.

8 So I wanted you to be aware of that before you
9 got the next answer.

10 MR. BROWN: These data are the data that underlie
11 the modeling study performed by Dr. Frazier for the Hosgri
12 fault which he introduced here as his testimony in
13 Question 7. He has applied a methodology and done modeling
14 in other instances, and he refers in fact in his testimony
15 several times as to how he has tested his model.

16 We have some very pointed questions which can
17 be addressed by him if we are able to see the application
18 of the methodology of the study, and there are some that go
19 to certain inconsistencies in the application, and whether
20 that application is, indeed, being done in a way with
21 parameters that are appropriate here. That is, we are
22 going to test the studies here, and the way we will do
23 that is looking at how he applied his model for his studies
24 elsewhere.

25 So it is central to an understanding of his





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study here, and to the entire basis upon which there might be a judgment as his conclusions.

MR. NORTON: We have the information available. We will supply it. Dr. Frazier thinks he has all the tables here, and he has more than one copy. So we can give you a copy as soon as the hearing is over.

We do not object to producing the information. Mr. Olmstead may well object to our producing it, but we don't object to producing it.

CHAIRMAN SALZMAN: I would like to confer with my colleagues, please.

(Off-the-record.)



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CHAIRMAN SALZMAN: Gentlemen, I think that if Mr. Norton would kindly make the information available, we will deal with the problems that are undoubtedly going to arise when we wish to use it in the morning when we are all a little better relaxed and focused ourselves at 8:00 a.m. The hearing will adjourn until tomorrow morning.

(Whereupon, at 6:30 p.m., the hearing was recessed, to be reconvened at 8:00 a.m., the following day, Wednesday, October 22, 1980.)





NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

in the matter of: Diablo Canyon

Date of Proceeding: 10/21/80

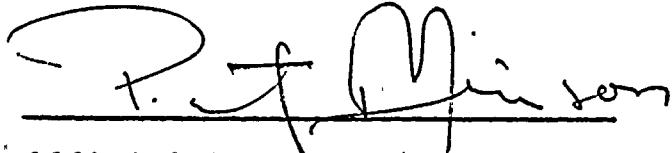
Docket Number: 50-323 50-275

Place of Proceeding: San Luis Obispo, CA

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Pat Minson

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Atomic Safety Licensing Appeal Board

in the matter of: Diablo Canyon

Date of Proceeding: 10-20-80

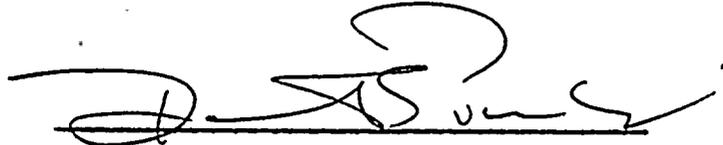
Docket Number: 50-275, 50-323

Place of Proceeding: San Luis Obispo, CA

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