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MISSION

IN THE MATTER OF:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

**Docket Nos. 50-275
50-323**

Place -- Avila Beach, California

Date -- 18 December 1978

Pages 6102 -- 6359

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the matter of:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

Docket Nos. 80-275
80-223

Cavalier Room,
San Luis Rey Inn,
Avila Beach, California.

Monday, December 18, 1978.

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

BEFORE:

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

DR. WILLIAM E. MARTIN, Member.

GLENN C. BRIGHT, Member.

APPEARANCES:

On behalf of Applicant, Pacific Gas & Electric Company:

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

MALCOLM H. FURBUSH, Esq., and PHILIP CRANE, Esq.,
Legal Department, Pacific Gas & Electric Company,
77 Beale Street, San Francisco, California 94106.

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1 On behalf of the Joint Intervenor:

2 DAVID S. FLEISCHAKER, Esq., Suite 507,
3 1025 15th Street, N.W., Washington, D. C.

4 STEPHEN KRISTOVICH, Esq., Center for Law in the
5 Public Interest, 10213 Santa Monica Boulevard,
6 Los Angeles, California 90067.

7 On behalf of the Regulatory Staff:

8 JAMES R. TOURTELLOTTE, Esq., MARC STAENBERG, Esq.
9 and EDWARD KETCHEN, Esq., Office of Executive
10 Legal Director, U. S. Nuclear Regulatory
11 Commission, Washington, D. C. 20555.
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 12/18/78

C O N T E N T S

Witnesses: Direct Voir Dire Cause

Stephan Alan Graham) 6105 6130

Edw Alfred Silver) 6049 6150

6156 6238

Exhibits:

Id. Evd.

Intervenors:

48 Graham testimony and Prof. qualis 6106 6146

49 Silver testimony and Prof. qualis 6107 6148

 50 Map: Plate tectonics: Earthquakes, 6146 6153
 A Primer (Zolt)

 51 Map: Buchanan-Banks, Pampayan, Wagner, McCulloch 6227 6228
 Preliminary Map, Recency of Faulting in
 Coastal South-Central Cal. USGS Map
 MF-910, Sheet 1 or 3

52 USGS map (as above) Sheet 2 of 3 6227 6228

Applicant's:

30 Geo. Soc. of Am. Abstract w/Program 6235 6302

31 Interp of Prelim Gravity Map of Calif and 6249 6302

32 Box end on map 6274 6302

33 Open File Rpt 75-121 6276 6302

34 USGS bathymetric profile 6282 6302

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

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THE WITNESSES:

There is a witness to the fact that the defendant has been
 found guilty of the crime of murder in the first degree.
 The witness is the State of California.

BY MR. DISTRICT ATTORNEY:

Q Now, witness, would you please state to the jury the facts
 that you know?

A I witnessed the crime of murder in the first degree.

Q Now, witness, would you please state to the jury the facts
 that you know?

A I witnessed the crime of murder in the first degree.

Q Now, Mr. Graham, have you any other evidence for
 this proceeding?

A I witnessed the crime of murder in the first degree.

Q Have you any other evidence for this proceeding?

A Yes, I have.

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Q I would like to show you what has been marked as Joint Intervenor's Exhibit Number 48 and ask you whether this document contains the testimony that you have prepared, and a copy of the professional statement that you have submitted.

(Handing document to the witness.)

(Whereupon, the document referred to was marked as Joint Intervenor's 48 for identification.)

A Yes, it is the testimony and the statement.

Q Thank you.

MR. FLEISCHAKER: I am now turning over to the Reporter three copies of Joint Intervenor's Exhibit marked Number 48.

BY MR. FLEISCHAKER:

Q Dr. Silver, have you prepared testimony for this proceeding?

A (Witness Silver) Yes, I have.

Q And have you likewise prepared a statement of professional qualifications?

A Yes.

Q I'd like to show you what has been marked as Joint Intervenor's Exhibit Number 49 for identification.

(Handing document to the witness.)

eb3

(Whereupon, the document referred to was marked as Joint Intervenor's 49 for identification.)

Is this document that has been marked as Joint Intervenor's Exhibit Number 49 the testimony you have prepared and the statement of professional qualifications?

A Yes, it is.

MR. FLEISCHAKER: I have one copy of this. I am having two xeroxed and I will submit the other two later on this afternoon, and I'm giving this one copy to the Reporter.

MRS. BOWERS: Are there any corrections?

MR. FLEISCHAKER: I'll get to that.

BY MR. FLEISCHAKER:

Q Dr. Graham, are there any typographical errors or corrections to your testimony or to the prepared statement of professional qualifications?

A (Witness Graham) No, I haven't noted any.

Q Okay.

Dr. Silver, likewise have you noticed any corrections or typographical errors to either the testimony or to the prepared statement of professional qualifications?

A (Witness Silver) No, I haven't noted any either.

MRS. BOWERS: Dr. Martin left his copy of Dr. Graham's testimony at the motel. Couldn't he use one of

eb4

the exhibit copies?

MR. FLEISCHAKER: No problem.

(Handing document to the Board.)

MR. FLEISCHAKER: At this time we would offer Joint Intervenors' Exhibits Number 48 and 49 into evidence, and request that they be placed into evidence as if read.

MRS. BOWERS: You don't really mean that, do you? Do you have 30 copies of each one?

MR. FLEISCHAKER: No, I do not.

MRS. BOWERS: They can be marked as exhibits and offered in evidence.

MR. FLEISCHAKER: All right. I have had them marked as exhibits and I will offer them in evidence.

MRS. BOWERS: The Staff did that for the NEPA proceeding for Unit 1 because there had been a prior stipulation that all exhibits would be admitted without contest, so instead of offering them in 30 copies, then Counsel for the Staff turned them into exhibits.

MR. NORTON: We have no objection to 48. However, we have a motion to strike portions of Exhibit 49, so we object to that. And if it's appropriate, we'll proceed with our motion to strike at this point in time.

MRS. BOWERS: Let me check with the Staff.

Mr. Tourtellotte?

MR. TOURTELLOTTE: I neglected to write down which

eb5

one is 48 and which one is 49.

MRS. BOWERS: 48 is Dr. Graham and 49 Dr. Silver.

MR. TOURTELLOTT: For some reason I don't have a copy of Dr. Graham's testimony either. Is it all right to use one of the exhibit copies?

We don't have any objections to the testimony at this time.

MRS. BOWERS: Well, do you want to proceed then?

I think Mr. Norton should proceed now.

MR. FLEISCHAKER: Yes. Fine.

MR. NORTON: The portion of the testimony of Exhibit 49 that we are moving to strike is that portion which is on 1,2-7 at the bottom through 1,2-8, a section numerically entitled 3.3, the question of maximum earthquake magnitude expected on the San Gregorio-Hosgri Fault Zone.

If you read that section it is very clearly the section of a seismologist and not the testimony of a geophysicist or geologist.

Page 77 of Dr. Silver's deposition --- and Mr. Crane is passing copies of that deposition to you now -- reads as follows:

"QUESTION: All right. What would that effect be? Would it raise or lower the potential magnitude?

"ANSWER: I just say there may be an

eb6

effect because it's a different -- it looks to me like a different mechanical system.

"QUESTION: I understand that, but would the effect you would get be to raise or lower the potential magnitude, or is that outside your area of expertise?

"ANSWER: It is really outside. I mean --

"QUESTION: Okay.

"ANSWER: -- one could speculate.

"QUESTION: Well, let's not do that."

So Dr. Silver has stated himself that this is outside of his area of expertise. And if you will recall, there were objections made by Mr. Fleischaker to any seismological testimony from our first panel, and on that basis we would ask that this be stricken as outside the proposed area of expertise.

MR. FLEISCHAKER: I do not have a copy of the deposition at this point, unfortunately. We're having a copy xeroxed right now. So I don't know the context of that statement, but I don't believe that an adequate foundation has yet been laid to strike this testimony.

I believe that in order to strike this testimony that the Applicant must question this witness to demonstrate that he does not have experience or training to come to the

eb7

conclusions and use the relationships and calculations that he has used in Section 3.3, and without that kind of demonstration I do not think that merely on the grounds of labeling one kind of conclusion as seismological and one kind of conclusion as geological that one can strike this testimony. You must do more than that.

You must go to this witness. You must demonstrate that he has neither the experience nor the training to utilize the equations and to reach the conclusions that he has reached in this section. The Applicant hasn't done that and therefore, I believe that the motion should be overruled.

MR. NORTON: Mrs. Bowers, I was very happy to hear Mr. Fleischaker say that because now I would like to read Mr. Fleischaker's objection from the transcript of December 13, page 5395 and following.

At that point preceding 5394, Mr. Tourtellotte started to ask questions about Mr. Gawthrop's paper which is that of a seismologist dealing with the location of the 1927 earthquake.

MR. FLEISCHAKER: I'm going to object to that answer, too, because all of a sudden we've gotten into a whole new paper, Mr. Gawthrop's paper with which I am somewhat familiar, and I think that a fair interpretation of that paper would require extensive cross-examination of a seismologist. I

eb8

haven't got that and I don't intend to go into that paper with this panel of witnesses. And I think the selection of one figure out of that paper mischaracterizes the conclusions that the author draws."

There is discussion between Mrs. Bowers and Mr. Norton and Mr. Tourtellotte. Then Mr. Fleischaker again:

"Hold on. Can I reply to that, please?"

"I haven't introduced that document.

I have only selected articles out of that document that we have been discussing. I'm happy with the total document but I haven't done that, I've only brought in those portions that were relevant to the cross-examination, my cross-examination of these witnesses.

"Now they're offering up an interpretation of a document which is not mentioned in their testimony and I think have mischaracterized the conclusion."

And here's the key sentence:

"Furthermore, the document is written by a seismologist and draws conclusions that are basically those of a seismologist. These gentlemen, this panel, is of a geophysicist and two geologists, so I would object to the answer given and request that the response be stricken from the

eb9

record."

Now Mr. Fleischaker has suddenly taken a different tack.

MR. FLEISCHAKER: Well, I haven't taken a different tack at all because if you read the Gawthrop paper you'll find what he was talking about were focal plane solutions. Focal plane solutions, as was demonstrated by Dr. Bolt, are derived from seismograms and the interpretations that we were talking there about with the Gawthrop paper -- excuse me, the matters we were talking about there were focal plane solutions and the sense of motion that they may have or may not have suggested for the faults in the area of the Hosgri, and that was the purpose of that particular objection.

So I don't think that my reasoning there and the subject matter that we were talking about in the Gawthrop paper is at all applicable here. What we're talking about here are fault lengths and magnitude relationships and moment relationships, and I think that unless Mr. Norton demonstrates that this witness has neither the professional training nor the experience to deal with those questions, he cannot rely on my objections in order to sustain his opposition to this testimony.

MR. NORTON: Mrs. Bowers, if you'll look at the testimony we're offering to strike, it's Dr. Smith's equations. Dr. Smith is a seismologist. This was his 1975

eb10

FSAR submittal. That's what probably 75 percent of that testimony is about.

The last paragraph is Marks and Bonilla, which again are seismologists. They're not geophysicists, as is Dr. Silver.

As a matter of fact if you look at Dr. Silver's list of publications he doesn't publish in the areas of seismic moment or regression analyses, lengths and magnitudes of faults. There isn't one publication among his many publications. He's a geophysicist, not a seismologist.

MR. FLEISCHAKER: May I reply to that?

I think it should be made clear to the Board that there aren't clear lines of delineation between seismology and geology. There are certain areas in which people have experience. Seismologists, for example, tend to have experience with focal plane solutions, but I think that it is getting nowhere to discuss labels.

What you have to do in order to sustain an objection and in order to get something stricken is to demonstrate by laying a foundation that this expert, either in his professional qualifications -- excuse me, either in his training or in his experience, does not have the requisite training or experience to discuss the matters that he's discussing in this section.

Mr. Norton hasn't done that. He hasn't met the

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burden yet to demonstrate that this should be stricken. And
I object on that basis.

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MRS. BOWERS: Mr. Tourtellotte.

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MR. TOURTELLOTTE: Well I certainly agree with Mr. Fleischaker that there are overlapping areas between the various disciplines, and I think that was adequately demonstrated by the cross-examination that I made, particularly in Dr. Bolt's case. However, I disagree with the conclusion that he reaches, that the motion to strike should not be granted because there hasn't been a demonstration that this witness is not capable of making the kind of conclusion that he's making in this section of his testimony.

Most immediately, I would point to the fact that in the deposition as read by Mr. Norton, that there is an admission, I think, by this witness that we already have possession of without any further examination that would clearly demonstrate that he is not qualified to make this type of assessment. That's number one.

Number two is while I would agree that there are areas that overlap, I think we also established that there are areas that are purely one discipline or the other, purely geological, purely seismological, or purely structural engineering.

Now it seems to me that if Mr. Fleischaker is going to be consistent -- and he objected to my asking a question the other day about a paper of a seismologist to another expert, then I think that he ought to be required

agb2

to stay with that. And particularly in a case where -- we're not just talking here about overlapping disciplines, we're talking about the application of purely seismological formulas and the application of purely seismological methods in arriving at a conclusion which is a purely seismological conclusion.

Therefore, although I had not anticipated or really considered the motion to strike, myself, I must -- I believe on the basis of the facts presented and the law in the case support Mr. Norton.

MRS. BOWERS: Mr. Fleischaker, if you want an opportunity to respond to that, why don't you proceed?

MR. FLEISCHAKER: I guess the bottom line is that I find that there is no adequate foundation for the motion to strike as yet. Mr. Norton hasn't done the work that he's required to do in order to strike an expert's testimony, and that work is to question this witness to demonstrate that he has neither the formal education nor the professional experience to be drawing the conclusions that he has drawn here.

And as far as the deposition is concerned, I think that if you read what Dr. Silver -- the discussion here from '76 through '78, I think it's very ambiguous, it's not clear on its face to me what it is that he's talking about here. And I think that, you know, there just hasn't been an adequate

agb3

Foundation to strike this testimony. And if Mr. Norton, through his questioning can do that, then the motion should be sustained. But at this time he hasn't done it.

MR. NORTON: Mrs. Bowers, I would only suggest that the Board read the biographical data of Dr. Silver and look what his degrees are in and look at the titles of his articles, it's very clearly geophysics geology, there's nothing seismological in there at all.

Also on Page Five of the deposition, Dr. Silver says:

"All right, Dr. Silver, what is your area of specialty?"

"Answer: Marine geology and marine geophysics."

There's nothing about seismology there. He's not a seismologist by any stretch of the imagination, nor does he claim to be anyplace in any of his written materials or his deposition.

Incidentally, Mrs. Bowers, they do have a seismologist, Dr. Brune, coming to testify.

(The Board conferring.)

MR. NORTON: Excuse me, Mrs. Bowers, before the Board reaches a decision, the formula that Dr. Smith submitted, I suspect anyone who has gone through the 10th grade could take different numbers and substitute them into the

agb4

formula and come up with an answer. I know my son could with his calculator with no problem and he's in the eighth grade.

The problem is, if you look at the terms of the formula, the terms of the formula are seismological in nature, they deal with seismic moment and so on and so forth, so anyone can stick numbers in. The question is how you derive those numbers and how you understand the concepts or the seismological concepts that are involved, seismic moment et al.

And if you'll recall, there was a rather lengthy cross-examination of Dr. Smith about those concepts. So, you know, anybody whether they're a geologist, a mathematician or a schoolteacher, can figure those -- can take that formula and stick numbers into it.

That's not the basis of the objection. The fact is, it's in the area of expertise where the terms such as seismic moment have a unique meaning, as Dr. Smith in lengthy cross-examination pointed out.

MR. TOURTELLOTT: In addition, I think it is also whether they stick the numbers in or not, relates to the expertise involved. In other words, a seismologist would know whether the numbers that we are using are the correct numbers to be using from a seismological standpoint. One who is not a seismologist would not know whether they are or not, even though you could accomplish the mathematics.

MRS. BOWERS: The Board's not satisfied with the

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information in the deposition and so we will defer ruling on the motion until after Mr. Norton goes ahead with further questions of this witness as to his qualifications.

MR. NORTON: May we voir dire at this time?

MRS. BOWERS: All right.

VOIR DIRE EXAMINATION

BY MR. NORTON:

Q Dr. Silver, would you give us all the assumptions used in the formula on Page 1.2-2 of your testimony, all the assumptions used in arriving at seismic moment? Not just the ones you have set out there, but the ones that go into Dr. Smith's formula from which you took this formula. First state the assumptions.

A (Witness Silver) Okay. My purpose in using this was to --

Q Excuse me, Dr. Silver, could you answer the question, list the assumptions that go into the formula?

DR. MARTIN: Do you mean numbers?

MR. NORTON: No the assumptions of seismic moment, et cetera.

DR. MARTIN: The assumptions don't go into the formula, numbers go into the formula.

MR. NORTON: Well I assume you make assumptions and predicate them on --

DR. MARTIN: You can't multiply three times

agb6

Assumption A.

MR. NORTON: But the formulation is derived from assumptions, I presume. I believe that was Dr. Smith's testimony.

BY MR. NORTON:

Q First of all, Dr. Silver, are you a seismologist?

A (Witness Silver) No, I'm not a seismologist.

Q All right.

And have you ever done this kind of analysis, the kind of analysis that was done by Dr. Smith from which you drew this formula, have you ever done that kind of analysis for any project of any kind?

A I've used seismic moment determinations for calculations in various areas. I haven't published them.

Q Have you ever done the kind of formulation Dr. Smith did, have you ever done that sort of thing? Because I believe he testified that was the first time it had been done for any type that he had ever seen in the literature.

MR. FLEISCHAKER: Objection. That's a multiple question. Mr. Norton is testifying.

BY MR. NORTON:

Q Dr. Silver, have you ever done that sort of thing?

A (Witness Silver) This is the first time I've ever used Dr. Smith's formulation. It's just been recently brought to my attention and it seemed most applicable to

agb7

1 this case and for that reason I used it here. I have never
2 before this used Smith's formulation.

3 Q Or have you used one like it?

4 A Well as I say, I've used Brune's formulation
5 quite extensively, it's a very valuable --

6 Q Whose?

7 A Jim Brune's Formulation.

8 Q He's a seismologist who's going to testify at
9 these hearings for the Intervenors?

10 A Right.

11 Q And wouldn't you feel this was in his area of
12 expertise as opposed to yours?

13 A It's more in his area, yes. I was sticking
14 precisely with the terminology and formulation of Smith for
15 this purpose.

16 MRS. BOWERS: Mr. Norton, I can't put my finger
17 on it at this moment -- well, I could, but Dr. Smith is not
18 a seismologist, is he?

19 MR. NORTON: He certainly is by training and --
20 that's all he's done for the last 10 years.

21 MRS. BOWERS: I thought he was a geophysicist.

22 MR. NORTON: Dr. Stewart Smith, that may be his
23 degree but he's been a seismologist and practiced since the
24 1960's.

25 DR. MARTIN: Well how can you tell whether somebody's

agb8

a seismologist?

MR. NORTON: That's the point. Dr. Smith said he was and Dr. Silver said he wasn't.

MRS. BOWERS: Looking at Dr. Smith's qualifications: Professor and Chairman, Graduate Program in Geophysics, University of Washington, Seattle, and his three degrees are in geophysics, the Ph.D. geophysics and mathematics.

MR. NORTON: Yes, that's correct. But he considers himself a seismologist and has practiced seismology for at least the last 12-13 years, and I don't know about before that. There's never been any question about his qualifications in the area of seismology.

Dr. Silver admits he's not a seismologist, however.

And Dr. Bolt, is not a seismologist by that criteria either, incidentally, if you look at his degrees.

MR. TOURTELLOTTE: If it's of any help to the Board, seismology is a subdiscipline of geophysics. Geology is not a subdiscipline of seismology -- I'm sorry, of geophysics.

MR. FLEISCHAKER: Along those lines, I would point out that Dr. Silver is a member of the American Geophysical Union, Society Exploration Geophysicist of the Seismological Society of America.

BY MR. NORTON:

Q But Dr. Silver, you've testified you're not a

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Q Dr. Silver, how much regression analysis have you done? I've looked through your publications and seen nothing involving regression analyses.

A I haven't published anything on regression analyses. It's a very easy thing to use, and in this case I'm simply using the published analysis of Marks and Bonilla. I'm not altering their work at all.

Q But that is also the work that is generally done by seismologists and not--

A No; it can be done by anybody.

Q It can be done by anybody.

A It can be done by geologists. There is no--

Q So you don't have to know anything about--

A It can be done by sociologists. Anyone can do a regression analysis.

Q All right.

So you don't have to know anything about seismology to do a regression analysis like this to have meaning?

A A regression analysis is a statistical use. One can apply that to any field. One can apply it to medicine.

Q Well is there anything in this area you feel unqualified to testify about in the area of seismology, Dr. Smith's area of work?

MR. FLEISCHAKER: Objection. That's irrelevant--

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Excuse me; it's overbroad. It's just a fishing expedition.

BY MR. NORTON:

Q Is there any area of seismology, Dr. Silver, you feel unqualified to testify about?

MR. FLEISCHER: Again I object. And I request a ruling from the Board. That's an overbroad fishing expedition. If Mr. Norton is trying to demonstrate something about this 3.3, let's get to the point and talk about the equations used there, and the disciplines, and the training and the experience that's relevant to conclusions that are reached in 3.3. Let's not go on a fishing expedition.

I have an objection.

MRS. BOWERS: We'd like to hear from the Staff before we rule.

MR. NORTON: I'll withdraw the question, Mrs. Bowers.

BY MR. NORTON:

Q Do you teach any courses in seismology, Dr. Silver?

A (Witness Silver) No; I teach courses in applied geophysics, global tectonics and oceanography.

Q Nothing in seismology?

A Seismology comes in occasionally, especially in global tectonics, using things like fault plane solutions, and occasionally seismic moment. But the concentration is not



in seismology.

Q Have you ever done any work in the area that Dr. Smith's formula deals with? Have you ever done work in the area of formulating that sort of a formula?

A Deriving from scratch, are you saying? I don't understand.

Q Yes.

A No.

Q Do you understand or are you familiar with the assumptions that Dr. Smith relied upon in arriving at this formula?

A The assumptions Dr. Smith states in his answer to Question 217, August, 1975, is one, average rates of earthquake occurrences have been constant over the past 10 to 20 --

Q Excuse me, Dr. Silver. We've all read that document. It's in evidence here.

A I'm sorry.

Q Other than what you have read, do you have any familiarity with it or are you just basing it on what you read there?

A I'm basing my knowledge of his assumptions on what he's written about the nature of assumptions.

Q And have you been told or have you read what he testified here about the nature of those assumptions as to whether they are conservative or not?

eb2

A I have only heard a little bit about that. I've not seen the testimony.

Q All right.

So you don't know whether they are, in his opinion, conservative, ultraconservative, or --

A He states they are very conservative.

Q Do you know whether he would use that formulation today, based on the advance in knowledge in seismology over the past three years?

A Well, that's up to him to say.

Q Do you know whether or not he would?

MR. FLEISCHAKER: Objection. Asked and answered.

MR. NORTON: I'm sorry, I don't think he answered the question.

BY MR. NORTON:

Q I asked if you knew whether or not he would use this formula today.

A (Witness Silver) From my understanding --

MRS. BOWERS: Just a minute.

The objection is overruled. It was not responsive.

WITNESS SILVER: From my understanding, and I have no read his testimony, from my understanding of just discussing his testimony, he would prefer not to use this here although he doesn't negate the use entirely. But I haven't read his testimony in detail.

eb3

BY MR. NORTON:

Q Who told you that, as to what he would do or not do today? You said from what you understand. Who told you that?

How do you come to that understanding? Let me ask it another way.

A (Witness Silver) I believe it was in discussions with David, but I have not studied his statements so I really can't give an honest answer, I mean a clear, definitive answer to what Dr. Smith would do today.

MR. NORTON: Well, Mrs. Bowers, you know we could beat this into the ground. I think it is very clear that Dr. Silver is not a seismologist and it is not his area of expertise, and to take someone else's formula and arrive at a different number puts that seismological conclusion into evidence, and I just think it's improper because I think it is out of his area of expertise.

He doesn't know what Dr. Smith's opinion is regarding the assumptions today of that formula, and I would think that would be a very important ingredient before one goes ahead and uses it.

MRS. BOWERS: Do you have an opinion, Mr. Tourtellotte?

MR. TOURBELLOTTE: Can I ask him a few questions?

MRS. BOWERS: Fine.

BY MR. TOURTELLOTTE:

Q Dr. Silver, when did you draft your testimony?

eb4

A (Witness Silver) I don't remember the date. It was in November.

Q And where did you get the formula?

A I first saw it in the document in his response to NRC Question 2.17 of August, 1975.

I also saw it in his paper in Geophysical Letters, 1976. I think it's June 1976.

Q And you read those papers before using the formula?

A Yes.

Q And did those papers state the assumptions upon which he based the formula?

A Yes.

Q And did you consider whether or not those assumptions were conservative before you used the formula?

A Yes. They seemed very conservative.

Q Did you consider whether they were too conservative or not?

A Yes.

Q And do you believe that your expertise allows you to make a determination of whether they are too conservative from a seismological standpoint?

MR. FLEISCHAKER: I object to that question because it is not clear what "from a seismological standpoint" means in the context of a discussion about this equation which has to do with moment and which, according to the testimony,

eb5

falls within the ambit or the expertise of a geophysicist.

MRS. BOWERS: Do you want to respond to the objection, Mr. Tourtellotte?

MR. TOURTELLOTTE: I think the best way to find out is to ask the witness whether he understands the question or not, whether it's unclear to Mr. Fleischaker.

MRS. BOWERS: Well, the objection is overruled. The question seemed clear to the Board.

WITNESS SILVER: Well, I don't understand what "too conservative" means. It simply has to do with the time scale and the time scale he used was a very long time scale.

BY MR. TOURTELLOTTE:

Q In your view, this formula was not too conservative to use so that-- Strike that.

Is it my understanding that after reviewing the formula, the assumptions, and the conservatism that you arrived at the conclusion that one could still apply the formula in the way that you applied it and believe that the solution is reliable?

A (Witness Silver) Well, I don't know what "reliable" is. It is very easy to apply his formulation. Reliability depends on what you put into it.

Q Precisely.

A You can get very good precision out of it, but again, it depends on what your input is. Whatever you input

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will determine the output.

Q Let me get this clear. You don't understand what "reliability" is?

A I don't understand how you're using it. I understand the word.

Q Okay.

A It could mean accuracy or precision.

Q Are you called upon from time to time to make certain analyses in your area of expertise, just in broad, general terms are you called upon to make analyses?

A Called upon by whom?

Q By anybody? Does anybody ever employ you to make any analysis of anything? Has anybody ever employed you to make an analysis, an analysis of anything?

A I mean as far as my employment, I've been largely with the university, in which case my employment is teaching. I get many requests from students that are not in the nature of employment.

My past work was with the U. S. Geological Survey who would ask me numerous questions.

I'm still not clear about what you're asking. I am not a consultant. I don't get hired by outside groups.

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Q Has anyone ever given you a problem to solve?

A People have asked me numerous problems, yes.

Q Good.

We're going to start --

DR. MARTIN: Excuse me.

Mr. Tourtellotte, I'm not sure what you're talking about either. When you say "Have you ever done an analysis", are you talking about a mathematical analysis, a psychiatric analysis, a chemical analysis? What kind of analysis do you have in mind?

MR. TOURTELLOTTE: Well, Doctor, if you'll just wait maybe you'll find out.

DR. MARTIN: Well, I would like to. Thank you.

BY MR. TOURTELLOTTE:

Q Okay. Suppose you have a problem that is posed to you. What is the first thing you want to do to solve that problem? Do you get facts?

A (Witness Silver) Yes.

Q And do you interpret those facts?

A Yes.

Q And based upon your interpretation of those facts, do you arrive at a conclusion?

A Yes, as best I can.

Q Now, if you arrived at a conclusion about which you had a great deal of doubt, would you consider that

mpb2

conclusion reliable?

A Well, I'd consider it clouded by a great deal of doubt and I would try to quantify as best I could the limits of the doubt.

Q Would you consider that reliable? Would you consider the conclusion something you could rely upon as a basis for taking action?

A It would simply depend on the limits of the doubt.

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It's a quantitative question. One has to deal with it quantitatively.

Q All right.

If you had absolutely no doubt whatsoever about the conclusion, would you consider that as something that you could rely upon?

A That sounds fine. I mean, one tries to place constraints on any kind of conclusion as well as you can.

Now if the constraints are much broader -- the bounding constraints are much broader than the differences in what you're seeking to resolve, then you have no faith in the conclusion. If the constraints are smaller in differences, then you can proceed.

Q Very well.

Now suppose that the problem that we're solving involves gathering certain facts together, and in the

mpb3

interpretation process you use the formula, which you know nothing about how the formula was conceived or very little about how it was conceived, but you can apply it to the facts to arrive at a conclusion.

Would you be able to rely upon the conclusion in that circumstance?

A Are you asking this in a hypothetical case, or are you asking this with respect to these particular formulas here?

1 Q Well, you said you didn't really understand
1 what I was talking about when I said "reliability". And if
1 you want to apply it to this case, that's fine too.

1 But what I'm trying to get at is a common under-
1 standing between you and me as to what reliability is and
1 whether you feel safe in using the formula with a given set
1 of facts not really knowing how conservative the formula is.

1 MR. FLEISCHAKER: Objection. That assumes
1 facts in evidence that aren't in evidence.

1 MRS. BOWERS: He's been laying a foundation for
2 it.

2 Objection overruled.

2 MR. TOURTELLOTTE: I didn't really even ask a
2 question, as a matter of fact. But....

2 BY MR. TOURTELLOTTE:

2 Q What I'm driving at is --

mpb4

A (Witness Silver) I was aware of the degree of conservatism of this formulation. Part, in fact, of what I had done was to try to decrease the nature of that conservatism.

Q How are you aware of the degree of conservatism?

A On the basis of Smith's stated assumptions.

Q Did you ever talk to Dr. Smith about it?

A Not to Smith, but to Brune.

Q You talked to Dr. Brune about Dr. Smith's formula?

A Yes.

Q And how conservative that formula was?

A Yes.

Q Who do you think is the more qualified person to discuss the meaning of a formula, the author or someone who reads about it?

A Well, in this case Brune was one of the pioneers in applying seismic moment determinations to the study of earthquakes and to seismic slip. As far as the direct use and alteration that Smith made, Smith would be the right person to talk to. But Brune is a very qualified person as well, if I had to pick a person --

Q I would appreciate it, Dr. Silver, if you'd answer my questions directly. I didn't ask you about Dr. Brune at all. I simply asked you a very --

mpb5

MR. FLEISCHAKER: Excuse me, Mr. Tourtelotte.

Don't argue with the witness.

MR. TOURTELLOTTE: I'll readdress that.

Mrs. Bowers, I wish you would direct the witness to answer my questions directly and be responsive. I think that question was not responsive.

I asked him a general question designed to set a foundation for making my objection, and I'm not getting responsive answers.

MRS. BOWERS: Well, but while he gave some preamble to it, I thought his answer concluded that Dr. Smith would be the one he would prefer to talk to. He was recognizing that Dr. Smith has the best information on his own work.

MR. TOURTELLOTTE: I certainly don't disagree with the answer, the ultimate answer; but I don't believe the witness is being responsive.

And even though he ultimately gives me the answer I want, it does not alter the fact that his answers are not really responsive.

MRS. BOWERS: Well, we've been permitting witnesses -- and this has been going on for two weeks -- to give a preliminary explanation before they get to the heart of the question.

MR. TOURTELLOTTE: I might add in that respect that a lot of that has been going on simply because it's

mpb6

beneficial to the Staff's case. And if I had been in Mr. Fleischaker's shoes I would have been treating it a little differently in certain instances; or if I had been in a different situation. But I really believe that lawyers are entitled to direct, concise answers to the question they ask and then if the witness wants to explain after giving that answer, he can say so.

WITNESS SILVER: In response to that, I am sorry to have given the preamble first.

My understanding of the question was that when you were saying the author or someone who had only read it and had no other knowledge of that, my understanding was that you were referring to Brune in this case, and that's why I clarified the statement.

MR. NORTON: Excuse me, Mr. Tourtellotte.

Mrs. Bowers, if I could be allowed to ask a couple of questions I might well -- depending on the answers -- withdraw my motion. And I would like to ask just a couple of questions.

I realize it's out of order and Mr. Tourtellotte hasn't finished, but we seem to be bogging down.

MRS. BOWERS: Mr. Tourtellotte, will you yield to Mr. Norton?

MR. TOURTELLOTTE: Yes.

MR. NORTON: All right.

mpb7 1

BY MR. NORTON:

2 Q Dr. Silver, was there a difference between ML
3 or MS?

4 A (Witness Silver) ML refers to local magnitude;
5 MS to surface wave magnitude.

6 Q All right.

7 And what is your understanding as to the data
base that this formula was derived on, was it ML or MS? --
Without reviewing the article can you tell us that?

1 A I believe it was MS, but I'm not absolutely
1 certain; so I can't tell you for certain.

1 Q All right.

1 Would there be a difference between using ML
1 or MS?

1 A Yes. MS often -- MS is generally dealing with
1 much longer wave length data, ML with shorter wave length.

1 Q Is there any point at which ML data is no good?

1 A In large magnitudes, greater than about 7 or 7.2.

1 Q And do you understand how that ML-MS was used in
2 this formula, and whether or not Dr. Smith's opinion regard-
2 ing the use of ML and/or MS in the formula has changed?

2 MR. FLEISCHAKER: Objection. That's a multiple
2 question.

2 MR. NORTON: That's well taken.

2 BY MR. NORTON:

mpb8

Q Are you aware of how ML or MS was used in the original formula?

A (Witness Silver) No.

Q Are you aware of what Dr. Smith's opinion regarding the use of ML and/or MS in the original formula was at the time?

A No.

Q Are you aware of what his opinion is now regarding the use of ML or MS?

A No.

Q All right.

MR. NORTON: Mrs. Bowers, I think our motion is well taken. It's those kinds of assumptions that give meaning to a formula like this.

Unless you have a knowledge and understanding of that -- and that was just one of the assumptions of Dr. Smith, and I'm referring to page 5774 of the transcript of these proceedings, where the second assumption -- if you go back to 5773, he says:

"Assumption number two would be that the seismic moment can be related to the magnitude, the local magnitude, with the kind of relationship that I published."

Then over on 5774 he says:

"I believe that the relationship used now

mpb9

has a sound theoretical framework when used with surface wave magnitude, but the same functional formula is no longer appropriate when one is using ML, the local magnitude."

And he, of course, specified, incidentally, Dr. Silver, that he used local magnitude the first time.

It's that kind of understanding that a seismologist has to have to have this have meaning. And for somebody to pull it out of the air and plug numbers into it and say it proves something is without foundation.

MR. FLEISCHAKER: First of all, there's been a misstatement of fact -- well, let me get to the point.

The point is that he has established two things only:

First, he established that Dr. Silver cannot recall from memory whether the data utilized in the initial calculations included both ML and MS. That's the only thing that he recalls. And I'm sure that Dr. Silver could go to the calculations and determine as to whether both kinds of data were established.

But the only point that has been established is that he cannot recall from memory whether both ML and MS data were utilized.

The second thing that he has established is that Dr. Silver doesn't know how Dr. Smith has changed his mind,

mpb10 or whether he has changed his mind with respect to the use
of ML or MS data. But it doesn't go to the issue before this
Board, which is whether he has the knowledge to utilize this
equation, and what data he would plug into it. And I think
that's the issue before the Board.

And my recollection of the testimony is this:

First, with respect to '75, MS and ML data were
both used.

Secondly, with respect to '76 -- with respect
to now, Dr. Smith would prefer to use one over the other.
I can't recall, but he said that it would be likely that
both would give legitimate answers.

That's my clear recollection of the testimony.

MRS. BOWERS: Do you have anything further, Mr.
Tourtellotte?

MR. TOURTELLOTTE: Well, I think there probably
should be a few more questions maybe if the Board isn't
certain as to whether or not Dr. Silver is capable of apply-
ing this formula with an understanding of its limitations and
when it should be applied and when it should not be applied.
That's really the key to whether he has the expertise or not.
It's not the business of whether he can take a formula from
one seismologist and talk to another seismologist and do the
math.

The question is whether he in his own -- within

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the framework of his own skills, has the understanding of when to apply the formula and when not to apply the formula, so that he can come out with a reliable conclusion.

It doesn't do any good to arrive at a conclusion that you can't rely upon. And in spite of the fact that he may have a difficult time understanding what reliability is, I don't think the Board has any difficulty in understanding what reliability is.

We're talking about evidence here upon which the Board is going to be able to rely to arrive at a sound conclusion. And it's my view that we simply can't have testimony in the record as evidence which has no reliability. And the person who does not know when to apply a formula, even though they can apply the formula, does not have the necessary understanding or expertise to present that evidence because the conclusion is subject to deep, deep doubt.

And while that to some extent may go to the weight of the testimony, again you have an evaluation that you have to make as to whether it is so -- it lacks so much reliability that you simply can't allow it in the record at all; and I really think we're in that position here.

MR. NORTON: Excuse me.

Mr. Fleischaker, I think I may give you a little support here, if I might interrupt for a moment.

MR. FLEISCHAKER: Can I correct a misstatement



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in the record?

MR. NORTON: Certainly.

MR. FLEISCHER: My recollection is clear now with respect to the use of the ML and MS.

My recollection is that with respect to the equation now, Dr. Smith's opinion was that you utilize MS in this equation. If you utilize ML you'd use a permutation, a more difficult equation.

But in either case he viewed it as being a useful equation.

And finally, the bottom line of all of this really is what is his opinion? Does he have the expertise? Would he use the formula? Why? What data would he use, and why?

That, I think, is the bottom line question that has to be answered here. And I don't believe that either the Staff or the Applicant has demonstrated that Dr. Silver does not have the requisite expertise. Indeed, I think they have demonstrated that he has used the formulation very much like this many times in the past, and therefore has the experience and expertise.

MR. NORTON: Mrs. Boveas, the only comment I have on what Mr. Tourtellotte has said, I think we're transposing. And I think it has significance later in the hearing.

We're transposing the word "reliability" for

mpb13

"validity". As I understand from my limited science courses, "Reliability" is you get the same result over and over and over again, and that result may be valid or invalid. And "validity" is the question of whether or not it's meaningful. "Reliability" just simply means if you use the formula and pump numbers into it that you get the same answer over and over and over. That's reliability.

I think Mr. Tourtelotte's comments were well taken, except the word "validity" should be substituted for the word "reliability". And I don't want to start out this cross-examination using the wrong word.

And maybe we could ask Dr. Silver.

BY MR. NORTON:

Q If you switched the word "validity" for "reliability", would that make a lot more sense in the line of Mr. Tourtelotte's questioning?

A (Witness Silver) Well, that distinction is very good. You're after validity. As far as -- another way to put it is precision versus accuracy.

One could plug the same numbers into a formula and get precisely the same answer each time; but if the numbers you put in were way off, then your accuracy would be way off, or your validity. So the critical thing in my mind is the input parameters to the equations.

(The Board conferring.)

mpb14

MRS. BOWERS: I'm going to start out with a preamble.

Recognizing the difficulty that the Joint Intervenor have in obtaining witnesses, the limitation of their resources, while we recognize that Dr. Silver is not a professional seismologist, we think that he has done some homework in this area.

And so the motion will be denied.

MR. FLEISCHER: Okay.

So the testimony's in?

MRS. BOWERS: Right.

MR. FLEISCHER: Good.

(Whereupon, the document previously marked as Joint Intervenor's Exhibit number 48 was received in evidence.)

MR. FLEISCHER: I'd like to have marked as Joint Intervenor's Exhibit 50 a map which is a reduction of the exhibit which is on the easel.

(Whereupon, the document referred to was marked as Joint Intervenor's 50 for identification.)

MR. FLEISCHER: And I would like to offer this

mpb15

in evidence as Joint Intervenor's Exhibit 50.

MRS. BOWERS: One other point that I should have made is that when we are considering evidence, having this sponsorship, it very definitely will go to the weight of the evidence.

MR. FLEISCHAKER: I offer that into evidence.

MRS. BOWERS: Well, let me check first with Mr. Norton.

You had the motion dealing with one part of 49. But I thought when we started out that you indicated there might be more than one part.

MR. NORTON: No. That was, our motion to strike was based on the parts so specified. We have no objection to the remainder of it.

Although I am a little curious that these are being moved in before the testimony. Normally they are done after the testimony. But, you know, there really hasn't been any foundation laid, but I don't have any doubt about the fact that the foundation will be laid.

For example, now he's offering into evidence this new exhibit, and I haven't heard a word spoken about it. And I assume I'm not going to object to it, but I would just as soon hear some foundation.

MRS. BOWERS: Well, we would prefer some foundation too.

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Now I'm not sure -- and maybe you can refresh my memory on it -- when 49 was offered you immediately made a point, Mr. Norton, that you had a problem with it. And so after extensive discussion we have determined that your motion will be denied.

But I don't think that we took a position on admitting 49 into evidence.

MR. NORTON: Right.

And we object to the admission of that portion we have moved to strike.

And I presume, however, if you have overruled my motion to strike, you would overrule my objection to its admittance into evidence. But upon cross-examination we may renew our motion.

MRS. BOWERS: Well, both 49 and 50 are.

MR. NORTON: You mean both 48 and 49?

MRS. BOWERS: Well, 48, I think, was admitted. There was no objection by anybody to 48.

Well, to clear up the record, 48 and 49 are admitted into evidence.

(Whereupon, the document

previously marked as

Joint Interveners' Exhibit

49 was received in evidence.)

MRS. BOWERS: We recognize that you have reserved

mpb17

the right during cross-examination to further notions.

Now, 50 has been offered in evidence without --

MR. FLEISCHAKER: I'll be happy to lay some foundation.

DIRECT EXAMINATION (Resumed)

BY MR. FLEISCHAKER:

Q Dr. Graham, directing your attention to Joint Intervenor's Exhibit number 50, which is placed here on the easel, are you familiar with this schematic?

A (Witness Graham) Yes.

Q Could you describe what it depicts?

A It shows via several lines of geologic and geophysical evidence, the fundamental crustal plates on the surface of the earth and their boundaries. That's what it shows.

Q In your professional opinion, is it a reasonably accurate depiction of that subject?

A At the scale that it shows, yes. There are certainly complications in local areas, but this is a widely published map. It's been published by a number of different people.

This particular version I believe is in Bruce Bolt's book.

MR. FLEISCHAKER: With that foundation, we will move Joint Intervenor's Exhibit number 50 in evidence.

mpb13

MR. NORTON: I would like to voir dire just a couple of questions.

MRS. BOWERS: Go ahead.

VOIR DIRE EXAMINATION (Resumed)

BY MR. NORTON:

Q Who prepared it?

A (Witness Graham) I believe David prepared it.

Q A lawyer prepared it?

A You commissioned it be produced directly from Bruce's book, is that correct?

MR. NORTON: I'm sorry, I'm asking you witness questions. I don't think he has the right to examine his attorney.

I would like to hear answers from the witness.

BY MR. NORTON:

Q You don't know?

A (Witness Graham) That's my understanding. That's what David said.

Q But you don't know who prepared it?

A I don't know the artist, the reproduction company.

Q Those arrows on there, what do you know about those arrows? Do you know if these are accurately placed on there, the black arrows, from any reproduction? Have you compared it with where it was reproduced from?

A I have not made a side-by-side comparison of the

mpb19

original versus the reproduction.

Q Have you compared the original from the reproduction?

A That's what I just stated. I have not.

MR. NORTON: Well, Mrs. Bowers, on the basis of those answers we would have to object to its being moved in at this time.

All I understand is that some unknown artist -- that it's some unknown artist's reconstruction of somebody else's drawing, and I don't think that's any basis for admitting an exhibit whatsoever.

MRS. BOWERS: Well, let me ask a couple of questions.

Is what you have been handed, a normal size sheet of paper, is this an identical copy of the same information in Dr. Bolt's book?

MR. FLEISCHAKER: This is not a xerox of Dr. Bolt's book.

My understanding is that it is an identical representation of what is in Dr. Bolt's book. But I think, if I may explain, I think the important question is to ask Dr. Graham whether this is an accurate depiction of the forces and the things that he expects to explain, and if in his professional opinion it is, then I think that is sufficient to support the introduction of this particular exhibit into

mpb20

evidence.

It's not required that it be an exact replica of Dr. Bolt's. We don't have to prove that.

What we have to prove from this witness is whether in his view it is an accurate representation, depiction of the tectonic forces that he's going to discuss.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: Well, I think technically Mr. Norton may be right from the legal standpoint. On the other hand, I would imagine that this is being offered not for the truth of the matter asserted, that is not that there is any big argument about whether this map is a map that is the center of controversy, but whether it's being offered up only as a matter of reference for the witness to make an explanation of movement of tectonics. And in that regard I wouldn't have any objection to it being admitted.

But whether it's offered up for the truth of the matter asserted or not, I suppose is a matter that Mr. Fleischaker can tell us.

MR. NORTON: Excuse me, Mrs. Bowers.

Mr. Tourtellotte I think stated it very well. I don't have any particular objections to this exhibit. It doesn't bother me really whether it comes in or not.

The point is that we start --

(Telephone ringing.)



mpb21

MR. NORTON: Getting back to what I was saying, Mrs. Bowers, the problem is the precedent of having no or a very sloppy foundation for later documents. And if you sit back and don't object now, then you are to be accepting that kind of practice. And I want to make it very clear that we are not going to allow this; that a proper foundation has to be laid to get documents like this into evidence.

You can't just bring in a piece of paper that somebody thinks is a fairly close approximation of someone else's book. In any event -- we'll withdraw our objection to this exhibit going into evidence. But I would caution that if something becomes more critical we are not going to withdraw those objections.

MR. FLEISCHAKER: All right.

MRS. BOWERS: Well, the document which has been identified as Joint Intervenor's 50 will be admitted into evidence.

(Whereupon, the document previously marked as Joint Intervenor's 50 was received in evidence.)

MRS. BOWERS: And of course all of this, as we said earlier, is subject to subsequent motions.

Is it possible to turn that so that people in the audience can follow, since we each have a copy of it?



mpb22

Now I noticed also, Mr. Fleischaker, that it's colored. Is it color coded? Yes, you can tell at the bottom. Is the color essential?

MR. FLEISCHAKER: No.

I believe that the distinction in the size of the marks is sufficient, at the bottom, to permit identification on the black and white.

MRS. BOWERS: All right. Fine.

MR. FLEISCHAKER: The earthquake zones are little tiny dots, and volcanoes are big spots, and those are pretty distinct.

I don't think that the color coding is essential for purposes of identifying the distinctive marks on the black and white.

MRS. BOWERS: All right.

DR. MARTIN: Excuse me.

There are green dots and black dots on the easel. They're all black dots on the copy in front of me. Is there a distinction between those? What I see up there is red surrounded by black and green and black. I only see two different sizes of dots on the copy I've got.

MR. FLEISCHAKER: I think that if you look at the easel here, what it is is the green dot is the earthquake zone and the volcanoes are the red area and the black dot inside of it, and those depict the volcanoes.

mpb23

DR. MARTIN: All right.

Then what are the black dots without the green around them? Or am I seeing things?

(Laughter.)

MR. FLEISCHAKER: I think that you're seeing things, Dr. Martin.

(Laughter.)

DR. MARTIN: What I see is a concentration of green, and it looks like black dots. And what looks like black dots from here are really green dots.

MR. FLEISCHAKER: This is really becoming controversial --

DR. MARTIN: I see dots in front of my eyes, and I want to know what they are.

MR. TOURTELLOTTE: The green dots there have little black dots right in the middle of them, and they are depicted in the handouts as being -- they look like very small dots. Then the orange dots are depicted on the map with red around them, and they're depicted on the handouts as being the larger dots on the map. And that's the difference.

The larger dots are volcanoes and the smaller ones depict earthquake zones.

DR. MARTIN: All right.

My glasses tell me there are three kinds of dots.

mpb24

You tell me there are only two; and I'm satisfied.

MRS. BOWERS: Do you want to proceed, Mr. Fleischaker?

MR. FLEISCHAKER: Yes, ma'am.

DIRECT EXAMINATION (Continued)

BY MR. FLEISCHAKER:

Q Dr. Graham, would you please summarize your educational and professional experience?

A (Witness Graham) Yes.

I have a Bachelors degree from Indiana University obtained in 1972. I have a Masters degree and Ph.D. in geology, both obtained from Stanford University in '74 and '76 respectively.

Since I left Stanford University I've been employed in two capacities: first in 1976 by Exxon Production Research Company in Houston as a research geologist, and having left there and since that time continuing to the present, I've been an exploration geologist with Chevron, USA in San Francisco.

Q Dr. Silver, could you please summarize your educational and professional experience?

A (Witness Silver) I have a Bachelors degree from the University of California Berkeley, 1964; Ph.D. from Scripps Institution of Oceanography in 1969. I did post-doctoral work at Scripps Institution, 1969 and 1970.

mpb25

I was with the U.S. Geological Survey from 1970 to 1974. And from 1974 to the present I've been on the faculty of the University of California, Santa Cruz.

Q Now Dr. Graham, would you please summarize the testimony that you have submitted into evidence in this proceeding?

MR. NORTON: Excuse me.

Before we proceed with that, am I to understand that these gentlemen are incorporating each other's testimony as their own, or are we supposed to cross-examine them individually?

MR. FLEISCHAKER: You can cross-examine them as you please. They are not incorporating their testimony together.

BY MR. FLEISCHAKER:

Q Okay.

MR. FLEISCHAKER: Let me go off the record for one second to get the projector on and get sort of set up.

MRS. BOWERS: Fine.

MR. FLEISCHAKER: Thank you.

(Pause.)

MRS. BOWERS: Before you start, Dr. Graham, this has come up with other slides:

For our record it's incomplete if you say "here" or "there". You know, there has to be an identification.

mpb26

WITNESS GRAHAM: Okay. I'll try to watch that.

But not being used to it, you might have to help me along.

MRS. BOWERS: Well, you'll have a lot of other watchers.

BY MR. FLEISCHER:

Q Also, Dr. Graham, your slides I believe are correlated to the figures in your testimony.

A (Witness Graham) I'll explain it.

Q And would you identify the figures in the testimony when the slides come on for purposes of the record?

A Yes, I will do that.

Q Thank you.

A Members of the Board, this morning I'd like to lay out for the the conclusions and the bases for the conclusions that are put forth in my testimony. And what I'd like to do is lay this out more or less in the fashion in which it occurred. And I want to do that to give you some sort of feeling for the thought processes that were involved in coming to those conclusions.

And to that end, if I say anything that seems unclear in any of my reasoning, I invite you to question me at any time concerning those things.

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2A

Now, Mr. Tourtellotte was correct, I think, in his view of this illustration and this is where I'd like to start.

MRS. BOWERS: By "this illustration," you mean Plate 50?

WITNESS GRAHAM: Yes.

It's going to serve basically as a point of departure here and sort of a point of reference. And what I want to show here is that this particular Exhibit Number 50 illustrates the basic crustal plates into which the surface of the earth is divided.

It has been a widely published map, based on a large data base as you can see from the legend and the spots on the map. And the thing that we'd like to look at in particular here is that the San Andreas Fault Zone, noted here on the map, is the fundamental plate boundary between two great crustal plates, the Pacific plate and the North American plate.

And as such, over perhaps the last 30 million years there has been, by published accounts at least, 1000 kilometers of slip between these two plates in a sense such that the Pacific plate is moving this way, that is, to the northwest relative to the North American plate. So we have here a fundamental crustal boundary, the San Andreas Fault system.

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Now at the scale of this map, that's a fine characterization. The San Andreas seems good as this fundamental crustal plate boundary.

When we start to look at the San Andreas Fault system in detail -- and I will move here to the first slide which is, I believe, Figure One in Exhibit B in my testimony.

(Slide.)

Can everybody see that?

Okay, as we move to the San Andreas Fault system in detail -- and here is the San Andreas Fault Zone in particular -- there have been several unresolved controversies and I believe some of these have been brought to light already in testimony, particularly by Dr. Jahns. I'll review those very briefly for you, and they are this:

There seems to be a difference in the amount of right lateral strike-slip on the San Andreas Fault south of a line like across the Transverse Ranges here, south of this area, the total strike-slip on very old rocks, that is, basement rocks, rocks in excess of 100 million years old is about say less than 300 kilometers. In contrast to that, the offset of basement rocks north of the Transverse Ranges is more like on the order of 500 kilometers.

Dr. Jahns and many others have noted this discrepancy, why should it be?

A second point worth noting is this: Now we'll

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look just at the ground north of the Transverse Ranges on the left side of this figure. And the total offset of these very old basement rocks is, as I said, about 500 kilometers from a point near the bottom of the San Andreas -- of the diagram east of the San Andreas here to a point west of the San Andreas up near Point Arena, about 600 kilometers.

In contrast to that, rocks about 40 million years old, Eocene in age, near say the letter "z" here east of the fault apparently are offset only to about the latitude of the word, "San Gregorio," on the west side of the San Andreas. So again we have a discrepancy here, about 300 kilometers for these Eocene sandstones versus 600 for the total offset of basement.

Similarly, there are other well-established San Andreas crust fault ties similar to the Eocene ties -- I just mentioned that also suggest considerably less than 600 kilometers, and all of those ties are established south of San Francisco on the San Andreas Fault.

Now there are several ways that you could account for this discrepancy, for both discrepancies that I have just reiterated from previous testimony.

And one of those -- and it's a very intriguing idea -- is that perhaps this excess strike-slip, 300 kilometers or so, might have occurred on faults other than the San Andreas restricted but other faults on the San Andreas



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Fault system as a whole. And indeed there are a number of other faults in the Coast Ranges that have been well mapped over the years and can be seen on any number of California geologic maps.

So this was the situation as it stood in the early-1970s, that is, we had this discrepancy, there had been some speculation as to how we could account for the discrepancy but no firm answers.

It was in 1972 that I arrived at Stanford in graduate school. And after looking around a bit, I decided to try and address this problem in a doctoral dissertation.

And so the question arises, how do we go about seeing if there is any strike-slip on any of these other faults that are associated with or that are at least more or less parallel, similar in character, to the San Andreas in the Coast Ranges.

Well the way to do it, it occurred to me, was the way that the San Andreas history of movement itself is attacked and successfully attacked. And that is, we go to a fault like this and we look for rather distinctive, if possible, unique features that abut on the fault and have been truncated by it. We go to the other side of the fault and see if we can find those distinctive or hopefully unique features on the other side of the fault. If we can make that correlation, if we can feel good about that correlation,



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then we've got a way to constrain the amount of slip and also the timing of that slip on that particular fault.

Now as far as the San Andreas goes, perhaps the most significant paper, early paper, was one done by two Richfield Oil Company geologists in 1953. That's Phil and Dibblee.

And in that paper they suggested that the San Andreas had, indeed, experienced that sort of large scale strike-slip and pointed out several possible offset pairs.

Despite that suggestion, it was not until I'd say at least the mid-'60s that papers debating that point became infrequent in the geologic literature. There was considerable debate until that time.

The way that the history of movement of the San Andreas Fault has been established, then, has been an incremental sort of thing. And that is that individual workers or teams of workers have gone out and looked for specific points, made those correlations and, over the period of the last -- I would say the period between 1953 and some time in the mid-60's, enough of these distinctive or unique points had been accumulated that the concept was accepted widely in the geologic community.

So this is the approach that I thought I would take on faults out here west of the San Andreas.

So I started to focus on an area essentially from

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Monterey south to roughly San Luis Obispo where we are today. And the San Gregorio Fault itself lies peripheral to that primary area. But I was aware of some things, some relationships along that fault that struck me as anomalous and I'll point to one of those right now.

In the area along the San Mateo coast, here marked San Gregorio, this is just south of San Francisco, on the west side of the San Gregorio Fault on land here is a two-mile thick succession of rocks of Cretaceous age, that is, roughly 60 million years old, 65, 70, something like that.

That two-mile thickness of rocks is totally unknown immediately to the east of the fault in the Santa Cruz Mountains. And this two-mile thickness of Cretaceous rocks immediately butts up against the San Gregorio Fault and is truncated by it.

At the same time, looking at the other side of the fault, another succession of rocks of about equal thickness, slightly younger, say from oh 55, 60 million years old up to as young as perhaps 25 million years old, are represented here. A great thickness but, again, as with the other case, are totally absent on the west side of the fault.

MRS. BOMERS: Dr. Graham, when you say "thickness," are you talking about width or depth?

WITNESS GRAHAM: These rocks have been tilted,

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so that to look at them now on the ground, they're laid out at an angle. But if you were to add up the total vertical thickness as they were originally deposited as flat layers, they represent a section perhaps some 10,000 feet in thickness. It's a considerable body of rock.

So these kind of relationships, that is, the sort of marked contrast across the fault that you see here is exactly the sort of thing that tipped people to the possibility of major right lateral strike-slip on the San Andreas Fault proper. It was that sort of relationship, then, that started me to wonder whether there might be that kind of strike-slip on this fault.

MRS. BOWERS: You're pointing to the San Gregorio?

WITNESS GRAHAM: Yes.

At the same time, Hill and Dibblee in that prophetic paper in '53 that I mentioned, talking about the strike-slip fault on the San Andreas, had speculated on several other faults that are similar in character to the San Andreas as possibly also having strike-slip but which they couldn't document at the present time. And they, in '53, had suggested that the San Gregorio Fault might be such a fault.

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So I had reasons, based on these geologic anomalies, at least to me anomalies, and Hill and Dibblee's early comment that this fault ought to be one I keep an eye on, as well as the others I was investigating.

At the same time I became aware of several other pieces of information that were emerging at about that time, and those are these:

Allen Cooper at the U. S. Geological Survey, with some others, had mapped offshore using seismic profiling methods, the northward extension of the San Gregorio Fault from San Gregorio up onto the San Andreas near Eolinas north of San Francisco. This established a tie of the San Gregorio Fault to the San Andreas Fault.

The onland section of the San Gregorio Fault here pointed to had been mapped for some time. At about that same time in the mid-'70s, Gary Green at the U. S. Geological Survey, also doing offshore profiling, had mapped the San Gregorio Fault extending south across Monterey Bay toward Carmel or the latitude of Carmel.

A fault has been known some time on land here at Point Sur, also at San Simeon farther south, and also at about that same time, Holly Wagner put out an Open File Report at the U. S. Geological Survey, again using offshore profiling techniques, documenting the existence of a large, continuous fault zone along the coast out here off where we are having

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the meeting here today. This fault had been reported also a couple of years earlier by two geologists from Shell Oil, Hoskins and Griffiths.

So I noted all of these segments and despite the fact that in detail, connections had not been established between these long mapped segments, and we're talking about segments that were fairly well defined on the order of ten's of kilometers in length, key breaks having not been established, for instance, between the Sur Fault and the San Simeon and between the Hosgri and the San Simeon, despite the fact that we had imperfect knowledge in those areas, I thought wouldn't it be extraordinary that there's a chance alignment of so many very long, continuous segments of faults.

So this further caused me to want to look very carefully at the rock bodies at either side of this system or I should say elongate fault zone along the coast.

This is a difficult problem because there aren't many onland exposures on the west side of the fault. But still and all, I took that tack and combined with Bill Dickinson, who is on the faculty at Stanford and is my co-author, we arrived at seven sets of geologic features which we feel that here regionally are distinctive in character, which we feel give us an estimate of the amount of right lateral strike-slip on an inferred, through-going system encompassing all of these elements.

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I want to move to the next slide here, and also a figure on the easel.

I don't know how we're going to do this in the dark.

MRS. BOWERS: Well, let's try to have some lights on. This may be very distinct.

(Slide.)

WITNESS GRAHAM: Let me introduce these two figures. The slide on the screen is Figure 7, Attachment B.

The panel on the easel is Figure 6 in Attachment B.

Now on these two illustrations I have laid out in graphic and map form these seven pairs, and I intend to discuss these in some detail, again to give you a feel for the nature of this correlation that I've made, but there are a couple of remarks I need to make first, prefacing that discussion.

The first is this: We had substantially arrived at these offset pairs I believe some time in 1974. We made our conclusions known I think to the geologic community here in California who had been involved with various segments of this fault, either in late 1975 or early 1976. The exact date escapes me.

Bill Dickinson and I, being interested in this problem, circulated a letter amongst a group of perhaps 20 professionals here in the State of California who have been involved in one way or another with all aspects of this

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problem. We invited them to come together at Stanford for a day and just sort of have an open session, discussing what we'd seen and try and tie these things together. And a number of people were there.

I think this was the first time I had presented this to other people.

These conclusions then appeared in a more widely publicized form in 1976 in my dissertation in March, and later that year orally and in abstract form for the National Meeting of the Geological Society of America in Denver. And since that time, 1976, we have put out our conclusions in a couple of other forms, including the Division of Mines Report, just released, and a Science article earlier this year.

Now as far as these specific offset ties, I will make a couple of other prefacing points, and those are these:

Individually, we feel that any given offset pair of ours is probably not sufficiently unique or distinctive to require major major strike-slip on the San Gregorio-Hosgri Fault Zone as we're using it. However, we have assembled seven pairs of things which display a common offset. We feel that this would be a remarkable circumstance if it were purely by accident, and we feel that this coincidence forms a compelling argument for strike-slip on this particular system, and I would again point out that this is exactly the kind of reasoning that has been used to document

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the historical movement record on the far back and forth to
said.

For there is important in the problem of off-
set, when displacement comes from lateral motion and it's
accepted by display and release condition of the hypothesis
on this graph.

This graph shows each of the seven offset points
which I'll discuss, and it shows the amount of offset that we
feel is possible for each of those displayed here on this
axis on the left-hand side of the graphic kilometers.

So that, for instance, we deal on this particular
offset here the range of offsets we might describe could be
as low as, say, 98, 93 kilometers, but might be as high as
115.

BY MR. FLEISCHAKER:

Q Excuse me, Dr. Graham. To coin a phrase that was
used earlier, you're not transparent so we can't see through
you, so could you back up and extend the pointer, please?

A (Witness Graham) Thank you, Mr. Fleischaker.

The uncertainty arises from several things, and I
think that will become clear as I discuss each of these,
but they are things like in some instances the ray relations
we would like to see are underwater and we have no data, but
we feel we can still infer their existence reasonably.

Also, some of these features have been modified

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by erosion and are absent for that reason and that, too, gives rise to a certain degree of uncertainty.

MRS. BOWERS: I'm sorry to interrupt. If this is going to go on for some period of time perhaps we should take a mid-morning break now.

WITNESS GRAHAM: It will, yes.

MRS. BOWERS: Well, I'll say ten minutes.

(Recess.)

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MR. FLEISCHAKER: Mrs. Bowers, for the record, I'd like to note that Joint Interveners are giving two more copies of Exhibit Number 49 to Mr. Bloom. So I think that completes the submission.

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BY MR. FLEISCHAKER:

Q Dr. Graham, do you want to continue, please?

A (Witness Graham) Having made before the break some statement of explanation of this offset display, I want to move to an explanation of these various offset pairs, again to give you some idea for why we feel this claim of ours regarding large-scale strike-slip is a good one. This may be a bit of a juggling act because I'm going to refer back and forth between the screen and the easel over here.

I'm going to consider first the offset pair marked on this chart as "Gualala-Pilarcitos offset." And to do that, I'll turn to the map on the easel.

Q Excuse me, Dr. Graham. Could you identify again, just for convenience, which figure that is in the testimony?

A I believe that the figure on the easel, the map is Six in Attachment B. The offset chart is Seven in B.

Yes, that's correct.

Turning to the map, the San Andreas Fault in Central California in general separates two very distinctive types of basement rock: essentially granite on the southwest and a complex body of rock called the Franciscan complex on

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the northeast. They're quite distinctive.

So this is generally the boundary. There are a couple of exceptions, however, and a notable exception is here just south of San Francisco in an area called the Pilarcitos Fault. The Pilarcitos Fault is the line at the southwest boundary of this cross-hatched or diagonally-ruled area.

In this particular area, Franciscan basement occurs, underlies the ground and that is diagonally-ruled, yet it's southwest of the San Andreas Fault. So at least here locally, the Pilarcitos Fault is the boundary between granitic basement and Franciscan basement.

The Pilarcitos Fault, in work by Allen Cooper, apparently is truncated by the San Gregorio Fault just offshore of Point San Pedro. So here we have a rather distinctive geologic feature, a contrast in basement types apparently truncated by the San Gregorio Fault.

Is that situation realized anyplace else west of the San Gregorio Fault? We would suggest that it is.

Moving northwest of San Francisco to the area I've called the Gualala Basin, the Gualala Basin itself west of the San Andreas is structurally and perhaps stratigraphically underlain by basement rock that has been characterized as Franciscan formation. It's an altered basaltic volcanic rock typical of the Franciscan elsewhere in the state. There is

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some uncertainty about the character of that basement, but it is -- it's a small exposure but it has been characterized as probable Franciscan in origin.

In contrast to that, the next exposure of basement rock, moving southeast along the San Andreas Fault but on its west side, is at Bodega Head. They are -- outcropping at Bodega Head are granites, granites quite typical of the rest of the basement southwest of the San Andreas Fault.

So that we have a fundamental difference in basement types between the Gualala Basin and the Bodega Head outcrops. Unfortunately, the place where we would predict that that contact has to occur is underwater. We've indicated that that contact must lie there, however, by this dotted line in the figure between Gualala Basin and Bodega Head. We don't know what the orientation of this contact is or in detail what it looks like. Because it's underwater, the area has not been well studied. But we suggest that somehow such a contact analogous to the one down at the Pilarcitos Fault must exist between these two areas.

That then forms the basis for the first offset pair in the chart that you see over there, the Gualala-Pilarcitos offset.

The second offset pair that I show on the chart is the Point Reyes-Ben Lomond Mountain offset. And I'll turn to another slide.

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Could I have the next slide?

(Slide.)

This is Figure Eight in Attachment 3.

Now at Ben Lomond Mountain on the map, just north of Santa Cruz, east of the San Gregorio Fault, there occurs a tertiary geologic stratigraphic section that has, we feel, some rather distinctive characteristics. And it's shown on the right-hand side of the diagram there, Figure Eight. And I'll describe it to you briefly.

At that locality, Paleocene-age rocks, and these are rocks on the order of 60 million years old, rest depositionally on granitic basement. Overlying those Paleocene rocks, are middle-Miocene rocks, roughly 15 million years old.

The important thing here is that a tremendous amount of geologic time is missing in that section, that is, roughly the time between say 45, 50 million years ago and something on the order of 15 or 16 million years ago. That amount of geologic time is not represented in that section. Instead, there is an erosional contact at the top of the Paleocene.

So we have a lot of section that's missing there.

Similarly -- to go on then up in the section, the top of the section is capped by an upper-Miocene to Pliocene section which are rocks of say 10 million years up

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into something younger than five million years, perhaps four million years. But there's a break, again, between those middle-Miocene and upper-Miocene rocks.

Now as we move farther to the northwest but west of the San Gregorio Fault, we see a similar section, in fact, remarkably similar in our view, at Point Reyes northwest of San Francisco, in that area and that's shown on the left-hand side.

You see Paleocene rocks resting on basement, a large gap in the geologic record with missing intervening section, middle-Miocene rocks, another break, and then upper-Miocene-Pliocene rocks.

Now it's certainly true that Miocene rocks of the general character in both of these two columns are widespread through all of coastal northern California.

What we want to emphasize here is the packaging of these particular rock bodies, that is, the tripartite division in both instances. That is, old rocks, a great deal of intervening section missing, and then these two separate packages of middle-Miocene and upper-Miocene-Pliocene rocks. That is significant we feel because, in intervening areas, that section that I've characterized as missing here is not missing.

For instance, immediately north of Ben Lomond Mountain on this map, in the general Santa Cruz Mountain area,

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say at the latitude of the word "Pescadero," and east of the San Gregorio Fault, the interval that is missing in the Ben Lomond Mountain section is represented by 30,000 feet of sediment, according to people who have worked in the area.

I can't testify exactly as to that amount, but it's on the order of tens of thousands of feet of sediment missing at Ben Lomond Mountain.

Similarly in the vicinity of Point Reyes, if you move to the north of Point Reyes to this Gualala Basin the interval of time that has no represented section at Point Reyes on that column is represented in the Gualala Basin by again perhaps 10,000 feet of rocks of intervening age, that is, Eocene in age, Oligocene in age.

So that we feel that this rather distinctive stratigraphic packaging, the three-fold division here, is a feature that's distinctive.

What's more than that, the granitic basement in these two localities seems to have some affinities, common affinities that aren't represented elsewhere in the granitic basement down here.

And I refer to work done by Don Ross, a U.S. Geological Survey staff member, and he found that certain mineralogical characteristics of the granitic basement at Point Reyes and Ben Lomond Mountain seemed to be identical and were not matched elsewhere in the basement southwest of

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the San Andreas Fault.

So this correlation between Point Reyes and Ben Lomond Mountain forms the second of the offset pairs.

The third one then that I would like to address is an offset pair matching rocks west of the San Gregorio Fault between the words, "Pascadero," and "Ano Nuevo," with rocks in the Santa Lucia Range. And I've already alluded to this in as much as these rocks near Pascadero comprise the two-mile thick section that is missing on the east side of the fault.

So the question is, if that's a problem there, where might those rocks really belong? Are there any rocks of a similar character on the east side of the San Gregorio Fault?

We would suggest that there is or there are. And, although in the area west of the fault from San Francisco all the way down to Monterey there are no rocks at all of that age, Cretaceous, down here in the Santa Lucia Range they are abundantly preserved. And they are of a character, a sedimentary character -- that is, the way they were deposited -- that is similar to the rocks at Pigeon Point, compositionally they also have similarities.

And one detail of this that I won't go into in any great length is that apparently the edge of a Cretaceous Basin characterized by shallow water deposits is defined,

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well defined here in the Santa Lucia Range and the presence of shallow marine sediments within the Pigeon Point formation west of the fault here seems to corroborate that offset of the Cretaceous from here, east of the fault, to there, that is, at Pescadero, west of the fault.

In addition to the Cretaceous section, there's a younger section west of the fault in the vicinity of Pescadero and Ano Nuevo. It's a section that is roughly of the same age as the ones that I've shown here for San Lomond Mountain, the slide that is still on the screen, that is, they are Miocene and Pliocene in age.

And two workers at the U.S. Geological Survey Earl Brabb -- Joe Clark, I believe, is at Indiana University in Pennsylvania -- these two people both did their dissertations, doctoral dissertations on these rocks in the '50s and '60s, and have continued to work on those rocks from that time and, I venture to say, probably know them and have seen them more than anybody else.

They have offered, in Division of Mines Report Number 137, the same report that this illustration appears in, they feel that there is a marked contrast in those younger rocks also across this fault from the Santa Cruz Mountains east of the San Gregorio to the Ano Nuevo-Pescadero exposures on the west. They feel they are quite dissimilar. They feel that that dissimilarity is best explained by strike-slip

age 9

movement on the San Gregorio Fault. They have not specified what they feel those rocks might correlate with. We have a suggestion. The suggestion is this:

My dissertation work was here in the Santa Lucia Range chiefly and I worked primarily with rocks of that age. And the rocks that are exposed at Ano Nuevo and Pescadero have a character that is compatible with rocks of that age in the Santa Lucia Range.

So I'd say that in addition to the Cretaceous rocks, the tertiary rocks exposed west of the San Gregorio Fault in the vicinity of Pescadero and Ano Nuevo have a happy equivalent here in the Santa Lucia Range. We would suggest then that that's the basis for our third offset pair.

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For the fourth offset pair we relied on the conclusions of work done by Ed Silver at U. C., Santa Cruz, and published in 1974 I believe in a Geological Society of America oral presentation and abstract, published abstract, and those conclusions were these:

He noted, and it is commonly recognized, that there is a second boundary between granatic basement and Franciscan basement south of the San Andreas and that occurs roughly along the line here on the map shown by the letter "K," the Sur-Nacimiento Fault. Franciscan rocks occur to the southwest, granitic basement to the northeast. So that in actuality, south of the San Andreas Fault, granitic rocks occupy a strip that runs between the San Andreas Fault and out here at the southwest limit of these Cretaceous rocks in the Santa Lucia Range.

Now because of the marked contrast in basement type, Dr. Silver suggested in this abstract that were this trend offset by the San Gregorio Fault, it may well have some gravity magnetic expression on the west side offshore. And his suggestion in the abstract was that indeed there is a marked gravity gradient offshore here in the vicinity of Ana Nuevo Point, and his suggestion was that that was the offset expression of this fundamental basement contrast in the Santa Lucia Range.

We adopted his conclusions and found that they were



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compatible with the order of strike-slip that we had suggested, based on the geologic offset features I've already mentioned and the others, I'll continue to develop.

So that's the fourth set of features that I've included in the offset chart that we'll get back to in a minute.

The fifth feature I've labeled as partial offset of Big Sur-Miocene sandstone. I think I'll pass that for a moment and go on to the one on Figure 7 that is labeled as the sixth, that is, the Point Sur-Cambria offset. I'll do that with the next slide which is I think Figure 4 in Exhibit B. Yes, Figure 4.

(Slide.)

Now the area we're looking at first on this map to the right, the offset pair map, Figure 6, will be the vicinity of Point Sur here west of the Sur Fault in this system -- in this area, and then further down here in the area of Cambria labeled on that map. And I'll shift over to this slide, Figure 4.

This offset pair has a couple of interesting aspects. The portion on the left is just an index map; the portion on the right is a blowup of the area circled on the left, and it's a reproduction of a thesis map done by Wyatt Gilbert in a Ph. D. thesis at Stanford University in 1971 or somewhere in there.

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What Wyatt has done in this area is highlighted the sort of major contrast across a fault zone here that I've indicated earlier is the sort of thing that oftentimes signals strike-slip. I'll explain that here.

In the vicinity of Point Sur on the map from, say, Pfeiffer Point to Point Sur, we're dealing with Franciscan complex outcrops and these rocks are chiefly sandstones and shales that are structurally disturbed; that is, faulted and folded, but they are not altered significantly from their original depositional state by younger metamorphism, that is, chemical alteration due to pressure and heat and the like.

It's a large terrane of ground, as you can see some 16 kilometers.

Wyatt Gilbert, although he didn't have an explanation for it in his dissertation, noted a marked contrast in the Franciscan complex to the southeast in this outcrop area in, say, the vicinity north of Lopez Point. In that area he found that again the Franciscan consisted of sandstone and shales, but these were not in their pristine state. Rather, they had been subjected to metamorphism; that is, they had suffered some chemical alteration.

Now there's a way that you can quantify this and this is what this slide presents.

During this sort of metamorphism, this sort of alteration, the feldspar, the potassium feldspar and sandstone

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grains tend to be altered to other things, other minerals, and disappears so in places where the rocks have not been metamorphosed, there's a lot of feldspar, potassium feldspar. Where it has been metamorphosed there is not.

Each one of these circles on here represents a data point of Wyatt Gilbert, so we're talking about here a data base of several hundred observations and these include stained slabs of rock, they include petrographic examination of thin sections of rock.

The two kinds of points that are shown here is the solid point, the detrital potassium feldspar present and present in quantities on the order of 10 percent versus open circles where detrital potassium feldspar is effectively absent. And strikingly you'll notice the difference.

In most instances up here in the vicinity of Point Sur there's a lot -- there is abundant presence of potassium feldspar. In this area around Lopez Point it's absent, virtually absent. Quite a contrast. Again the sort of thing we would want to look at, at least get suspicious of.

Now the Sur Fault System that goes through here is quite a complex system, quite an old system in its origins, as Dr. Jahns has already testified. However, it does have a young history of movement as well, as Wyatt Gilbert has pointed out. And of the many complex faults in here, one in particular seems to be chief of those, and that Wyatt Gilbert

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as pointed out, not only in his dissertation but in the publication based on that dissertation, a full article in the Geological Society of America Bulletin of 1971, and that is this particular strand here, I believe, called the Serra Hill Fault, and also its splay on the other side of this block, the Rocky Creek Fault Zone.

c5

And Wyatt suggested, although again without any data offshore, that perhaps that fault continued offshore like so (indicating) and truncated at the older Sur Zone, thus giving a way to explain the contrast between these very large terranes of Franciscan here and here (indicating).

Now we would suggest that this has two significant aspects. One is this:

The fact there is this contrast here suggests to us that somehow through this complex fault zone and perhaps using the Serra Hill Fault, there has been strike-slip, right lateral strike-slip to account for this big contrast in large blocks of country here in the Franciscan.

The second thing is well, here we have a rather distinctive piece of Franciscan here, unmetamorphosed. Is there anyplace east of San Gregorio-Hosgri where we have a similar thing?

Well, looking further south on the coast from Point Sur back back on this index map and we move down south-- Well, we'll shift over here to the other map at this point.



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Moving south, most of the ground between the south end of Wyatt Gilbert's work, which is, oh, roughly in the vicinity of this "X," most of this ground has been studied and examined by one of the more noted workers on Franciscan rocks, who has done some of the pioneering work on Franciscan rocks, whose name is Ken Sues, who is now at the Technical Institute in Zurich, Switzerland.

He has found and has published that as a generalization, almost all of the Franciscan in this intervening ground between Cambria-Pine Slab and Point Sur east of the Hosgri-San Gregorio Fault is of a metamorphic character; that is it lacks in general significant amounts of potassium feldspar. It's metamorphic.

However, he noted that there is a large block of ground east of the Hosgri Fault which he called the Cambria-Pine Slab. It's on the coast, well-exposed in the vicinity of Cambria, that is unmetamorphosed. It's sandstone and shale, and it is of the same character of Franciscan as that exposed west of the fault at Point Sur.

We suggested therefore that these two rather distinctive but large blocks of Franciscan in which detrital potassium feldspar is preserved in abundance may be offset correlatives. And in addition to that, subsequent work done in two master's theses, one by a University of Santa Cruz student, Mike Underwood at Point Sur, and one by a University

eb7

of New Mexico graduate student, Gregg Smith, on the Cambrian-Pines Slab, reinforces this interpretation.

They both did a detailed study of these two bodies of rock, concluded that they were unmetamorphosed, and otherwise similar blocks of Franciscan sandstone and shale. And both of their results have been published in a Field Trip Guide Book last year by the Pacific Section of the American Association of Petroleum Geologists.

So we'll move on to the next offset feature, and I will retain that slide I guess.

That feature, the fifth one on the offset chart, is one that's shown on this slide as a Franciscan-derived Miocene sandstone, and I'll have to explain that a little bit.

It's at this scale map almost unseeable. It's a very small exposure of rock, actually measuring only hundreds of yards across, and it's entirely bounded by faults, so it's not rooted, as it were, to either granitic basement or to Franciscan basement.

But the thing I feel is significant about it is that it occurs in outcrop about a mile away from granitic basement and this is granitic basement, based on my thesis work in the Santa Lucia Mountains that was exposed and available for erosion during the Miocene time, the time that the sandstone was deposited.

The important thing is, in my view, that that



eb8

1 sandstone contains no granitic debris. Rather, it contains
2 solely clasts, that is, pebbles and sand grains derived from
3 Franciscan basement. It contains serpentine, things like
4 that that -- metamorphic rocks that aren't found in the
5 Salinian -- that is, the granitic basement east of the Sur
6 Fault here in this general area, granitic basement again that
7 was exposed during that time.

8 Now it's conceivable to imagine local drainage
9 patterns that might enable you to derive a sandstone exclu-
10 sively from one type of rock, even though a much broader
11 expanse of source rock was available, just a vagary of the
12 local stream course. But in view of the expanse of granitic
13 basement that we knew was exposed at that time and available
14 for incorporation in sediments, it seems to us to perhaps not
15 be the easiest answer.

16 Alternatively, perhaps this fault slice of sand-
17 stone is better looked at in strike-slip along the San
18 Gregorio-Hosgri.

19 For instance, if you move this sandstone along
20 the fault zone, say something in the order of 60 kilometers to
21 the south, you'll find that it is immediately adjacent to a
22 large, unlimited expanse of Franciscan rocks that could
23 potentially serve as the source material for these sediments.
24 But you have to move it a distance of, as I say, some 60
25

eb9

kilometers to get that kind of expanse of Franciscan exposed, such that you don't have the easy potential for contamination by granitic rock through erosion.

On the other hand you can't apparently move this sandstone too far south, the reason being that in the vicinity of Cambria down the coast, sandstones of that age quite typically have pebbles of a volcanic formation, the Cambria field site which has been mentioned here before, incorporated in them. The sandstone at Big Sur or Point Sur does not have those.

Therefore, we would suggest that it's not too likely that that sandstone originated down there. It's possible by local drainage, just as it's possible that this could have been originated up here through local drainage, but we don't think that's the easiest explanation. That doesn't pose any particular problem to us as far as total offset goes because this sandstone is totally bounded by faults; it's not rooted to either of these two basement types.

That means that it could have been picked up at any intermediate position along the way during the history of movement and this --

MR. TOURTELLOTT: Mrs. Bowers, I'd like to interpose an objection at this time. My understanding was that Dr. Graham was going to summarize his paper, and my understanding is also that we're required to file in advance

eb10

written testimony of what we're going to say at this hearing.

What is going on right now is an elaboration on the paper that he has referenced in his testimony and in his testimony says virtually nothing. We have had no notice at all of the kind of testimony that Dr. Graham is giving here, and we have no way of knowing how to prepare for this testimony, and I would move that his testimony, supposedly summarized thus far, be stricken and that he be advised to give us a brief summary of his article as he was supposed to do.

MRS. BOWERS: Mr. Fleischaker?

MR. FLEISCHAKER: Well, I think that Dr. Graham's statement is a fair characterization of the attachment -- I think it is either A or B -- to his testimony, and there is no new information, or very little new information. I haven't followed it word for word, so I'm not sure, but it is almost identical to the descriptions that are laid out in detail in Attachment B to his testimony which is part of his testimony.

And inasmuch as the Graham and Dickinson article and the conclusions have been subject to substantial discussion previously by the witnesses in this proceeding, we think that it is fair and appropriate that Dr. Graham take this time to explain the seven sets of correlations that are set out in his testimony.

There is nothing new here. There are no surprises here. It was all set out in the testimony that was prefiled.

to WRB/mpbl

MRS. BOWERS: Mr. Morton?

MR. MORTON: Well, I think it's very difficult to follow the paper and follow the oral presentation to tell if there's something new or not. But I agree in essence with Mr. Tortolotta that this is supposed to be a summary.

Dr. Johns and Doug Hamilton's written testimony was over 100 pages long, written testimony. The summary took a little over an hour or a little less than an hour, around an hour. That's a summary.

I'll guarantee you everyone in this room could have read this paper in the length of time we've been listening to this summary, they could have read it maybe two or three times. I don't think it's a summary either. And yet it's almost impossible to tell, because he's skipping around, whether or not he's saying things that aren't in the paper. Only a detailed review of the transcript and the paper side by side would tell us that.

But I too thought we were supposed to have summaries of written testimony. His written testimony is exactly one page and a couple of lines long. And then he attaches an article.

Now this is not a summary of that article. This is -- as I think the word Mr. Tortolotta used was -- I forget the word, but it's an expansion on the article -- elaboration was the word. And it certainly is that.

mpb2

I don't understand why it wasn't given in the written testimony.

MRS. BOWERS: Mr. Fleischaker?

MR. FLEISCHAKER: I think the effort to divide the testimony into two parts is inappropriate. The testimony consists of both the summary in the front and the article. Both were sworn to and both were submitted as his written testimony.

So I think that the effort to somehow segment out the article and call it something other than testimony is inappropriate. He has sworn to that. It has been submitted to the record. And I think is appropriately designated as testimony.

As I indicated, it seems to me that a primary objection here, like Mr. Tourtellotte, is that there is something new. There's nothing new here, it's all in the testimony. There's no new information. There are no surprises.

Mr. Graham's article has been out in the published literature for some time. And I don't believe that this explanation is surprising either the Staff's geologists or Mr. Hamilton or Mr. Willingham, who are the consultants to the Applicant.

As far as the length of the presentation, I think that it's appropriate under the circumstances. The San Gregorio-Hosgri is the major feature that we're here to

mpb2

discuss. We spent well in excess of a day and a half in this hearing discussing or listening to the Applicant's detailed examination of this conclusion, and I think that it is useful to build a full record to have Dr. Graham explain in some detail the basis for the conclusions drawn in the testimony.

MRS. BOWERS: Well, Mr. Tourtelotte, you started this.

Do you have further comment?

MR. TOURTELLOTTE: I would say that if indeed there's nothing new in what Dr. Graham is saying, if it is all in the testimony, then I think we can rely on the testimony to tell us that. And if this is going to be a summary, I think it should be a summary.

Now the problem that I'm having with it is that I'm going to have to go through his entire so-called summary which is lasting an inordinate length of time and find out if there's anything in the transcript that should be stricken because it goes beyond the scope of the filed testimony. And that's a terrible burden to have to impose on anybody. And really I shouldn't have to do that.

A summary is easy to follow, and it doesn't have to be this long. I could hold his paper upside down and read it backwards faster than the summary that we've gotten here today. And I think it's imposing a terrible burden on us, and I would just urge the Board to make a ruling

mpb4 1 that we have a summary that is a summary, and not a summary
2 that is a single reading or elaboration of the testimony.
3 He certainly shouldn't elaborate the testimony.

4 MRS. BOWERS: Well, first, we consider the testi-
5 mony as filed to also include the article. So to characterize
6 it as a page and a half is not really accurate.

7 The purpose of a summary -- and perhaps this
8 hasn't been mentioned to Dr. Graham -- is so the general
9 public, who attend these hearings, will have an idea of what
10 the Board and the parties have in front of them in the way
11 of testimony. And other witnesses have briefly summarized
12 rather than going through the testimony on a step by step
13 basis, and that's what we think is appropriate.

14 So Mr. Tourtellotte's objection is well taken.
15 I don't know at this point how you can wrap it up.

16 WITNESS GRAHAM: My response would be this:

17 This of course is the first time that I've been
18 involved in such proceedings. And to have written testimony
19 of the sort that Mr. Norton had indicated would have basically
20 entailed rewriting the article and incorporation in the testi-
21 mony. And it was my assumption that tacking it on as an
22 appendix included it in the record.

23 Fine. I'll proceed. I have perhaps only ten
24 more minutes of comments, and they're mostly summary in
25 nature. Is that adequate?

2E cont.
agbl
flwsmpt

MRS. BOWERS: Fine.

Dr. Graham, have you talked about new matters here today that are not in your article?

WITNESS GRAHAM: As this discussion went on, I was trying to think of things. And I think there have been just a couple of instances and I will cite those to you in particular. I don't think, in my opinion, that they are of particular importance.

For instance, in connection with a slide that I have up here, I just cited two university Masters theses that postdate this work. I think such comments that I've made that represent elaboration or additional testimony not incorporated in the article are of that character.

However, in general -- actually I think in detail I've stuck specifically to the things that I've said here in the paper, the text of the paper.

So in that sense, I don't think there is an elaboration. There's no additional information that's not contained in the paper.

My intent in showing these slides was to try and make as clear as possible to the Board the basis for my conclusions.

MRS. BOWERS: Well why don't you proceed to your conclusion.

WITNESS GRAHAM: It'll be brief.

agb2

Let me have the next slide, please.

(Slide.)

The last offset pair, San Simeon-Point Sal offset, is an offset reported by Clarence Hall in Science in 1975. We adopted his offset, it seemed reasonable, we had no other interpretation.

So I want to draw together, then, the lines that I've just presented of these offset pairs. Just a couple of quick points:

The first conclusion is this, based on our offset pairs, there has been large scale strike-slip movement on the San Gregorio-Hosgri Fault Zone at some time. We suggest that by the common amount of offset indicated between these pairs, it's 115 kilometers, like so (indicating).

Furthermore, to have that strike-slip accepted as valid requires that during the time of that strike-slip there was throughgoing continuity in some fashion along that San Gregorio-Hosgri Fault.

As far as age of movement, timing of movement, these particular offset pairs are not very specific. The youngest feature that's very reliable data that forms a fairly firm point is this Miocene sandstone that's partially offset, and so it suggests then that the strike-slip which would have incorporated the sandstone is younger than say post-middle Miocene in age.

agb3

But as far as present continuity of the system or as far as necessity of movement, these offset pairs are insufficient information, they don't address that point. They simply require that at the time of strike-slip there was continuity.

But we do have some other things that bear on the age of that strike-slip, and that is the history of the San Andreas Fault movement and the history of movement of the North American and Pacific plates.

And apparently, as Dr. Jahns has testified already, those two seem to be at the same rate roughly for the last five million years or so. That is, during that time, the San Andreas Fault in a strict sense has served as the main plate, fundamental plate boundary between the Pacific and North American plates.

Prior to that, though, between this permissive middle Miocene, post-middle Miocene offset, this 115 kilometers of strike-slip must have occurred. Therefore, we've bracketed the timing of movement of this 115 kilometers to some time between say roughly 15 million years before present and five million years before present.

So I would suggest then, finally, that this strike-slip, coupled with the physical tie to the San Andreas Fault, suggests to me that during the timing of the strike-slip, the San Gregorio-Hosgri Fault was a key element of

agb4

this fundamental plate boundary, the San Andreas-Transform Fault system and that, during that time, it was an important strike-slip feature and that during that time it was essentially analogous to the present San Andreas in character, may even have been a predecessor to the San Andreas.

That's the conclusion of my testimony.

MR. FLEISCHAKER: We'd like to move on next to Dr. Silver, who will summarize the testimony that he has submitted for the record.

MRS. BOWERS: We don't have all the lights on. I wonder if someone at the back of the room could turn the rest of the lights on.

42E

2F wbl

MR. BRIGHT makes a point: Is it in better sequence to have this witness cross-examined now rather than having Dr. Silver go ahead?

MR. FLEISCHAKER: No. I think the better sequence would be, since they're up there as a panel, would be to get both pieces of testimony summarized and into the record, and then Mr. Norton can go ahead and cross-examine.

I discussed this with Mr. Norton before proceeding, and it was my understanding that was the way we were going to proceed. That is the way we would prefer to proceed.

MRS. BOWERS: All right, fine.

MR. NORTON: I guess this is a query and a comment. I presume, since they're up there as a panel-- I don't understand: they don't adopt each other's testimony. They're each giving separate pieces of testimony. I don't understand this panel concept. I presume I'm going to cross-examine Dr. Silver and then I'm going to cross Mr. Graham, or vice versa. But I don't presume that one is going to chime in on the answer of the other, because they haven't adopted each other's testimony. And they have both prepared separate pieces of testimony.

So I don't understand, when he says they're up there as a panel, what he means. To me they're up there as two individuals, you know, from everything Mr. Fleischaker has stated.



wb7

I don't have any objection to it, being a USGS map, I don't have any objection to it being in evidence. But I don't understand how anybody in the room can follow. I can't see anything on it from here.

WITNESS SILVER: I have one copy, or I could simply refer to the geographic locations.

MR. TOURTELLOTTE: We have a copy if somebody wants to borrow ours. We can see from over here.

(Document handed to Mr. Norton)

MR. NORTON: Mr. Fleischaker, you've had it marked as an exhibit. Are you having that great big thing marked as an exhibit?

MR. FLEISCHAKER: That's correct.

MR. NORTON: Three of them?

MR. FLEISCHAKER: We've been through this before. I'll get three copies of this map to submit for purposes of the record. I don't have three copies of it. We had it mounted like this for purposes of this hearing because we thought that this would be a way that we could present the evidence and discuss the testimony with reference to this map.

MRS. BOWERS: Well I think the witness has suggested he will give geographic locations. So we can follow.

MR. FLEISCHAKER: I propose that we move it up closer to the Board.

MR. NORTON: I think that's a good suggestion



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exhibit number. I can't find it. It's a USGS map.

MR. MORTON: I don't believe this map was previously marked as an exhibit, Mr. Fleischaker. But I'm not sure.

MR. FLEISCHAKER: Well I think we can make it for purposes of identification.

MR. MORTON: Well I'd like to see it.

MR. FLEISCHAKER: Okay. Fine.

Before we go any further, I'd like to have this map, which is the USGS map that's referenced in the testimony, the first reference, Buchanan-Banks, Pampayan, Wagner and McCulloch, 1978, Preliminary Map Showing Recency of Faulting in Coastal South Central California, U.S. Geological Survey, Miscellaneous Field Studies Map MF 910, three maps at 1:250,000. I'd like to have this marked as Joint Intervenor's Exhibit 51.

(Whereupon the document referred to was marked for identification as Joint Intervenor's Exhibit 51.)

MR. MORTON: Is this all three maps?

MR. FLEISCHAKER: Just one, or two of the three maps that have been put together for purposes of this proceeding.

MR. MORTON: May we have a copy of it so we can follow what is being said? That's my problem. You know,

wb5

1 difficulty in trying continuous lines from where a fault is
2 seen onshore to where a fault is seen in the offshore. And
3 this is due to the fact that it is very difficult to inter-
4 pret seismic reflect data or even run a ship close to shore --
5 run a ship in when you're in very shallow water. And to
6 cover problems such as this--

7 MR. NORTON: Excuse me, Mrs. Bowers. I'm sorry
8 to interrupt.

9 Is this map in the testimony?

10 MR. FLEISCHAKER: This map is referred to in the
11 testimony.

12 MR. NORTON: I can't possibly see any of the
13 lines from where I'm sitting. I don't know if the Board
14 can, but I tend to doubt it. I can't see any lines at all
15 from where I'm sitting. I just can't make out a thing. I
16 can't follow what he's saying. I hear the words, but I
17 can't make it out looking at the map from here. Believe me,
18 I just can't see it.

19 WITNESS SILVER: I have one extra copy of the
20 map.

21 MRS. BOWERS: Is this the same map that was
22 color coded in Dr. Jahns' testimony?

23 MR. NORTON: No.

24 MR. FLEISCHAKER: It is not. This is a map that
25 we had previously marked as an exhibit. I'm looking for the



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WITNESS SILVER: I would just like to briefly summarize my testimony, and I'd like to do this in reference to this map which is a Preliminary Map showing Recency of Faulting in South Central California, put together by Buchanan-Banks, Pampeyan, Wagner, and McCulloch of the U.S. Geological Survey in 1978. This was prepared on behalf of the U.S. Nuclear Regulatory Commission.

The point I want to make from this map is basically: this shows from the area of Ano Nuevo in the north down to the area south of Point Sal that we have an essentially continuous fault zone which is the combined San Gregorio-Hosgri fault zone.

This work was referred to by Dr. Graham. The continuation of the San Gregorio Fault zone has been made to the north to intersect the San Andreas Fault north of San Francisco in the area of Bolinas.

Here on their map -- and I have spotchecked their data -- the offshore data is based primarily on seismic reflection information. There is additional information, additional data, aeromagnetic data, gravity data, etc. I've used these kinds of information to check on the constraints of this map. But basically this map shows fairly clearly the extent of the combined San Gregorio-Hosgri fault zone.

In reading a map such as this, especially relying on the seismic reflection information, one can see some

wb3

note there is an intertwining. They haven't adopted each other's testimony, but let me point out the reason we have them up there together.

In Dr. Graham's correlations he relies on work that was done by Dr. Silver. And so there may be questions to Dr. Graham about the seven sets of correlations and there may be a question to Dr. Graham about the correlation for which he relies upon Dr. Silver's work. And at that point it may be more useful to have Dr. Silver answer the question.

Likewise, Dr. Silver in reaching his conclusions relies on some of the work of Graham and Dickinson. And so when there's a specific question to Dr. Silver about his reliance on Graham and Dickinson, or some specific aspect of Graham and Dickinson, it may be as useful for Dr. Graham to respond.

But I leave it to Mr. Norton to decide how he wants to proceed.

MRS. BOWERS: Mr. Tourtellotte, does the Staff agree with the procedure that is suggested?

MR. TOURTELLOTTE: Yes.

MRS. BOWERS: Fine.

Well, why don't you proceed, then, with Dr. Silver?

MR. FLEISCHAKER: Before you proceed, let me identify the exhibit that's on the stand.

wb2

I'm just confused by what he means by "They're up there as a panel." I don't understand that.

MRS. BOWERS: Mr. Fleischaker?

MR. FLEISCHAKER: Mr. Norton, of course, has the right to limit his questioning to any individual, and to limit that questioning, of course, to their testimony. However it may well be that one of the other members might be able to address the question raised. If that's the case Mr. Norton can accept that. He doesn't have to. The Board may also wish to have questions that one or the other -- that either one of the people can raise.

I'm not objecting to Mr. Norton's way of proceeding. If he wants to limit his questions to any individual that's certainly his right, that's his right to proceed that way in cross-examination.

MR. NORTON: Okay. I presume if I ask a question that doesn't appear in Dr. Graham's testimony and also doesn't appear in Dr. Silver's testimony, in other words a general question about geology, or a general question about magnitude, or something like that, then either one of them could respond. But as long as we're talking about the subject matter of one's testimony, I presume we're directing our cross-examination at that one individual, because they've not adopted each other's testimony.

MR. FLEISCHAKER: That's correct. But I would

eb1 because these things are so big that we've been given-- That's
fls wh7. been cut. And what we've got here we can't spread out to
look at either. On the part where he's showing faults and
stuff, you can't possibly see it.

MR. TOURTELLOTT: I was going to ask Mr. Fleischaker
if he was suggesting that we move it away from the Staff.

(Laughter.)

MR. FLEISCHAKER: I'm trying to work out a way
that everybody can see it conveniently. We had it mounted
especially in anticipation of this problem, and this was our
best solution. I'm sorry we don't have eight maps to go
around for everybody.

MR. TOURTELLOTT: I'll stand over where I can
watch it.

MR. FLEISCHAKER: This was our best effort to try
to get an exhibit that everybody could look at so that the
testimony would make sense.

WITNESS SILVER: Again the way I'd like to
summarize this is it does indicate to me an essentially con-
tinuous fault zone, at least from the northern end of the map
at Ano Nuevo down to the south, to the area just south of
Point Sal. I say "essentially continuous" because the lines
are not drawn continuous; there are gaps. There are small
gaps.

One area of difficulty in observing the direct



eb2

connection is the area just north of Point Sur where the San Gregorio Fault is inferred to go onshore, and that area is controlled by detailed offshore bottom gravity studies by Woodson, and that's referred to in the testimony.

Another area where the map does not show a direct connection but where I believe one exists is in the area just north of Ragged Point; just north of the San Simeon headland north of Ragged Point a gap is shown here on the map, which only I can see.

Buchanan, Banks and others show three strands of the fault ending in question marks, queries, and the significance of the question marks on this map is that they infer that that's as far as they can trace the fault. They infer that the fault is somewhat longer.

If one projected that that projection of the San Simeon Fault --

MR. NORTON: Excuse me. You just said that the question mark shows that it is inferred that it goes longer. Is that in the legend? I see there's a huge legend up in the upper right-hand corner.

WITNESS SILVER: Yes. That is how they interpret a queries at the end of a fault, meaning they don't have the data past the end of that question mark. They infer, although they don't have the data, that the fault would be longer but they don't know how much longer. That is, they have not

eb3 mapped the end of the fault. They just simply have run out of
2 data.

3 It does not mean the fault does not end shortly
4 after that. It simply means they have not mapped the end of
5 the fault.

6 MR. MORTON: Could you tell us where that is in the
7 key where it says that, because I can't read it.

8 MR. FLEISCHAKER: I can ask a clarifying question.

9 BY MR. FLEISCHAKER:

10 Q Is a query on a map a commonly accepted geological
11 expression, Dr. Silver?

12 A (Witness Silver) Yes. It means various things.
13 It could mean uncertainty in the location of the fault, and
14 they do show where they have queries within the trace of
15 the fault where they have dashes and then queries that those
16 infer some uncertainty in the location.

17 Where they have a query at the end it infers un-
18 certainty as to the direct end, the exact end of the fault.

19 The point I'm making is where they map a query
20 here they have not shown that the fault has ended.
21 They have simply run out of data at that point.

22 Q Okay.

23 Could you continue?

24 MR. TOURTELLOTT: Before he continues, I would
25 like to interpose an objection rather than asking a question

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as Mr. Norton said.

It seems to me that the legend of the map tells exactly what it is: a junction mark at the end of the line, and it is not clear that it is a junction mark. It is a junction mark from someone's reflection profile, located in approximate. And that's all that says. And it seems to me that if Dr. Silver is going to testify about what the meaning of the map is, that he ought to stick with the legend or come up with some evidence of his own from the people who use the map.

Consequently, I would ask that his remarks about what the legend means be stricken, because that's not what the legend says.

MR. FRIEDMAN: I would like to get one thing clear. I understood the rules to be that there was to be an introductory statement and after the introductory statement there was going to be cross-examination.

Now all of the witnesses have had opportunities to get up and make introductory statements without interruption by Counsel. I think that the rules that apply to the Applicant and the rules that apply to the Staff should equally apply to the Intervenor. And if Mr. Fourtellette and Mr. Norton have questions, then they can raise those questions when their turn for cross-examination comes.

But the purpose of this is to permit Dr. Silver to summarize his testimony. Mr. Fourtellette can bring his



eb5

1 point out on cross-examination, so I'm going to object to any
2 further interruptions.

3 MRS. BOWERS: One of the physical problems here
4 is that Dr. Silver couldn't see the high part of the map to
5 read the legend, so he was attempting to give his own explana-
6 tion of normal practice.

7 MR. NORTON: Mrs. Bowers, I think Mr. Fleischaker's
8 point is in part well-taken. However, the only reason I
9 interrupted was I wasn't sure-- This is 2 of 3 maps. I
10 thought perhaps he had a different legend than I did because
11 he was saying something different than I was reading in the
12 legend, and that's why I interrupted to find out if we had
13 the same legend, because I can't see from here what legend
14 he has.

15 I apologize for the interruption.

16 WITNESS SILVER: It says:

17 "Query: where connection, continua-
18 tion or existence uncertain."

19 MR. FLEISCHAKER: I'd like to see if we can agree
20 to a groundrule that there won't be the kinds of objections
21 that Mr. Tourtellotte made because I understood that that was
22 the rules by which we were proceeding, and that was the rule
23 that I adhered to with respect to the Applicant's presentation,
24 and I think that it's unfair and unnecessary to interrupt
25 our summary statement with objections.

eb6

MR. TOURTELLOTTE: I disagree altogether because the fact that Mr. Fleischaker didn't see fit to interpose an objection has nothing to do with this particular situation. Perhaps, just perhaps the other witnesses were testifying about things without making mischaracterizations. I think I have the right, if this witness is going to testify about a map, to object to his introducing into the record and into the evidence mischaracterizations of the map which are clearly stated.

Now if there's something on that map that is different from my map, I also think that that would come out upon stating an objection, but I don't believe that anybody has the right to summarize and put into the record matters as evidence which are actually inaccurate and incorrect. I don't think we have to wait until he gets through to make our objection.

MR. FLEISCHAKER: Mrs. Bowers, the way that it is done in other proceedings is to put the evidence, the testimony into the record and begin cross-examination right then. But I understand we've adopted a different method, and that purpose is to allow the witnesses to summarize their testimonies both for the Board and for the public. And to have this kind of disruption entirely defeats that purpose.

And I believe Mr. Tourtelotte and I have a direct disagreement and I would request the Board to lay down the



eb7

rule.

MR. NORTON: Excuse me, Mrs. Bowers. I would only remind the Board of Dr. Enright's testimony two years ago at the Ramada Inn where, during his summary, we made an objection to strike it because it contained all kinds of material that he didn't have in his direct evidence or in his prepared testimony, and the Board granted that motion because he was way far afield from where he had been in his prepared testimony.

So interposing an objection during summary is totally appropriate and it has precedent in this proceeding. In fact, such a motion was granted in that specific instance.

MR. FLEISCHAKER: If introductory statements are going to be made open game, let's tell me because I'll treat them as such.

MRS. BOWERS: Well, we do feel it's appropriate during the summary testimony when a matter comes up such as was phrased by Mr. Tourtellotte to, at that point, get the clarification or objection in.

Now we have a real logistics problem here in the fact that Dr. Silver can't read the top of the legend because it's too high, it's too far away from him. The rest of us don't have copies.

So anyway, we do think that the legend speaks for itself even if we can't see it and that as long as it has an

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explanation of certain matters that that should speak for
itself.

I think Dr. Silver was not aware of that particu-
lar part of the legend when he attempted to explain general
usage of symbols.

WITNESS SILVER: I will try to keep my comments
restricted to those that one doesn't have to get a nose right
up to the map.

MR. FLEISCHAKER: Well, I'm still not sure, are
the opening statements open for objection?

MRS. BOWERS: If the objections are appropriate.

MR. FLEISCHAKER: Okay.

MRS. BOWERS: I think everybody attempts not to
interrupt any more than necessary, but I know when Dr. Graham
was testifying and he used the word "thickness", I had no idea
what that meant and thought it was more appropriate at that
time to have the record clarified.

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Was it a motion to strike the testimony different from the legend?

MR. TOURTELLOTT: Yes.

MRS. BOWERS: Well the motion to strike is granted.

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WITNESS SILVER: Let me get back to this.

The map shows three segments of the fault where they mapped it ending in queries, and a gap on the map between the queries and the traces of the San Simeon Fault Zone on land.

I believe myself from looking at another map, a published aeromagnetic map that I'll refer to in a minute, that these traces do connect with the San Simeon Fault Zone.

To the south, they have also mapped the very continuous Hosgri Fault Zone from south of Point Sal up toward and projecting to the San Simeon Fault Zone, to the south end of the San Simeon Fault Zone.

However, again they show a gap in the near-shore region where the fault does not connect through. Had one made a straight projection from the southern part, the dominant part of the Hosgri Fault, northward without the bends that they show here, one would have projected a continuous fault, however they do not map that.

I'd like to point out that in this area just south of San Simeon, while they do not map a connection, they write "No data." What this means is not no data of any



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kind, but virtually no seismic reflection data on which they can draw a conclusion of whether or not there is continuity between these two zones.

Now, if I could refer to another document -- I believe everyone has this -- this would be the written testimony, Volume One, of Bettinger, Hamilton, Jahns and Smith, and I'd like to refer to Figure 42 of that document, which I hope everyone has.

Figure 42 is a portion, a part of the aeromagnetic map. Unfortunately, it does not show the coastline, so locating geographic features may be a little difficult, and I'll try to help you out in that.

But it locates --

MR. NORTON: Excuse me, is this reference to the direct testimony, Dr. Silver?

WITNESS SILVER: No, it is not.

MR. NORTON: Mrs. Bowers, I don't understand why if this is a summary of his direct testimony he's now discussing maps of Applicant's witnesses.

WITNESS SILVER: I'm sorry, I'd like to discuss the aeromagnetic map, which I do discuss in my testimony, and I'm just trying to find a simple way to do that.

MR. FLEISCHAKER: Let me respond for Dr. Silver.

We discussed this last night, the easiest way for everybody to look at the aeromagnetic map, which is referenced

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in his testimony, we have a copy of it here. And it appears to be the same map that is set out here in the applicant's testimony or a portion of it is.

So that we thought, for everyone's convenience, we could look at Figure 42, and that's the reason that we are referring the Board to Figure 42, because it is a convenient vehicle for viewing the map that is, in fact, referenced in Dr. Silver's testimony.

MRS. BOWERS: With that explanation, Mr. Norton, do you have any further problem with this?

MR. NORTON: Well, with that explanation, I don't think I will, but I might have, it depends on where he goes.

WITNESS SILVER: Figure 42 shows a portion of the aeromagnetic map run by the U.S. Geological Survey and the California Division of Mines in the area both north and south of and including the San Simeon headland, and it also includes this region that I was just discussing south of San Simeon, which has bearing on possible connections between the Hosgri Fault and the San Simeon Fault Zone.

To get some orientation, the San Simeon Fault goes offshore to the south, just about in the area of the end of the word, "Fault," essentially at the LT of "Fault" in the central part of the diagram. That represents the little cove just at the south end of the San Simeon headland where the San Simeon Fault would be projecting offshore to the

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south.

Now this map is the Applicant's and they've drawn their own interpretation of where the fault is.

Now the Hosgri Fault Zone does not show up so clearly on the aeromagnetic map from the south, and the Applicant has drawn at least a strand of the Hosgri Fault Zone coming up from the north at the south end of the map, so that black line essentially at the bottom of the page essentially right of the central part right of the middle of the figure, the black line that lies south of the word, "Fault Zone," trending up is part of the Hosgri Fault Zone or is in the vicinity of the Hosgri Fault Zone.

Now, as far as my own interpretation of this aeromagnetic map, first of all, one cannot go from this map and draw a unique conclusion of whether or not there is a connection between the fault zones. However, one can rule out certain connections and show where other connections might be possible, especially in the zone where it's very difficult to get seismic reflection or to interpret seismic reflection data.

One possibility is, for the Hosgri Fault Zone coming up from the south to join that major trace of the San Simeon Fault, that is, that dashed line in which the Applicant has inferred the existence of the San Simeon Fault.

Another possibility is that the Hosgri Fault

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extends northward along a north trending -- a northwest trending magnetic gradient, and here it may be a little difficult to locate. But one can see,... Let me try to describe the map so it's a little clearer.

One can see going to the north, just to the left, to the west of the word, "San Simeon Fault," on the other side of the dark line there's a very pronounced elongate magnetic high, and that magnetic high can be extended southward to a somewhat broader, not quite so peaked magnetic high, which goes south and ends in a small nose.

Now one could, from this map and this map only, project the trace -- project a hypothetical trace of the Hosgri Fault along the nose or along the west side of this magnetic high parallel to that very pronounced magnetic gradient northward across the San Simeon headland to the north of almost the straight line and somehow intersecting the San Simeon Fault to the north.

The point of the testimony is not to say that in fact this documents such a connection, it does not. The point of this testimony is that it certainly does not rule out such a connection, and it might be a reasonable kind of connection to make from this sort of data.

So, in summary, as far as the location and the length of the fault, the map of Buchanan-Banks and others indicates a nearly continuous fault zone from the area of

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San Francisco -- well from the area of Anc. Juv. and other work projects it runs to San Francisco and slightly north southward to the area just south of Point Sal.

There is some question as to the continuity between the San Simeon segment and the Mosqui segment, from what I've seen in the data, I think we cannot rule out a connection, nor do I think we have enough data to make an absolute connection on the ground.

Now, there's some other lines of evidence that bear on the nature of a possible connection, a possible throughgoing connection of this long fault zone. The second kind of evidence is basically the evidence presented just now by Steve Graham for possibly very large geologic slip on this fault zone.

If that interpretation does prove to be correct, that requires that at least during the time that this fault was active we must have had a continuous zone of crustal breakage along that whole segment.

The conclusion of a possible continuous fault zone from somewhat south of Point Sal to the area north of San Francisco suggests that we may be dealing with a fault zone, albeit complicated, a fault zone approximately 400 kilometers in length.

And this gets to the next aspect of the testimony dealing with how one makes an interpretation of what might

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be the maximum expectable earthquake along a long fault zone, especially along a long fault zone for which we have a rather limited seismologic record, the seismologic record does not go back very far in time, certainly it is much less than a century.

Now there have been several ways suggested for which one can make this kind of an evaluation. Neither way requires that the fault, in fact, be capable of this maximum earthquake, but there have been ways of estimating what might be a possible maximum earthquake for a fault of a given size.

One way was suggested initially by, well, it was suggested early on by Bonilla and Marks and somewhat later, I believe in 1977, by Marks himself. And this was to essentially graph the known data relating measured fault length along a slip zone, a zone of slippage during an earthquake, with the maximum earthquake that was observed on that fault zone.

They found a great deal of scatter in their results and they, essentially, drew a line of regression that related the log of the magnitude with fault length.

Their graph is not a terribly precise graph to use, that is, there's a great deal of uncertainty, that is, one can often observe large earthquakes on rather small faults.

But in general, the larger the fault zone, the larger the expectable slip, especially for strike-slip fault



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zones as is inferred for the Hogri-San Gregorio.

MRS. BOWERS: Mr. Fleischaker, I hesitate to interrupt. We've learned from experience if we don't break at 12:00 we run into a problem with being served in the restaurant. I can't know how close one witness is to concluding.

WITNESS SILVER: Maybe five minutes, but I'd be happy to break.

MRS. BOWERS: Well, go ahead.

WITNESS SILVER: If we use that curve to get a rough estimate, we can see that if we took a length of fault 400 kilometers long, the relations of Marks and Bonilla would predict that their data set approximately 50 percent of the faults greater -- with a slip length of greater than 400 -- of 400 kilometers or greater were capable -- had earthquakes of magnitudes, in the order of magnitude 8.

Okay, now a second approach was one that was offered by Stewart Smith as an answer to Question 2.17 by the NRC. The question was:

"Provide additional discussion and arguments for determining the maximum earthquake that can be expected on faults of various lengths within the San Andreas system and relate this to historic seismicity."

I won't go through their methodology, that would



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take some time and everybody concerned has this documentation, I believe. But Smith developed, using the well-known relationships that had been developed earlier by other seismologists between seismic moment -- that related seismic moment and fault slip. He determined a method for estimating maximum magnitude that could be expected. What he had to know was, within a given time period, how much fault slip would have occurred. He had to know the area over which the slip would occur, or he had to estimate the area. He had to have a value and he had to have a value for rigidity.

Now, the values he used for the Hosgri, I believe, were too small for estimating maximum magnitude, based on two pieces of evidence: one, the suggestion that has been made in a number of cases that the Hosgri-San Gregorio is a continuous fault zone perhaps approaching the order of 400 kilometers long. This is a longer fault than he was dealing with.

But secondly and much more importantly, the number that was used for determining fault slip during a period of time. Now he used a very low number for fault slip and his conclusions for maximum earthquake were certainly precise. But as far as I can read from the geologic literature, there has been only one major study of the rate of offset along this fault zone, the San Gregorio-Hosgri Fault Zone.

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One detailed study that gives you an estimate of the rate of offset in the late Pleistocene, that is, in the last 1- or 200,000 years, that would be of great interest to this kind of work and that is a study by Rimmer and Lajoie that was initially published as -- given as an oral publication, given as an abstract in the Geological Society of America abstracts with programs in April, 1977, in Sacramento.

And Rimmer and Lajoie concluded that during the past 200,000 years -- in this abstract, what they concluded is that the average rate of slip along three combined traces that they measured of the San Gregorio Fault Zone at Ano Nuevo, which is very far north of here but along the San Gregorio Fault Zone, was between a minimum of 0.63 centimeters per year and a maximum of 1.3 centimeters a year.

Now, since then Weber has increased this maximum slightly to 1.6 centimeters a year. But if one takes values of that order 1.3 or 1.6 -- I used in my testimony 1.6 centimeters a year for the maximum, and a length of fault 400 kilometers long, and to simply be less conservative than Smith had done, I used a time span of 1000 years rather than 10,000 years -- using this formulation, I concluded that the maximum earthquake by this method would be approximately 8.25.

So the point of this is not to put these numbers out as firm numbers for an expected earthquake of this fault,

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1 they are conservative, they are maxima. And even if the
2 length, the rate of slip and all these other things were
3 very precisely determined, it still does not ensure that the
4 fault zone itself will have an earthquake of that magnitude,
5 it simply sets a maximum limit on the outer expected magnitude
6 that one might look for within a certain length of time.

7 I think I'll stop there. Thank you.

8 MRS. BOWERS: We'll reconvene at a few minutes
9 after 1:00.

10 (Whereupon, at 12:05 p.m., the hearing in the
11 above-entitled matter was recessed, to reconvene at 1:05 p.m.,
12 this same day.)
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AFTERNOON SESSION

(2:05 p.m.)

MRS. BOWERS: We'd like to resume.

Whereupon,

STEPHAN ALAN GRAMAM

and

ELI ALFRED SILVER

resumed the stand as witnesses on behalf of the Joint Interveners, and, having been previously duly sworn, were examined and testified further as follows:

MRS. BOWERS: I would like to remind people who are in the audience that Counsels' notes are confidential work products and you are simply not free to come up to various Counsels' tables and review their writing. And that goes for everybody in the audience.

Now of course, those who are members of a group would naturally from time to time be consulting with their Counsel, but I'm just talking about other people.

Do you remember, Mr. Tourtellotte, at the two weeks of environmental issues, the Staff set up a table where you put your exhibits and your direct copies, 30 some copies, and then you found that people misunderstood and thought that that was set up to make all those documents available to the public.

Do you recall that?

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MR. TOURTELLOTT: Yes.

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MRS. BOWERS: Well, anyway, we do want you to remain behind the line, except when you're members of a group and you're consulting with your Counsel.

3

Do you remember in the movie Gaslight --

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(Laughter.)

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-- where Ingrid Bergman was losing her mind because Charles Boyer was making the lights flicker?

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(Laughter.)

7

MR. TOURTELLOTT: I hope it isn't Charles Boyer right now.

8

(Laughter.)

9

Or we're all in a lot of trouble.

10

MR. NORTON: That's a 10-4, big buddy.

11

(Laughter.)

12

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

13

MR. FLEISCHAKER: Yes, ma'am.

14

I believe that that completes the presentation of the witnesses and the introductory statements.

15

I'd like to offer Joint Intervenor's Exhibit number 51 into evidence, which is the USGS map. And we will obtain copies of the two plates that have been mounted in a sufficient number to submit them for the record.

16

MRS. BOWERS: Copies for the Board and all parties and the three sets?

17

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MR. FLEISCHAKER: Yes, we will get sufficient copies. We will get those at Manila Park.

MRS. BOWERS: When you are marking it 51, is that right?

MR. FLEISCHAKER: That's right.

(Whereupon, the document referred to was marked as Joint Intervenor's 51 for identification.)

MRS. BOWERS: And you are now offering it in evidence?

MR. FLEISCHAKER: That's correct.

MR. NORTON: I would suggest that they be marked 51 and 52 because they will be two separate maps.

MR. FLEISCHAKER: Yes, that's a good suggestion.

(Whereupon, the document referred to was marked as Intervenor's Exhibit 52 for identification.)

MR. NORTON: We have no objection.

MR. TOURTELLOTT: No objection.

MRS. BOWERS: Well, the Joint Intervenor's Exhibits identified as numbers 51 and 52 are accepted in evidence.

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(Whereupon, the documents
previously marked as
Joint Intervenor's Exhibits
51 and 52 were received
in evidence.)

MR. FLEISCHAKER: That is all, Mrs. Bowers, and
the panel is now prepared for cross-examination.

MRS. BOWERS: Mr. Norton?

CROSS-EXAMINATION

BY MR. NORTON:

Q Dr. Graham, at your deposition you characterized
the presentation that you have made as a theory on a number
of occasions, and we've discussed the use of that word and
you agreed that that was the best word to describe it, is
that correct?

MR. FLEISCHAKER: Objection.

The basis for this objection is that the purpose
of the deposition is to be used -- I mean, the deposition is
not evidence. It is not admissible as evidence. It is to be
used for purposes of impeachment. And until Mr. Norton can
demonstrate an inconsistency between this witness's testimony
and something stated in the deposition, the deposition is not
to be used.

Mr. Graham has submitted sworn testimony and he
is to be cross-examined on the basis of that sworn testimony.

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And until such time as an inconsistency can be demonstrated the deposition is not to be used.

MR. NORTON: Mrs. Bowers, I can't believe I just heard that. Would Mr. Fleischaker care to cite some authority of law for that provision? I've never heard that.

MRS. BOWERS: Mr. Tourtellotte -- let's give Mr. Fleischaker an opportunity.

MR. FLEISCHAKER: I can go into my evidence book here, McCormick, and find a specific citation, if that's what we need.

I think it's a well established rule of law that a prior statement is used for purposes of impeachment and purposes of impeachment only. And before you can use a prior statement for purposes of impeachment it has to do a couple of things:

First you have to establish the time and the place. You have to indicate the person, and you have to also discuss with the witness the subject matter. And then you can require the witness to examine the prior inconsistent statement and read it into the record.

But a deposition is not testimony and it is not to be used to test testimony when you have consistent statements. It's only used in the instance of inconsistent statements.

MRS. BOWERS: The Staff?

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MR. TOURTELLLOTTE: I would like a citation of authority.

MR. NORTON: Mrs. Bowers, I can only say that that is mind boggling. I have never heard that argument in my life. And if Mr. Fleischaker can come up with a statement of authority -- he's absolutely right, the deposition is not in evidence. He's absolutely right about that.

But I can ask any questions about that deposition I want. It's no different than an article that he's published.

Is Mr. Fleischaker willing to carry that argument to the articles these gentlemen have written? They weren't even under oath, as the deposition was when written.

MRS. BOWERS: Well, I know that at the two weeks of evidentiary hearings on environmental issues parties were certainly permitted to refer to the depositions to refresh the recollections and to discuss matters that were within the deposition.

MR. FLEISCHAKER: This witness, however, has shown no lapse of memory. And so it doesn't seem to me that the deposition is an appropriate instrument to be used in this case either to refresh his recollection, because he's shown no lapse of memory, or to impeach him because he has yet to be demonstrated that his statements under deposition were inconsistent with the testimony he has given to this Board.

MR. NORTON: Mrs. Bowers, this is kind of a silly



objection and argument anyway, because I can ask those questions. You know, I can read them from the deposition if that would please Mr. Fleischaker.

I'm trying to proceed quickly in a very normal acceptable practice. And the objection has no basis in law whatsoever.

MR. FLEISCHAKER: Excuse me.

The way to proceed is to ask him Would you characterize this as a theory. If he doesn't characterize it as a theory then he can certainly go ahead and impeach him on the basis of his prior deposition or prior sworn statement.

But he can't proceed by cross-examination on the basis of that deposition as the instrument from which the question flows. It can only be used, one, to refresh recollection, and, two, to impeach in the case of a prior inconsistent statement.

It's absolutely black-letter law.

MR. MORTON: Well, then, perhaps if it's such clear black-letter law, you shouldn't have any trouble finding it in your volume, and then you could cite it to us.

MRS. BOWERS: I remember one example.

Mr. Morton, you said to a witness What did you mean when you said a 'seat of the pants' estimate, and he said I wouldn't have said that. And you said, Well, it's

mpb5 1 right here. And then I found several pages earlier that you
2 had asked the question using the term.

3 MR. NORTON: Yes.

4 (Laughter.)

c7 5 MR. NORTON: Well, Mrs. Bowers, unless Mr.
6 Fleischaker can come up with this black-letter law, I would
7 suggest we proceed because he isn't going to find it and
8 we're going to be here a long time while he's looking.

9 And I would ask for a ruling from the Board so
10 we can proceed.

11 MRS. BOWERS: Well, we'll give him a few minutes.

12 MR. FLEISCHAKER: I don't understand why the
13 burden is on me, although I'll look for the law. I haven't
14 heard any citations from either of the Counsel on either side
15 of me.

16 MRS. BOWERS: We heard the one that was suggested,
17 that you could put your finger on it.

18 (Pause.)

19 MR. NORTON: Mrs. Bowers, while he's looking
20 I'll reask the question, so the objection doesn't matter.
21 I'll ask the question another way so that we can proceed and
22 he can continue to look.

23 MR. FLEISCHAKER: Fine. I don't have any problems
24 with that.

25 MRS. BOWERS: Fine.

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BY MR. NORTON:

Q Dr. Graham, would you be disappointed if the work you had done proved to be wrong?

A (Witness Graham) No.

Q And why is that?

A It's a piece of geologic work we drew together to try to explain a set of relationships we observed along the California coast. As such, it constitutes I think a theory. It is a theory.

However, it is a theory that represents our most reasonable interpretation of these relationships.

Q Right.

And it is indeed a theory, and that's how you've characterized it before and continue to characterize it today. Nothing has happened between November 21st at 8:30 p.m., and today to change your opinion, has it?

A That's correct, Bruce. I think it's a fine work.

Q And it's a theory?

A Yes.

Q Well, let's leave theory for a moment and go to Dr. Silver.

Dr. Silver, one of the points, offset points used in the Graham-Dickinson article as testified in both the article and in the summary we heard this morning was your offset point suggested in 1974, is that correct?



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mpb? 1 A (Witness Silver) Yes, that's correct.

2 Q All right.

3 Dr. Silver, you might as well move that micro-
4 phone over there by you because I think we're going to be
5 together for a while.

6 Now that first came out in an abstract, or you
7 gave a presentation in 1974 and the abstract actually came
8 out in 1976, is that correct?

9 A No. The abstract was published in 1974.

10 Q Well, the copy I have comes from the Geological
11 Society of America, Abstract with Program, Cordilleran Section,
12 Las Vegas, Nevada, 1976.

13 Is that just the wrong year, because the "76"
14 is written in in pencil. Or was it at 1974? There is no
15 data on the printed abstract. Somebody had written across
16 the top where it appeared, and they may have just written
17 down the wrong last number.

18 A Yes, it's 1974, Geological Society of America,
19 Abstracts with Programs, Volume 6, Number 3, page 253. That's
20 enough to determine the year.

21 Q All right.

22 Well, I have a copy of that page, 253, which is
23 the one your abstract appears on.

24 MR. NORTON: And I'd like to at this time have
25 this marked as Applicant's Exhibit number 30. And there is a

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pencilled note at the top which identifies Geological Society of America (GSA) Abstract With Program. And then it has 1976 written down there. That was written by someone, I don't know whom, and it can be disregarded.

(Whereupon, the document referred to was marked as Applicant's Exhibit 30 for identification.)

BY MR. MORFON:

Q Now you've been handed a copy of Applicant's Exhibit 30, and I ask is that a true and correct copy of your abstract?

A Believe me, it was photographed. You don't have to read each and every word.

A (Witness Silver) That's correct. I haven't read it for a while.

Q Now that conclusion that you drew was based on gravity data, was it not?

A Which conclusion, the end or --

Q The offset.

A No.

The offset was based on using gravity data to constrain geologic interpretation in the offshore region west of Ano Nuevo to get some idea of the geologic structure of that region. The offset itself was based on geology, that is,



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mpb9 : my inference of the geology of that region based on gravity
and the published geology farther to the south.

I'd be happy to amplify on that.

Q That's not necessary.

A Okay.

Q Now we asked about that in your deposition taken
on October 26, 1978, and I'm going to quote to you your
answer and ask you if that is consistent with the answer
you have given here today.

It starts at line 19. It says:

"Now a third offset is one that I suggested"--

A Can I ask which page?

Q Page 8 of the deposition, I'm sorry. I apologize,
I didn't give that. Page 8, line 19.

It says:

"Now a third offset is one that I suggested
in 1974. That is more -- in fact is more geophysical
in nature, looking at more of the gross basement
types and inferred basement types in the area. The
northern feature is what I have called the Farallon
Ridge. Now this is a ridge that can be traced off-
shore geophysically, both using seismic reflection
data and using gravity data. And on the basis of
gravity data I was able to define the shape of this
more precisely. One can follow this form, in fact,

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as far north as Point Arena, offshore of Point Arena south from the Farallon Islands, from which it derives its name, continuing south and bending toward the coast, bending southeastward toward the Ano Nuevo area, at which point the feature is truncated by the San Gregorio fault.

"I inferred that the most likely continuation of this ridge of rock could be found to the south, east of Monterey in the granitic basement of the Salinian Block. The reason I inferred that offset was that wherever we see or sample rocks of the Farallon Ridge it is granitic in nature.

"I also inferred that where we see the granitic rocks to the south, that is east of the San Gregorio fault in the Monterey area, they are truncated by complex fault zones. So while not actually mapping these fault zones along the whole length, but mapping them in local areas, I inferred a relationship between the Farallon Ridge structure and the Salinian basement structure in the Monterey area.

"When I matched these up I interpreted approximately 80 to 90 kilometers of offset on the fault."

I think that basically -- you go on to speak.

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but I think you then say what Graham and Dickinson did with that, and what I was concerned about was your answer.

Now, Dr. Silver, then you did infer this based on gravity data, correct?

A Based on gravity data to help constrain the geology. But the gravity data alone certainly can't give you a fault --

Q During that presentation in Las Vegas you also said that when the gravity data onshore was found you would expect it to be matching -- to show a matching pair, isn't that correct, where you projected that it would be, 80 to 90 kilometers south? You felt that when that gravity data appeared that wasn't available to you, that it would show a match.

A I don't remember that, and I don't see it in the abstract.

Q No, it's not in the abstract. It's what you said in the hearing -- at the meeting when you presented it.

A I honestly don't remember what I said. So I'm not arguing that I didn't say that, but I don't remember.

Q Okay, fine.

In any event, you later published an article which is Attachment B to your testimony, and that is an article that hasn't been published yet, but is in preprint form, is that correct? Attachment B to your testimony?



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A Attachment B? Oh, I'm sorry.

Yes, Attachment B hasn't been published.

Q Okay.

And these you again refer to back office, do you not?

A Yes.

Q All right.

When was that submitted? It hasn't been published. When was it written and submitted?

A Well, it's been written and revised over the past three years.

Q When was the last time you worked on it?

A Probably eight months ago, something of that sort. I can't remember exactly.

Q Well, didn't you review it before you admitted it as sworn testimony in this hearing?

A Oh. Well, I mean I guess I don't understand about "worked on". Yes, I did reread it.

Q And there isn't anything in there you would want to change based on any information you've gotten between eight months ago and the time of the sworn testimony, is there Dr. Silver?

A I couldn't honestly swear to that. I would have to reread it again to tell you.

Q Oh. All right.

mpb13

A I mean, I couldn't tell you --

Q How about CDM Special Report 137 that just recently came out in preprint? Now when did you work on that last?

A Let's see.

Q I believe it was at the time of your deposition, wasn't it, Dr. Silver? When we were taking your deposition you told me that you were doing your final editing things. You had just finished it and there weren't going to be any more changes?

A Right.

The final editing had been done significantly prior to that, actually, probably six or eight months prior to the time of the deposition. The final changes at that time were not in the way of major changes, but essentially typographical.

Q Okay.

A That's right. At that time there were no changes in this article.

Q And it hadn't been submitted for the preprint yet, had it, at the time of your deposition in October? It was in the process of being submitted and it had not physically been --

A No, that had already been submitted the previous -- quite some time before.

npb34

Q Well, let me ask you this. Let me try to do this by example.

If you write an article in your field and something happens and you want to change something -- let's say an off the top of my head example -- you stated a rock is ten million years and all of a sudden you get a notice from the lab that had done the dating work, Gee, we made a mistake, that's 100 million years old.

At what point can you change, when you've got a misstatement like that in your article where it says this rock is ten million years old, and it's of some significance, at what point can you change that -- or maybe better put:

At what point are you precluded from changing that?

A You're precluded from changing it once it reaches the printers.

Q All right.

Then obviously your Attachment B hadn't reached the printers.

A No.

Q All right.

And let's see, that CDM thing at the time of your deposition hadn't reached the printers yet, had it?

A No.

Q Okay.



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And in your deposition at pages 45 and 47, I asked you if there is any data -- I was in the process of asking you if there is any data that would change your mind or any data that you hadn't finished with or anything, or that you had new conclusions from, and you answered, line 18, page 46:

"Okay. There is a new unpublished and as yet an unfinal -- not in final form -- gravity map of the State of California that is scaled 1 to 750,000 put out by a number of people which I am a coauthor for my contribution in contouring some of this offshore data. It's just been shown to me in a form, a complete form, and I haven't at this time, right now, utilized that data, that map to come to any conclusions.

"So whether I will have a chance to do anything between now and the hearing, I don't know."

MR. FLEISCHAKER: I'm going to renew my objection.

The purpose of this objection -- or the basis of the objection is that the deposition is being used improperly. The witness takes the stand, he gives testimony. The purpose of cross-examination is to cross-examine the testimony that the witness admits to the Board.

The purpose of using prior statements is, one,

mpbl6:

to refresh the recollection of the witness, or, two, to impeach him when he has made a prior inconsistent statement.

This witness has not shown, with respect to this question, any lack of memory; and number two, I think that in McCormick, Chapter 5, Impeachment and Support, I think there is a clear statement that before prior inconsistent statements can be utilized to impeach a person, you have to demonstrate -- you have to lay a foundation in order to:

"One, avoid unfair surprise to the adversary;

Two, to save time as an admission by the witness may make the extrinsic proof unnecessary; and three, to give the witness, in fairness to him, a chance to explain the discrepancy."

There has been no discrepancy here. The witness -- excuse me, Mr. Norton is proceeding by way of using a prior statement for cross-examination. The purpose of a deposition is discovery. It is not to be used as a tool to bootstrap him to cross-examination. It's to be utilized, one, to refresh the witness's recollection when he shows that he can't remember the facts; and two, to demonstrate an inconsistency.

That hasn't been done here. Cross-examination is on the basis of the testimony, and that's how we should proceed.

So I object.

mpb17

MR. NORTON: Mrs. Bowers, I'm not impeaching the witness with reading that testimony at all. I'm pointing out the chronology of events.

At the time of his deposition that is what he had to say. I am not using it to impeach him in any way. I haven't said Well, that's inconsistent with what he said before, or anything else.

What Mr. Fleischaker just read is what you must do to use a deposition for impeachment purposes. In other words, if he had said something in contrary to his deposition, I must say Do you recall your deposition, and he says Yes, and Do you recall what you said then. And he says yes or no; and then I may use it.

But I'm not using it for impeachment purposes. His objection just has no basis. There's no basis for it at all.

MR. FLEISCHAKER: Excuse me, Mrs. Bowers.

He has no foundation for using that, that statement. Cross-examination is on the basis of the statement made here, and he can go to the prior document when there is a valid reason for doing so, to refresh recollection or a prior inconsistent statement. And he hasn't shown either of those circumstances in this case.

The purpose of the deposition is discovery. If the witness doesn't show up, then it might be introduced into



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evidence. But if the witness shows up and presents testimony, the cross-examination is on the basis of the testimony given to the Board. And he is cross-examining him on the basis of the deposition and he hasn't laid a proper foundation.

MRS. BOWERS: Mr. Fortbellette?

MR. FOURTELLOTT: Well, I think that's really a sort of a cramped interpretation of the law, and I don't believe that's what the law states, number one.

Number two, it isn't really consistent with the kind of practice we've had before the Commission. And number three is I don't think the underlying reasons for taking that sort of an approach are really the kind of reasons that we're interested in.

We're interested in seeing pursued in an administrative hearing, I think probably the way that Mr. Norton is proceeding is by far the most judicially efficient way to proceed, in the first place.

And in the second place, I don't really believe that Mr. Fleischaker's analysis of the legal points are valid. And that's why I asked initially for some citations, because if there's some new law on the books that I haven't discovered over the last 18 or 19 years, it would be very enlightening to me.

MRS. BOWERS: Well, Mr. Fleischaker, your objection is denied.

mpb39

Now at the prior segments of this proceeding, as well as other proceedings, administrative proceedings, the deposition is used as a tool to try to get a complete record. Your prior Counsel who participated in prior segments of this proceeding never raised this objection, and yet the same method was used.

So we'll proceed, Mr. Norton.

BY MR. NORTON:

Q Now, Dr. Silver, so you -- if I can chronologically do this, in 1974 some time you came up with this hypothesis based on primarily gravity data and what you would expect to find should there be new gravity data and what you knew of the rock formations.

A (Witness Silver) Again, the offset is primarily an offset, a geologic offset, using gravity data to try to constrain the geology. It's very, very difficult to get an offset using gravity alone.

Q And then in -- sometime in 1976 you wrote Attachment B, and you have again cited it. You cited it in your deposition in October of '78; you cited it in the special report 137 in 1978.

Did you ever receive data -- gravity data which refuted your theory in the interim?

A Well --

Q Yes or no, Dr. Silver. Did you receive gravity

mpb20

data which refuted your theory in the interim between 1974 and 1978?

MR. FLEISCHAKER: I'm going to object to Mr. Norton pushing Dr. Silver. It was apparent that he was either looking for papers or trying to get his thoughts organized. And I think that I'll object to that kind of repetitious questioning which may have the effect of unsettling the witness.

BY MR. NORTON:

Q I want a yes or no answer.

Did you receive and review such data, yes or no?

MRS. BOWERS: Well, the objection is overruled.

I think the witness does need perhaps a minute or two to review his --

MR. NORTON: He can have as much time as he wants. But he started off by saying "Well, uh...", and that was not a yes or no answer.

WITNESS SILVER: The exact answer to your question is no. However --

BY MR. NORTON:

Q Thank you.

MR. FLEISCHAKER: Mrs. Bowers --

MRS. BOWERS: He's entitled to explain.

MR. FLEISCHAKER: Exactly; right.



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WITNESS SILVER: I have some later recent

data, that is a complete gravity map based not only on the offshore data which I had only available to me prior to -- for all my previous work, but also the current data, including gravity data as well. And that was in actually published form in 1976, prior to the deposition.

BY MR. NORTON:

Q I would like to talk about that now. That's exactly what we're going to talk about.

MR. NORTON: At this time we would like to have marked as Applicant's Exhibit 31 an article entitled Interpretation -- well, let me strike that a little bit.

There's a cover sheet that says Interpretation of the Preliminary Gravity Map of California and its Continental Margin, E. W. Silver, Editor. And there is a Table of Contents of that entire thing.

And then there is one place written by Dr. Silver which is entitled -- let me find it just a moment -- Offshore Northern California (35°-42°N.) by E. A. Silver. And it follows from pages 73 to 81 -- or through 80, excuse me. And that is the portion -- the entire portion of Dr. Silver's article which we have attached here as Applicant's Exhibit 31.

I believe sufficient copies have been passed out to everybody.



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[Whereupon, the document
referred to was marked as
Applicant's Exhibit 31,
for identification.]

BY MR. NORTON:

Q Now, Dr. Silver, I would like you, if you would
to turn to page -- well, first of all, Dr. Silver, on the
upper right-hand corner it says "Revised 7/21/70, Silver".
And you mailed this to me, isn't that correct?

A (Witness Silver) Yes.

Q So you revised this on 7/21/70, is that fair to
say? That's your handwriting and your name?

A No, it's not my handwriting. It's my name, but
not my handwriting.

Q Did you revise it at that time?

A I don't remember the date of my own revision.

Q It was prior to your deposition, wasn't it?

A It was prior to my deposition.

Q All right, because you told me about it during
your deposition.

A Yes.

Q You didn't tell me what it said, but you told
me upon questioning that such a document did exist, is that
correct?

A I believe so.

mpb23

Q All right.

And I asked you to mail it to us and you did do that.

A Yes.

Q Now let's turn to page 75. And I would like you to read the paragraph that starts "The granitic rocks underlying..." through page 76, the end of the first paragraph, where the words "Oscar Santa Cruz" start. Read through that. In other words, two paragraphs.

A "The granitic rocks underlying the Farallon Ridge and Bodoga Basin are part of the Salinian block, a long sliver of dominantly granitic basement in central California, bounded on the east by the San Andreas fault and on the west, at least from Monterey south, by the San-Huachuapilla fault. The latter is probably offset across Monterey Bay in a right lateral sense by the San Gregorio fault zone. The amount of offset of a variety of geological features across this fault has been estimated at 115 km (Graham and Dickinson, 1973). Because the Farallon ridge is granitic whereas granitic rocks have not been recovered from the Santa Cruz high, it is possible that the west margin of the Salinian block passes between these ridges and lies

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along the west side of the Farallon ridge.

"The gravity data apparently conflict with the interpretation of large lateral offset on the San Gregorio fault. The gravity high that overlies the Farallon ridge intersects the coast at Pigeon Point and appears to continue onshore into the Santa Cruz Mountains over the Ben Lomond batholith. This continuity across the fault may be fortuitous. Many granitic masses occur in the Salinian block and the San Gregorio cuts the block at a low angle, so the chance of such a juxtaposition is significant. Alternatively, the continuity of the anomaly may indicate very little horizontal offset along the fault. A saddle in the gravity high and deflection of the contours in a right-lateral sense occur where the fault crosses the gravity high, as expected from the presence of such a fault, but these effects do not require large offset. Ironically, large right-slip offset on the San Gregorio was suggested initially on the basis of the offshore gravity map and the onshore geology, matching the Farallon ridge at Pigeon Point with granitic rocks just north of Point Sur (Silver, 1974). The geologic studies



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of Graham and Dickinson (1978) essentially support large right-slip offset, but the new gravity map presented here raises doubts about such an interpretation. We feel the continuity of the gravity anomaly is fortuitous and that the fault has undergone large Neogene right-slip. But a more vigorous study of regional geologic relations and an attempt to establish offset lines is clearly needed."

Q Thank you.

Now, Dr. Silver, can you tell me why you didn't include this information in your submittal to this Board?

Well, perhaps we can move on to another question.

Can you tell me why you didn't inform me of this during the deposition --

MR. FLEISCHAKER: Excuse me.

We have a question posed, and I think it's appropriate that the witness be given the opportunity to respond.

MRS. BOWERS: The witness should have the opportunity to answer in some way the question posed.

WITNESS SILVER: Okay.

This is a very preliminary document that I have developed here. This is a preprint. As such, the paragraphs

npb26

I've read to you have not been reviewed. They were done on the basis of the examination of the gravity map, again in a preliminary way. And that was my reading at the time.

BY MR. HORTON:

Q Well, let me see if -- you mean this isn't a conclusion on your part at all, this is just words?

A (Witness Silver) It is preliminary; it may be the final.

Q Does it represent a conclusion on your part of the data that you reviewed in preparing that article, that preprint?

A In preparing this?

Q Yes. It does represent your conclusion, doesn't it?

A Well, it doesn't give a conclusion. It gives an uncertainty.

Q Well, I thought it says:

"Ironically, large right-slip offset on the San Gregorio was suggested initially on the basis of the offshore gravity map and the on-shore geology, matching the Farallon ridge at Pigeon Point with granitic rocks just north of Point Sur (Silver, 1974)."

And then you say what Graham and Dickinson support. And then you say:



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"We feel the continuity of the gravity anomaly is fortuitous and that the fault has undergone large Neogene right-slip. But a more vigorous study of regional geologic relations and an attempt to establish offset lines is clearly needed."

And isn't that a conclusion?

A Oh, yes.

Q And yet in your deposition at page 46 and 47 you stated, line 24, the bottom of 46:

"It's just been shown to me in a form, in a complete form, and I haven't at this time right now, utilized that data, that map, to come to any conclusions. So whether I will have a chance to do anything between now and the hearing, I don't know."

My question to you, Dr. Silver, is:

Why didn't you tell me then when you were under oath about these conclusions?

A Well, what I said was basically right: I haven't had -- really I hadn't at that time -- I mean I haven't until this time had a chance to go over the gravity map in a careful way.

The conclusion based here is -- it says, number one, that there's an uncertainty involved in the offset, and secondly --



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Q Excuse me, Dr. Silver--

MR. FLEISCHNER: Hold on.

MR. NORTON: Excuse me, Dr. Silver.

MR. FLEISCHNER: Just a minute.

I'm going to object as counsel constantly interrupting the witness. I think the witness is trying to explain his answer and he should be given adequate opportunity to do precisely that. He's dealing with a technical subject matter that requires interpretation about analysis, and he should be given an opportunity to explain fully his position.

Mr. Norton apparently does not want to hear that explanation. He would rather have the record full of half answers. I would just as soon see the record with full answers, and I think this witness should be given the opportunity to give a full answer.

MR. NORTON: Mrs. Bowers, I think he did answer my question, then he started to go on to reiterate what the conclusions in the 7/21/78 paper were which we had just gone over, and we didn't think that was necessary to go over those conclusions again.

MRS. BOWERS: Well, Mr. Norton, are you following this line of questioning because you think the revision had been completed by July 21, 1978, and it wasn't acknowledged on October 28th when the deposition was taken?

MR. NORTON: There was certainly no suggestion, if



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you read the deposition, that there was ever such a conclusion even thought of.

MRS. BOWERS: Well, but won't the record of this proceeding show that the witness stated that he didn't make the notes on the front of this document?

MR. NORTON: No, but he's testified that he had reviewed it and had written this prior to the deposition.

MRS. BOWERS: All right.

MR. NORTON: I don't care whether it was 7/21 or what. It was prior to the deposition.

BY MR. NORTON:

Q As a matter of fact, Dr. Silver, the status of this --

MR. FLEISCHAKER: I have an objection. I would like to get back to that point.

I think Dr. Silver should be permitted to explain fully his answer, and I object to Counsel continuously interrupting to leave half statements, half sentences on the record.

MR. NORTON: Mrs. Bowers, my response to that is the same as Mr. Tourtellotte's earlier today, and that is -- I think it was when he was doing voir dire -- that the witness should answer the question and 10- or 15-minute speeches for each question are generally not necessary.

Now Mr. Fleischaker chose to allow our witnesses to speak-- I think in response to one question, Mr. Hamilton

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spoke for 50 minutes. That's Mr. Fleischaker's problem, not mine and Mr. Hamilton's. And if he chooses not to object to that kind of a response to a simple question, that's his problem, but I'm not going to listen to 50-minute speeches for simple questions, and I don't think Mr. Tournallotte is either. The witness doesn't have that prerogative.

MR. FLEISCHAKER: I'd like to put it into perspective. I bet you if we looked in the transcript we'd find the most words belong to the person who is allegedly asking the questions but indeed giving speeches, Mr. Norton.

It seems to me -- and I will even bank on that.

It seems to me Mr. Norton should ask questions and permit the witness to give an answer. This witness has not taken up the Board's time with lengthy explanations. I think he should be given an opportunity to fully answer the question. He hasn't gone overboard.

He hasn't at all carried on for 10 or 15 minutes. Indeed, it's the questioner who carries on for 10 or 15 minutes, so I object and I would like to have -- I would like the Board to permit this witness to answer the questions fully.

MRS. BOWERS: Well, the objection is sustained, to the effect the witness is permitted to answer the question.

Mr. Norton, if you feel he's repeating testimony that was given earlier, then address your problem to the Board rather than interrupting the witness.

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MR. NORTON: I would have to interrupt the witness to address the Board, but I understand what you are saying.

MR. FLEISCHAKER: Thank you. I appreciate that, Mrs. Bowers. I think it will work a lot better.

BY MR. NORTON:

Q Dr. Silver, I think you're supposed to still be talking.

A (Witness Silver) Could you repeat the question?

Q No, I don't recall exactly what the question was. I asked you why you hadn't told me of those conclusions during your deposition.

A Well, okay. Basically I don't feel that the conclusions here are significantly different than the earlier ones based on the geologic interpretation, but they do show more uncertainty in how one interprets the gravity data.

Q Now in your testimony on page 1.2-6 you say:

"In summary, evidence for continuity of the San Gregorio fault zone is good from near San Francisco to as far south as San Simeon."

Do the conclusions expressed in this Exhibit 31 in any way affect that opinion?

A I'm sorry, which is Exhibit 31?

Q The one we've been talking about, the one you were just handed, the one we've been talking about for the last 10 minutes.



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A No, it doesn't at all.

Q It doesn't affect it in any way?

A No. And-- Can I expand?

MRS. BOWERS: Yes.

MR. NORTON: Mrs. Bowers, excuse me. You know, that's what I have a problem with because if it doesn't affect it, that's fine. All he has to do is say No. If I want to ask him why it doesn't, that's my prerogative, but I haven't asked that question.

MRS. BOWERS: Well, we've been very liberal in permitting witnesses to explain their answers and we certainly had some thorough explanations from some of your witnesses on direct.

MR. NORTON: I agree, but that was because Mr. Fleischaker didn't object to that. I mean when you ask someone if they have an opinion they're supposed to say Yes or No, they're not supposed to state the opinion because other Counsel may have an objection to that opinion, or to him expressing an opinion if there hasn't been sufficient foundation or what-have-you.

So when you allow a witness to say No, and then go into the next -- to the response to the next question, you immediately have taken away the opportunity of all other attorneys to object to that question, and they may well have a basis for it.

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1 MRS. BOWERS: Is it your point that if
2 Mr. Fleischaker wants to develop it he can do it on redirect?

3 MR. NORTON: He certainly can.

4 MR. FLEISCHAKER: Well, it has usually been my
5 experience, and my experience is consistent with the Board's
6 opinion, that it is a waste of time and it is not the most
7 efficient way to permit the cross-examiner to limit the cross-
8 examination to Yes or No answers. We're dealing with a highly
9 technical matter and as long as the witness doesn't ramble on
10 for hours, he should be given the opportunity to explain the
11 basis for a Yes or No answer.

12 So I believe the Board's position is well-taken.
13 If there's a Yes or No answer, the-- Well, excuse me. I
14 think my position is if the witness is requested to give a
15 Yes or No answer, he should be permitted the opportunity to
16 explain the basis for the Yes or No answer.

17 MRS. BOWERS: Part of the thing here, he was asked --
18 and I don't recall the exact words -- if there was an impact
19 between the two documents, or whatever words were used, did
20 one impact on the other, and he said No.

21 And so then I think MR. Norton's idea was well,
22 why pursue that?

23 MR. NORTON: That's right.

24 MRS. BOWERS: Mr. Tourtellotte?

25 MR. TOURTELLOTTE: Well, I of course agree that

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every witness, when they are asked a question which requires qualification, which requires explanation, can certainly request to the Board that an explanation be made.

On the other hand, I believe that if a question is one which can be answered with a Yes or a No, unequivocally, then no explanation is either required nor is it even invited. And this is one of the things I was complaining about earlier today.

I would simply say that what we've been doing in the past with regard to the responses of the Applicant's witnesses does not really bear any weight on what we're talking about here.

I can guarantee you that had the Applicant's witnesses been making extensive replies which hurt my case, I would have been screaming to high heaven, but in fact they were building my case. They weren't destroying it, so I had no reason to object.

But in strict terms, I think Mr. Fleischaker had the right to object and whether he found there was good reason to object or not is something else. But the simple fact that he allowed that sort of thing to go on when he was cross-examining and parties who were sympathetic to what the responses were were not objecting is no reason to establish that as some mode of behavior right now.

I think a witness is required, when he can answer

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1 a Yes or No question, to either answer it Yes or No, and then
2 if he wants to he can say "May I explain?"

3 And at that time I think it is up to the Board to
4 determine whether this is the kind of question that requires
5 explanation or it's the kind of question which requires that
6 Counsel on the other side, if he wishes, establish that sort
7 of thing on redirect.

8 MRS. BOWERS: I think that puts it in perspective
9 and we'll proceed with the understanding that the witness, if
10 possible, will answer Yes or No, and if he feels he must give
11 an explanation to further explain the answer, then he can
12 request permission to do so.

13 BY MR. NORTON:

14 Q Dr. Silver, one of the things you cite in your
15 testimony and it's cited in the Graham-Dickinson paper that
16 you cite in your testimony is the work done by Hall. Is
17 that correct?

18 A (Witness Silver) Yes, that's correct.

19 Q All right.

20 And you're not familiar with the southern end of
21 the Hosgri, are you?

22 A How far south?

23 Q The southern end of the Hosgri, down around Point
24 Sal, south of Point Sal?

25 A I have not done a lot of work on that, no.



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Q And you don't have any strong feelings about it at all, do you?

A Not strong, no.

Q So you're just citing somebody else's work and you haven't done any work down there?

A Okay. Yes, I'm citing Hall's work.

Q Okay.

A That's a two-part question. Yes, I'm citing Hall. It's not true I haven't done any work in that area.

Q Well, you haven't done any work that bears on the question, have you?

MR. FLEISCHAKER: Objection. I don't know what question we're talking about at this point.

MR. NORTON: Obviously we're talking about the Hall hypothesis.

BY MR. NORTON:

Q Aren't we, Dr. Silver, the Hall offset?

A (Witness Silver) If you're asking me have I done work that bears on the Hall offset, the answer is No. My work has been more concerned with the location of the fault rather than the offset.

Q This next line of cross-examination, Dr. Silver, is going to take a moment to set up, and while the people are doing that, I may ask you a few preliminary questions.

Are you familiar with the BARTLETT data?

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- 1 A Yes.
- 2 Q In what way are you familiar with it?
- 3 A Well, I took some of it.
- 4 Q What do you mean by some of it?
- 5 A I took-- Let's see. I was responsible for taking
6 the data essentially from Point Sur down to near Point
7 Conception near Point Arguello.
- 8 Q How many runs were there?
- 9 A 28-- I'm sorry, that's including little cross-
10 ties, 14-plus small lines. I'm adding all the end lines as
11 well.
- 12 Q Weren't there three segments of this run?
- 13 A Of the BARTLETT?
- 14 Q Yes.
- 15 A Yes.
- 16 Q There were three legs?
- 17 A Yes.
- 18 Q What would you call them?
- 19 A Mine was leg 2.
- 20 Q Okay.
- 21 So you had leg 2 of 3 legs?
- 22 A Yes.
- 23 Q Did you have anything to do with leg 3 or leg 1?
- 24 A I was out on the ship. We divided the leg into
25 three parts. Gary Green was responsible for leg 1, Roland

eb11 Von Huene for leg 3.

Q And you were for leg 2?

A Yes.

Q Tell me, this is one of the seismic reflection lines. Right? This is what the purpose of this cruise was? I'm not asking you to address your attention to that at all.

A Yes. We took seismic reflection gravity magnetic dosimetry.

Q And what do you do? Do you reduce this to paper that shows profiles of what's under the water?

A Essentially you take a record -- you come up with a direct analog record of essentially the vertical travel time data and because you're taking vertical travel time data at very close intervals, in this case every four seconds, it's displayed as though it were continuous data.

Q Okay.

How do you know where you are out there? It's a big ocean. Do you spot a tree alongshore and run off that, or how do you know where you are?

A By satellite navigation, supplemented with radar if you're close to shore, with LORAN. Satellite navigation was the main. It's usually the --

Q How did you do it, for example, on leg 2?

A Satellite control.



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1 Q Did you do that on leg 1 and leg 3 also?

2 A Yes.

3 Q And it has Chief Scientist-- I'm looking at the
4 Open File Report, and it has Chief Scientist, Gary Green,
5 legs 1 and 4; Eli Silver, leg 2; and Roland Von Huene, leg 3.

6 Why would you divide it up out there? Why wouldn't
7 one person be responsible?

8 A We were concentrating on different areas. Gary
9 Green had been working on the Monterey Bay area for a long
10 time, and he had a great body of data, so we were taking new
11 data in Monterey Bay and it was logical for him to do that.

12 I was interested in the Central California segment
13 from Point Sur southwards. I had worked on some data in the
14 past but it was relatively poor quality. So this, up to
15 that time, was the best quality I had available.

16 Q All right.

17 Is the Chief Scientist responsible for the data on
18 his leg, or is somebody else responsible for it?

19 A You mean responsible for interpreting the data?

20 Q Well, responsible for collection of data?

21 A Well, we were all contributing to the collection
22 of the data. We had common technicians.

23 Q Okay.

24 But the Chief Scientist is the one who supervises
25 it?

eb13

A That's right.

Q It is his responsibility?

A Yes.

Q Okay.

Now we have a large exhibit which is the original track chart, and I believe we have reduced copies of that. We have reduced copies of a portion of that.

First of all, will you describe-- We have put--

MR. NORTON: Mrs. Bowers, this thing is impossible to reproduce in sufficient copies, but it is a blowup track chart and we have copies of a portion of it. And as soon as we get those passed out we'll ask Dr. Silver to describe what they are.

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Excuse me, they are also in B-42, this is nothing more than a blowup of a portion of B-2, which is the attachment to Dr. Silver's testimony. And we'll have Dr. Silver identify specifically which portion it is. I believe it's the bottom portion of B-42.

8.200.

BY MR. NORTON:

Q All right Dr. Silver, that is indeed the original track chart of the bottom your B-42, is it not?

A (Witness Silver) A part of it, yes. It includes an area to the south for which Roland Von Huene was in charge as well.

Q I appreciate that, but I'm just talking about it is what appears on B-42.

A Yes.

Q Okay.

Except it's a blowup that we can see and deal with.

Now, tell me how you draw those lines. I take it you don't do this out on the ship, do you?

A , How I draw the lines?

Q Yes. You don't do it out on the ship, do you? When do you do it? When do you draw the lines that are up there?

A Well those lines represent the track of the ship.

Q Yes.



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A So we lay out generally where we want to go beforehand.

Q You draw those lines beforehand?

A Oh, generally where we want to go. Those lines don't say where we wanted to go, they say where we actually did go.

Q Oh, those lines -- You don't do those beforehand, you do them later after you've been out there?

A Yes. Every point of location is based on, as I say, satellite navigation location, so the exact point has been determined at sea, in general, where you wanted to go within a kilometer or a half a kilometer depending upon how accurately you can lay it out.

Q Okay. Well that's what I -- when you draw this afterwards then, when you get back on shore and you sit down with your data, how do you draw those lines, how do you know where to draw them?

A From the ship location.

Q And where do you get that from?

A Satellite navigation, it's produced by computer.

Q Yeah, but where do you get -- how do you know when you sit down to draw this line where to draw it? I mean, I hear you saying words but I don't understand where you get the numbers from.

In other words, how would I know on that piece



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of paper where to put down my first dot?

A Oh, well I can't see what you have on that map from back here. But along the track line, you locate the position at a given time, so you know your time and you know where the ship was at that time. Then on, say, the seismic reflection record or the gravity or whatever, you have some information: seismic, gravity, magnetic, at a given time.

Q Where do you get the information as to where the ship was from when you sit down in your office or wherever it is to draw up this track chart, where do you get the information as to where the ship was?

A Right out of the computer. You see, there's a lot of computation that has to be done to reduce the satellite navigation information.

Q How about a ship's log, do you get it from that as to where the ship was--when they turn courses, don't they keep a log?

A Yes.

Q When they turn, they give the time they turn, and --

A Yes.

Q What other kinds of information do they give?

A Well if they're taking radar information, if they're taking star fixes.

Q Well what did you do on this cruise on the



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BARTLETT?

A It was dominantly satellike navigation. This was in 1973 and I honestly can't go up and tell you at every point --

Q Well let me give you the ship's log would that help?

A It may help.

In fact, for this, quite frankly, we had some technicians doing the location work, so I didn't personally draw the location track.

Q Well, what did we reduce all this to? We reduce this to a seismic profile, don't we, to see what the bottom looks like, what the earth underneath the water looks like. Isn't that what we do it for, to give us, you know, structures?

A Yes, the dominant information we're getting was seismic reflection. We also had gravity and magnetic and so on.

Q Well it helps, doesn't it, to know where you're taking the picture? I mean, if you get a ridge or a dip or something, it helps to know where that is, I mean, otherwise it's all meaningless, isn't it?

A Yes.

Q All right.

Now you said earlier that you're within half a kilometer or so of where you think you are.

agb 5

A Often better than that.

Q Isn't it acceptable to be within maybe 30 or 40 feet of where you're supposed to be?

A A satellite will rarely give you that accuracy.

Q But pretty close to it?

A It's more like a quarter to half a kilometer standard error.

Q You would never be one to seven miles off, would you?

A I shouldn't say never, but it would be rare.

Q It would be pretty useless data, wouldn't it?

A It depends on where you were.

Q How about this data, if you were one to seven miles off, would that be pretty useless data?

A No, one mile --

Q Well, how about ---

A -- one mile wouldn't necessarily be useless. No, none of the data would be useless. It would just -- the worse the location, the more difficult it is to locate it, to draw -- well to do locational things, none of the data is --

Q How about in close to shore, how about locating the fault or how about missing a fault? Wouldn't it be important if you were a few miles off?

A It's important to know your location.

Q It's very important, isn't it?

agb :

A Yes, it's important.

Q Okay.

Now, would you go up to that and look at the second -- I don't know what they call those, track lines but the second one from the top. okay?

I guess I don't mean the line, the second box in from the top on the right-hand side. Could you go up and look at that, because I believe your drawing in your testimony is too small to scale anything off.

Could you point to the one I'm referring to so we all know which one it is, it's the second one on the right.

That's the first box and the second box and, you know, you see it forms an end, the top thing. That's the first box end to the right of your finder, the box end. Right there, now drop down one to the second one.

A Here?

Q No, I'm talking about the track lines, Dr. Silver, the little brown line.

A Yes.

Q Now it forms a box end, doesn't it?

A Box end? Oh, I see.

Q Yes, box end.

A Yes.

Q There.

Now would you go down to the second one.

agh7

A This one?

Q Yes.

A Yes

Q Now I have a ruler, if you don't, and could you scale off how far that is away from shore, based on the scale on the map itself, on the track chart?

Here's a ruler if you don't have one.

Okay, could you scale off the distance of the top of the box from shore and then the bottom of the box from shore?

A It looks like a little over four kilometers.

Q How about the bottom?

A On this map, approximately eight kilometers.

Q Okay.

So the top of that box we're talking about is four kilometers, the bottom number is eight or a little over four and eight. Okay.

Now Dr. Silver, what we've done is we've handed out a blowup.

MR. NORTON: And we'd like at this time to have it marked as Applicant's Exhibit Number 32, which is a blowup of that box end.

(Whereupon, the document previously referred to as Applicant's Exhibit 32 was marked for identification.)



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MR. NORTON: It's not really a blowup. It's just a Xerox of that box end. It appears to be a blowup because it's on much smaller paper.

BY MR. NORTON:

Q Do you have a copy of that, Dr. Silver?

A (Witness Silver) Yes.

Q All right. Would you take that up there and satisfy yourself that it is, indeed, a Xerox of the original track chart?

Dr. Silver, this is just a Xerox of the chart. I just want you to satisfy yourself that, indeed, it is a true and correct copy and not something we fictitiously made up.

MR. FLEISCHAKER: Mrs. Bowers, before we go any further on this, I'm not sure quite where we're going. I suppose that we're going to some place with ship logs and measurements and distances and errors and miles and something. I'm not sure that it has yet been established through this witness that this is actually the ship's log, I mean, the original track chart. It may well be, I don't know, but we have Mr. Norton's testimony on that point.

MR. NORTON: I'll do it.

MR. FLEISCHAKER: -- And I think that before we go any further with this, we need to establish with this witness that he is certain that this is an accurate

agb9

representation or copy of the original document.

BY MR. NORTON:

Q Dr. Silver, that is indeed the track chart, is it not, of the BARRETT run, in fact, the box we're looking at is -- Hang on just a moment.

(Pause.)

(Continuing) -- Line Six, Line Seven and Line Eight of leg two for which you were responsible, is it not, Dr. Silver?

A (Witness Silver) It appears to be, yes.

Q On Line Seven is the box end that we've been talking about.

I'm now going to pass out as Applicant's Exhibit Number 33, I believe, the Open File Report 75-121. We'd ask that be marked as Applicant's Exhibit Number 33.

(Whereupon, the document referred to as Applicant's Exhibit 33 was marked for identification.)

BY MR. NORTON:

Q Now Dr. Silver, how do I find in this Open File Report where the boat was, or the ship, if you prefer, when it turned the corner from Leg Six to Leg Seven, and how far it went before it turned the corner from Leg Seven to Leg Eight and, equally important, in what direction it was heading

-gbl:

when it entered the corner, how do I find that?

MR. FLEISCHAKER: Excuse me, before we get into this as a base document, I think we need to lay a little for the Foundation with this witness to give him an opportunity to examine the document to determine that it is what it purports to be.

I've never seen it before. Perhaps it won't take much time, but I think we ought to have it in the record.

BY MR. NORTON:

Q Dr. Silver, do you have any doubt in your mind that this is a copy of Open File Report 75-171, showing you as the chief scientist on Leg Two?

MR. FLEISCHAKER: I think it says 121 up here, Mr. Norton.

MR. NORTON: I'm sorry if I didn't say 121, that is indeed what it says.

BY MR. NORTON:

Q Do you have any doubt, Dr. Silver, that that is indeed a true and correct copy of the log from the USGS Open File Report 75-121?

A (Witness Silver) It looks like the log, yes.

MRS. BOWERS: Mr. Norton, I don't know what's on that thing on the screen because, you know, I can see the big lines but I can't see the figures.

You've been referring to line numbers. Now I



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see what appear to be line numbers on this B-42, but I don't see anything on the portion of the --

MR. NORTON: That's because they're not on there, they don't give the line numbers on the large thing, this is just a reduction.

MRS. BOWERS: Well but I think your PG&E Number 32 should show those lines -- I mean, they could be marked in, because you're now referring to them by line number.

MR. NORTON: Fine.

If we look at PG&E Exhibit 32, if you look at the upper left-hand corner, you see dark lines that form a triangle with the numbers 2000 and 2100 on them.

The next structure in big, bold, dark lines down is a kind of a rectangle open ended on the left side. The top of that rectangle is, indeed, Line Six. The right-hand side of that rectangle, the closed end with the number 1300 on it is Line Seven. And then the bottom, across the rectangle having the numbers 1400 and 1500 on it is Line Eight.

And if everyone would be good enough to mark their exhibits, we'll be happy to mark them on the ones supplied to the Court Reporter.

MR. FLEISCHAKER: May I have just a second, I'd like to take a look at the original that's on the board.

agb12

(Pause.)

Thank you.

BY MR. NORTON:

Q Now, Dr. Silver, I started this out asking you how you found out when you turned a corner and what direction you turned the corner and where you were at and all that. Now where do you find that in this -- I see you've already been at work with your protractor, you're anticipating my questions.

How do you find that out from this Open File Report? Could you tell us what page to turn to? I'm interested in knowing how you went from Line Six to Line Seven to Line Eight.

A (Witness Silver) The way you find that out is from the satellite navigation. The satellite navigation is hopefully reflected on the track chart.

Q Where it gives course and speed and all that sort of stuff and the time?

A Where it plots out the track chart.

Now you can go down to this log as well, the log doesn't give you location.

Q Well but look --

A The log will give you gyroscopic heading. The ship does not -- it doesn't necessarily give you true ship heading. I could tell you on the log where to go, but that



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agb 1 doesn't mean that that's what the ship is really doing.

2 Q Oh, the log doesn't represent what the ship was
3 really doing?

4 A That's right, because there's also wind and
5 currents out there.

6 Q Well then how do I know that your lines are
7 representative of where the ship really was?

8 A You have to go back to the original navigational
9 data.

10 Q How about taking a bathymetric profile of the
11 same area and then reading the depths along your lines and
12 matching them up, would that work?

13 A That would be a good check.

14 Q And if those depths were way off, would that
15 indicate that the lines were maybe way off?

16 A It could.

17 Q It could.

18 Can you do that?

19 A Sure.

20 Q Okay.

21 How would we proceed to do that? Would a
22 bathymetric profile of the shoreline there help you, in a
23 form that can be shown up there on a viewgraph and then you
24 can overlay the track lines over the bathymetric map along
25 the same coastline, the same scale, would that do it?

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A Go ahead.

Q Okay.

(Pause.)

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MR. NORTON: While Mr. Williamson is doing that we would ask at this time that bathymetric map -- a photostatic copy of a portion of it that matches the other map we're looking at be marked as Applicant's Exhibit Number 34.

(Whereupon, the document referred to was marked as Applicant's Exhibit 34 for identification.)

BY MR. NORTON:

Q Dr. Silver, Applicant's Exhibit 34, as you can see, is now being projected on the overview, and it is a bathymetric profile, USGS bathymetric profile of the area in question. And I think you can check that out and verify that by overlaying the shoreline, xeroxed shoreline of the chart that appears in B-42 of your testimony.

Could you come up and do that, match up the shoreline along with the bathymetric to show that it's the same scale?

MR. FLEISCHAKER: Excuse me. I'm going to object to the use of this exhibit until he has some further foundation laid for what it is. All I see up there is a slice out of a map which Counsel has testified is a USGS map. I don't know when the data was taken or whether it was 1952, 1972, or whenever.

There is just no information there to permit this

eb2

1 witness to understand what this map is.

2 MR. NORTON: Mrs. Bowers, we have the entire bathy-
3 metric map here. This is just a xerox of a portion of it.
4 Mr. Hamilton is going up to get the entire map now, but it's
5 a USGS bathymetric map, and all he has to do is match up the
6 shoreline from B-42 with the shoreline on that and he'll
7 rapidly see that it is.

8 MRS. BOWERS: I thought the purpose was to locate
9 PG&E's Exhibit Number 32 on that.

10 MR. NORTON: It is, and the way you do that is by
11 matching up the shorelines, like this. You have to get it on
12 there just right. And we'll have the entire map down here,
13 the bathymetric map, in a moment.

14 But you can obviously see, Mr. Fleischaker, that
15 it is indeed the USGS map, the same shoreline.

16 MR. FLEISCHAKER: I'm not worried about the shore-
17 line. Shorelines are shorelines. What I'm worried about are
18 all the squiggly lines out there to the left of the shoreline,
19 and what they represent and who took them, and at what time.

20 MR. NORTON: Well, let me ask Dr. Silver.

21 MR. FLEISCHAKER: He may know, but I'm not sure
22 that there's sufficient information on that screen to permit
23 him to identify that, and that's why, before you go any further,
24 I'd like you to ask him some questions as to whether or not
25 he can identify it. Maybe he can; I don't know.



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1 MR. NORTON: Mrs. Bowers, we'd be happy to.

2 MRS. BOWERS: Fine.

3 BY MR. NORTON:

4 Q Dr. Silver, we're bringing down the entire USGS
5 bathymetric map right now, but looking at that, do you have
6 any problem believing that it is indeed a copy of a portion
7 of that map? You're very familiar with those maps, are you
8 not?

9 A (Witness Silver) The bathymetric map. It looks
10 like a part of the -- What are they? -- the NOS map series.
11 That's what it looks like to me.

12 Q And you have no problems with the bathymetric lines
13 shown on that map, do you, Dr. Silver? There's no dispute
14 about those bathymetric lines, is there?

15 A Well, I don't know. I had nothing to do with draw-
16 ing them. I've never seen the original.

17 Q Well, it's an official government publication and
18 they're generally accepted by professionals who work offshore,
19 like oil companies, private companies, and everything else,
20 and USGS. Isn't that true, Dr. Silver, as representing the
21 bathymetric part of that offshore?

22 A It's the most up-to-date map I know of.

23 Q All right.

24 A I won't say it's true, but it's the most up-to-date.

25 Q All right.



eb4

1 Now how do I know if I look at this-- Maybe I
2 could use your pointer.

3 How do I read as to how deep the water is on this
4 bathymetric map at, say, the corner of 7 and 8 right here?
5 Do I look at that line and find out what the depth of that
6 line is, the one that intersects the corner?

7 A Yes.

8 Q And that tells me how deep it is. Right?

9 A Yes.

10 Q All right.

11 Can you do that for me? Can you look at that and
12 tell me?

13 A I believe these contours are in meters. Correct
14 me if I'm wrong, because I don't have enough label on this map
15 to see.

16 MR. FLEISCHAKER: Right there I'd like to object
17 to going on any further on the basis that until he has an
18 opportunity to see the map and to read the legend and under-
19 stand what it's all about, he shouldn't be forced to speculate
20 and to guess as to what this map is all about. Because we're
21 obviously going to some kind of test of the location of the
22 lines and that sort of thing.

23 You know, before we do that, I think that Dr. Silver
24 ought to have an opportunity to look at the data.

25 MR. NORTON: I have it right here.



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MR. FLEISCHAKER: Fine. Let him look at it.

Dr. Silver, could you give us some further identification of that map, like the official name and the date, and the people who put it together?

WITNESS SILVER: This is CNES-1306N-20, Cape San Martin to Point Conception, U. S. Department of Commerce, Environmental Science Services Illustration, Coast and Geodetic Survey.

MR. FLEISCHAKER: What is the date?

WITNESS SILVER: 1967.

BY MR. NORTON:

Q And, Dr. Silver, it is in meters, is it not?

A (Witness Silver) Yes.

Q With 50-meter offsets?

A Yes.

Q All right.

So now could you give us the depth where you turn the corner from line 7 into line 8? And perhaps they could run line 6, line 7 and line 8 on the Viewgraph.

Mr. Williamson can do that while you're figuring out the depth.

A Okay. The depth of this corner appears to be on the map 450 meters. The depth of this corner appears to be less than 100 -- a little over 100 meters.

MR. TOURTELLOTE: Excuse me. You're saying "this

eb6

corner" without identifying it.

WITNESS SILVER: The north corner, a little over 100 meters; the south corner, 450 meters.

BY MR. NORTON:

Q Now if I go to the ship's logs then, when a ship says it turned the corner, will I find the depth given, Dr. Silver, yes or no?

A (Witness Silver) Yes. Depths are recorded on most of the times.

Q All right.

And turning the corner from leg 6 to leg 7, what depth does it give?

A It doesn't give a depth.

Q Excuse me. I see a line that says "Time 12:36." It says "Line 6," and then it says "1300." That's 24 minutes later, and it says "7." Now how do I know when you turn the corner from line 6 to line 7?

MR. FLEISCHAKER: Excuse me. Can anybody tell me what page we're on?

BY MR. NORTON:

Q Dr. Silver, could you give us a page number? I don't have it. I think it's page number 26 but I'm not positive.

A (Witness Silver) Mine are not paginated. You have to go on the left side, the left column, in Julian days. It

eb7 1 is Julian day 321.

2 Q Yes. 25 and 27 have numbers on them, 26 doesn't
3 seem to, but it is 26.

4 MRS. BOWERS: I don't see any numbers. Well,
5 those numbers are written in I guess.

6 WITNESS SILVER: Yes.

7 MR. NORTON: Yes, in the upper right-hand side.

8 MR. FLEISCHAKER: There are a couple of pages with
9 321 on. I'm not sure which one we're on. A bunch of pages
10 have 321 on them.

11 MR. NORTON: If you look at the upper right-hand
12 margin you will see pagination numbers.

13 DR. MARTIN: There aren't any page numbers on this.

14 MR. BRIGHT: Page 27. I found that.

15 MR. FLEISCHAKER: I don't see any page numbers here.
16 Do you have any page numbers, Dr. Silver?

17 WITNESS SILVER: Yes. The page that --

18 MRS. BOWERS: Wait a minute. Let me see if I can
19 straighten this out. Dr. Martin found his page number. The
20 problem is somebody had handwritten page numbers in when they
21 did this and they are at the very top, and I guess in xeroxing
22 some of them are cut off and some aren't.

23 But if you look through in the upper right-hand
24 side you'll find a page that's clearly 25 and one that's 27,
25 and it is obviously the page in between that is page 26.

eb8

1 MR. FLEISCHAXER: Right.

2 MR. NORTON: And that's the page we're looking for.

3 Mine happens to be written in but that I guess was done after-
4 wards.

5 BY MR. NORTON:

6 Q Dr. Silver, I think we're all looking at the same
7 page now.

8 Now if you go down where it says "line" you see
9 the number 6 and you go down and it shows "Time 12:36, line
10 6," and then it says "1300, line 7." Now how do I know when
11 you turned that corner, and how do I know at what angle you
12 turned the corner?

13 A (Witness Silver) Okay. It says "12:36 changed
14 course to 152."

15 Q That's 152 degrees; right?

16 A Yes.

17 Q So that means that when you got to the point be-
18 tween line 6 and line 7, the ship changed course to 152 degrees;
19 right?

20 A That's what is recorded, yes.

21 Q All right.

22 And then it proceeded in that direction; is that
23 correct? -- for the duration of line 7?

24 A Yes. There's a recording of that at 1300 and 1330.

25 Q Okay.

deb9

1 So it took about almost an hour to go that leg;
2 is that correct? -- pretty close to it?

3 A Yes.

4 Q Okay.

5 So the first check, I take it, we've got is we know
6 how many degrees the ship was heading; right? It was heading
7 at 152 degrees?

8 A Yes.

9 Q Okay.

10 Now how do we check that? Your line up there should
11 be at 152 degrees. Obviously your line couldn't be at a
12 different --

13 A No, not necessarily. There are two things.

14 One, it points up a discrepancy. There may be an
15 error here. Or secondly, the ship may have been heading at a
16 given angle and we were dealing with relatively high winds.

17 Q Okay.

18 So you wouldn't be surprised then if the angle of
19 the line connecting 6 and 8, line 7, was at about a little less
20 than 90 degrees, would you, instead of 152 degrees?

21 A That is a large discrepancy.

22 Q Well, would you go up and measure the angle then?
23 I don't know if you can do it on the large one, but you can
24 do it with a protractor on the Viewgraph. Could you measure
25 the angle for us?

eb10

1 MR. FLEISCHAKER: Which discrepancy are we talking
2 about? Which angle are we talking about?

3 MR. NORTON: I'm not sure which discrepancy we're
4 talking about, but we're talking about the angle 6 to 7.

5 WITNESS SILVER: Do you have a protractor?

6 MR. NORTON: Yes, we have a protractor.

7 (Handing protractor to the witness.)

8 WITNESS SILVER: In the Viewgraph I measured 187
9 degrees.

10 BY MR. NORTON:

11 Q 187 degrees.

12 Now where are you measuring from? I'm talking about
13 line 7.

14 A (Witness Silver) Yes.

15 Q Now it's 187 degrees?

16 DR. MARTIN: That's heading.

17 BY MR. NORTON:

18 Q That's the heading of it?

19 A (Witness Silver) Yes.

20 Q All right.

21 And it says in here 152 degrees; right?

22 A Yes.

23 Q So that's 30-some degrees off. Now you say that
24 could be accounted for by wind or currents or those kinds of
25 things?



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eb11

1 A I'm not saying that's right. That may be an answer.

2 Q Okay.

2 A It's not uncommon.

3 Q Now about looking at the depth then that's listed
4 on the ship's log and comparing it?

5
6 Now we see the depth where it says-- How do we
7 know the depth at the end of line 6? Is that given in this
8 map -- excuse me, on this chart or whatever it is, this log?
9 Is the depth at the end --

10 A No, it is not given at the end of the line.

11 Q Now about the beginning of line 7? Now about the
12 end of line 7? Let's do that one. It should be there,
13 shouldn't it? In fact, it is. If we look down there we see
14 it, 1330. "Line 7," it says, "end of line," then it says
15 "165 meters," doesn't it?

16 A Yes, it does.

17 Q Now didn't you just testify that the end of line
18 7 up there is about 450 meters?

19 A Yes.

20 Q All right.

21 So doesn't that indicate to you that it is way off
22 course?

23 A It does indicate a discrepancy, yes.

24 Q How far inland do you have to go to get to 165
25 meters of water from the point that you've drawn on your map?

eb12 1 Could you go up and scale it off and see how many meters you
2 have to go toward the shore to get a depth of 165 at the
3 point where 7 and 8 intersect?

4 A 4 kilometers, if I am matching the maps correctly
5 on the Viewgraph.

6 Q 4 kilometers?

7 Now does that indicate to you that there's an error
8 in there of something on the order of 4 kilometers?

9 A There may be, yes.

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12 WRB/mpbl 1

Q Now when you do the data, do you check for these kind of errors, or do you just do the data and send it out?

A Unfortunately, I did not check for that.

Q You did not?

A Yes, unfortunately.

Q Well, how much of your data do you check for those kind of errors?

A As a general rule I check most all of it. However, this data set I didn't check any of it.

Q Oh.

Well, then, maybe we can cut this whole procedure short because it can get very tedious. And I will ask:

Based on what we've just gone through, would it surprise you that the range of error in what we have marked the track chart, the southern portion of B42 in your testimony is off by one to seven kilometers?

A Yes, it would.

MR. FLEISCHAKER: I'm going to object.

There's no foundation for that question. I'm not sure that -- all this witness can do on the basis of the one example that he has here is speculate. And, as Mr. Norton has pointed out before --

MR. NORTON: Excuse me.

Mr. Fleischaker's objection is probably well



mpb2 1

taken.

BY MR. NORTON:

Q Let's put it this way:

Based on what you've seen so far of this data checked against other methods, would you rely on that data without further checking it?

A (Witness Silver) Rely on it for what?

Q For use, for the use for which it's intended without further checking to see if the locations for those track lines are four kilometers off? Would you rely on it for the use for which it was gathered?

MR. FLEISCHAKER: Objection.

That hasn't been -- that's a vague statement.

MRS. BOWERS: I thought the witness testified earlier that there could be a range of error in the plotting up to four kilometers.

MR. NORTON: Up to one-quarter of a kilometer.

WITNESS SILVER: It could get larger. It could get as much as a kilometer with normal data. But four kilometers is fairly large.

BY MR. NORTON:

Q We could go through a whole lot of spots on this, Dr. Silver, and do this whole thing.

But the point I'm trying to get at-- and I can save us all a lot of time, maybe I can -- is based on the



mpb3 1 demonstration we've had so far, would you want to further
2 check the remainder of the data before relying on it?

3 A (Witness Silver) Yes.

4 Q All right.

5 MRS. BOWERS: I think we should take a break.
6 So, ten minutes.

7 (Recess.)

8 MRS. BOWERS: We'd like to get started.

9 Mr. Norton, Mr. Willingham mentioned to me he'd
10 be back in a minute or two.

11 Can you proceed without him?

12 MR. NORTON: Yes.

13 BY MR. NORTON:

14 Q Dr. Silver, two maps that were identified that
15 are up on that large board, were USGS NF910, they were
16 Joint Intervenor's Exhibits 51 and 52.

17 Now could you go to the map that's up there and
18 take with you -- hang on just a minute and I'll find out
19 which one of our exhibits it is -- the two viewgraphs which
20 were 34 and 32.

21 Could you do that, grab the two viewgraphs 34
22 and 32, so that you can put one on top of the other and line
23 the shorelines up and hold them in your hand there?

24 Now, the line in question, line 7, that is off
25 Cape San Martin, isn't it? Isn't it directly the southern

mpb4 1 portion of line 7 where it goes into line 3 is almost due
2 west of Cape San Martin in the north portion at some dis-
3 tance, whatever the distance of line 7 is north of Cape
4 San Martin, isn't that correct?

5 A (Witness Silver) Yes.

6 Q And isn't that part of the USGS map that has
7 a lot of question marks on it in that area, that very area?
8 Yes or no?

9 A Up in here, yes, there are question marks.

10 Q All right.

11 Maybe now we have a partial explanation of the
12 question marks. Would you agree with that?

13 MR. FLEISCHAKER: Objection.

14 That's ambiguous. I don't know what Mr. Norton
15 is referring to.

16 BY MR. NORTON:

17 Q Well, Dr. Silver, this data was given to USGS,
18 wasn't it?

19 A (Witness Silver) Which data?

20 Q Your BARTLETT runs.

21 A Yes.

22 Q And yet they show question marks in that area,
23 do they not?

24 A Yes.

25 Q All right.

mpb5 1

MR. NORTON: Nothing further on this subject.

2

BY MR. NORTON:

3

Q Dr. Silver, in your testimony you talk about --

4

excuse me. I have someone's pointer over here. I don't

5

know whose it is but I'll pass it back.

6

MRS. BOWERS: Can't we put some of these things

7

to one side? Are we going back to the log and --

8

MR. NORTON: No. At this time we can move the

9

ones we've had marked into evidence, which are Applicant's

10

Exhibits 30, 31, 32, 33, and 34.

11

We would ask that they all be moved into evi-

12

dence at this time.

13

MRS. BOWERS: Mr. Fleischaker?

14

MR. FLEISCHAKER: Let me see what they are.

15

Let me catch up on what we're talking about, please.

16

MR. NORTON: I'll do it very quickly for you.

17

Applicant's Exhibit 30 is the --

18

MR. FLEISCHAKER: I'd rather do it slowly myself.

19

Let me just take a look at them, please.

20

MR. NORTON: Fine.

21

MR. FLEISCHAKER: Mr. Norton, the big exhibit

22

that was up on the board there, was that marked?

23

MR. NORTON: No.

24

That was taken from B42 of your testimony. It

25

is an attachment to Dr. Silver's testimony.

mpb6 1

MR. FLEISCHAKER: Just one moment.

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(Pause.)

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MR. NORTON: It's also the same as the open file map. In fact, it's the original best evidence of B42 from which B42 was reduced.

6

7

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MR. FLEISCHAKER: The difficulty I'm having is this B42 has line numbers on it. Does that have line numbers on it, this large thing?

9

10

MR. NORTON: Yes, it did. But they were so very small you couldn't see them.

11

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MR. FLEISCHAKER: Well, the problem I'm going to have is that we may wish to pursue this question of measuring and location further.

14

15

16

So I'm going to object to the introduction of Applicant's Exhibit number 32 unless we have the large original marked also.

17

18

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MR. NORTON: Well, the large original, as I understand it, is the property -- hang on just a moment.

That's a proprietary piece of paper. That doesn't belong to us. And we had to go borrow it.

21

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MR. FLEISCHAKER: Proprietary?

MR. NORTON: We can get copies of it.

In other words, it belongs to someone else. But we can make copies of it. But we can't -- you know, there's no problem in making copies of that.

mpb7 1

MR. FLEISCHAKER: Okay.

2

Can we reach agreement, then, that that will be marked as Applicant's exhibit?

3

4

MR. NORTON: Sure. I have no problem with that.

5

6

MR. FLEISCHAKER: Can we further reach agreement that we can have a copy of it tonight to examine?

7

8

MR. NORTON: I don't know if I can get a copy of that monster made by tonight.

9

MR. FLEISCHAKER: The copy you have?

10

11

MR. NORTON: No, we cannot give you that. It's one of a kind and it doesn't belong to us.

12

13

14

We would suggest -- I don't know where Dr. Silver got B42, but it's obviously the same source. So you certainly have that available to you.

15

Drawing B42 of your testimony.

16

WITNESS SILVER: Which is B42?

17

18

MRS. BOWERS: Well, you'll have to look at your testimony.

19

20

MR. FLEISCHAKER: There are two problems, I think, and they are separable.

21

22

23

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25

The first one is whether we should permit these documents -- particularly Applicant's Exhibit number 32 -- to go into the record or any of the testimony without the supporting document. And my position would be that you cannot, that you have to have that large document that he had up there

mpb6 1 in order to do that.

2 I think we've reached some agreement on that.

3 MR. NORTON: Mrs. Bowers, we have laid sufficient
4 foundation, Dr. Silver has identified all these documents.
5 He's agreed that the one we marked was a photocopy of a
6 portion of a great big large map.

7 If Mr. Fleischaker wants to go into other things,
8 then let him get his own map. You know, we have laid the
9 foundation that's required. That's all we have to do.

10 If Mr. Fleischaker wants to go into some other
11 area, he's free to do so.

12 MRS. BOWERS: Well, the witness compared 32 to
13 the large map, and he testified that it was in fact a part of
14 that large map, a reproduction.

15 MR. FLEISCHAKER: I have no objection to 31
16 through 34 going in.

17 MR. NORTON: How about 30? That's Dr. Silver's
18 article.

19 MR. FLEISCHAKER: No, I have no problems. I
20 have no objection to that.

21 MRS. BOWERS: Mr. Tourtelotte?

22 MR. TOURTELLOTTE: No objection.

23 MRS. BOWERS: Well, Applicant's Exhibits 30
24 through 34 are admitted in evidence.

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mpb9 1

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(Whereupon, the documents
previously marked as
Applicant's Exhibits 30
through 34 were admitted
into evidence.)

3g ebl

MR. NORTON: Shall we proceed, Mrs. Bowers?

MRS. BOWERS: Yes.

BY MR. NORTON:

Q Dr. Silver, do you recall in your deposition comparing the San Gregorio as a major California fault zone?

A (Witness Silver) Yes. I don't recall exactly where, but I do recall.

Q Well, as a matter of fact, you said that there were-- I asked you-- You said it was a major fault zone in the State of California, and I asked you to list some other fault zones. Do you recall that?

A Yes.

Q All right.

Could you do that for us now, list the major fault zones, in addition to the San Gregorio-Hosgri fault zone, what other major fault zones there are? You know, this is obviously your opinion.

A Okay. Without a California map it's hard to simply list every fault zone. I could start listing --

Q Excuse me. Let me rephrase my question to make sure we're understanding one another.

You classified the San Gregorio-Hosgri as a major fault zone.

A Yes.

Q Then I asked you to list other major fault zones,

eb2 1 and you started out with the San Andreas and you named a few
2 others.

3 Now I'm asking you the same question again today,
4 to give the major California fault zones. You don't have to
5 repeat your testimony. If you forget one I'm not going to
6 quibble over that. I'll just tell you what it is that you
7 forgot.

8 MR. FLEISCHAKER: Excuse me, Mrs. Bowers. This
9 line of questioning is argumentative. I would like Mr. Norton
10 to limit himself to asking questions. He doesn't have to
11 make speeches and instruct the witness during the course of
12 the cross-examination. So I'm going to object to that ques-
13 tion; the form of the question is argumentative. He's in-
14 structing the witness and I would request that he limit him-
15 self to asking questions of the witness.

16 MRS. BOWERS: Do you want to respond to the objec-
17 tion?

18 MR. NORTON: No.

19 MRS. BOWERS: Does the Staff think that it was
20 argumentative?

21 MR. TOURTELLOTTE: I have never understood a
22 question like that to be argumentative, but I might add this:

23 It isn't a good idea for an attorney to get into
24 a colloquy with a witness. However, I don't view that ques-
25 tion as being argumentative, and I don't see how it could be

eb3

1 sustained.

2 MRS. BOWERS: Well, the objection is overruled.

3 Mr. Norton, could you help the witness by giving
4 a page reference?

5 MR. NORTON: I don't have my deposition open, but
6 I can find it.

7 MRS. BOWERS: Is that what you're looking for,
8 Dr. Silver?

9 WITNESS SILVER: Yes.

10 MR. NORTON: I don't have it. I can get it for you.
11 Let me look at my notes.

12 BY MR. NORTON:

13 Q Pages 84 and 85. I'm not checking your memory.
14 That's all I'm trying to say. I just want to start talking
15 about them.

16 A (Witness Silver) Well, there are a number of fault
17 zones in California. The Hayward-Calaveras is a fault zone.

18 Q Excuse me for interrupting, Doctor, but I asked
19 for major fault zones now. I'm not interested in all the
20 fault zones, not that you didn't previously describe it, but
21 please limit your answer to what you told me before were the
22 major fault zones.

23 A Mendocino is a major fault zone.

24 Q Which one was that?

25 A Mendocino.



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Q Okay.

2

A The Hayward-Calaveras is a major fault zone.

3

The Rinconada may be a major fault zone.

4

The Garlock is a major fault zone.

5

Q Dr. Silver, I'm really trying to --

6

A California is riddled with faults and many fault

7

zones-- The word "major" remains to be worked out on many of
8 them, just how major are the--

9

Q I'm not trying to test your memory.

10

A There are many large fault zones.

11

Q I'm not trying to test your memory. I'm just

12

trying to get a listing.

13

You also mentioned the Santa Lucia Bank.

14

A The Santa Lucia Bank fault, yes.

15

Q You also mentioned the San Gregorio-Hosgri, did you

16

not?

17

A Yes.

18

Q Now would you add to that list the Sierra Nevada

19

as a major fault zone?

20

A The Sierra Nevada?

21

Q Yes.

22

A No.

23

Q How about the San Jacinto?

24

A The San Jacinto is certainly an important fault

25

zone.

eb5

1 Q Would you classify it as a major fault zone?

2 A I don't know.

3 Q How about the San Andreas?

4 A Oh, yes, the San Andreas.

5 Q Now when you told me in the deposition that these
6 were major fault zones, what did you mean by "major fault
7 zones"?

8 A That they had appreciable length.

9 Q Anything else?

10 A That they had -- they were associated with signifi-
11 cant seismicity.

12 Q Okay. What else?

13 A For many of them it would be important to know their
14 offset history, but for many of them the offset history
15 really hasn't been worked out; that is, the amount of geologic
16 displacement.

17 Q Since you've chosen to classify these as major fault
18 zones, I want to know your assumptions that underlie your
19 classification of them as major fault zones.

20 So far you've given me length and significant
21 seismicity. What other assumptions make them major as
22 opposed to minor, or some other adjective?

23 A Well, there's certainly a whole spectrum between
24 the variety of fault zones one sees in California. Length
25 is the primary characteristic we have to work with.

eb6

1 Q Is there a minimum length that makes something a
2 major fault zone?

3 A Well, I can't answer that because a relatively
4 small fault zone that has a certain kind of compressional
5 movement may be associated with significantly large earth-
6 quakes, so I don't think one can just easily characterize a
7 minimum length.

8 Q All right.

9 A It's a very difficult question to categorize.

10 Q I believe it was your term, "major." I don't want
11 to get into that with Mrs. Bowers about seat of the pants
12 again, but I believe you were the one who suggested "major
13 fault zones" --perhaps not -- in your deposition.

14 Well, as I read the deposition there's some question
15 about who first used the term "major," but we were discussing
16 major fault zones, as I recall, and I am trying to now find out
17 what you had in your mind when you said "major fault zones,"
18 so whether those words started with my question or with your
19 answer, it doesn't make any difference. Whether it started
20 with your answer, I would presume you may be better apt to
21 tell us, but why don't you --

22 MR. FLEISCHAKER: I want to restate my objection.
23 This is exactly the kind of improper cross-examination that
24 results when somebody uses a deposition to bootstrap into
25 some sort of impeachment or attempted impeachment. You know,



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1 Mr. Norton isn't quite sure who used the term "major" and
2 now he's trying to develop some kinds of lines of inconsisten-
3 cies in this witness' testimony, and it doesn't seem to me that
4 we're getting anywhere, that we're going anywhere.

5 So I want to state an objection to the use of the
6 deposition as the main basis for a line of questioning when
7 there has been absolutely no inconsistency shown in this wit-
8 ness' statement.

9 MR. NORTON: Mrs. Bowers, I'm not trying to develop
10 this inconsistency about which faults are major fault zones
11 and which aren't.

12 Believe me, Mr. Fleischaker, I'm not trying to do
13 that. In fact I was helping him name them off. I want to
14 discuss them. I'm trying to find out why he classifies them
15 as major. That's all I'm trying to find out. And if that's
16 the wrong word, I want to find that out, and find out what the
17 common ties are.

18 MR. FLEISCHAKER: I think if someone read this
19 whole deposition they would see in the context of an hour or
20 two or three that MR. Norton threw out a question, name some
21 fault zones, and the question may have been name some major
22 fault zones -- I don't know -- and Dr. Silver named two or
23 three and he said I can't remember them all. Those are a few
24 that I can remember.

25 And it seems we're going from that kind of nebulous

eb8

1 discussion into a characterization that Dr. Silver has
2 developed a major ranking order system. He hasn't. He didn't
3 say that he did in this deposition. There is nothing in
4 his testimony to say that he has developed a well-ordered
5 system for objectively classifying faults across the State of
6 California.

7 I think that's what we're leading into and I think
8 the problem is that we have started from a deposition in an
9 effort to build a line of cross-examination, and you should
10 start with the witness' testimony, not the deposition.

11 MRS. BOWERS: Mr. Tourtellotte, does the Staff
12 want to respond?

13 MR. TOURTELLOTTE: No.

14 MRS. BOWERS: Well, we ruled earlier that it was
15 appropriate to use the deposition, partly for efficiency and
16 also mentioned helping witnesses to recall. The witness of
17 course was attempting to find the location in the deposition
18 where this was discussed.

19 Your objection is overruled.

20 BY MR. NORTON:

21 Q Dr. Silver, is there anything else other than
22 length and significant seismicity that you use as a criteria
23 to classify major faults?

24 A (Witness Silver) One would like to know the his-
25 tory of offset and the modern rate of offset on faults. We

eb9

1 often don't know that on many of the fault zones. We have a
2 good idea for a few.

3 Q Do you know the length of the San Andreas?

4 A It's the order of 1,000 kilometers.

5 Q Could it be as long as 1200?

6 A I say the order of 1,000 kilometers. I'd have to
7 measure it on a map.

8 Q But could it be as long as 1200?

9 MR. FLEISCHAKER: Asked and answered.

10 MR. NORTON: I'm afraid it wasn't answered,
11 Mrs. Bowers. That's why I asked it again.

12 MRS. BOWERS: The answer was not responsive.
13 Please answer the question.

14 WITNESS SILVER: It could be, but to do any more I
15 would have to go to a map and measure.

16 BY MR. NORTON:

17 Q How about the Hayward-Calaveras?

18 A (Witness Silver) I can't give you numbers on this
19 off the top of my head. And also, there has been recent work
20 on the Hayward-Calaveras also that indicates it may be much
21 larger than was previously thought.

22 There is a recent article in Geology, December 1978,
23 by Darrell Hurd of the U. S. Geological Survey.

24 Q Excuse me, Dr.-- Well, go ahead and look it up.

25 I was interested in what you knew, not what an article says.

eb10

1 A What Hurd suggests is that the Hayward-Calaveras
2 fault zone may be part of a much longer fault zone than had
3 previously been thought. Originally the fault zone was mapped
4 -- I'm looking at scales here -- approximately 200 kilo-
5 meters. However, in his recent paper he suggests that the
6 fault zone may be in excess of seven or eight hundred kilo-
7 meters, not as a through-going zone but as a series of offset
8 segments, en echelon zones.

9 Q How about the Rinconada?

10 Doctor, if you know, fine. I don't really expect
11 you to do research.

12 A Well, I remember going through this in the deposi-
13 tion and going to a map and making an estimate from a small-
14 scale map, so I'm happy to go through my deposition and
15 try to find the figure and repeat it to you.

16 Q I think the only thing you said there is it's over
17 100 kilometers, page 87, the last line. And then you go out
18 to 130, 140 on page 88.

19 A I think at the top of page 88 you're talking about
20 the Santa Lucia Bank fault.

21 Q Yes, I'm sorry, I was. So I guess you got it a
22 little over 100 for the Rinconada. Is that correct?

23 A That's what was in the deposition, based on an
24 estimate on a very small-scale map, yes.

25 Q Okay.



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eb11

1 And the Mendocino I believe you said 250 to 300
2 in the deposition. That's also on page 88. I'm trying to
3 speed up the process a little bit.

4 A Yes, I'll stay with that.

5 Q Okay.

6 And how about the San Gregorio-Hosgri? I think
7 you have already testified that that's 400, did you not?

8 A The order of 400, yes.

9 Q Okay.

10 How about the Garlock?

11 MRS. BOWERS: Is that in the deposition?

12 WITNESS SILVER: No, it isn't.

13 MR. NORTON: He didn't mention that one.

14 WITNESS SILVER: I don't have a map including the
15 Garlock. It would be of the order of 100 kilometers, but
16 I can't tell you.

17 BY MR. NORTON:

18 Q How about the San Jacinto?

19 A (Witness Silver) I can't give you a number off the
20 top of my head.

21 Q An approximation?

22 MR. FLEISCHAKER: I'm going to object to the wit-
23 ness speculating. He has already given an answer that he
24 can't give a number off the top of his head. We've got lots
25 of maps around here, and I'm sure that if we need to go to a

eb12

1 map to get one out in front of the witness, we can sit down
2 and scale these things off.

3 MRS. BOWERS: Do you have a map now, Dr. Silver?

4 WITNESS SILVER: Yes. It's a rather old one.

5 From this map of Crowell it could be as much
6 as 200. However, as an individual segment he maps it maybe
7 80 kilometers, but it looks to have been part of a much longer
8 fault zone so-- No, I'm sorry.

9 BY MR. NORTON:

10 Q Why do you not include the Sierra Nevada in your
11 list of major fault zones?

12 A The Sierra Nevada is a large mountain range. It's
13 a large granitic rock. It does have associated with it fault
14 zones. There is-- In fact one should include faulting along
15 the east escarpment of the Sierra Nevada for sure.

16 Q Are you telling me there is no such thing as a
17 Sierra Nevada fault zone?

18 A There are faults within the Sierra Nevada.

19 Q But there are no maps, state maps or anything that
20 show a Sierra Nevada fault zone?

21 A By your question I interpreted you to be asking
22 originally, do I consider the whole mountain range a fault
23 zone.

24 Q No, the Sierra Nevada fault zone, are you familiar
25 with that?

eb13

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A There may be one. I can't think of it.

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Q You're not familiar with anything called the Sierra

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Nevada fault zone?

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A There may be, the name is so common, but I can't
5 place it.

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1 Q Now the next thing you talked about was signifi-
2 cant seismicity; at least that's what I wrote down on my note
3 pad.

4 Could you tell me what you mean by significant
5 seismicity? --what you meant by that term?

C10

6 A Having earthquakes associated with the fault
7 of the order of magnitude of 5 or greater.

8 Q In other words, your definition-- Let me see
9 if I understand this.

10 If a fault zone had a length of 140 kilometers
11 and had a 5.5 magnitude earthquake on it in the past 500
12 years you would consider that a major fault zone; yes or no?

13 A Well it's difficult to tell. One might or one
14 might not, depending on---

15 Q Well, Dr. Silver, I'm trying to understand how
16 you call things major fault zones and the assumptions that
17 you use. You told me length, and the shortest one I've got
18 is actually the San Jacinto, 80 to 200 kilometers. But we'll
19 take the 200 and move off that one to the Santa Lucia Bank
20 which you said was 130 to 140 kilometers in length. So I
21 took that as one of your lengths.

22 And then you said anything above a magnitude 5.
23 So I took a 5.5. And I put those two together and I thought
24 you would be able to tell me yes, that would be indicative of
25 major fault zone.

wb2.

1 So I guess I don't follow whatever assumptions
2 you must be using, other than those two.

3 MR. FLEISCHAKER: Is there a question?

4 BY MR. NORTON:

5 Q If you can't answer that question I assume there
6 are other assumptions.

7 A (Witness Silver) The reason this is going very
8 haltingly is that I have never sat down to characterize the
9 faults in California in terms of a ranking, major, minor,
10 in terms of these characteristics.

11 Q Well I believe in your deposition, Dr. Silver,
12 that you indeed did classify the San Gregorio-Hosgri as a
13 major fault zone, did you not?

14 MR. FLEISCHAKER: All right. I'd like to object
15 to that question. Because the whole line of questioning is
16 getting out of hand.

17 One has to read the deposition to understand
18 that it began from a very gradual discussion about faults
19 generally. And Mr. Norton asked him to list a number of
20 faults. And Dr. Silver started listing some faults and
21 said "I don't know that I can think of them all." And he
22 named two or three or four, and he said "These seem to be
23 major faults." And all of a sudden we have from this a
24 construction on the part of the applicant, an implication that
25 Dr. Silver has created a ranking system. And now he is.



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wb3 1 requiring him, or cross-examining him to state the rationale
2 for a ranking system.

3 We just got the answer. This witness has not
4 created such a system of ranking of faults in the State of
5 California. So I'm going to object to the line of question-
6 ing as irrelevant.

7 If you want to talk about the San Gregorio-Hosgri
8 and why he considers that major, that's one thing. We can
9 talk about the San Gregorio-Hosgri and question him as to
10 why he thinks is a major zone and what he means by major
11 zone. But this witness has not set forth to this Board, or
12 in his testimony or in any demonstration a rank order system
13 for the faults in California. And that's where this cross-
14 examination is going. And that's why it's improper. And
15 it grows nebulously out of the deposition.

16 MR. NORTON: I'm not sure I understand the
17 basis for the objection. I heard a long speech but I don't
18 think I heard a basis.

19 MR. FLEISCHAKER: It's irrelevant. This witness
20 just gave you an answer: he does not have a ranking system.
21 And it's irrelevant.

22 If you want to talk about the San Gregorio-Hosgri
23 and why he calls it major, fine: let's talk about that.

24 MR. NORTON: Mrs. Bowers, I can only say that if
25 the faults -- if California faults are irrelevant to this

wb4. 1 hearing I don't know why we're here.

2 MR. FLEISCHAKER: That's not the point. The
3 point is that in this cross-examination he is asking him to
4 state a rationale for a ranking system that he never has,
5 that he has never constructed. And he has just stated that
6 on the record. Therefore any other cross-examination on this
7 question is superfluous.

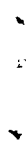
8 Cross-examination on the issue of "Do you consider
9 the San Gregorio-Hosgri to be major?" is relevant. And that,
10 it seems to me, is what the questioning should be directed
11 to and not to a ranking system.

12 MR. NORTON: Mrs. Bowers, that question of whether
13 the San Gregorio-Hosgri fault is a major fault zone only has
14 relevance if we know what a major fault zone is. And we have
15 to talk about other major fault zones in order for it to have
16 any meaning. Otherwise you're talking in a vacuum.

17 I'm amazed at this objection. I mean, it's just
18 absurd to talk about one fault and put words on it like
19 "major" if you don't know what they mean.

20 MRS. BOWERS: Mr. Tourtellotte?

21 MR. TOURTELLOTTE: My understanding of what's
22 been going on is that Mr. Fleischaker indicated that
23 Mr. Norton could ask a question about whether the San Gregori-
24 Hosgri zone was a major fault zone. I think that was the
25 question that was asked. And my understanding is that the



wb5

1 questions that accompanied that question were directed
2 toward finding out the meaning this witness has for the
3 term "major," not in the context of trying to get this
4 witness to classify events but simply finding out what he
5 means by "major." And so far I haven't been able to discern
6 from the answers of the witness that he has answered that
7 question. So I don't believe the objection is well taken.

8 MRS. BOWERS: Well the objection is overruled.

9 The witness said while he hasn't done an exercise of labeling
10 faults in the California are as major or minor, he has given
11 his basis for determining in his own opinion as to what would
12 be a major fault dealing with length and seismic activity.

13 And we certainly agree that you can't consider only one
14 fault and get it in perspective unless you also get testimony
15 on the other faults.

16 So will you proceed, Mr. Norton, please.

4A fls

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BY MR. NORTON:

Q Dr. Silver, I'll just quote one line of your direct testimony in 1.2-4. The page doesn't have line numbers but it is starting at the end of the fifth line down. It says:

"The San Gregorio-Hosgri Fault Zone is the only major fault zone with documentation to satisfy this criterion."

So I'm trying to find out, Dr. Silver, what you mean by "major," so far you've told me length and significant seismicity.

I asked you what you meant by "significant seismicity," you said: Oh, anything over a five magnitude earthquake. So I gave you a hypothetical of a fault zone that is 100 and -- we'll say 150 kilometers in length, that has had one 5.5 magnitude earthquake on it in the past 500 years. And I ask you, does that fit your definition of major fault zone?

A (Witness Silver) Well, it would have a major length for sure.

Could I expand or get maybe to the more basic question here of --

Q I would like to ask the questions.

A All right.

MRS. BOWERS: Can you answer that question?

agb2

BY MR. NORTON:

Q Can you answer that question?

A (Witness Silver) I'd say yes, the length is major.

Q And it has significant seismicity if it had a 5.5 earthquake 500 years ago?

A Well you're very unlikely to have discovered a 5.5 500 years ago. It would have had to be much more recently than that.

Q How about 200 years ago?

A That's fairly unlikely in California. Maybe 100.

Q All right.

A And it may be major.

Q So, if an earthquake occurred that had a 5.5 magnitude in 1940, we would have known it, wouldn't we, in California?

A We probably would have.

Q Would there be any reason why we wouldn't have?

A We probably would have.

Q And you can't tell me any reasons why we wouldn't have if we had a 5.5 in 1940, for example?

A No.

Q Okay.

So then I will change my hypothetical to 150 kilometer length fault which had a 5.5 magnitude in 1940 that,

1
agb3 according to your definition, is a major fault zone, is that
2 correct?

3
4 A It may be. I don't know.

5 As I say -- what I would consider more significant
6 is looking at everything one knows about the fault zone.

7 Q Excuse me, Dr. Silver, you didn't have any problems
8 ranking the San Jacinto as a major fault zone, did you?

9 A Yes, I said it may be a major fault zone because --

10 Q How about Santa Lucia? You didn't ever say
11 maybe about that one, did you?

12 You said it was a major fault zone, did
13 you not?

14 MR. FLEISCHAKER: I'm going to object, it's a
15 multiple question.

16 MR. NORTON: I'll withdraw the question.

17 BY MR. NORTON:

18 Q Is the Santa Lucia Fault Zone, or Santa Lucia
19 Bank Fault Zone a major fault zone, Dr. Silver?

20 A (Witness Silver) I believe it is, yes.

21 Q All right.

22 And what do you base that on, Dr. Silver?

23 A On its length.

24 Q Only its length. Isn't that --

25 A That's right. I have no knowledge of the other
things.

agb4

1 Q You have no knowledge of its seismic history, do
2 you?

3 A Very little.

4 Q And you have no knowledge of its offset?

5 A Some knowledge of vertical offset. None of
6 horizontal.

7 Q Okay.

8 So the only thing you know about there is length,
9 and you believe that that is a major fault zone.

10 Now let's go back to my hypothetical. Why is my
11 hypothetical maybe a major fault zone, instead of a major
12 fault zone?

13 A Because I don't know what kind of offset your
14 hypothetical has. I do know, for the Santa Lucia Bank Fault
15 Zone, that it has appreciable vertical offset in places of
16 the order of a kilometer, possibly more.

17 Q How about the Mendocino, what do you know about
18 its offset?

19 A The Mendocino -- let's see, our knowledge of the
20 offset history along the Mendocino comes from knowledge of the
21 spreading rate of the sea floor along the Gorda Ridge. The
22 Gorda Ridge is a spreading center that intersects the
23 Mendocino Fault to the north.

24 The rate of movement at the present time along
25 the southern end of the Mendocino is maybe three or four

agb5

1 centimeters a year.

2 Q What do you base that on?

3 A The magnetic anomaly.

4 Q You're able to predict rate of movement on the
5 magnetic anomaly?

6 A Yes.

7 Q -- at three to four centimeters a year for the
8 Mendocino Fault?

9 A Yes.

10 Q Q Have you published that?

11 A I published maps showing the data.

12 Q Over what span of time is this rate of slip?

13 A That's several million years.

14 Q Over several million years?

15 A Yes.

16 Q So you don't know its present rate of slip?

17 A That's correct.

18 Q Okay.

19 Do you know the Hosgri's present rate of slip?

20 A The only thing I know about rate of slip along
21 the Hosgri-San Gregorio is the data very far north at Ano
22 Nuevo which I talked about today. I don't know of strong
23 constraints.

24 Q And that's based on other people, that's not your
25 personal work?

agb6

1 A That's right.

2 Q Would you say this is about a major fault zone,
3 that it's capable of an 8+ earthquake?

4 A No, not necessarily.

5 Q Is it capable of a 7+ earthquake?

6 A Not necessarily.

7 Q Is it capable of a 6+ earthquake?

8 A Not necessarily.

9 Q What do you know about distribution of seis-
10 micity, if anything, in terms of if you have a maximum credible
11 what do you expect underneath it?

12 A I'm sorry, if I have a what?

13 Q That's a tough question. Let me try it again.

14 Let's say the San Andreas -- which I think everyone
15 here would agree is capable of a magnitude 8 earthquake, all
16 right.

17 Would you agree?

18 A Yes, along certain parts of it especially. Not
19 necessarily the whole length.

20 Q Where is it not capable of an 8+?

21 A It may not be along its central regions in, say,
22 in the area south of Hollister.

23 Q Is that in the Big Bend area?

24 A No, it is not in the Big Bend area.

25 Q North of it or south of it?

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A It's north of the Big Bend.

Q Okay.

Well excluding that part then, let's talk about what would you expect to find in terms of a distribution of magnitude 7s, magnitude 6s, you know, underneath the 8?

Do you understand what I'm driving at?

A Okay. One would expect the distribution of seismicity to follow essentially some kind of a logarithmic curve.

Q Okay.

Then if we take a stretch of the San Andreas that's capable -- let's take a 400 kilometer stretch on the San Andreas from, oh, San Francisco south. You have a 400 kilometer stretch there, don't you, that's capable of an 8?

A No.

Q How far is it?

A The area from, let's say, Hollister north to Cape Mendocino might be a 400 kilometer stretch.

Q And it's all capable of an 8, right?

A Yes.

Q Okay.

And I believe you testified, and maybe you haven't, but I'll ask you if you have: have you testified that there's a 300-year return period of a magnitude 8 on the San Andreas?

A No, I haven't testified that.

agb8

1 Q Okay. Do you believe that, from the data you've
2 reviewed and the papers you've read, that that portion of the
3 San Andreas is capable of a magnitude 8 with a return period
4 of 300 years?

5 A No, I'm not aware of that figure.

6 Q All right.

7 Do you have any concept whatsoever for a return
8 period for the San Andreas for magnitude 8?

9 A Yes, one can make an estimate of return period.

10 You see, we have only one earthquake of magnitude
11 8, 1906, in that stretch, so one can make an estimate of the
12 amount of return for a magnitude 8.

13 Q Okay. What's your opinion as to the return
14 period for a magnitude 8 on that stretch of the San Andreas?

15 A Anywhere from 100 to 200 years.

16 Q Okay.

17 Let's take your hind number of 200 years, okay?

18 Now, how many 7s, magnitude 7s, would you expect
19 in that 200-year period. If it's logarithmic, wouldn't it be
20 10?

21 A Something in that.

22 Q Give or take a couple, given the statistical
23 scattering, is that correct?

24 A It could be.

25 Q Well what's your opinion, then?

agb9

1 A Well, as far as I'm aware, the segment of the
2 San Andreas from north of Hollister, north to the Cape
3 Mendocino area, has a relatively low seismicity. So that,
4 even though there was a very large earthquake in 1906, and
5 one can go through sort of gross estimates to get what one
6 thinks might be the recurrence interval, the seismicity in
7 that area has been fairly low, so I'm not sure that there have
8 been that many --

9 Q What's the seismicity in the area of the Hosgri?

10 A It's fairly low also.

11 Q Oh, okay.

12 What does that mean to you?

13 A Well the area north of San Francisco suggests
14 to me that the reason that the seismicity is low probably is
15 a result of what one calls dip-slip faulting, that is,
16 large parts of the energy release in that area come from
17 movement on the very large earthquakes rather than dis-
18 tributing them through the spectrum.

19 As opposed, for example, to the same faults in
20 the San Andreas south of Hollister, which does not have --
21 for some distance south of Hollister, which does not have a
22 history of magnitude 8s, and that has relatively high seis-
23 micity, that is, earthquakes up to and including maybe
24 magnitude 6s and smaller ones, but not getting up to the very
25 large ones.

agbl0

1 Now, getting back to the more relevant question
2 here, for the Hosgri, the low seismicity there could tell me --

3 Q Excuse me, I don't believe I asked you that
4 question, Dr. Silver.

5 MR. FLEISCHAKER: I think you did.

6 MR. NORTON: Excuse me, Mrs. Bowers, I don't
7 believe I asked him that question.

8 MRS. BOWERS: Well you asked about the seismic
9 activity on the Hosgri earlier.

10 MR. NORTON: No, I asked if it was high or low
11 and he said it was low and I said okay and went on to another
12 question about the San Andreas.

13 MR. FLEISCHAKER: I'd like to have the sequence
14 of questions read because I understood him to be asking
15 about the Hosgri also.

16 BY MR. NORTON:

17 Q Go ahead and answer the question. I don't believe
18 I asked it but go ahead and answer it anyway and we won't have
19 to have the record read back.

20 A (Witness: Silver) Answer what? I'm sorry.

21 Q What you started to answer, low seismicity on
22 the Hosgri.

23 A That's what I understood you asked me.

24 Did you ask me why -- that was my understanding
25 of your question.



agbl1

1 Q I asked you if the Hosgri had low seismicity
2 and you said yes.

3 A Yes. And then you asked me why, I thought.
4 But I'd be happy not to answer it.

5 Would you like me to make an answer to that?

6 Q Sure.

7 A Low seismicity on the Hosgri could mean one of
8 several things. It could mean that over very long periods
9 of time there is very low seismicity, or it could mean some-
10 thing analogous to the San Andreas north of San Francisco,
11 that seismic release may come with large earthquakes but on
12 a very long time scale.

13 Q What do you mean by "a very long time scale?"

14 A Longer than, say, the 100 years for the San
15 Andreas, maybe, several hundred.

16 Q Well isn't this contrary to the current annual
17 rate of slip that you've cited for Weber and Lajoie of 1.6
18 centimeters per year?

19 A Is what contrary?

20 Q One large amount of slip very infrequently.

21 A The Weber and Lajoie data is based on offset
22 marine terraces dated at 100,000 years and 200,000 years,
23 so they're looking at markers that are averaging over the time
24 period of about 100- to 200,000 years.

25 And when I talk about long time for large

agbl2

1. earthquakes in a hypothetical case, I'm talking about several.
2. hundred. So I don't see that that has any connection.

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4B wbl

1 Q Can you state within a reasonable degree of
2 geologic certainty as to what the maximum capability on the
3 Hosgri is?

4 A No, I can't.

5 Q Can you state within a reasonable degree of
6 geologic certainty that the Hosgri has never produced an
7 earthquake as large as 6.5 magnitude?

10.260

8 A No. At the time of-- Can I expand on this?

9 Q If you're saying No, I don't need an expansion
10 at all.

11 A No.

12 Q Can you state within a reasonable degree of
13 geologic certainty that the Hosgri ever will have a 6.5
14 magnitude earthquake?

15 A No, I can't.

16 Q Now let's get to the thing you were going to
17 want to talk about, and that's the 1927 earthquake.

18 Would you turn to Attachment B of your testimony,
19 page 8. And at the bottom of that page, on B-8, you say-- I'd
20 like to start with the sentence,

21 "The Hosgri fault is probably seismically
22 active."

23 Have you found that?

24 A Yes.

25 Q "An earthquake of magnitude 7.3 occurred in

wb2

1 the vicinity of the southern Santa Maria Basin
2 in 1927, and Byerly (1937) reports that a tsunami
3 occurred along the coast of southern California
4 following the earthquake. Recent relocation studies
5 (Gawthrop, 1977) placed the 1927 epicenter at the
6 southern end of the Hosgri fault."

7 If you were to rewrite that paragraph today,
8 Dr. Silver, would you change it?

9 A Yes.

10 Q And why would you change it

11 A Because of the recent work that in fact was called
12 to my attention at and after the time of the deposition,
13 the work of Hanks, which I was aware of but I wasn't specificall-
14 ly aware of his results. I was aware he was looking at the
15 problem. And the work of Smith which questions the location
16 of the fault, as to whether in fact it did occur in the
17 southern part of the Hosgri or occurred slightly offshore
18 in a very small fault called the Lompoc fault. And their
19 opinion seems to be that it was more likely on the Lompoc.

20 I have not reviewed the data. I don't have an
21 opinion. But I have no reason to find argument with their
22 opinion.

23 So I would change that. I would probably--- Well
24 I haven't thought how I would change that, either. I would
25 just put a large error or uncertainty or just add the degree

wb3 1 of "probably more likely," or just add a sentence: Gawthrop--

2 Q I'm not asking you to--

3 MR. FLEISCHAKER: Excuse me. I want to object.

4 Mr. Norton constantly is interrupting. In that
5 case he interrupted this witness in the middle of a sentence.
6 I think he should be permitted to complete his question --
7 or, rather, to complete his answer. In that case I'm not
8 sure the Reporter picked it up: I didn't.

9 So I'm objecting to Mr. Norton's continuing
10 interruption of the witness while he's trying to answer
11 the question.

12 MRS. BOWERS: One thing that appears to me is
13 happening: Mr. Norton had some rather rapid-fire questions.
14 And he assumes the witness is done when he not always has
15 completed his testimony.

16 MR. NORTON: That was an example of it. And I
17 tried to stop and back off. And I did, I hope. But if the
18 Court Reporter didn't get it he can tell us so and you can
19 finish your answer.

20 THE REPORTER: I didn't get it.

21 BY MR. NORTON:

22 Q I think you were saying, Dr. Silver, you would
23 probably add a sentence.

24 A (Witness Silver) A sentence also summarizing the
25 Hanks and the Smith work as well, and showing the degree of

wb4

1 uncertainty. I'm just summarizing what they say.

2 Q All right.

3 Dr. Silver, your area of expertise is not such,
4 is it, that you would feel qualified to distinguish as to who
5 was right, Hanks and Smith or Gawthrop; is that correct?

6 A Well I haven't looked at the data. I don't spend
7 much time at all working on earthquake records. And so I
8 would not--

9 Q All right.

10 MR. NORTON: Mrs. Bowers, I would like to take
11 a break, if I could.

12 MRS. BOWERS: All right. Ten minutes, please.

13 (Recess)

14 MRS. BOWERS: We'd like to continue.

15 BY MR. NORTON:

16 Q Dr. Silver, your understanding of movement on
17 the San Gregorio I believe you testified was based on the
18 Weber and Lajoie abstract in part. And then I believe there
19 is another paper that somebody talked about earlier, that
20 they got an oral communication from Weber that it was 1.6;
21 is that correct?

22 A (Witness Silver) Yes. My talking to Weber; that's
23 right.

24 Q I'm sorry?

25 A My talking to Weber. An oral communication to me.

wb5

Q All right.

Are you aware of the mathematical inconsistency in the Weber abstract, that if you add up the columns those numbers don't jibe at all?

A No.

Q The only reason I ask, it was done earlier in the hearing: somebody pulled the abstract out, and if you just add up the numbers and divide them they come out to what they say.

So if you can find a copy of that abstract and take a quick look at it for me, perhaps you could explain the inconsistent numbers. If you don't have a calculator I suppose we have one here that we could loan you to make it a little easier.

A I don't have a calculator.

Q Hang on. We have a copy. I believe the Joint Intervenors marked it.

MR. FLEISCHAKER: Mrs. Bowers, I'm going to object to this line of questioning on the basis that he's cross-examining this witness on the basis of someone else's calculations. I believe, you know, that the inconsistency in that data-- Dr. Silver, as he's testified, talked to Dr. Weber, and it came from him, an estimate as to the offset on those terraces. And I'm not sure that it's appropriate to cross-examine this witness about somebody else's calculations.

wb6

1 MRS. BOWERS: Mr. Norton?

2 MR. NORTON: I believe he relying on the calcula-
3 tions in his testimony. I believe he cites them in his
4 testimony. I believe he cites the abstract in his references.

5 MR. FLEISCHAKER: Well I think his testimony here
6 isthat he has cited the -- I don't know whether he has cited
7 the abstract in his testimony or not. He's talked to
8 Dr. Weber, and Dr. Weber apparently has come up with a
9 maximum estimate of 1.6 centimeters per year. And what might
10 be a misprint in this abstract, or might be a miscalculation,
11 I think is something beyond this witness' experience and area
12 of expertise.

13 MR. NORTON: Mrs. Bowers, that brings us right
14 home to the point. Because we're going to move to strike
15 any conversation with Mr. Weber. That is hearsay piled on
16 hearsay. "Well somebody told me it was 1.6" is the rankest
17 hearsay.

18 What we have here is an abstract of the study.
19 And that seems to me to be clearly the best evidence, if
20 they're going to rely on that person's opinion, of what that
21 person's opinion is.

22 Now there's an error in the numbers that they're
23 relying on in the abstract. So they're going to rely on
24 "Well that's what he told me." There's no place in an
25 administrative hearing for what somebody told you.

wb7

1 WITNESS SILVER: He told me, and also gave it to
2 me in writing.

3 MR. NORTON: Mrs. Bowers, that is not in evidence
4 here at all. I don't know what he's referring to that he has
5 in writing.

6 But, you know, I'm just trying to find out if
7 he can explain the obvious mathematical error that everybody
8 picked up on. I think it was Dr. Martin who first picked up
9 on it several days ago.

10 MRS. BOWERS: I think it was Mr. Bright.

11 MR. FLEISCHAKER: I don't know whether there's
12 an error or not because I don't know whether those things are
13 supposed to add up linearly or whether those columns are
14 supposed to add up--- I really don't know, because I'm not
15 the expert. I'm not the person who compiled the article.

16 But whether they add up or not is not the relevant
17 point. What is relevant is whether he has obtained information
18 regarding the maximum estimate. That maximum estimate he has
19 obtained both through oral communication with Dr. Weber and
20 it is also reported in the CDM report which has been published
21 by the California Division of Mines. I think it was in the
22 Coppersmith and Griggs article in which they indicated
23 that Dr. Weber had a maximum estimate of 1.6 centimeters per
24 year. And they also cited an oral communication.

25 I think that is information which is reliable.

wb8

1 It has been printed in the report. And this witness is
2 prepared to testify about his conversations.

3 I don't think he should be made to explain what
4 may or may not be an inconsistency. I mean, I don't know: I
5 didn't talk to him about it. But it seems to me it is
6 inappropriate to cross-examine him on the basis of that.

7 MRS. BOWERS: Let me check with Mr. Tourtellotte.
8 Does the Staff have a position on this?

9 MR. TOURTELLOTTE: I don't understand what the
10 basis of that objection is. The word "inappropriate" doesn't
11 mean anything to me. Is it irrelevant? Is it immaterial?
12 Is this witness incompetent to do; or what?

13 I don't know what "inappropriate" means. I don't
14 know how to answer.

15 MRS. BOWERS: Mr. Fleischaker.

16 MR. FLEISCHAKER: I'm trying to think of the
17 exact legal framework to put it in.

18 (Pause)

19 The subject that the applicant seeks to examine
20 this witness on -- that is, the proposed inconsistency in
21 the addition of the columns is beyond the scope of this
22 witness' testimony. He's not testifying about the addition
23 and subtraction in that column, he is not testifying about
24 that matter, and it's beyond the scope of his testimony, and
25 therefore an inappropriate matter for cross-examination.

wb9

1 MRS. BOWERS: Well, but didn't he testify as
2 to the figure 1.6?

3 MR. FLEISCHAKER: That's correct. He said he
4 got that figure in oral communication from Dr. Weber.

5 The problem here is that that addition and
6 subtraction could be due to several things. It could be due
7 to a misprint in the Bulletin. It could be due to-- It may
8 not be a mistake at all. It may be that Dr. Weber's techni-
9 que has something in it that doesn't require straight
10 addition and subtraction. I'm not sure that this witness
11 is in a position to testify about that matter.

12 What matters is that he obtained through
13 Dr. Weber an estimate as to the maximum, and that's 1.6.
14 That has also been recorded in the CDM report.

15 MR. NORTON: Mrs. Bowers, he specifically cites
16 this abstract in his testimony. To not be able to cross-
17 examine on it is folly. There's no basis for this objection
18 at all.

19 MRS. BOWERS: The objection is overruled.

20 BY MR. NORTON:

21 Q Now, Dr. Silver, I presume you were calculating
22 and adding and all those good things there while we were
23 doing other things.

24 A (Witness Silver) Yes.

25 Q Is there any explanation for the numbers given that

wb10

1 you can come up with?

2 A No. There is an error in addition in the
3 abstract.

4 Q Well does that mean that-- Did you check that
5 data before you relied on it in your testimony, or in your
6 other publications where you cited it?

7 A I didn't use this in my testimony.

8 Q You never cited that abstract?

9 A Oh, yes, I cited it. But I didn't use the number
10 in my testimony.

11 Q But you cited the abstract?

12 A Yes, I did.

13 Q Did you check it before?

14 A No, I didn't.

15 Q How do you know it's valid? If the abstract on
16 its face is inaccurate-- Let's go back to the word
17 "reliable" and "validity." How do you know that it's
18 reliable?

19 A Okay. As far as adding up the numbers, I do
20 confess to not having added them up. I looked at the numbers,
21 they came out to grossly the same result; that is, the
22 published number was .63, and when you add it up it's .56.
23 On the low column, the published number was 1.3, when you
24 add it up it's 1.2. So, examining those columns, the number
25 of times looks similar. However I did not use those numbers

wb11

1 in the testimony.

2 Q Okay.

3 But doesn't that inaccuracy raise some questions
4 in your mind, as a scientist?

5 A Well,-- I mean, I don't know where the errors
6 lie.

7 Q Could you answer my question, please?

8 A It raises questions as to where the errors lie
9 in those numbers, and I don't know where the errors lie.

10 Q Does it raise any question to you about the
11 basic data?

12 A From what I know of the method used, an error
13 of plus or minus 10 percent is probably not going to be
14 improved upon. So that's the error in the numbers.

15 There is no reason in fact to publish an abstract
16 with any error in addition. I don't know why they did that.
17 I mean, their numbers should have added up exactly. But as
18 far as the difference in the columns, it certainly was within
19 the error of -- in fact, the range that they're giving is
20 the range of error of the method. Adding .6 to 1.3, the
21 real addition of these columns-- I mean if the error is in
22 the addition and not somewhere in the columns, the .56 to
23 1.2, it is giving you some idea of the inaccuracy of the
24 method involved.

25

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2 Q Dr. Silver, you heard Mr. Fleischaker mention
3 the Coopersmith and Griggs article where the oral repre-
4 sentation of 1.6 was cited.

5 Have you reviewed that article?

6 A Coopersmith and Griggs? Yes, I did review the
7 article.

8 Q And you agree with the statement contained
9 therein that a second order triangulation over the last 16
10 years has shown no offset?

10.500 10 A Oh, I haven't checked that out. I don't have
11 any reason to dispute that.

12 Q All right.

13 Well, what would you get in 16 years at 1.6
14 centimeters per year, what distance?

15 A 16 times 1.6 centimeters.

16 Q What distance is that?

17 A 25 centimeters.

18 Q All right.

19 And for us nonscientists, how many inches is that?

20 A Ten.

21 Q Nearly a foot?

22 A Yes.

23 Q All right.

24 Wouldn't you expect, if that were the current
25 rate of slip, to see some cultural evidence of a foot or ten

mpb2 1 inches of slip?

2 A Well, it depends on how the slip was distributed.
3 If there were slip on that time -- again, I don't know --
4 he's essentially dealing with one triangle.

5 Q Well, I'm talking about the S--

6 A So I don't know the --

7 Q Well, I was talking about cultural evidence,
8 not the triangle. Roads, fences, sidewalks.

9 A No sidewalks. There's just a little dirt road
10 going through there.

11 There may be some rickety old fences going
12 through, but there's very little cultural things. It's
13 essentially a farm area.

14 Q Have you ever checked out the cultural -- where
15 the fault goes onland in the San Gregorio? Are there cultural
16 things there, such as the fences and the roads? Have you
17 ever personally viewed that?

18 A I've been over the ground, but I haven't made a
19 study, no.

20 Q You never got out to look and see if there's
21 any cultural evidence?

22 A I have looked at parts of it, yes. I've gone
23 over one of the main roads -- in fact, I took a class out
24 and did a seismic refraction study of one of the traces. One
25 can see turns in the road, bumps, topographic effects. This

mpb3 1 may or may not be a result of slippage. I mean the effects
2 I've seen don't necessarily mean that they happened in the
3 last 16 years or the last whatever.

4 And I don't know the effect of that. I have
5 seen effects over the fault trace, but I can't put an age on
6 it and I don't know whether that is a result of movement or
7 not a result of movement.

8 There are visible effects that you can see.

9 Q Well, wouldn't one expect a second order survey
10 to pick up ten inches of movement?

11 A Well, I don't know in this survey because
12 essentially if they show, it's about one triangle.

13 Q How many traces of the fault are there there?

14 A Weber and Lajoie --

15 Q I'd like your personal knowledge first.

16 Do you have personal knowledge of how many
17 traces of the fault there are there?

18 A No. I mean one has to go through the method
19 that they did, and I haven't gone through their method.

20 Q All right.

21 Well, let me put it this way:

22 Dr. Graham I believe testified that there was
23 no evidence -- and I may be overstating that. And I believe
24 he testified something to the effect that he was not testify-
25 ing as to whether the San Gregorio-Hosgri was a continuous

mpb4 1 fault at this time. I believe that's a fairly accurate
2 representation of what he said.

3 I see him nodding his head yes.

4 A (Witness Graham) That's right.

5 Q That being the case, even if you have a current
6 rate of slip on the San Gregorio, that does not mean you know
7 what the current rate of slip on the Hosgri is, does it,
8 Doctor?

9 A (Witness Silver) That's correct.

10 Q All right.

11 Dr. Silver, what kinds of seismic reflection
12 data are there? What are the three basic kinds?

13 Well, that's probably a bad question because
14 you weren't here when we went through all this with Mr.
15 Willingham. So let me ask it a different way.

16 Mr. Fleischaker asked some rather extensive
17 questions of Mr. Willingham regarding the types of seismic
18 reflection data, and it basically broke down into three types:
19 high resolution, shallow penetration data, single channel
20 sparker data, and then multichannel.

21 Would you basically agree with those three types
22 of seismic reflection data?

23 A Well, there's really a spectrum, a whole spectrum,
24 from a shallow penetration down to deep penetration, high
25 energy data. So one need not categorize three.

mpb5 1

I would just say depending on your system there can be a whole spectrum of single channel and multi-channel.

3 Q Okay.

4 And then there's high resolution.

5 A Yes, that's what I say. There can be a whole
6 spectrum from the very highest resolution depending on the
7 frequency of sound energy used down to very low frequency
8 sound very deep penetration.

9 Q All right.

10 Why don't you tell me what kind of data you have
11 reviewed of seismic reflection data in the area at San Simeon
12 with the cove that you mentioned when you were talking about
13 the aeromagnetic map, where San Simeon came out of the cove,
14 San Simeon cove I think it was, isn't that correct? Or was
15 it a different name?

16 A I just said projected south of the San Simeon
17 area.

18 Q And I think you mentioned a little cove.

19 A Yes.

20 Q Anyway, from there all the way southward to the
21 end of the Hogri, could you tell us -- or let's say Point Sal,
22 because I believe you said you hadn't studied that part of it
23 extensively.

24 So could you tell us what kind of reflection data
25 you reviewed in that offshore area? And I'm not interested in

mpb6 1 going way off to the Santa Lucia bank; I'm talking basically
2 in the area of what you call the Hosgri fault zone.

3 A I reviewed largely the deeper penetration seis-
4 mic data of the USGS. I have also looked over their high
5 resolution data very cursorily. I found it very difficult
6 to get much out of that.

7 Q What specifically were you referring to, the
8 high resolution data?

9 A The USGS has taken high resolution data in that
10 area as well, several different cruises. I've not reviewed
11 that in great detail.

12 Just rolling out the records I found a great
13 deal of it very difficult to interpret and it would have been
14 very time consuming. So I have reviewed -- the data I have
15 reviewed has been the deeper penetration data.

16 Q All right.

17 What data, if any, have you reviewed that goes
18 from the north end of Estero Bay to San Simeon?

19 A The USGS data that I just mentioned.

20 Q Have you reviewed the Aquatronics data of 1974?

21 A No.

22 Q Have you reviewed the USGS KELEZ, late-1973
23 data?

24 A Yes, the deep penetration data.

25 Q Not the high resolution data?

mpb7 1 A I've looked at it, but I haven't reviewed it
2 in detail.

3 Q How about the Lee data, USGS 1975?

4 A No.

5 Q How about oil company data in that area?

6 A Oh, wait a minute. The Lee 1975?

7 Q That would be lines 516 through 563 sequentially,
8 including both single channel sparker and high resolution.

9 A No, I haven't.

10 Q All right.

11 Oil company data?

12 A No.

13 Q How about BB&M data, 1974, on the WHITE PLUME?

14 A No.

15 Q You did review the FSAR, did you not, that was
16 submitted in this proceeding?

17 A I've seen parts of the FSAR.

18 Q And I believe we discussed this in your deposi-
19 tion, and I'm going from memory now.

20 A But I didn't see all the volumes.

21 Q But I believe you said you had reviewed it,
22 Mr. Fleischaker had submitted it to you, or Mr. Hubbard, if
23 I'm not mistaken. And I asked you if there was any data in
24 there that you wanted to review that was referenced, primary
25 data, or that you had come across, is that correct, that

mpb8 1 was referenced, such as seismic lines, et cetera?

2 A Yes.

3 Q Did you review it and see all this data I just
4 mentioned to you referenced?

5 A Let's see. I have seen -- well, excerpts of
6 some of the data. But I haven't reviewed those data sets
7 except for the USGS, I mean the whole set.

8 Q And you realize they were all run in the area
9 where between the north end of Estero Bay to San Simeon, all
10 in that area and further out.

11 A No, I don't.

12 Q Well, excuse me --

13 A Wait a minute. Let me get to the north end of
14 Estero Bay.

15 Okay. The track chart I have shows a very few
16 lines of those other sets outside of USGS. Now it may be
17 that I just simply have an older track chart.

18 Q Well, the Lee data is not shown on that because
19 it's not plotted in the FSAR, but it is open file, is it not,
20 USGS?

21 A I believe so, yes.

22 Q All right.

23 Well, I guess my question to you is:

24 Why did you not review that data, that seismic
25 reflection data prior to coming into these hearings?

mpb9. 1 A Well, I reviewed what data I could fairly
2 easily. Now my feeling was as far as a detailed review of
3 a lot of the data, it was that people in the USGS, mainly
4 Dave McCulloch and Holly Wagner, with whom I've been working
5 for many years, have been spending most of their time doing
6 just that, doing those interpretations. So my feeling was
7 to discuss with them the results of what they did, but not
8 to begin an entire new overall project.

9 And so I spot-checked some of the data, but
10 I certainly didn't see all of it.

11 Q Did they draw a fault through there with all
12 of their analysis?

13 A I think I pointed up before --

14 Q Excuse me.

15 Yes or no; did they draw a fault through there?

16 A Through where?

17 Q From San Simeon to the north end of Estero Bay?

18 Did they draw a fault line through there?

19 A No, they don't continue their fault south of
20 San Simeon.

21 Q All right.

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1 A Can I add one thing to that or not?

2 Q Sure.

3 A I did discuss this with Dave McCulloch.

4 Q Excuse me. If you're going to tell me what Dave

5 McCulloch told you, I really am not interested and I

6 just again think that's hearsay. As I understand it,

7 Mr. McCulloch is the author of some of these maps."

8 MR. NORTON: At this time we would like to pass
9 Dr. Silver to Mr. Tourtellotte for cross-examination, and when
10 Dr. Silver's cross-examination is finished, we'll cross-
11 examine Dr. Graham.

12 MR. TOURTELLOTTE: Can I have about five minutes
13 to consult here? It may take four hours and it may take four
14 minutes.

15 MR. NORTON: Excuse me. I made a mistake. I did
16 have one more question. I'm sorry. If I can finish that up?
17 I just looked at my notes here.

18 MR. TOURTELLOTTE: I'll wait.

19 BY MR. NORTON:

20 Q I would like you to go to page 1.2-8 of your testi-
21 mony. This is the portion of your testimony I moved to be
22 struck, the last line thereof, right above the conclusions.

23 Would you read that sentence out loud for me?

24 A (Witness Silver) Which sentence?

25 Q The last one above the conclusions.

eb2

1 A "From Marks' regression of magnitude
2 on log L we can find that for the data used, 50
3 percent of the earthquakes occurring on a fault which
4 ruptured over a length of 400 kilometers will have
5 magnitudes greater than 8.2."

6 Q Can you tell me the relevancy of that sentence to
7 these proceedings?

8 A The relevancy there is simply an attempt to find
9 criteria on which to base any kind of an estimate of maximum
10 expected earthquake on a fault. One of the methods that has
11 been published is the method of Marks.

12 Q I understand that.

13 A So --

14 Q Well, doesn't it say "...on a fault which ruptured
15 over a length of 400 kilometers...."? It is not your hypo-
16 thesis, is it, Dr. Silver, that the entire San Gregorio-
17 Hosgri fault zone can rupture its entire length, is it?

18 A That would certainly be a maximum estimate.

19 Q Dr. Silver, are you aware of any earthquake fault
20 zone that has ruptured over its entire length at any time in
21 the world, at any time in history?

22 A No.

23 MR. NORTON: That's all I have.

24 (Pause.)

25 MRS. BOWERS: Are you ready, Mr. Tourtellotte?

eb3

MR. TOURTELLOTTE: Yes.

BY MR. TOURTELLOTTE:

Q Dr. Silver, is earthquake magnitude a simple function of fault length? Is that what you're testifying to?

A (Witness Silver) No. Essentially what Marks and others have done with the data is made a simple correlation between the length of the surface rupture of the fault and observed earthquake magnitudes on faults.

It's not at all simple. They've calculated best-regression lines to fit a rather scattered data set, but it's not simple at all. It varies with a great many factors, and this is also maximum magnitude. Obviously we can have anything below the maximum. And it's only a statistical correlation of whether that maximum will be reached.

Q In making your estimate which is I guess-- Is it 1.2-8 for the magnitude or it's 1,2-8?

In arriving at your estimate, do you rely upon the Bonilla-Marks approach to arrive at the conclusion?

A Yes. I simply used their graphs, their curves.

Q You took other factors into consideration?

A For this it was just simply that maximum length versus magnitude.

Q To arrive at your conclusion?

A To arrive at that statement.

Q That statement being which statement?

eb4

1 A The statement I read for Bruce Norton just above
2 the conclusions.

3 Q The last sentence there that starts, "From Marks'
4 regression...."?

5 A Right. That is exclusively based on that. It's
6 simply a statistical thing.

7 MR. TOURTELLOTTE: No other questions.

8 MRS. BOWERS: Do you have redirect for Dr. Silver,
9 Mr. Fleischaker?

10 MR. FLEISCHAKER: I'd like to take the opportunity
11 to look at the testimony tonight before our redirect.

12 MR. NORTON: We strongly object to that, Mrs. Bowers.
13 We don't just quit in the middle of the proceeding to do your
14 redirect. Counsel are supposedly taking notes and making
15 points. I don't mind a five- or ten-minute break but a 12-
16 hour break is ridiculous.

17 MRS. BOWERS: Well, if we took a five-minute or
18 ten-minute break it would get us done awfully close to five
19 o'clock.

20 MR. NORTON: I didn't realize it was that late. I
21 thought it was about 4:15 or 4:20.

22 MR. BRIGHT: It's 14 'til.

23 MR. NORTON: Well, then I withdraw my objection.
24 I apologize. I thought we had about 45 minutes to go.
25

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2 MRS. BOWERS: We'll plan on you starting
tomorrow morning.

3 But there is another matter --

4 MR. FLEISCHAKER: One other thing, Mrs. Bowers.

5 I don't want to begin my redirect until they
6 finish cross-examination with both witnesses, and then I can
7 begin my redirect on both.

8 MR. NORTON: No, Mrs. Bowers. Mr. Fleischaker
9 said we could go anyway we want to, and we're going with
10 Dr. Silver first and Dr. Graham second.

11 MR. FLEISCHAKER: You can ask your questions
12 any way you want, but the panel stays up there as a panel.
13 I don't believe I have to redirect this panel until they've
14 completed their cross-examination.

15 MRS. BOWERS: Well, the Board originally suggest-
16 ed that it might be more orderly to take them one at a time
17 and go ahead with the cross-examination. And I thought at
18 that time that it was agreed that they would both remain
19 there and either one could answer, however the questions had
20 been directed to Dr. Silver.

21 MR. FLEISCHAKER: Well, the way we've been pro-
22 ceeding with respect to the other panels was that you would
23 complete cross-examination of the panel; both, in the case of
24 the Applicant's panel, the Intervenor and the Staff were
25 required to complete their cross-examination of the entire

mpb2 1 panel and then the Applicant redirected. And I don't see
2 any reason to adopt new rules in the middle of the proceeding.

3 MRS. BOWERS: Well, we've given other Counsel
4 the opportunity to proceed as they chose to. So, Mr.
5 Fleischaker, you'll be given that opportunity too, and not
6 start the redirect until after Dr. Graham has been completed.

7 MR. FLEISCHAKER: Thank you.

8 MRS. BOWERS: There's another matter I'd like
9 to discuss, and I think we'll go off the record, because
10 it's primarily concerned with another proceeding that I'm
11 assigned to.

12 So we'll recess until 8:30 tomorrow morning.

13 MR. NORTON: Before we do that, can we talk
14 about when we're going to quit Friday?

15 MRS. BOWERS: Do you want to do this on the record
16 or off the record?

17 MR. NORTON: On the record.

18 MRS. BOWERS: It was mentioned earlier -- I
19 don't know whether it was on the record or off -- about the
20 difficulty in getting on the flights going north to
21 San Francisco Friday afternoon. And the suggestion was
22 made that we plan to go through, straight through until like
23 one o'clock or so, and then recess for the day on Friday.

24 MR. NORTON: Mr. Fleischaker, do you object to
25 that?

mpb3 1

2

concur.

3

MR. FLEISCHAKER: I'm sorry, I sort of missed it.

4

Go from 8:30 until 1:00?

5

MRS. BOWERS: Until about one o'clock.

6

7

Now actually if there's a matter that could be completed within a few more minutes, we'd keep with it.

8

Is there no objection, Mr. Fleischaker?

9

MR. FLEISCHAKER: No objection to that.

10

MRS. BOWERS: The Staff?

11

12

MR. TOURTELLOTTE: The Staff is willing to work as long as need be.

13

14

If the other parties see fit to leave at one o'clock we certainly won't object.

15

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MRS. BOWERS: What I wanted to discuss off the record, Mr. Tourtellotte tells me that his information on getting to and from Richland, Washington would really kind of knock the stuffing out of three days. And so I'm sort of faced with the idea of whether I need to do something, either ask to have someone else assigned, because this is the beginning of the proceeding, or how much that would interfere with it. So we'll talk about this timing off the record. And we'll recess until 8:30 in the morning.

(Whereupon, at 4:50 p.m., the hearing in the above-entitled matter was recessed, to reconvene at 8:30 a.m., the following day.)

