NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

Docket Nos. 50-275
50-323

Place - Avila Beach, California

Date - 8 December 1978

Pages 4370 - 4551

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UNITED STATES OF AMERICA

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(Diablo Canyon Units 1 and 2)	

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

Friday, December 8, 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 O. BRIGHT, Member.

APPEARANCES:

On behalf of the 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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On behalf of the Joint Intervenors:

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

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

On behalf of the Regulatory Staff:

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

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12/8/78

C O N T E N T S

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P R O C E E D I N G S

MR. BOWERS: We can proceed if the parties are ready.

Whereupon,

RICHARD H. GAMES,

DOUGLAS H. HAMILTON,

and

C. RICHARD WILLINGHAM

resumed the stand on behalf of the Applicant and, having been previously duly sworn, were examined and testified as follows:

MR. BOWERS: We have a preliminary matter that we would like to discuss first, before we get back to the taking of evidence.

Wednesday morning we had a long discussion about the Intervenors's request for the Board to subpoena two ACRS consultants, and we told you that we would review the transcript from that day, and also review the documents that were identified as Attachments A through I.

Well, we have been able to do that and what we have determined is that the Intervenors, on transcript page 4101, summarized the four points that they felt would establish exceptional circumstances that would warrant the issuance of subpoenas.

Also, I would like to bring to your attention

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transcript page 4200 and 4201. Those are the two pages where the documents, Attachments A through I, are fully identified.

We carefully reviewed the transcript and the foundations, and we have determined that exceptional circumstances have not been established. We do think, since we have said the documents A through I, that it is appropriate for those documents to come into this record. So we will make those documents Grand Exhibit Number 1.

(Thereupon, the documents referred to were marked as Grand Exhibit 1 for identification.)

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Now the reason is that we feel this will give us a good record and a thorough understanding of what these two NCRS consultants have said, what their positions are. In the discussion of Counsel it was stated that there would not be new direct testimony submitted and that the two of them would be essentially sponsoring these documents. Both Applicant and Staff said they had no objection to the documents coming into the record, and suggested the possibility of the parties stipulating.

Mr. Fleischaker said that was not acceptable to the Intervenors, that they wanted the witnesses here in person.

Our review shows us that we will have the information before us, from the discussion of Counsel, that we would have if the witnesses appeared. And in our opinion there are no exceptional circumstances here that would warrant the subpoena of witnesses.

Now Mr. Norton, I think in a moment of haste the Applicant offered to make copies of these so they would go in as exhibits. Is that correct?

MR. NORTON: It must have been a very heated moment because I don't remember.

(Laughter.)

MRS. BOWERS: Well, you first suggested they go in.

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MR. NORTON: I may have done that, and we have no problem. We can make-- I don't remember that, though. It seemed he was going to supply some more documents, Mr. Fleischaker was.

MRS. BOWENS: Well, after lunch we got those three additional attachments.

Are there additional documents, Mr. Fleischaker?

MR. FLEISCHAKER: No, Ma'am.

MRS. BOWENS: It was after lunch, and that's the second page I referenced.

MR. NORTON: So we need --

MRS. BOWENS: Three copies.

MR. NORTON: Yes, but then we all need a copy of what went in.

We'll have the copier redo.

MRS. BOWENS: Well, we have ours.

MR. NORTON: You all have a copy?

MRS. BOWENS: We have full sets.

MR. NORTON: So then we will make a lesser number. That's fine. We'll take care of it.

MRS. BOWENS: Fine.

We will give each of the parties an opportunity to respond to what the Board has determined this morning.

Do you have anything, Mr. Norton?

MR. NORTON: No.

eb3

MRS. BOWERS: Mr. Fleischaker?

MR. FLEISCHAKER: I am honestly disappointed and I was trying to look at the rule for directed certification, but I suspect that I would make such a motion. I just haven't got the rule, and I will probably come back over the weekend with some appropriate motion.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No objection.

MRS. BOWERS: We see no reason to further identify the attachments. I think we have identified the two pages in the transcript where they are fully described.

MR. NORTON: Excuse me, Mrs. Bowers. If we could have what you have put together as an exhibit we'll have them start making copies.

MRS. BOWERS: Very well.

Well, we're ready to resume.

CROSS-EXAMINATION (Continued)

BY MR. FLEISCHAKER:

Q Dr. Johns, I would like to direct your attention to page 4419 of the transcript from December 6th.

MR. NORTON: May I have the page number again, please?

MR. FLEISCHAKER: 4419.

MR. NORTON: Thank you.

BY MR. FLEISCHAKER:

Q Do you have that, Mr. Baker?

A (Witness Baker) Yes, I have it in front of me.

Q On Level 3 through 27, you indicate that there has been relatively minor movement in the Salt Water and Fort Bleidercrook or Poloosha times.

What is the basis for that conclusion?

A The principal basis is the sum of evidence of discontinuities and offset features along parts of the San Gloria Fault and the Mogul.

Q Is that primarily the evidence that is found as the result of the seismic reflection survey?

A Primarily so, yes.

Q Have you, yourself, reviewed that evidence?

A I have reviewed it briefly.

Q Did you find evidence of sea floor offset?

MR. Before answering that, I have neglected to ask that you identify Plan Sheet Offset.

MR. I'll re-phrase the question.

What evidence did you find that resulted you to cause the recency of movement?

A I found no evidence personally. I only reviewed the evidence that has been compiled.

Q What evidence did you review?

A This is the evidence of seismic profiles, principally.

eb5

Q And what did those profiles reveal?

A The profiles reveal rupturing, discontinuity of the subbottom section along the trace of the Hosgri Fault.

Q And what was it about the nature of that rupturing that permitted you to date movement? Was there anything about that rupturing that permitted you to draw conclusions regarding the date of movement?

A Pretty much the normal kinds of evidence where one attempts to correlate the respective ages of units in the subbottom section with the respective offsets suggested or indicated by the subbottom profiling.

Q Could you be more specific?

A In what way?

Q Well, here on page 4419 you stated there that there have been relatively minor movements in the Late Pleistocene and Post Pleistocene or Holocene time, and I'm wondering what specific evidence did you find in the seismic reflection data that permitted you to draw that conclusion.

A Oh, I see what you're getting at.

Well, here we're referring to whether or not the youngest datable materials or materials whose age can be reasonably inferred have been offset and if they have, by how much.

Q What were the youngest datable materials that you're referencing here in your conclusion?

A Well, the youngest datable materials along the reach of Reaton traversed by the Hooghi would be the Post Wisconsinian materials, those deposited on the sea floor during the past 17,000 years or so.

Q Will you explain with what geologic episode or event this Wisconsinian layer is associated?

A Well, that can be best tied in with the episodes of world-wide glaciation and deglaciation. During the Pleistocene episodes of maximum glaciation, a good deal of water in the earth's surface budget was tied up in the form of ice sheets, so that that had a dramatic effect on the world-wide sea level.

The world-wide sea level was most recently at a minimum roughly 17,000 years ago. At that time, something happened, presumably climatically, to prompt the onset of a very abrupt and it must have been truly dramatic melting of the ice sheets so that sea level rose very rapidly during the first few thousand years after about 17,000 years ago and continued to rise at a rather rapid rate until about 5,000 years ago.

And between 5,000 years and now, it has been roughly in its present position, although by no means exactly so.

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So what we're dealing with here is a changing regime that we can refer vertically to something on the order of 300 or 400 feet relative to sea level.

Q I'm sorry, I didn't understand the last part of your statement. What is 300 or 400 feet relative to sea level?

A Well, I was trying to provide some notion of what this variation at sea level was.

To put it another way, 17,000 years ago it was between 300 and 400 feet lower worldwide than it is now.

Q So we have this strata, this non-conformity that serves as a time benchmark, is that basically what it is?

A Yes, that's correct.

Q Now does this non-conformity extend throughout the region offshore and through which the Hosgri Fault traverses?

A No, it does not. It may well have at one time, but it has been removed by erosion from some areas, so that the blanket of younger material is by no means continuous any more.

Q Which is the younger material?

A This would be material post-17,000 years old.

Q So there is this one benchmark and above that is material that's 17,000 years, post-17,000 years?

A Yes.

Q What is that called?

A That would be the post-Wisconsinian sea floor cover.

aph2

Q And you refer to that as pre-sediment?

A Yes, that would be sedimentary material.

Q So if I understand this geologic sketch, that's the boundary with offshore, it is that there is this overburden and if the fault penetrates that stratum which divides the Wisconsinian materials and the sediment, then we can say that the fault has occurred at least in that last 17,000 years? Is that correct?

A Yes, that's correct. One could say that to whatever extent that younger material has been ruptured along the fault, the fault has been active during the period of time represented by the age of that material.

Q And conversely, if the fault doesn't perforate through to the sediment, you would conclude that the faulting occurred 17,000 years ago?

A Or more.

Q Now, how do we date a fault which ruptures the upper sediment?

A Then we look very carefully at the sea floor. And let us suppose that we find corresponding to the trace of the fault, a scarp on the sea floor. Then that scarp can mean either of two things.

It can mean, for example, that there has been very recent movement on the sea floor and that the sea floor literally has been offset.

agb3

On the other hand, that scarp can and often does in offshore California represent differential erosion of unlike materials that are older that are juxtaposed along the fault, so that the scarp, under those circumstances, can represent much more ancient faulting.

This is the reason why I asked you what you meant by an offset of the sea floor. Because often the terminology used includes both those possibilities, and yet the very nature of the term, "offset sea floor," suggests that literally it has been offset. And often that's not the case.

MR. FLEISCHAKER: Could I have the last part of that answer back, please?

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

BY MR. FLEISCHAKER:

Q Well I take it from the last part of his statement that, therefore, when we look at a seismic reflection profile and we see the loose word I will use as "break at the surface," that may represent faulting and it may represent differential erosion?

A (Witness Jahns) Yes, that's correct.

Actually, in either case, it represents faulting. But the implications concerning the age of the youngest faulting can be quite different.

Q It is at least 17,000 -- younger than 17,000 years

if it is in the system we're talking about though, isn't that correct?

A That's correct, if it's in the system we're talking about and the material involved immediately beneath the sea floor is post-Wisconsinian.

Q Then how do we distinguish, by looking at this offset whether it is -- how do we date that sea floor offset?

A Step one certainly must be to determine the age of the material immediately beneath the sea floor that is offset. If it is post-Wisconsinian and if it has been offset, then we can safely conclude that the youngest faulting has been geologically pretty young.

If on the other hand, the material immediately beneath the sea floor is Miocene, say 10 million years old, then the situation is ambiguous, and we should critically examine that scarp on the sea floor to determine whether it represents literal offset of the sea floor which is, itself, a very young time feature, or whether it represents differential erosion on the sea floor relative to some much more ancient youngest movement on the fault.

Q Now, as I understood it, as we look at the strata that is below the water, we start with the sea floor. And the area that I'm talking about is the area through which the Hosgri traverses.

agb5

A Yes.

Q Then we have some strata of sedimentary material.

A That's correct. When we're lucky we do.

Q And below that we havethbe post-Wisconsinian division, the division between the sedimentary material and the Wisconsinian layers.

A Yes, that contact would represent the boundary between the post-Wisconsinian material and whatever older material lies under it.

Q Okay.

Now, as I understand your testimony, we can be certain with respect to one thing: If a fault breaks through the post-Wisconsinian material, we can date it as younger than 17,000 years.

A Yes, if we can be satisfied that that material is, indeed, post-Wisconsinian.

Q Okay.

And let's assume that the fault traverses -- excuse me, extends into the sedimentary material.

A Yes.

Q How do we date that?

A The sedimentary material being what, post-Wisconsinian?

Q Correct.

A Okay.

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Then we have to make some effort to determine what more precisely the age of that younger cover on the sea floor might be, and that, of course, isn't always easy.

Q Was an effort made in the interpretations taken by PG&E, or the interpretations and the research conducted to date this younger sedimentary material?

A I am reasonably certain that such an effort was made, but I'm not personally familiar with what was done in that area.

Q Who is personally familiar?

A Mr. Hamilton here, I believe, is.

Q Dr. Jahns, do you have a copy of the PSAR available?

MR. FLEISCHAKER: Could you make one available, Mr. Norton?

MR. NORTON: I think they may have one over there with them.

Which volume do you want, what section?

MR. FLEISCHAKER: I'm going to be asking questions throughout the morning, at least, about Appendix A to volume, I think it is, 2D -- Section 2I of the PSAR and Appendix 2.5(e).

MR. NORTON: Mr. Willingham, did you hear that? You have it there in front of you, is that right?

WITNESS WILLINGHAM: Hopefully, we've got it.

agb7

BY MR. FLEISCHAKER:

Q Now, for purposes of illustration so that we can make sure that we're understanding, could you please turn to Figure 11 in Appendix 2.5(e)?

Now, could you explain to me what that represents?

A (Witness Jahns) Are you addressing me?

Q Mr. Hamilton, would it be better for you to address this or Mr. Willingham, since I've asked you questions already?

A I think Mr. Willingham or Mr. Hamilton would be better.

A (Witness Hamilton) I think we should have Mr. Willingham address this.

MR. NORTON: Mrs. Bowers, excuse me.

When we are into the FSAR and specific sections, these gentlemen have specific duties as to the different sections, I, of course, don't know which one worked on which one. But if we could have the question identified as to what it is directed at, then the appropriate person can answer and we don't have to play, "who's got the ball," each time.

MR. FLEISCHAKER: Well, for future references, just so we understand where we are on this -- in this "who's got the ball" game, for this panel I don't mind that. But for other panels, I will resurrect my objection regarding

agb8

the presentation of witnesses and I will direct my questions to specific witnesses. For this panel, I'm prepared to direct my question to the panel or whoever is most able to answer.

MR. TOURTELLOTTE: Excuse me, what was the section and the figure again, please?

MR. FLEISCHAKER: Appendix 2.5(e), Figure 11.

BY MR. FLEISCHAKER:

Q Are we ready to go, Mr. Willingham?

A (Witness Willingham) Was I asked the question?

Q Or Mr. Hamilton, it doesn't matter.

A (Witness Hamilton) I think we concluded Mr. Willingham might respond, but I think we need the question again.

Q Okay.

Could you explain Figure 11?

What I'm trying to do is to get a reference point for Dr. Johns' and my discussion about the faulting and the post-Wisconsinian materials. And I believe what we have been discussing is illustrated in this Figure 11.

A (Witness Willingham) By "explain," I take it you would like a comment on the significance of the various lines drawn on the record?

Q Correct.

A All right.

agb9

The post-Wisconsinian material is that material above the wavy line roughly bisecting, horizontally bisecting --

MR. NORTON: Excuse me, may I interrupt?

I'm not so sure that this is of any benefit to the Board without a copy of the figure in front of them to follow. It may be fine for our record and somebody pull out the figure reading at some other time. But I don't have a copy of it in front of me either. We only have the one. And it's the normal practice that when a table or a graph or whatever is going to be cross-examined on that counsel supply copies for everybody so they can follow the line of questioning.

I wonder if Mr. Fleischaker has done that or how we are to proceed.

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MR. FLEISCHAKER: I agree it would be useful to have the Board have a copy of this. And the answer is that -- let me see. I might have an extra copy.

MR. NORTON: Well, one copy isn't going to do us any good. We do have copying facilities in the hotel. But I personally would like to follow the line of questioning and answers too.

MR. FLEISCHAKER: Well, don't you have a copy of the FSAR?

MR. NORTON: Yes, Mr. Willingham is looking at it. You know, we don't everybody have a copy of the FSAR.

MR. TOURTELLOTTE: I don't have one.

WITNESS HAMILTON: Mr. Norton, may I make a suggestion?

MR. NORTON: Certainly.

WITNESS HAMILTON: This same figure is Figure 45 in the direct testimony, and more copies are available there.

MR. NORTON: All right. Maybe we can find it.

But I would suggest that if we're going to do this with other figures in the FSAR that we have sufficient copies so that everyone can follow the questioning.

MR. FLEISCHAKER: Does everyone have a copy of Figure 45 in the testimony?

BY MR. FLEISCHAKER:

mpb2

Q Could you proceed, Mr. Willingham?

A (Witness Willingham) All right.

The lines have been drawn on this diagram on the basis of the continuity and the amplitude of the reflecting horizons. The post-Wisconsin sedimentation is generally, in the terms of Mr. Fleischaker, a bit more acoustically transparent than the underlying material.

That means that the amplitude of reflections that one views in the post-Wisconsinian material is lower than the amplitude of reflection that is viewed in the underlying material. In interpreting this record, the record was viewed and a distinct line of high amplitude reflection was seen across roughly the middle portion of the record. The dark wavey line drawn though that area therefore is interpreted to be the interface between the poorly consolidated sediment, post-Wisconsin sediments, and the harder better consolidated sediments representing the underlying material.

The vertical line dividing the two roughly rectangular areas labeled A2 was based upon the termination of the upward convex reflections visable on the western side, or on the left side of the record. Such terminations frequently represent the presence of a fault.

However, it should be pointed out that when viewing this kind of high resolution sub-bottom profile,

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abrupt termination of underlying bedding can be caused by minor changes in the near-surface lithology. For instance, if a small thin layer of gravel that might not readily show were present within the post-Wisconsinian, it could sufficiently disrupt the input wave form generated by the source, which is a very weak wave form, sufficiently to prohibit enough energy from passing through that horizon to reflect off underlying strata that may be continuous.

Q What's the point of all that, that last two or three sentences about the lithology?

A To try to give you a full view of the principles involved in interpreting such records.

Q Well, I see here that this wavey line sort of separates the sedimentary material from the underlying material, and the wavay line above it is the post-Wisconsinian materials, is that right, the sedimentary materials that Dr. Jahns and I were talking about?

A Right.

Q And the straight line that goes up through the middle here is the fault, correct?

A The deep fault?

Q It represents a fault.

A A fault.

Q All right.

And it says here, down in the third sentance:

mpb4

"The fault does not disturb the post-Wisconsin unconformity, the overlying post-Wisconsin section, or the sea floor."

A Correct.

Q That was the interpretation?

A That was the interpretation.

Q Okay.

Does the panel have a copy of the SER -- excuse me, Supplement 4 of the SER?

A No, we don't.

MR. FLEISCHAKER: Well, I have to admit that I did not come prepared to have xerox copies of the SER and the FSAR, and I'm sorry. But I thought we'd have sufficient copies of that.

Could we make one copy of the SER available?

MR. NORTON: Yes.

But, again, if you're going to use figures, specific figures to ask questions from, there is no way in the world we can have sufficient copies of the FSAR for the Board and all the attorneys and everybody to look at here.

MR. FLEISCHAKER: Okay.

This is text.

MR. NORTON: Well, the SER was prepared by the Staff. I assume they have an extra copy there that they could pass to the panel while we're looking for our copy.

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Do you have Supplement 4?

MR. TOURTELLOTTE: We have a copy.

MR. NORTON: Okay.

Well, we'll see if we can find ours.

MR. PUECHNER: While they're looking for the SMR, I will move on to one other thing.

We prepared an exhibit that I'd like to have marked. I believe this is Joint Intervenors' Exhibit 16.

DR. MARTIN: While we're getting this exhibit handed out, I have a question about Figure 45.

I notice that the line between A2 and A2 is very straight and very dark. Shall I assume that was drawn with a straight-edge, that's something added to the record?

WITNESS WILLINGHAM: Are you directing that to me, Dr. Martin?

DR. MARTIN: Well, whoever can answer it. If you can answer the question, yes.

WITNESS WILLINGHAM: You mean the heavy --

DR. MARTIN: Vertical line.

WITNESS WILLINGHAM: -- vertical line, yes.

That was drawn with an ink pen and a straight-edge.

DR. MARTIN: All right.

Now, was emphasis added to the dark wavy line roughly at right-angles to that?

mpb6

WITNESS WILLINGHAM: Yes.

DR. MARTIN: Is there something you can direct my attention to in what I assume to be a copy of the actual record that's used as a basis for drawing those two lines in heavier?

WITNESS WILLINGHAM: Not within the docketed material. We'd have to go to the original record.

DR. MARTIN: The original record doesn't look like this?

WITNESS WILLINGHAM: Oh, I'm sorry. I guess I misunderstood your question.

We do not have any in the FSAR that are not already interpreted. That means with ink lines emphasizing interfaces.

DR. MARTIN: I guess what I'm looking at -- what's bothering me is it looks remarkably uniform all the way across the page and all the way down the page except for the top part. And I don't see what features are being emphasized. It just looks to me like lines were drawn on there in an arbitrary manner.

WITNESS WILLINGHAM: After having had some experience at looking at them, information begins to gradually pop out of that seemingly uniform mass.

DR. MARTIN: Well, I'm wearing bifocals, I'll admit; but I really can't see anything that you're following.

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WITNESS EMMERSON: We may have available a xerox copy of the original record in the same area that this record was taken from which has no annotations on it. If we do, it's in a copy of a report that Mr. Norton has as a loose inclusion in that report.

DR. MARTIN: Well, I just thought maybe the copying process ameliorates the features that you're emphasizing.

MR. NORTON: We have what they are referring to here, although we only have one copy of it. We didn't know these questions were going to come up. But I perhaps can give this to Mr. Willingham and he can describe it to you, although I suspect you're going to have to be fairly close to him to see what he's pointing at on this thing.

DR. MARTIN: Well, I don't mind getting close to him.

(Laughter.)

WITNESS EMMERSON: I think even from a distance that figure does show the interface that's drawn by the wavy line here.

MR. POUNDSTONE: Excuse me.

So make sure that I understand, I understood Mr. Willingham to say that on the right side, the A2 on the right side has some marks, and if you look at those, right above the A2, right below the A2, directly almost on 7 site

mpb8 on what looks to be a straight line across there.

And below that, about another, oh, a little over a quarter of an inch is another straight line on the other side, on the left side. That straight line does not continue across, but instead there is an incline waving

c2 action. Instead of going straight across it's inclining and waving.

And I understood Mr. Willingham to say that that indicates that there's a fault.

Is that right, Mr. Willingham?

WITNESS WILLINGHAM: No.

DR. MARTIN: That's not what it says in the caption.

It says the undulation and the unconformity is due to surface wave action.

And I'd just like to have pointed out to me what you see on the actual record that enables you to emphasize those particular f[illegible]. And I would rather hear it from Mr. Willingham than [illegible]rtellotte.

MR. FL[illegible] Can I ask something here?

Is th[illegible]e can throw that up on the screen and have Mr. Wil[illegible]ve us a quick course in interpreting those th[illegible] it would be useful for the rest of the cross-[illegible]

MR. NORTON: [illegible] just what I was going to

suggest, even though we don't have a transparency made at this moment.

But I'll ask the question:

Can a transparency be made of this, and if so then everybody could see. And he could use the pointer. Can it be?

WITNESS MARTINSON: Mr. Norton, we do have a slide of the Figure 45, or Figure 11, as it's called here, which is the illustrated version of this record.

I can provide you with a slide if you will allow me a few minutes to sift through my box here that I believe shows the same record in transmitted form.

MR. NORTON: Super.

WITNESS MARTINSON: It's a 35 mm slide.

DR. ADAMOV: I just wanted to be sure this isn't another case of Mr. Knutson dueling a picture of his eyeball that he looked through a microscope.

(Laughter.)

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(Slide.)

MR. NORMON: For the record, this is not anything that has been marked in evidence, but I guess we can best describe it as an original of Figure 45 that doesn't have the printing on the record, both lines and letters.

Would that be sufficient for you, Mrs. Bowers, as to identification for the record because, you know, we don't have it in the form that can be made an exhibit.

MRS. BOWERS: Fine.

WITNESS WILLINGHAM: In response to Dr. Martin's question, we are now viewing a slide, an unannotated slide of the figure. Here we can see the wavy lines. These waves, which constitute the interface between water located here (indicating) and Post-Wisconsinian sedimentation in here (indicating).

These wavy lines are not true undulations in the sea floor, they are merely a manifestation of surface waves affecting the recording vessel.

Now as we pass the water-sea floor interface and go downward through the section we see that a line of high-amplitude reflection which is continuous across the record is encountered. This type of high-amplitude reflection is very typical of the interface between the low-amplitude reflectors of the Post-Wisconsinian sedimentation and the underlying, more consolidated materials.

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St this interface is interpreted as the boundary between Post-Wisconsinian versus Bedrock.

The horizontal lines which have been observed by several people, including Mr. Bourtsellotte, who made a statement about them, are actually timing marks. They are very clearly visible in the water section of the record. They are masked by noise, geologic noise, noise generated by the reflected returns, incoherent reflections in the subsurface. They are clearly visible, however, on the right-hand side of the record but become lost when they are involved or become superimposed upon relatively high amplitude reflections associated with sub-surface layering.

DR. MARTIN: Thank you very much. I can see it on this slide. I couldn't see it on the paper copy of it.

MR. BOURTSELOTTE: Just for the record, there may have been a lack of communication between Mr. Willingham and I but that's exactly what I thought I said.

(Laughter.)

The squiggly lines on the left is the point-- Or where the squiggly lines start is the point where the fruit was drawn in a vertical way all the way up to the point of intersection of the high-resolution line which is the top of the "m" and I thought that's what I said. And I'm glad now that I understood it right the first time.

(Laughter.)

eb3

BY MR. FITZSIMMONS:

Q Mr. Willingham, as long as we have this on the screen, can I ask you a couple of questions about it?

We talked yesterday about the first seismic reflection signature and the fact that sometimes it makes it difficult to interpret the strata below. I think you indicated that in high resolution, in using high resolution data, we have that trouble less.

This is high resolution data. Is that correct?

A (Witness Willingham) Correct.

Q Could you tell us what the first seismic reflection signature is?

A All right.

The input pulse form constitutes the first three pulses that you see in this area (indicating). I don't know how to better explain it than to point to it. It is extremely small.

Q How small is that?

A Right now I do not recall what the spacing of the timing marks were. We can look that up and have it for you in just a second.

(Pause.)

As it turns out, these lines approximate a distance in the ground of 15 feet, so we could say that the bubble pulse or input signal pulse constitutes perhaps three,

eb4

four feet.

Q And the purpose of high resolution data is to compress that area there that we can't resolve. Is that correct?

A Correct.

Q Okay.

We talked about yesterday reverberation, and I believe that there is a term of art you use for that first section that you can see without the noise. What is the term that you use for that?

A Bubble pulse.

Q No, I'm talking about-- Well, there's a source of noise on the record that results from the sound being trapped between the sea floor and the water surface, and I believe that phenomenon is called reverberation.

A Correct.

Q Okay.

Now I also believe you testified that we are able to see, without that noise, to a depth equivalent to the water depth, the depth in the layer equivalent to the water depth. Is that correct?

A I hesitate to say yes because I'm not exactly certain of what you're stating.

Q Okay. What don't you explain --

MR. NORTON: Excuse me, Mrs. Bowers. I would like

eb5

to object to Mr. Fleischaker's continually rephrasing in his own words prior testimony and saying "Is that correct?"

The very problem-- By that answer he said he wasn't sure what he was saying. It obviously then wasn't what he testified to.

I don't understand why he can't just ask a question instead of continually rephrasing, in his own language, prior testimony and then saying "Is that correct," and then of course later seizing on one word that's different than it was before.

MR. FLEISCHAKER: Mr. Norton has been around technical proceedings long enough to know that sometimes you do that in order to explain to the witness where you are. If I'm incorrectly stating his testimony, then I would trust the witness could correct the-- I'm certainly not trying to lead this witness.

MRS. BOWERS: Well, the Board has no problem with the way you're proceeding, Mr. Fleischaker.

BY MR. FLEISCHAKER:

Q Could you please explain the phenomenon of reverberation in the context of this slide?

A (Witness Willingham) This is not a good one to do that with because it does not show any reverberation.

Q Do you have a good slide for that?

A I think we can find one.

eb6

Q Okay. Good.

(Pause.)

MR. NORTON: We're going to be getting into a problem with these slides, Mrs. Bowers. I suppose we can have pictures of the slides made at a later date and then submit them as exhibits but--

MR. FLEISCHAKER: I think that would be useful in fact.

MR. NORTON: -- but we hate very much to have to put on Mr. Fleischaker's case for him. I don't understand why he doesn't have exhibits ready that he wants to use as opposed to pulling out slides. Let him do it instead of us doing it.

I don't know how far this is going to go on but obviously there are hundreds of slides, and the ones we had chosen to present to the Board we had made copies of and put in the testimony, and so on and so forth. I'm just a little bit concerned that we're going to have a difficult record when we have all this conversation about slides being shown when there are no figures and markings on them.

As Dr. Martin said, on the last slide there's no way a reader can follow what he was talking about.

MR. FLEISCHAKER: So that we know where we're coming from, I prepared my questions with respect to the figures in the FEAR and to those that are in the testimony,

eb7

and then I thought it would be useful and I understand the Board thought it would be useful to have Mr. Willingham give us a quick discussion on how these profiles are interpreted.

So that what I'm suggesting essentially is that there may be one or two slides that may be useful to demonstrate how the profiles are interpreted, and I don't intend to request that a number of the slides be put on the screen, but I think that it would be appropriate for purposes of the record to have the one or two slides that we see marked and perhaps introduced.

MRS. BOWERS: Well, why don't you proceed. We certainly agree with Mr. Norton that it's an undue burden if you're getting into more than just a few slides.

I would also like to ask people in the audience to be very careful of conversations. The acoustics in this room are such that even whispered conversations bounce around and will make it difficult for us to hear and for the Reporter to hear what's being said in the proceeding.

WITNESS WILLINGHAM: Do you wish me to proceed?

MRS. BOWERS: Yes.

(Slide.)

WITNESS WILLINGHAM: Rather than specifically--Well, go ahead.

BY MR. FLEISCHAKER:

ecs

Q. Could you explain the concept of reverberation?

A. (Witness Billingham) Yes.

Explaining the different components that we are viewing here, first of all this is a typical sparker record. The time of initiation of the signal occurs at the beginning of the record at the extreme top of the slide. We see a band of information across here which is merely the direct arrival of the source to the receiver as it travels across the surface of the water.

The down-going pulse continues until it hits the sea floor, then reflects back to the receiver and gives us the image that we view here.

Graphically, if the source is located here (indicating), the first reflection comes down, bounces off the sea floor, comes back to the receiver. That reflection is very strong. When it reaches the air-water interface there's enough energy left in it for it to be reflected back, travel back down to the sea floor and back up to the receiver and be recorded as a second or multiple pulse, a second image of the sea floor, a false image of the sea floor. On the record, we view that as the line I'm now pointing to (indicating).

This line merely represents a second, shall we say ghost image of the actual sea floor.

In this particular case there was enough energy

cb9

in the down-going pulse to produce yet a third multiple image, another image of the sea floor down here, a true sea floor, a first ghost, a second ghost.

In very shallow water such as we have on the right-hand side of the image, -- we haven't really gotten to water that's shallow enough yet -- the width of the bubble pulse, which is the input signal itself, and that constitutes this zone (indicating), the input signal itself becomes as broad as the space between the sea floor and the first -- well, the surface and the sea floor.

When that occurs all one sees is multiple images of the input pulse. That is the reverberation mode that Mr. Fleischaker is questioning.

Q Mr. Willingham, on this record, how much of the upper strata is disguised by the first seismic reflection signature?

A I assume you're referring to this zone disguised by the actual input pulse (indicating).

Q Correct.

A About 200 feet.

Q Now in simple English, does that mean that for 200 feet it is very difficult to discriminate what's happening in that layer?

A Yes. That figure may be a little high on this particular record, by the way.

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lE agb1

Q Now will that figure change as you move toward the right on this figure, or does it remain constant?

A No, it'll remain constant.

Q So throughout that profile, we have 200 feet of strata that is very difficult to interpret?

A Yes.

Q That is the strata immediately below the sea floor?

A Correct.

2.260 Q Now the first water bottom multiple, do we have any difficulty with interpretations at that point?

A We have no difficulty at all in interpreting material between the sea floor and the first water bottom multiple.

Q What happens at the first water bottom multiple?

A Below the first water bottom multiple, we have to attempt to discern between true reflections and ghost images of the overlying strata superimposed upon those reflections.

Q So, in that area below the first water bottom multiple, we have reflections -- we have data which represents the area above it plus the data between the first water bottom multiple and the second water bottom multiple?

A Correct.

Q -- superimposed images?

agb2

A Correct.

MRS. POWERS: Before you leave this point, would you go through that 100 feet discrepancy again?

WITNESS WILLINGHAM: All right.

As I said, that was a comment made as I stand here, and I think that figure probably is a little bit high for this diagram. I'd like to reduce that to, perhaps, 100 or 150 feet.

You see these three hard reflectors --

MRS. POWERS: You're pointing at what looks like a superhighway at the top.

WITNESS WILLINGHAM: Yes, this freeway consisting of several very, very high amplitude or dark reflections. That is an image from the source itself.

If you recall from the testimony yesterday, we send a spark through the water, it creates a gas bubble. The external pressure crushes the gas bubble and actually overcompresses it. Then we get a rebound, hence, the second image. And then we get another compression, hence, the third image.

The reverberation will go on a number of times depending upon the configuration of the housing that the spark occurs in and the magnitude of the spark itself. Different systems yield different amounts of reverberation.

MRS. POWERS: Well I still don't understand.

agb3

But let's assume 100 feet.

WITNESS WILLINGHAM: All right.

MRS. BOWERS: Are you saying from the top of your freeway to the bottom of your freeway, there could be 100 feet?

WITNESS WILLINGHAM: Yes.

MRS. BOWERS: And so then, which do you use?

WITNESS WILLINGHAM: For determining the location of a reflection, one goes to the first onset.

For instance, we have a reflecting horizon running through here (indicating). And the actual reflecting horizon is located at this level.

The several pulses you see after that are merely reflections of the secondary pulses from the source. So one would annotate only the uppermost line as being a reflection.

MRS. BOWERS: Well, if I'm following; so there's not really a 100-foot problem.

WITNESS WILLINGHAM: Yes.

What Mr. Fleischaker is apparently questioning here is how much information can one obtain from this zone at the very top of the record. And the answer to that is, in general, very little. There is a blackout zone at the very top of the record, that is why on cruises people carry along high-resolution instrumentation such as the previous slide,

agb4

there's to look in this window.

You notice the detail that we see coming up in here. This line, this deeply dipping line is -- are a series of reflections.

Let's just pick one. It goes up and suddenly we see it disappear and we cannot trace it to the sea floor. It has become lost in the very high amplitude reflections generated by the bubble pulse off the sea floor.

MR. BOWERS: Well, but you just use one line, don't you, to determine the depth or the configuration of the sea floor?

[illegible]: Yes, the configuration of the sea floor follows the line I am tracing out here.

We might say that, because of the nature of the source, we actually get several images of the sea floor, the first one being the true image and then we get the secondary images which I'm indicating here. They are so strong that they mask sub-sea floor reflections that continue to the surface. That, I believe, is the point of this.

MR. MONTOO: Excuse me, Mrs. Bowers.

This is a little bit unusual, we're using slides according to Mr. Fleischaker for educational purposes for the Board, and the Board is asking questions and so on. For us to then have our testimony come a day or two later, it doesn't seem to me that we get any input into the educational process

agb5

that Mr. Fleischaker is attempting to pursue to be used in the rest of this hearing.

The clear inference that Mr. Fleischaker is trying to impress the Board with is that the first hundred feet we can't see and, therefore, there is no fault. And yet -- and that's true of this record, but it has to be tied in with the other records which are the high-resolution data that we were looking at before where this sort of thing couldn't be shown to Mr. Fleischaker, and that's the high-resolution data which indeed does show the first hundred feet.

MR. FLEISCHAKER: If you'd like to testify, Mr. Norton, you can get on the stand and I'll be happy to cross-examine you.

MR. NORTON: The point being this being for educational purposes --

MR. FLEISCHAKER: I'm sure Mr. Willingham could explain it, I heard him indicate that it was between the high-resolution and this data, the single-channel sparker data, is that you're able to compress that.

MR. NORTON: I was addressing the Board, I believe, Mrs. Bowers.

My point being, if this is for educational purposes, I think we should be allowed to have our input into it, too. Obviously the questions determine how much education one gets, and if the questions are just limited to the shortcomings

agb6

of the record, then the education is kind of one-sided, that's all.

And if that's the purpose of this, then we would appreciate the opportunity to ask Mr. Willingham some questions at the same time so that we don't proceed for a couple of days with only half an education.

MR. FLEISCHAKER: I would object to that manner of proceeding. If Mr. Willingham believes there's additional information that he wants to give, I'll be more than happy to listen to him.

DR. MARTIN: I think I have about two cents' worth to contribute to this discussion.

Yesterday, Mr. Willingham described to us several techniques that were used for getting an idea of what these undersea faults look like and the stratigraphy of the rock and unconsolidated material beneath the ocean.

Today we had a look at one of those records, and I had difficulty seeing some rather subtle features in the record. Not having seen one before, it looked like the same kind of wallpaper to me on both sides of the vertical line.

So we are simply extending this educational process, as you call it, from a description of the kinds of techniques used, to viewing the pictures that have to be interpreted by someone who understands the instrumentation and the nature of

agb7

the record being interpreted.

So that there's no genuine difficulty here, except that we have two techniques, one for looking at stratigraphy very close to the sea floor in the upper direction and a different technique for looking at rocks that lie below those surface rocks and sediments.

I'm stating this not to be argumentative, but simply to have on the record at least one-third of the Board's understanding of what the purpose of this line of questioning is.

MR. NORTON: Dr. Martin, my only concern is that, it's very obvious to me that you do understand the presentation but I'm not so sure about someone a year or two or three down the road who's reading the record, and that was my concern, that the slide that is up there now was pulled to show an area where you do not have very good resolution.

And if that's the only thing a person reads about three years from now that wasn't here and didn't see what he was pointing at and so on and so forth, he might think that all such records look like that, that was my only concern.

DR. MARTIN: Okay. This is fine, now we have your statement and my statement, and the record is annotated for future generations that may attempt to understand what went on here in this room.

Thank you.

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BY MR. FELDSCHAKER:

Q Mr. Willingham, I have a few more questions on this.

You have the three lines, or the four lines that represent the first seismic reflection signature. Then you have an area before the first reflector, the first reflection I think you call it, reflector, good reflector.

What was the term of art you used for that layer?

A (Witness Willingham) I believe I just called it reflector.

Q Okay.

Well, what's between that first reflector and the first seismic reflection signature?

A What appear to be some low amplitude discontinuous reflections. I was merely pointing out the first very prominent reflector.

Q Are you able to interpret -- how were you able to interpret whether that area there, between the first seismic reflection signature and the first prominent reflector, is faulting?

A How am I able to interpret that it is faulted?

Q Right -- whether it's faulted.

A Whether it's faulted.

Q Yes.

A One would look for discontinuity.

agb9

Q Is that an easy task?

A It depends very much on the nature of the strata. In some cases, it is very obvious, in other cases, it's extremely subtle.

Q And this zone without prominent reflectors, is it more difficult to discriminate the structure?

A I don't know if this is actually my prerogative, but I see us drifting a bit away from -- would you give me the latitude to answer that question?

Q Sure, any way you want.

A -- in a devious way?

Q Sure.

A Your question, as stated, implied to me that there was some zone in here that was in some way different from the material beneath it. Not true.

From the sea floor to the first prominent reflector that we encounter down here, if we were to put a boring through it, we probably would be able to tell very little difference between this material and the material encountered below the reflector.

That's why I have difficulty in answering your question, I feel you had something specific in mind that I do not see there.

Q I wasn't getting at the difference, or the material that might be above or below that reflecting strata.

agk10

What I'm asking you is whether that strata above the prominent reflector, might that be -- might that strata be characterized as one of relative transparency?

A In this parsicular record, the material above this reflector could be characterized as relatively transparent.

Q What does that mean?

A In the sense that we have used the term in these proceedings, it means that it only returns low amplitude reflections.

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Q What does that mean in terms of recognizing structures, like faulting, in that zone?

2.75

A It may make it more difficult to look for discontinuity in bedding.

Q On what occasions would it be -- strike that.

Could you say that the difficulty in discriminating structure would relate to the transparency of the zone? That is, as it become more transparent the more difficult it was to identify structure?

A Well, carrying that to its extreme, if the zone is acoustically transparent you simply will not receive any reflections from it, or the images that you do receive in that time frame will not be associated with actual bedding, in which case one cannot make a structural judgment based upon the record.

However, I point out that that is an exceptional case, and I personally have never viewed that in the 12 years of reviewing records.

Q Have you reviewed records where, because of the transparency immediately below the seismic reflection signature it was difficult to interpret whether -- to determine whether a structure, a fault, for example, existed in that zone?

A In your question you used the phrase "Beneath the seismic reflection signature".

mpb2

Q The first signature.

A Beneath the first multiple? Beneath the sea floor? I'm not certain.

Q Beneath the first signature, those four dark lines up there at the top.

A In the zone beneath those and the first prominent reflector?

Q That's right.

In is your experience -- have you run across records where it's difficult to interpret whether structure exists in that zone?

A Certainly.

Q And on what occasions?

A That's very difficult to answer because the situation you pose is one that varies from line to line in all areas.

I cannot say that there was any particular difficulty in that regard in interpreting the records that have to do with this hearing.

Q Okay.

Well, we might get to some particular records in the hearing.

MR. FLEISCHAKER: I think that's all the questions I have about these particular slides.

MRS. BOWERS: Since we started this morning at

mpb3

8:30 instead of 9:00, perhaps this would be a good time to take a 15 minute break.

MR. FLEISCHAKER: Mrs. Bowers, before we go off the record -- well, all right.

I was going to say before we go off the record I think it would be important to have these two slides identified. We'll be happy to pay for the copying of them, and we'll have them marked as exhibits and entered into the record.

MRS. BOWERS: They have to go into the record after all this testimony in some way.

Well, 15 minutes, then.

(Recess.)

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MRS. BOWERS: Let's proceed.

MR. FLEISCHAKER: We'd like to have the figure we had before the Board and the Applicant and the various Counsel and the witnesses, the figure marked Joint Intervenors' Exhibit number 16.

What this is, it relates to Dr. Jahns' testimony of yesterday where I asked him about the location of the northern boundary here of the transition zone, and he said it could go ten miles either way.

To save time we simply scaled it off according to the scale here and drew dotted lines A-1, which is ten miles north, and dotted line A-2, which is ten miles south.

mpb4

And I would offer that as an exhibit, Joint Intervenors' Exhibit 16.

(Whereupon, the document referred to was marked as Joint Intervenors Exhibit 16 for identification.)

MR. NORTON: We object to this. It assumes facts not in evidence.

First of all, I think that's a mischaracterization of the testimony. I don't believe Dr. Jahns was referring to specific north and south boundaries, both of them having a margin of error ten miles in each direction.

Secondly, I don't know whether this is ten miles or not. There is no foundation for this exhibit whatsoever.

We have Mr. Fleischaker saying, Yes, this is ten miles. So on a record basis, I don't know whether it is or not.

So I would object for lack of foundation at this time primarily.

But I also would appreciate further inquiry of Dr. Jahns as to whether indeed that was his testimony. Although we have the record in front of us, I'm not sure that's what he said at all.

MR. FLEISCHAKER: May I respond to that?

mpb5

At page 4669 of the transcript, at line 17 -- let me back up to line 15. This is from me to Dr. Jahns:

"Question: What is the structural control you have at the location of that northern line?

"Answer: The Northern line is much more arbitrary. It's just a line drawn through the general zones of bending in these various faults.

"Question: How arbitrary?

"Answer: Plus or minus ten miles, something of that sort."

This exhibit is offered on the basis of that testimony.

What I would suggest is that if Mr. Norton has questions about it he can clarify the record on his redirect. The Joint Intervenors are offering it as their Exhibit number 16.

MRS. BOWERS: What is the transcript page again, please?

MR. FLEISCHAKER: 4669-4670.

MR. NORTON: Mrs. Bowers, I think one only has to look at the exhibit. The lines don't even follow the same pattern.

If you look at Line A-2 and then look at the bottom line which it's supposed to represent, it doesn't even flow in the same direction. It's a totally different

mpb6

line.

Unless A-2 is supposed to be the northern line that drops down south -- I can't tell whether it's the northern line that drops down south or the southern line that goes up north. In other words, it appears as if the whole zone is moved north.

MR. FLEISCHAKER: The testimony was about the northern boundary. I specifically asked what question -- what structural control do we have on the northern boundary.

I think the testimony is clear, and we offer the exhibit.

MRS. BOWERS: You've taken the northern boundary and then done a plus or minus ten?

MR. FLEISCHAKER: That's correct. The northern boundary is plus or minus ten, and I think it's consistent with the testimony in the record.

MR. NORTON: Well, Mrs. Bowers, I suggest the Board read 4670 also because the flavor of the piece of testimony that Mr. Fleischaker picked -- you have to read 4670 to understand that what he's talking about is trends here, and that doesn't mean that you can pick the line up and move it ten miles north.

And of course, if they want a witness to sponsor this, fine; but to sponsor this as something that Dr. Johns has testified to is improper.

mpb7

Now perhaps we could withhold the ruling on whether it should be admitted or not until after Dr. Jahns has had a chance to testify about the exhibit. Perhaps he could ask Dr. Jahns if he agrees, and maybe Dr. Jahns will say it is, in which case I would have no basis for objection.

MRS. BOWERS: Will you respond, please, Dr. Jahns?

WITNESS JAHNS: Yes.

I could be very unhappy with this representation in terms of what kinds of misinterpretation it might provoke.

Harking back to the discussions, parts of which were just quoted by Mr. Fleischaker, my general criterion for considering the boundary on the northern side of this transition zone represented tectonic features. That's one means for drawing a boundary, and that's what I was referring to in expressing the degree of precision or fuzziness in drawing the boundary.

On the other hand, the boundary could equally well be drawn in terms of where the bends in trends of the various faults occur. And on that score, I think it is evident by inspection that the boundary as shown in the original Figure 18 is about as far north as it should be drawn.

In expressing the plus or minus ten miles, I was trying to be scientifically conservative in expressing an interpretation of the intrinsic fuzziness in a tectonic context of that northern boundary because it's a transitional

mpb8

boundary or that score of a transition zone. And this is the reason why I could be unhappy with this sort of presentation unless it was accompanied by some kind of explanation of the sort I've offered here.

MRS. POWERS: Well, the record will show your explanation and why you have problems with it.

WITNESS JAHNS: I think that's fair enough.

MR. NORTON: In addition, it was Dr. Jahns' testimony that Mr. Hamilton prepared the map, I believe.

If you look at 4670, the question:

"Mr. Hamilton, did you locate this line?

"Answer: Yes, this map was prepared under my direction."

And I'm not so sure that Mr. Hamilton has the same opinion as Dr. Jahns or not, as he prepared the map.

MR. FRISCHKNECHT: I think that's legally foreclosed.

I'm going to offer the exhibit and let the testimony stand.

MR. NORTON: Our objection is that it does not represent the views of Dr. Jahns or Mr. Hamilton, it hasn't been established. If they want to put it in through one of their witnesses as representing the views of that witness, fine.

But I don't even think with the explanation -- I think the explanation is that it does not represent the

mpb9

views of Dr. Jahns.

DR. MARTIN: I have a question for Dr. Jahns or Dr. Hamilton, either one, or both.

And that's to ask for a definition of transition zone.

WITNESS JAHNS: Well, the transition zone, as we have been using the term for this particular strip of ground, is a zone of structural and tectonic transition between the Transverse Ranges Province on the south and the Coast Ranges Province on the north. And it's the zone, for descriptive purposes, within which the typical structural elements of the Coast Ranges Province begin to change in orientation, and also change in behavioral sense, movement, style on the faults, and so forth, becoming more and more like the characteristic structural units of the Transverse Ranges Province.

So it is indeed a zone of transition in that way.

DR. MARTIN: Is it a gradual transition?

WITNESS JAHNS: It's a very gradual transition as traced from north to south. At the southern margin of the transition zone it's gradual in places and abrupt in others because there are transection relationships.

DR. MARTIN: I see.

So the southern boundary is more sharply defined

mpt10 than the northern boundary?

WITNESS JAMES: That's correct.

Indeed, in parts of the southern boundary you could draw the line right along a major fault.

DR. MARTIN: So if you were representing it in colors rather than a sharp line you might use some part of the spectrum grading from one color to another without perceptible changes over a short range?

WITNESS JAMES: Yes, something like that.

DR. MARTIN: All right.

Well, I think we have the same understanding of what is generally meant by transition zone as a place where the change is gradual and the boundary is -- any boundary is sort of misleading because the change isn't abrupt. It's not like the transition from the sidewalk to the street, which is marked by a curb.

WITNESS JAMES: Quite so.

DR. MARTIN: Okay. Thank you.

I guess I have another question, and this is for the Intervenors.

For what purpose is this exhibit being offered?

MR. PLESCHNER: To demonstrate that the placement of the lines on this paper are -- to use Dr. James' own words, I think -- fairly arbitrary. And if you move this line ten miles to the north you would find, for example, a

mpb11

substantial part of the Hosgri Fault within the transition zone. If you moved the northern line ten miles to the south you'd find a significant amount of the seismicity which is allegedly related to structure in that transition zone falling without that transition zone.

DR. MARTIN: Is it your intention later on to draw out reasons for moving it one way or the other, since it is arbitrarily located?

MR. DIBBLEE: No. The reason is simply to point out the arbitrary nature of the zone. That's all.

It's a comment on Dr. Hays' testimony.

DR. MARTIN: That the zone itself is arbitrary or the location of the --

MR. DIBBLEE: That the location of the zone itself is arbitrary. There are certain implications that are drawn with respect to this zone.

Now example, as I understand the testimony, we tend to get large earthquakes within this zone. But if we move this zone ten miles to the south -- that's the argument: but if we move the zone ten miles to the south we find a significant amount of the activity falling without the transition zone.

If we move the line, the northern boundary ten miles to the south we find then a significant part of the Hosgri falls within the alleged transition zone, which seems

mpb12

that that southern extent of the Rasgri might be subject to the forces, the stresses, the unusual forces and stresses that, by the Applicant's case, are supposed to exist in that zone.

MR. MOUNTELLOTTE: Excuse me, Mrs. Bowers.

If that's the purpose for introducing this exhibit in the first place, there's absolutely no reason to introduce it because the witness has already said that the lines were arbitrary, A.

B, whenever you introduce an exhibit into evidence, you don't draw the line for some other witness and then put the thing into evidence. Whatever is supposed to be in evidence on cross-examination is supposed to be a result of something that that witness has done.

The witness didn't draw these lines, Mr. Flaischaker drew the lines, or somebody drew them for him. And if he wants this exhibit in he ought to put them up on the stand and let them demonstrate that they can draw a line ten miles north and ten miles south and they can be arbitrary, if that has any particular evidentiary or probative value in this case, and I don't think it does.

It's an absolute absurd way to proceed. And this exhibit has no probative value at all.

Moreover, the point that Mr. Flaischaker says he's trying to prove is already conceded by the witness.

mpbll

MR. NOLSON: Excuse me, Mrs. Bowers.

I think Mr. Hamilton has been trying to speak on this question for a few minutes.

MRS. BOWERS: Mr. Hamilton?

WITNESS HAMILTON: Thank you.

As I think I mentioned in response to a question yesterday, this Figure 10 drawing was prepared in my office under my supervision. It was prepared in discussion with Dr. Dalton. But I feel that perhaps the rather specific information that's represented on this map has somewhat been lost sight of in the discussions.

I think that by inspection of Figure 10 it can be seen that the place where the line representing the northerly boundary of the transition zone, where that line was originally drawn does in fact represent the area where the generally straight line trends of faults in the Coast Ranges terminate to the north do begin to bend to a more arcuate trace.

In that sense the line is geomorphically rather well defined.

There are other less specific kinds of evidence which nonetheless are actual scientific evidence represented on this map that also entered into this determination. For example, fractures that are high angle and typically fairly straight feather to the north of the line are mapped as

mpt14 transitioning into thrust faults shown by barbed symbols along the trace of the fault as drawn on the map here at points south of that line in several cases.

And it happens that the seismic activity does generally fall south of that line. However the line is drawn more on the basis of tectonic style, as represented by the character of the fault, than it is by conveniently locating it to north of where most of the epicenters are represented here.

So I would like at least to suggest that I think that the proper location for the line is as drawn, and that to indicate a line at A-1 as the northerly boundary of this Transition Zone Province would not be a proper representation of the scientific evidence.

MR. FLEISCHAKER: Mrs. Bowers, I understand what Mr. Hamilton's opinion is. It was in the direct testimony. And I understand that that line in the middle there represents his interpretation of the evidence.

The only purpose of this exhibit is to demonstrate what would happen if we followed Dr. Jahns' instructions, that is to put a line ten miles above and ten miles bel[illegible].

The Applicant can obviously argue that that's irrelevant. The Staff can argue that that's irrelevant. But we think it's relevant, and we think we can mount a persuasive

mpb15

argument on the basis of the testimony that has been given.

Now we can spend the time to have Dr. Jahns draw a line that's ten miles above and ten miles below, but I think that this is consistent with the testimony. And we would submit that it should be put into the record so we can make that argument.

The Applicant would be free to rebut that argument, and the Staff will be free to rebut that argument. But at least the exhibit will be in the record so we can make our arguments.

and 2a

2b eb1

MRS. BOWERS: Well, Mr. Fleischaker, we will not admit it into evidence at this time. Now we will retain our copies of it and if you put on a witness that later you want to use to sponsor this, why that's different.

Dr. Jahns' testimony a few minutes ago, which I assume he considered clarifying testimony, was not the same as what he said yesterday. A few minutes ago he said in his opinion the line as drawn should be the northern boundary.

MR. FLEISCHAKER: Well, then, I'd like to re-cross him on that.

MRS. BOWERS: If I understood him correctly.

4.250 BY MR. FLEISCHAKER:

Q Dr. Jahns, do you have a copy of the transcript?

A (Witness Jahns) Yes, I do.

Q I would like to direct your attention to page 4069.

MR. FLEISCHAKER: Mrs. Bowers, if I may explain? I don't have witnesses that are going to testify about transition zones because my witnesses didn't-- Well, it's not their concept so they aren't going to draw lines.

MRS. BOWERS: Well, but I assume you'll have witnesses that are technically trained that will be able to testify, "Yes, these lines are to scale 10 miles above or below."

MR. FLEISCHAKER: There's a scale on the map.

eb2

MRS. BOWERS: Well, but you don't have a witness sponsoring it to testify to those things. So we'll hold it.

MR. FISCHWEIN: Okay.

Well, let me see. Do I understand the Board's problem to be that Dr. Jahns has not scaled off 10 miles on either side of this line and drawn a line? Is that the technical problem?

MRS. BOWERS: You've offered an exhibit that has been prepared, you tell us, to show a plus or minus 10 miles of the northern boundary. And Mr. Tourtellotte I think gave a good explanation. We don't know who did this work. We have no way of knowing whether it is even accurate.

But more than that, if I recall Dr. Jahns' testimony this morning, it differed as far as the plus or minus 10.

Correct me if I'm wrong, Dr. Jahns. I thought this morning you testified that you would not move that northern line 10 miles north.

WITNESS JAHNS: That's correct. And so are my remarks in yesterday's testimony. The two contents were different.

BY MR. FISCHWEIN:

Q Well, let me see if I can understand what you meant yesterday.

At 4669 I said:

eb3

"What structural control have you on the location of the northern line?"

And you said:

"The northern line is much more arbitrary. It's just a line drawn through the general zones of bending in these various faults."

And then I say:

"How arbitrary?"

And your answer is:

"Plus or minus 10 miles; something of that sort."

A (Witness Jahns) Right.

Q Okay.

What did you mean by "Plus or minus 10 miles"?

MR. NORTON: "....something of that sort."

Could we have the full sentence, please?

BY MR. FLEISCHAKER:

Q What did you mean:

"Plus or minus 10 miles; something of that sort."

A (Witness Jahns) The plus or minus 10 miles estimate was offered to you in the content of the previous testimony about the Transition Zone. In other words it was offered in a general tectonic content. And the thinking that lay behind that estimate, and it's an estimate I would make

eb4

still at the present time, is that there is a very gradual transition in terms of tectonic behavior, stress-strain pattern, distribution of stress, and style of fault movement in the northern boundary of the Transition Zone.

This to me means that it's very difficult to draw a crisp line. And when I responded to your question in yesterday's testimony, it was in that context.

Q So in your response-- Your response was not in reference to the northern line? Is that correct?

A It was in reference to the northern dashed line, indicating the northern boundary of the Transition Zone. Yes, it was.

But what we are talking about here at the present time is a different basis for drawing the line. One has a map. The map indicates a series of faults. Each fault has a certain configuration in terms of its surface trace. All right. One wishes to draw a boundary of some kind indicating a distinction between the Coast Ranges Province and the Transition Zone.

So the best best for drawing the line -- and the line is intended to indicate a transition of some kind, if you will a transitional boundary at the north edge of a Transition Zone. And the best means for doing that, which is somewhat arbitrary, is to draw a line connecting the various places where straight faults begin to bend.

eb5

If one does that, then I think the line as drawn as about as far north as it should go.

I cannot, you see, make the same claim for the tectonic influence of typically Transverse Ranges or typically Transition Zone features. This is the distinction.

Q We have agreed that you were talking about the northern line in your testimony yesterday.

A Yes, that's correct.

Q Now at line 2 at page 70, are you still talking about the northern line when you say:

"Plus or minus 10 miles; something of that sort."

A Yes, I'm talking about the northern line in this tectonic context.

Q Plus 10 miles where, in which way?

A Plus or minus 10 miles to me would mean north or south.

Q Does that mean you can take this dashed line and draw it just as easily 10 miles north?

A No, it definitely does not.

Q Then what does it mean?

A It means that on this somewhat revised Figure 10 that I see in front of me, the potential exhibit that's been under discussion, that the northernmost of the three dashed lines -- Let me be more specific, we have four dashed

eb6

lines --

Q Dr. Johns, maybe I can shorten this.

A Sure.

Q Let me get a clean piece of paper and you can demonstrate it.

MR. NORTON: Excuse me. Let him finish his answer to the question if he could.

MRS. BOWERS: Well, the northernmost line has been identified as A-A'. Is that the line you had in mind?

WITNESS JOHNS: Yes.

You see, what I'm trying to explain here is that if we operate on the basis of the content of my testimony yesterday, the northern of the two original dashed lines representing the northern edge of the Transition Zone is not really a line, it's kind of a locus of a transitional think.

By this same token, the line A-A' is essentially without meaning because the northern line in a tectonic context is intended to serve as a general guide to where the tectonic influences of the Transition Zone are fading out into the Coast Ranges area. And by drawing another line farther north, in this case A-A', one is carrying things a step farther and indicating one fading out of a fading out.

This is why I say it has essentially no meaning. The fading is already occurring south of the original northern line, and the northern line is intended to indicate

eb7

where the fading goes out completely.

And because I can't locate that sort of thing all that accurately, we have a plus or minus value there that I think is generous.

BY MR. FLEISCHAKER:

Q Well, would you agree that....Well, what was the significance of the middle line as you interpreted it?

MR. NORTON: Excuse me. What middle line are we talking about? I thought there were only a north boundary and a south boundary.

MR. FLEISCHAKER: We're talking about the middle line between -- Well, we don't have anything in evidence here so I'm not sure this makes any sense at all.

DR. MARTIN: Are you talking about the original northern boundary of the Transition Zone?

MR. FLEISCHAKER: Yes. I didn't draw that line.

WITNESS JAHNS: As that line was drawn under Mr. Hamilton's direction and within the content of our discussions earlier this morning, the basis was geometric. It was drawn at the southern end in effect of straight trends on faults of the Coast Ranges Province. It was drawn as a general locus of the beginning of bends in those faults as traced southward and southeastward.

As discussed yesterday, the northern boundary of the Transition Zone represented a tectonic context,

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In other words, a content of contrasting influences on the behavior of the various structural units in the area. This is a much more difficult thing to define precisely.

MR. FLEISCHMANN: I think I understand.

BY MR. FLEISCHMANN:

Q And as you move north, those influences are fading out?

A (Witness Johns) That's correct.

Q Okay.

And it's your testimony that about 10 miles north of the line that represents the northern boundary of the Transition Zone, those influences are very small or non-existent?

A Not exactly. It's basically my testimony that we have an original north boundary line that is intended to represent the locus of points along which the Transition Zone influences, the zone of conflict, are fading out.

Now the location of that cannot be established with complete confidence. We simply don't know enough about the detailed behavior of faults along and just south of that line. This leads me to look on the location of the line in the tectonic contents as subject possibly to some difference of opinion, depending on, for example, what new information we may get in the future.

So me it's inconceivable that the line would be

eb2

shifted in the light of future data, based on tectonic considerations, more than 10 miles in one direction or the other. And I would add that 10 miles north is a very generous estimate.

MD

2C agb1

Q What would be your new estimate for the north boundary?

A I can't make a new estimate, because that would imply less doubt than I had yesterday or than I have today in my mind, I just don't know.

Q So these forces may well be operating in the zone 10 miles north of the northern boundary of the transition zone, as indicated on Figure 16?

C5

A I would not use the term, "may well be," might possibly be. I think the probability of changing the posi ion of that line in the future is low. It's a possibility, but it's a low probability.

The important thing is to recognize that in a tectonic context, the line as originally drawn is the northerly edge, in other words, the fadout line of transition zone influence. And the uncertainty we're talking about is the position of the fadeout.

Q Okay. Let's move back to seismic reflection.

MRS. POWERS: Good.

(Laughter.)

BY MR. FLEISCHAKER:

Q Do you have a copy of the SER Supplement 4?

A (Witness Hamilton) Yes, we have a copy here.

Q Could you please turn to Page C-3, that's Appendix C.

At the bottom of that page, these are the comments written by the USGS included as Appendix I to Supplement 4. At the bottom of Page C-3, the first sentence in the paragraph that begins at the bottom of the page reads as follows:

> "In addition to these uncertainties, some information shown in the profiles is not shown on the maps and vice versa, and some profile data are not included that are important to evaluate the extension or character of some faults."

Did you have an opportunity, Mr. Hamilton, to identify what profile data the USGS was talking about there?

MR. NORTON: Excuse me while Mr. Hamilton is looking, for the record, the date of this SER is May of 1976, I know the Board doesn't have copies in front of it.

WITNESS HAMILTON: Mr. Willingham and I were discussing this issue. It's our recollection that there was an identification of some of these things that were described as inconsistencies or uncertainties, I believe, in the USGS letter. And it's my recollection that we did go back and analyze the things that were raised.

However, as I look at Page C-3, this is a general statement that doesn't identify where the information shown on profiles and not shown on maps and vice versa is, so I think it'll take us some time to look through and see if

agb3

we can relocate the place where these are actually identified.

BY MR. FISCHMAN:

Q That won't be necessary.

Did you have a discussion with USGS about the profile data that's not included and are important to evaluate, do you recall a discussion of that nature?

A (Witness Hamilton) By your question, do you mean profile data that is not specifically shown as figures within the licensing documents?

Q No, my question -- Let me restate my question.

Did you have a discussion with USGS about this statement: "...some profile data are not included that are important to evaluate...?"

A I don't recall that we discussed that exact statement with any representative of the USGS.

Q So you cannot at this time identify the profile data that USGS was referring to in this sentence at the bottom of Page C-3?

A No, in responding toyou here, I cannot.

As I stated earlier, it was my recollection that we did have some information which I thought came from one of the documents that we got that allowed us to identify that.

But, as I think back now to a thought process that occurred perhaps three years ago or two years ago, I think maybe we were talking about some features that were

ajb4

proposed as having a different and possible interpretation by the USGS. And it may be that we never got a specific identification of what these features shown in figures but not on the map might have been.

I'm sorry I can't be more precise on this exact issue.

Q I wanted to get out the track sheets athat are located in Appendix 2.5(d). I have an extra copy here for the Board.

MR. TOURTELLOTTE: Appendix 2.5(d) of what?

MR. FLEISCHAKER: Of the PSAR.

MR. NORTON: Could we have a specific -- I'm not sure which one you're referring to.

MR. FLEISCHAKER: This is, the pocket part here says Amendment 19, 1974, Appendix 2.5(d), Plate A1 and A2.

(Handing document to the Board.)

MR. TOURTELLOTTE: Mrs. Bowers, are we going to have to endure this throughout the whole proceeding that counsel is going to continue to bring in pieces of information for witnesses to examine without providing copies to counsel?

I mean, I really think that this is -- it's highly unusual and it's really contrary to what is generally considered to be fair practice in a trial proceeding of any kind and I really resent having to sit here and conceptualize all this stuff mentally simply because counsel isn't ready.

agbf

MRS. BOWERS: Of course it's a different situation from a usual drill in the sense that this is in evidence, the FSAR, and because of the nature of the documents. We don't pack them around, they're too big and too heavy. Normally you would have them with you.

MR. TOURTELLOTTE: I don't believe the FSAR is in evidence yet.

MR. SHOEMAKER: It could be that Mr. Mountebellmeier's copy is misplaced. We brought the FSAR, the parts pertaining to seismic and geologic matters. And it seems to me that the Staff, given its abundant resources, could have done the same. And I'm not going to apologize to Mr. Tourtellotte.

MRS. BOWERS: Well a year ago -- two years ago when we had the two weeks of evidentiary hearing on environmental issues -- and, of course, that was preceded by the Part 51 -- Mr. Norton, wasn't the FSAR offered?

MR. NORTON: I believe that we have stipulated, Mr. Tourtellotte, that the FSAR would be in evidence. I think Mr. Fleischhaker would stipulate that we didn't have to do anything to be in evidence and perhaps that ought to be in the record right now if at no other time. But I'm sure at the prehearing conference we had in Washington, that was stipulated on the record at that time.

We have the FSAR here. I'm not sure that we have ...

agh6

and we obviously have two copies, because the witnesses have one and I have one. If we have a third copy, we'll supply it to Mr. Tourtellotte because I agree with him that it's very difficult when you have it in discussion of maps that -- I don't know how he's supposed to follow it.

MR. TOURTELLOTTE: By the same token, assuming it is in evidence or even that it is stipulated in evidence, the simple mass volume of the FSAR and to have to cart that around simply at the convenience of -- maybe Mr. Fleischaker will pick out one piece of paper or he won't pick out a piece of paper out of the thousands and thousands of pieces of paper in there to me seems very discourteous if nothing else.

We're coming into this proceeding--we've been coming into this proceeding for some time, and if he knew there were references to the FSAR he was going to make, he could have let us know that so we could have picked them out. Or -- and I would again point out that the usual practice is that attorneys provide other attorneys copies of any information that they're going to use at the time that they're using it, it's a very common practice. And I really don't care whether I have an apology at all or not, what I want are the pieces of paper.

MR. FLEISCHAKER: Well, let me see if I can....

I'll give you an apologize for losing my temper,

agc7

had I known that you wouldn't have had the FSAR here, I would have said something. Frankly, I didn't anticipate that the Staff would not have the FSAR here and so I apologize for that.

DR. MARTIN: Excuse me a moment.

It appears that a portion of, at least, one of the maps in the package you're handing us is reproduced in Figure 32 attached to the evidence. Will that figure suffice the discussion you're about to engage upon?

MR. FLEISCHAKER: Dr. Martin, the problem is that's only a partial -- that only covers partially the area of coverage.

DR. MARTIN: Well, Figure 31 shows the total area covered.

MR. FLEISCHAKER: That's correct.

DR. MARTIN: Well, it's a simple question, will these figures suffice, in which case everyone has copies to look at. Or are you thinking about details that are on the map that are not in these figures?

MR. FLEISCHAKER: I'm concerned that they aren't going to be sufficient, because there is -- I can't anticipate what the witnesses' answers will be, I don't know where they have found things in their work. And also there's an additional figure that I will refer to that is not either Figure 31 or Figure 32 but is included in the FSAR.

MR. NORTON: Excuse me, Mr. Fleischaker, may we

agb8

see the packet that you took those documents from, because we apparently aren't looking at the same maps, the packet from the FSAR from which you --

MR. FLEISCHAKER: I think the Board has that.

MR. NORTON: The packet itself?

MR. BRIGHT: It's Appendix 2.5(d), Plate AI, Plate AII, Amendment 19, October 1974.

WITNESS HAMILTON: Mr. Norton, we might have the only volume that's in this room on the side of the Applicant over here on this table, which is why you may not be able to find where you are.

MRS. BOWERS: While people are thumbing through pages, I'd like to address this to all parties:

We don't want this situation to be repeated. And so, if it is intended that additional pages from the FSAR will be used, they should be reproduced so the Board has copies and all parties.

MR. FLEISCHAKER: Also, as long as we're thumbing through documents, Plate AIII, Appendix 2.3 is another place where I'll be examining.

I want to state for the record so there's no confusion, I had assumed, I think, on the basis of my prior experience before the Commission that both the Staff and the Applicant would have copies of the FSAR here.

MRS. BOWERS: And the Board?

agb9

MR. FLEISCHAKER: As a matter of fact, I assumed that the Board would have copies too. Now that may have been -- apparently it was a mistaken assumption. Because it was in evidence. But it was not my intention to cause all this trouble here. And in the future when we utilize copies of things from the PSAR, we'll make copies.

MR. TOURTELLOTTE: I take it we need other documents as well because, as I recall, there were other documents where we didn't have copies earlier. We're talking about all documents we're going to use for cross.

MRS. BOWERS: All parties and all documents.

end2C

BY MR. FLEISCHAKER:

Q Mr. Willingham, could you describe what Plate A-I represents?

A (Witness Willingham) Plate A-I represents the seismic data track charts showing the path that the seismic recording vessels took in generating the data that was available to us through I believe 1974. In other words it shows the location of the seismic profiles used for interpretation through that time.

Q Is it possible to discriminate between the tracks taken by the various vessels?

A Yes. That's what the legend attempts to do on the far right, immediately above the north arrow.

Q Can you identify where the high resolution data was taken?

A It is not shown separately. No high resolution data was attempted simultaneously with the single-channel deep penetration data on most of the government track lines, the KELEZ cruise. There was no high resolution data associated with the BARBARETTA.

So the high resolution shots by BB&N also is not individually shown but most of the lines immediately adjacent to -- many of the lines immediately adjacent to the plant site have high resolution profiles shot over them.

I'm sorry I can't be any more specific than that

eb2

with this plate.

Q All right.

Now could you turn to Plate A-III and tell us what that represents?

A Plate A-III is intended to show the locations of the figures presented in the appendix.

Q Now I would like to ask you a series of questions about the features that you have interpreted-- Well, let me back up.

Have you looked at the seismic reflection data that was accumulated through all of the runs that are represented here Track A-I?

A Yes.

Q Okay.

MR. NORTON: Excuse me, Mr. Fleischaker. Which plate are we talking about? I thought you said A-II. I thought he said A-III. Now I don't know if I misheard or one of you misspoke.

MR. FLEISCHAKER: I'm not sure, but we're talking about A-I and A-III.

MR. NORTON: Thank you.

BY MR. FLEISCHAKER:

Q Okay, let me see if I understand, Mr. Willingham.

You've examined the seismic reflection profiles that were gathered in all the cruises that are represented

eb3

here on track -- Excuse me -- on Plate A-I.

A (Witness Willingham) Correct.

Q Okay.

And that includes several cruises which are listed somewhere on this plate.

A Correct.

Q Okay.

Now could you help me understand just a couple of things here? I see that these lines here-- Do they represent the actual traverse of the ship as it takes the profile? Is that the point of this track?

A When you say "these lines" I assume you mean the lighter color lines on Plate A-III? Are we referencing Plate A-III?

Q No, let's reference Plate A-I, and could you help me understand more specifically what the lines on here that traverse back and forth out in the water, what that means, what these numbered markings are on them?

There are certain markings like 91, 99, and 101, 103, and then there look to be like little time marks near triangles. And I was wondering if you could explain that for us.

A All right.

MR. TOURTELLOTTE: Excuse me, Mrs. Bowers, but this map has a legend on it. It explains all those lines.

that's the purpose of going over it again in the record? Mine has a legend on it.

MRS. BOWERS: Does yours have a legend, Mr. Fleischmann?

MR. FLEISCHMANN: I only have a partial name here. Mine doesn't have a legend on it --

(Laughter.)

-- but I thought it might be useful for purposes of the record.

Now I know when I sat down with the reformatologist and I looked at this and I thought I understood it, he explained to me what all these little marks were. And I thought it would be useful for purposes of the record to get an explanation from Mr. Willingham as to what this is all about.

MRS. BOWERS: Well, but just reading the legend, that's part of the document, would not add anything to the record.

Are there explanations beyond the legend?

MR. FLEISCHMANN: Okay. So we all understand exactly what this means. Okay.

BY MR. FLEISCHMANN:

Q Now I want to ask you some questions about your interpretations. Which of these two charts, A-I or A-III would it be easier to refer to, just for purposes of

ehl

everything?

A (Witness Willingham) If you're going to refer to diagrams that are in the FSAR, A-III would be the preferred one.

Q I'll do that later. I'm going to ask more general questions first.

A Well, it's easier to read A-I I guess.

Q Okay.

Could you identify those areas where you found features that you interpreted as fault breaks in the soil there?

MR. NORRIS: Excuse me. May I put this in the form of an objection?

I'm not sure, I think we're looking at a 1974 document that would cover runs obviously made prior to the date of this document. There has been no foundation or no questions asked as to whether there were further runs made, subsequent runs to 1974, in the last four years, and I'm not sure that these questions are directed at interpretation of data up to a point in time preceding the date of this document, or whether they are covering interpretation of data that may have covered after that, if there have been runs and so on made after then.

And if the question could be specifically limited in time, because I hate to go through this whole thing up to

eb6

1974 and then turn around and go through this whole routine again with later maps.

MR. FLEISCHAKER: I understand that.

BY MR. FLEISCHAKER:

Q Let me ask this question: Mr. Willingham, is there anywhere a more complete map that might show later runs?

A (Witness Willingham) Yes.

Q Okay. Where is that?

A Appendix 2.5-E.

Q Okay.

MR. NORTON: Could we have the specific cite again so we can find ours, too?

WITNESS WILLINGHAM: So far it is only as specific as Appendix 2.5-E.

MR. NORTON: Thank you.

WITNESS WILLINGHAM: It is my recollection that we want I believe Plate II, and Plate I-N or II-N. Unfortunately I find our copy is missing of those plates.

II-N would be one of them.

MRS. BOWERS: Mr. Fleischaker, doesn't this put us into maps that the Board doesn't have a copy of?

MR. FLEISCHAKER: We have a problem. I have a problem in that I only have one copy of Appendix 2.5-E, that map. I'll be happy to give my copy to the Board and perhaps we can work out an arrangement where Counsel can

eb7

chart a copy.

MR. NORTON: There'll be no problem. You can come over here, Mr. Fleischaker.

BY MR. FLEISCHAKER:

Q Mr. Willingham, do you have a copy of Plate Number II in Appendix 2.5-E?

A (Witness Willingham) Yes, I do.

Q Okay.

Now could you, on that map, identify all instances where you found evidence that you interpreted as an offset of the sea floor?

A Yes. That's a relatively easy answer there. On this particular map there are none-- Excuse me.

There appear to have been some offsets to the sea floor associated with the Lompoc structure. Excuse me.

MRS. BOWERS: In what?

WITNESS WILLINGHAM: I'm looking at Plate II.

MRS. BOWERS: I knew these were not the same.

WITNESS WILLINGHAM: Are you looking at II-N?

WITNESS HAMILTON: If you look at the large envelope before II-N, II should be in that one.

MRS. BOWERS: I could tell from here that they're not the same.

MR. TOURTELLOTTE: We have an extra copy of Plate II if somebody wants to use it.

eb8

BY MR. FISCHBACH:

Q Mr. Willingham, okay, we've got this Plate II out now, and then there's a Plate II-N. Is II-N simply the northern extension of Plate II?

A (Witness Willingham) Almost.

Q Okay. Maybe we can simplify this thing.

I take it from your testimony then that the information on Plates II and II-N is different from the information that is contained on Plate A-II.

A It's a later interpretation based upon more data.

Q And there are more curdues reflected on more track lines on Plates II and II-N than on Plate A-II?

A Correct.

Q Okay.

MR. BRIGHT: It would appear that Plates II is the southern extension that, coupled with Plate II-N, would make a complete map.

WITNESS WILLINGHAM: That's correct. There is a small wedge where the two plates do not overlap. They come very close to overlapping.

DR. MARTIN: What's that on? Plate II-W?

(Laughter.)

WITNESS WILLINGHAM: No. Those were responses to questions from the NRC, and the plates were designed as answers to those specific questions and, as a result of that,

there was a small area of overlap or -- excuse me -- a small area where no overlap occurred.

MR. ZUMBERGE: I sort of got lost in the gap there.

BY MR. ZUMBERGE:

Q Does that mean that there's an area we don't have a map of for which there is seismic reflection profile data?

A (Witness Willingham) No, that does not mean that. It merely means that these two plates which were answers to specific questions from the NRC do not cover the entire area. If we look at A-E-B and consider these plates as well, then we have complete coverage.

There was no new data, no change in the interpretation in the area not shown on these two plates.

Q Okay.

Let's do this the simplest way possible.

A Good.

Q What I'm after is for you to identify the plates on the map -- you select the easiest map, okay? -- where you have interpreted -- and I will tell you the two categories I will be interested in: one, sea floor offset and two, faulting extrapolation into the Post-Wisconsinian sediments.

A All right.

To make this simple, let us not tie ourselves

eb10

strictly to the plates here. I will give you the current knowledge. Is that what you want?

A Yes, but I would like to have a map to look at so I can put points on the map. Which is the best?

A Dealing with these maps.

Q Okay.

MR. TOURTELLOTTE: Excuse me. Sea floor offset and what else?

MR. FLEISCHAKER: The other is penetration into the Post-Wisconsinian sediments.

2d

2B wbl

WITNESS WILLINGHAM: Seafloor offset was interpreted along the Lompoc structure which occurs up in the north -- well, in the upper lefthand corner of Plate 2. It is so labeled "Offshore Lompoc Fault Zone."

C6

BY MR. FLEISCHAKER:

Q Can you identify that more specifically, where that place is on that map?

A (Witness Willingham) The upper lefthand corner. There is an area indicating faulting, the heavy lines associated with faulting, labeled "Offshore Lompoc Fault Zone." In that area seafloor displacement was interpreted, post-Wisconsinian seafloor displacement.

Q Do you have the particular profile? Can you identify the particular profile that you identified that offset from?

A There are some in the FSAR. I would have to thumb through it to find the particular one.

Q Okay. Maybe you could do that during lunch.

Were there any other places on Plate 2 where you interpreted seaflor offset?

A No.

Q Okay.

Now on Plate 2-- Let me get back to this Lompoc fault zone.

I see here on Plate 2, two lines, one has an "A2"

wb2

below it. --both of them have "A2." One of them, however, has the writing "Offshore Lompoc Fault Zone" on it. Can you indicate generally along that line where you found the offset, how many instances of offset you found?

A In the central region-- Well, all right. You'll notice the area labeled "A2" is encompassed by a rather distorted ellipsoidal curve. We have a closure there.

Q Yes.

A All right.

About the central half of that ellipsoid the record sections appear to show warpage and disruption of what we have interpreted as the post-Wisconsinian surface.

Q You have interpreted it as what?

A Disruption or warpage of that surface.

Q On how many profiles?

A Well from looking at the map here I'd say, at the time this plate was drafted, on four profiles.

Q Is warpage and disruption-- Have you interpreted warpage and disruption as evidence of faulting?

A At the time this plate was drafted we were interpreting the disruption as faulting.

Q How are you interpreting it now?

A I think that my most current opinion on the matter is that there is a very small amount of faulting and more severe folding associated with this region.

vb3

Q What the basis for that new opinion?

A In part some data collected for Pacific Gas & Electric by Fugro.

Q When was this data collected?

A I believe it was either late August, early September.

Let's just say the middle of September. We can't recall the data right now.

Q By what technique?

A It was using a high resolution subbottom profiler given the trade name Sonic.

Q Did you personally examine the data?

A Yes.

Q When?

A This summer.

Q Did you inform the NRC of this? Did you inform the NRC of your opportunity to observe this data?

A No.

Q Before this time have you ever informed the NRC about this opportunity to examine this data?

A Not on a formal basis.

Q When, informally?

A That question is perhaps better directed at Mr. Hamilton, since he has been the one in contact with them.

Q Mr. Hamilton, when, informally, did you inform the

wb4

NRC of this data?

A (Witness Hamilton) I am now hardpressed to remember just what persons I have discussed the data with. I know that I have discussed it with representatives of the U.S. Geological Survey. And it had been my impression that I might have mentioned that the data was being acquired, or had been looked at, with some member of the NRC staff. But I can't specifically state that such a discussion was made. I can only say it wouldhave been some time probably several months ago, if it was made.

Q With whom on the NRC staff?

A That is a point that-- I can remember talking with Mr. McMullen. But at this point it becomes unclear in my mind whetner I was talking about other kinds of research done along the coast by myself and my staff or whether we would have mentioned the data that was obtained under contract to the Fugro Corporation.

Q Who in USGS have you discussed this data with?

A My recollection is that I've discussed it with David McCulloch and I might have discussed it with Polly Wagner.

Q When?

A I know what I mentioned it to McCulloch several months ago in the context of making an arrangement that the data would be provided to the U.S. Geological Survey on the condition that other records run by Fugro under contract to

wbf

the U.S. Geological Survey would be made available to PG&E, or to us as their representatives.

Q St. Pagne was working for -- or, was doing work for USGS and then did additional work for PG&E?

A That's correct.

Q Okay.

And there was a swap arranged so you got an entire set and USGS got an entire set?

A That was the arrangement that was agreed on. And such an exchange was in fact performed about two weeks ago.

Q Who at USGS has this data?

A I made the arrangement with Mr. McCulloch, as I recall, in a phone conversation. And I sent a messenger who arrived, according to the account given me, at the Security Control Desk at the Marine Geology Branch of the U.S. Geological Survey in Palo Alto, and at that time my messenger was given rolls of reproductions of the data that we had not had available which was obtained under contract to the Geological Survey, as well as a track chart of that data. And the person at the Security Desk, I presume representing Mr. McCulloch, was given a microfilm of the data obtained for PG&E and the track chart showing where that data was obtained.

Q Have you had an opportunity to review the data

wb6

that was done by Fugro for the U.S.G.S.?

A Yes, I have.

Q Have you formed an opinion, have you interpreted that data to form an opinion regarding faulting, evidence of recency in faulting?

A Yes, I formed an opinion based on my own examination of the data. And bear in mind that I am not a qualified geophysicist in doing this. So I'm examining this only on the basis of experience in looking at other such records.

I've also discussed it with Mr. Willingham, however. And I have compared it with the report that Fugro provided to the U.S.Geological Survey, which I also was given a copy of.

Q Mr. Willingham, have you examined the data that was done by Fugro for USGS?

A (Witness Willingham) I have casually examined it. We haven't had them long enough to perform a detailed analysis.

Q Have you discussed with the NRC staff the interpretation, the conclusions you've drawn from this casual examination?

A No.

MR. NORTON: Mrs. Bowers, before we go further in this what seems to being characterized as some sort of a conspiratorial thing, can we get a location of the data we're

wk7

talking about, a physical location, what area, what physical area this data covered?

MRS. DOWNS: Can you respond to that?

MR. FLEISCHAKER: Before they respond I would simply like to note that I think since May we've had a request in, in an interrogatory, for any additional data on seismic reflection matters. We specifically asked the staff on September 27th for the Fugro data. And it was only on November 30th that we were informed by Mr. Tourtellotte, Staff counsel, that a report was available.

MR. NORTON: Mrs. Downs, that's incredible, because they've already been with the Fugro report in their hand. And I have our copy right here. And it's dated November 15th, 1973.

I'm very sorry he didn't get it the day that it's dated.

MR. FLEISCHAKER: You didn't give it to me.

MR. NORTON: But he got it the same time we got it.

MR. FLEISCHAKER: That's not correct.

Do you have a recollection of when you called me and told me about the Fugro data, Mr. Tourtellotte?

MR. NORTON: That's less than thirty days ago, the date of the report.

Mrs. Downs, the thing I object to is Mr. Fleischaker

wb8

is obviously trying to raise the spectre of hidden data.

As I understand it, the coast is being continually examined by various people: oil companies, USGS, utilities, everybody that has an interest in offshore geology; dozens of outfits. And as data becomes available it's shared by interested persons in some cases; in other cases it's proprietary and it's not shared.

We can't stop people from collecting data. And we would hope that data collection will go on after this proceeding on into the future.

And because some data happen to have come out in mid-November, I don't see how that's a conspiracy. And that's obviously what Mr. Fleischaker is -- that's what the tone of his questions is leading toward. And I resent it very much.

MRS. BOWER: Mr. Tourtellotte?

MR. FLEISCHAKER: The characterization is yours. I'm not characterizing this as a conspiracy. I'm just trying to get some facts in the record.

MRS. BOWERS: Mr. Tourtellotte, can you respond?

MR. TOURTELLOTTE: Well my understanding is that the Fugro report has been obtained by USGS. But actually to this date, to the best of my knowledge, the mail going to Washington and me being here, we still have not received formally a copy of the Fugro Report from the USGS, the Staff has not.

However, on the 26th of November, just a day or so before I left Washington, we have a meeting of witnesses and those witnesses of course included members of the USGS. And at that time was the first time that I had -- that I was presented with a copy of the Fugro Report.

At as soon as I was presented with a copy of that report, I called Mr. Fleischhauer and told him that that report, that we had received the report and that we would try to get a copy of it made and provide that copy to him.

Now I guess he's already got a copy.

Is that right?

MR. FLEISCHHAUER: We got a copy. And the Staff alerted me on the 28th, I think, or the 29th. It was the first time I was aware of it.

MR. TOURTELLOTTE: So that was the first time that we knew -- we knew there was a Fugro Report out there somewhere but we had not seen it.

I think possibly an informal copy had also been provided to a member of our Staff a day before I found out that USGS had it.

But of course in the press of business, too, I had not been in contact with that member of the Staff.

We still haven't received a formal copy, I might add, from USGS.

MRS. SONTAG: Let's go ahead, let's proceed.

wb10

Is this a whole new line of questioning, essentially a new line? I'm looking at my watch and it's almost 12:00.

MR. FLEISCHMANN: Well I was going to continue for some time to discuss the seismic reflection -- their interpretation of the seismic reflection data. Now is as convenient a time as any.

MRS. DOWERS: Well let's recess for the luncheon break and be back at 1:00.

(Whereupon, at 11:51 a.m., the hearing in the above-entitled matter was recessed, to reconvene at 1:00 p.m., this same day.)

MADELON/
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AFTERNOON SESSION

(1:00 p.m.)

MRS. BOWERS: We'd like to get started.

Mr. Norton has mentioned to me -- oh, we're missing Dr. Jains.

Whereupon,

RICHARD H. JAINS,

DOUGLAS H. HAMILTON,

and

C. RICHARD WILLINGHAM

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

MRS. BOWERS: Well, anyway, Mr. Norton mentioned to me that the witnesses live in the Bay area and the last flight out is at 5:10, so asked that we could stop at 4:00 or a little after to make that flight. And they, I understand, will be back Monday, that there will be a continuation.

MR. NORTON: Yes.

If we could have finished today, you know, they would go home tomorrow morning. But it's my understanding that Mr. Fleischaker is planning to continue through Monday with his cross-examination, in which case they would very much -- they had planned on being home this weekend.

mpb2

They had no idea they would be here this long.

MRS. BOWERS: Well, I wanted to say something about it in case other people wanted to think in terms of this time.

MR. NORTON: Do you gentlemen have reservations on that flight for sure, or do you want somebody to make them for you?

WITNESS HAMILTON: We have reservations.

MR. NORTON: You have the reservations, all right. That's fine.

MRS. BOWERS: I was asked to make a decision that I think had already been made.

(Laughter.)

MR. NORTON: No, they've had those for several days, assuming they were going to -- that was my understanding, but I didn't know whether they had cancelled or what.

MR. TOURTELLOTTE: Incidentally, Mrs. Bowers, on Monday, believe it or not, before these hearings were scheduled, I was asked to make a speech in San Francisco, so I won't be here Monday. But my co-Counsel, Mr. Ketchen and Mr. Staenberg, will carry on for me.

MRS. BOWERS: We'll manage somehow.

(Laughter.)

MR. TOURTELLOTTE: I was just going to say don't wait for me to walk in the door Monday or it's going to be a

Myal long wait.

MRS. BOWERS: How do you get an invitation to make a speech in San Francisco?

MR. BOURNELLOTTE: You just have to know the right people.

(Laughter.)

MRS. BOWERS: I'll just take a half a minute.

Years ago the Construction Permit Board was on Bikeman and Counsel for the Intervenors asked for a two week recess because he'd been asked to give a paper to a section of the American Bar Association. So they congratulated him and recessed for two weeks. The title of his paper was "How to Delay and Frustrate Atomic Safety and Licensing Boards".

(Laughter.)

MR. BOURNELLOTTE: I've read that paper too.

(Laughter.)

Mine's an expert witness. I don't want to give you the idea that I have any ulterior motive in mind.

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

Something that occurred to us during the luncheon break is that it might be that this is going the longer more tedious route to attempt to use these drawings rather than simply asking the witnesses questions.

MR. FLEISCHAKER: Well, I need to be able to

mpb4

locate rather specifically where his interpretations of offset are.

MRS. BOWERS: Okay.

CROSS-EXAMINATION (Continued)

BY MR. FLEISCHAKER:

Q Okay.

Let's see, was this Mr. Hamilton or Mr. Willingham that was talking about the interpretation of the Fugro data, and specifically the interpretations relating to the Lompoc? I think it was Mr. Hamilton, or Mr. Willingham. Okay. I think it was Mr. Willingham.

I believe the words that you used before lunch were warpage and disruption of the surface.

A (Witness Willingham) Sea floor.

Q Have you interpreted that warpage and disruption of the sea floor as a fault that breaks the sea floor surface?

A In the early versions of the interpretation of sea floor disruption in the vicinity of the Lompoc trend, yes.

Q How about your later version?

A After reviewing the Fugro data, I am of the opinion that the amount of faulting at the surface is somewhat less than originally mapped.

Q How much was originally mapped?

A I believe we had about 1½ miles of surface faulting indicated on Plate 4, Appendix 2.5E.

mpbf

Q And how much surface faulting have you interpreted as a result of your review of the Fugro data?

A I believe in the map shown in direct testimony -- do you recall what the exact length was?

We'll have to refer to his measures here.

(Pause.)

Approximately three miles.

Q So it's your opinion that the seismic reflection data that Fugro has taken reveals three miles of surface sea floor rupture caused by surface faulting -- excuse me, caused by faulting.

A Wrong? I'm waiting for another clause or phrase of your sentence.

Q I'm trying to make sure I understand this, the interpretation of the warpage and the disruption at the surface.

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It's your opinion that this warpage and disruption at the surface is a fault that breaks the sea floor surface.

A As we pass over the Lompoc trend we witness that the sea floor no longer has smooth regular character that we observe over almost the entire area in the offshore between Point Conception and Point Beatrice Blanca. This is the only region in the entire area where there is any substantial elevation in the sea floor.

mpb6

The question naturally becomes why is that elevation there. The most reasonable answer in terms of the subsurface structure revealed in the seismic reflection records is that the elevation is there in response to severe folding of the strata and quite possibly faulting of the strata in the vicinity of the sharpest portions of the fold.

Q Did you see evidence -- or did you see faulting in the substrata?

A Yes, there's extensive faulting in the deeper section beneath the Lompoc trend, far more than is revealed in the maps shown because they are near-surface horizons.

Q How deep?

A If we go to the basement which -- well, I don't want to reach for numbers -- which is substantially below the surface in that area, the length of the Lompoc trend expands considerably.

Q Now, did you view offset strata continually from the base up to the surface?

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A Let's be specific. Are we still referring to the Lompoc trend?

Q That's correct.

A Yes -- well, a qualified yes. I can observe disruption of the sediments from the basement through the majority of the sedimentary section. As we approach the surface there is some question as to whether the faulting

mpb7

proceeds completely through to the surface, because the folding in this area is so severe.

Q Have you dated the emplacement of that warpage and disruption of the surface that you interpreted from the seismic reflection data?

A It must be post-Wisconsin.

Q Did you give any earlier bounds on it? Have you placed any earlier bounds on it in terms of recency, post-Wisconsin?

A I think Post-Wisconsin is the best estimate that I can give.

There may be -- no, I'll stick with that, post-Wisconsin.

Q Does that mean that your best estimate taken from the geologic data regarding recency of faulting in this area is 17,000 years to the present?

A Perhaps I was misunderstanding the previous question.

If you were asking when did the Lompoc structure faulting cease -- was that what you were intending?

Q No.

Let me have back my question. That's the question I want to ask.

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

mpb6

MR. FLEISCHAKER: Let me qualify that, just one qualification.

"This area" refers to the Lompoc.

MR. NORTON: Excuse me.

That was not the question that Mr. Willingham said he wasn't sure he understood. It was the question before that.

MR. FLEISCHAKER: I think the question that I wish to ask Mr. Willingham is there before him now.

MR. NORTON: That may be, but the witness has said he thinks he misunderstood the previous question, and if so we can't let the question and answer stand as is. And maybe he didn't misunderstand it, but we ought to clarify that before we proceed.

MR. FLEISCHAKER: Okay. I have no problems with that. If you want to go back and read that previous question that's fine with me.

(Thereupon, the Reporter read from the record as follows:

"Q Did you give any earlier bounds on it? Have you placed any earlier bounds on it in terms of recency, post-Wisconsin?")

BY MR. FLEISCHAKER:

Q Did you want to respond to that last question that the Reporter just read in any way?

mpb9

A (Witness Willingham) Just to quary what you meant by "earlier bounds". That was what I was uncertain of.

Q Okay. Let ma reask the question.

Is your best estimate from the geologic and geophysical data regarding the recency of faulting on the Lompoc 17,000 years to the present?

A The present disruption of the sea floor would have occurred since 17,000 years before present.

Q Does the geological or geophysical evidence permit you to be more specific in terms of dating recent faulting on the Lompoc?

A No.

MR. FLEISCHAKER: May I have just one moment to consult with Mr. Hubbard?

MRS. BOWERS: Surely.

(Pause.)

BY MR. FLEISCHAKER:

Q Okay.

Referring to, again, Mr. Willingham, to Plate 2 of Appendix 2.5E --

A (Witness Willingham) All right.

Q -- are there any other instances in which you have interpreted sea floor features as a fault that breaks the sea floor surface?

mpb10

A On Plate 2?

Q That's correct.

A No.

Q Are there any instances where you have interpreted non-fluvial features as differential erosion?

A No.

Q Are there any instances in which you have interpreted faulting in the post-Wisconsonian sediments?

A Yes.

Q Where?

A Associated with the Dunleith Fault.

Q Where are those features located in terms of grid and approximate time?

A Okay.

If you'll give us a moment we'll find the exact reference.

(Pause.)

Okay. Appendix 2.5E, Figure 19. The location of that figure is shown on 2.5E, Plate 3.

Q Is that the -- do you have any other instances in which you have interpreted faulting extending into the post-Wisconsonian sediments on Plate 2 of Appendix 2.3?

A I don't recall any other instances on this plate.

Q Okay.

What data can you attach -- what data do you

mpbll attach for recency of faulting with respect to that feature shown?

A I can say no more than I said in the previous answer to that question: post-Wisconsin.

Q Do you have an opinion as to the amount of vertical displacement?

A Well, for viewing the plate I would estimate five to seven feet.

Q Do you have any opinion as to the amount of horizontal displacement that that feature represented on that plate has undergone?

A From the information presented in that plate it's impossible to have any opinion about horizontal displacement.

Q Do you have any other information that would permit you to have an opinion as to the amount of horizontal displacement that that feature represented on that plate has undergone?

A I have an opinion based upon my regional knowledge of the structural geology, and that has already been docketed. The displacement -- well, let me back up on that.

I think that I had best simply say that on the Purisima Fault alone -- no, I have no opinion on the amount of possible horizontal displacement. I have seen no features that indicate substantial horizontal displacement, or for that

whether, any horizontal displacement on that structure.

Q Does that mean that you preclude -- that you have information that permits you to preclude horizontal displacement?

A No, it does not.

Q Now, from your examination of the Fugro data, does that permit you to draw any conclusions with respect to faulting in the post-Miocenean sediments in the region covered here on Plate 2?

A My examination of the Fugro data has been very cursory. I didn't get the reports long enough to do more than look through it.

Q Well, you've made some opinions about the Lompoc.

A Your first question was does the Fugro data lead me to any conclusions in the area of Plate 2. Are we still on that question, or did we just transfer to Fugro data versus Lompoc?

Q Let's go back to the first question.

A Would you restate it, please?

and
MARTIN;
MARTIN
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Q Do you have any opinions on the basis of your examination of the Fugro data regarding faulting in the post-Wisconsinian sediments in this area?described by Plate 2 in Appendix 2.5(a)?

A In my cursory examination of the Fugro data, and I'm referring to their report at this time, I felt that the conclusions reached there looked like they had been adequately substantiated in the report.

Q How did you arrive at the conclusion that the conclusions in the Fugro data had been adequately substantiated?

A From looking at their lines, from reading the report, viewing the lines, comparing them to the interpretations they had drawn.

I think I had one exception. If you view the map associated with their report, at the very northern end they have what's indicated as a sea floor fault break shown and I did not see any evidence for that actually coming to the sea floor -- excuse me, post-Wisconsinian break, and I did not see evidence for it breaking the unconformity.

Outside of that, it seemed that most of their conclusions were correct.

Q May I ask you to identify the map that you're referring to in the Fugro Report?

A Looking here, the map called Plate One, entitled, Geologic Map of the Point Sal to Point Conception offshore

agb2

Arroe, California.

MR. FLEISCHAKER: We have a disappearing map. May I have a moment, please, I had it here at lunchtime.

MR. NORTON: Mrs. Bowers, I'm going to make the same objection. If counsel is going to start pulling out maps, he'd better have copies for the Board and he'd better have copies to mark in the record. Otherwise, we have a transcript that nobody can follow.

MR. FLEISCHAKER: Well I got this report on the 20th from the Staff, and it was the Applicant's report, the Applicant failed to --

MR. NORTON: It is absolutely not the Applicant's report. It's the USGS report, Mr. Fleischaker, it is not the Applicant's report in any way.

MR. FLEISCHAKER: Well, you have the data, and we have --

MR. NORTON: I'm sorry, Mr. Fleischaker, that's incorrect. You didn't listen to the testimony of Mr. Willingham and Mr. Hamilton. That is USGS' report and we got it about the same time you did and we had to scurry for it as you did.

MR. FLEISCHAKER: Well I see a map that Mr. Willingham has and I noted that he indicated that he had drawn conclusions from Fugro data in his report.

The point is, I don't --

agb3

MR. NORTON: That's just wrong. We got this data the same time you did, Mr. Fleischaker, maybe a couple of days earlier, I don't know. You know, I don't think it makes a lot of difference. But it's not our data, it's USGS data.

MR. FLEISCHAKER: The data that PG&E requested?

MR. NORTON: This is not the PG&E report. This is the USGS report. Just look at it.

MR. FLEISCHAKER: Okay, I understand that.

But it seems to me that there's a map over there that Mr. Willingham has --

MR. NORTON: The same one you have and the Board does not have, that's my objection, and you don't have copies for the Board or for the record.

MR. TOURTELLOTTE: Mrs. Bowers --

DR. MARTIN: Mr. Willingham referred to the map in his answer.

MR. NORTON: That's correct, because he was asked the question.

DR. MARTIN: All right. Now we're going to have to look at the map if we have to pass it around.

MR. TOURTELLOTTE: Mrs. Bowers, this has come up before, not this particular item that they're discussing. But it's impossible for anyone else to participate in a proceeding when two attorneys get into an argument.

agb4

My understanding of the way this proceeding is to advance is that all objections are to be directed to the Chair, and the Chair will rule on those objections.

So if an objection is to be made, I think it should be made to the Chair so we can all speak to it, rather than two attorneys getting into an argument when it doesn't give the third attorney a chance to get in on a very legal basis.

And with respect to [illegible] has happened in previous hearings where we have been so and it's really hard to deal with them our standpoint.

If that's not the proper legal way to proceed, I'd appreciate it if somebody would tell me.

MRS. BUTLER: You're absolutely right, Mr. Tourtellotte.

Don't talk to each other.

Now where are we?

The witness referred to a drawing in order to answer a question, and Mr. Fleischaker, you say you can't find your copy of the map?

MR. FLEISCHAKER: I have a copy, I have marked on it, so I think it would be inappropriate to give my copy to the Board because it has my markings on it. I've circled a couple of features, and I think that Mr. Norton would be unhappy if I were to give that to the Board.

agb5

MR. NORTON: We'll give the copy we have to the Board, but I'm more concerned about if it gets in the record, what copies are there for the record, that's my concern.

MR. FLEISCHAKER: Well, I'll be happy to try to obtain a copy of this map for purposes of the record.

MRS. BOWERS: Well I think you'll need three copies if it becomes an exhibit.

MR. NORTON: Yes.

Mrs. Bowers, we don't have that problem with the FSAR because that is in evidence, so the maps that are being pulled out of the FSAR are, in fact, in evidence. But this map is no place to be found in the record at all.

MRS. BOWERS: Well let me ask you, Mr. Tourtellotte, are we talking about a map that the Staff intends to offer through its witnesses?

MR. TOURTELLOTTE: To the best of my knowledge, we don't intend to introduce the Fugro Report into the proceeding, we don't.

MR. NORTON: We have no intention, it doesn't add anything. In our mind, it does not add any new information to the question before the Board at all.

If Mr. Fleischaker intends to introduce it, then he should have three copies plus copies for the Board, and I don't know if he can -- you know, I don't know if he can support it with any evidence, I don't have any idea what

agb5

he had in his mind but, again, we don't feel it adds anything. It's information that is additive in the sense that it supports the conclusions that are already there, but it's nothing new, it's not something we intended to produce.

MRS. BOWERS: Mr. Fleischaker, what did you intend to prove by this?

MR. FLEISCHAKER: Well, I would have brought out the Fugro Report in any case, even though it was a report of studies that were commissioned both by PG&E and by the USGS. It's curious that the Intervenors are the ones who have to bring that out.

MR. NORTON: Excuse me, Mrs. Bowers, for interrupting but that's a misstatement of fact. It's just wrong. And I wish that would be cleared up. There are newspaper reporters here and it makes it sound like we've got a report that we're trying to hide and it's just not true, it's not our report.

MR. FLEISCHAKER: I think Mr. Norton is probably right, the report, the actual report itself, the Brown Book may well not be a USGS -- excuse me, a PG&E document.

What I'm referring to is the fact that PG&E requested Fugro to run sparker lines for them last summer, and PG&E received data as a result of those sparker lines run. We have never received any information from PG&E on those data. That's the first thing.

agb7

The USGS also requested Fugro to do some work. And we -- Mr. Tourtellotte was good enough to call me on the 28th of November to inform me that the report was out.

That report I understand contains conclusions that are drawn, one, from the work that was done for USGS and, two, from the work that was done for PG&E.

I also understand from the statements given here this morning that USGS and PG&E have worked out a data swap.

It was not until November 28th that we received anything.

Now, as I say, it's curious that we're in the position of having to bring this matter into the proceedings. I would like to do that because I think the data is useful. I don't have three maps at present.

end2F

Mr. Hubbard just pointed out to me at line 12 here in the Fugro -- excuse me, page 12 in the Fugro report itself, in discussing the offshore Lompoc Fault, that report states as follows:

"These lines were run for private groups, Pacific Gas and Electric Company and Earth Science Associates, at no cost to the U. S. government. Thus, the original profiles are not submitted with this report. However, permission has been granted to utilize these profiles in our examination."

With support I think my description of this report as being one which incorporates conclusions reflecting -- conclusions drawn from the data that was collected for USGS and PG&E.

MR. NORMON: Mrs. Bowers, I would like to read the introduction and summary of results, the first page.

"In May and June, 1979, Fugro, Inc. conducted an offshore geophysical survey between Point Sal and Point Conception, California, (Figure 1) utilizing the 3 kilohertz Sonia profiling system. The purpose of this study was to investigate the location and nature of the Hosgri Fault south of Point Sal, and to evaluate its regional tectonic implications.

"The investigation was performed under the U. S. Geological Survey's Earthquake Hazards Reduction Program, Contract 14020. The specific objectives of the Hosgri Fault investigation were...." and then they go on to describe in the report what it's about. That's what the report is.

There is mention in there that he has just quoted that they had done some other work for PG&E and had received permission to report the findings of that as they deal with the offshore Lompoc Fault, not with the Hosgri Fault, the offshore Lompoc Fault in this report as part of their overall analysis.

But this report is not a report done by PG&E, requested to be done by PG&E. PG&E hadn't anything to do with it. The report substantiates our position. We don't care if it's offered into evidence or not but it's just cumulative. There is no real point in it, and that's why we haven't presented it. We see no need to present it.

Additionally to that, as Mr. Willingham has said, there are many miles of data collected and Mr. Willingham really is not in a position to offer it into evidence because he hasn't carefully and in detail reviewed it.

Mr. Willingham has reviewed over 3700 miles of data in this investigation. This is an infinitely small piece that somebody just did. It doesn't add anything, and

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he didn't have the time, from the time he got the data to now, to review it so he can't sponsor it. He can't review it in that short period of time and say, "Yes, these little lines that we saw some of today are -- you know, support the report."

He said generally he sees nothing in it that's inconsistent with what's been done before, and that's why we haven't offered it. There's nothing there.

I don't care if the report -- if the Board has it or anybody in the room has got it, but for Mr. Fleischaker, just because it's a late piece of data, to somehow make a big thing out of it is-- And I don't understand where we're going.

MR. FLEISCHAKER: May I respond to that, please?

MRS. BOWLES: Briefly.

MR. FLEISCHAKER: That's a very strange characterization of this report because it has two basic conclusions that I will read here.

MR. NORTON: I object, to find out what the purpose of reading the report is. I thought we were talking about whose report it was, not the conclusions.

MR. FLEISCHAKER: The purpose is to respond to your point that it has very little to do with this hearing. One of the conclusions that it reaches is that -- quote:

"The displacements of Unit 1 indicate

eb4

that the Hosgri Fault has been active as late as Pleistocene and perhaps Holocene time, less than 17,000 to 20,000 years."

Okay?

MR. NORTON: That's exactly what the testimony before the Board is. That's exactly what's contained in the FSAR and the testimony of these witnesses.

MR. FLEISCHAKER: Earlier on page 11:

"The signature of reflectors on line 35 suggest the fault displacement is very young and that only the uppermost reflector is not affected."

That's out at the Hosgri Fault.

MR. NORTON: Please read all the conclusions, Mr. Fleischaker. Don't just read parts of it.

MR. TOURTELLOTTE: Mrs. Bowers, I simply want to respond to the characterization that was made by Mr. Fleischaker, that it's curious that he should be the one to introduce the piece of testimony, if indeed it is to be introduced, because the clear implication is that it's something that perhaps -- and I'm not speaking for the Applicant, but perhaps the Staff should have introduced.

I would simply point out in this regard that to begin with, the Staff has never formally received it, (a); (b), it's a report, to the best of my knowledge, which

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was prepared by the USGS for USGS. It was not prepared by USGS by reason of their contract with the NRC as our consultants, and for what purpose I have no idea as far as the USGS is concerned.

I do know that I did consult with my people because I feel that if there is some new information in there that will be of benefit to the Board or to this proceeding, information that we had not received before, then I believe it is our responsibility to present this to the Board. And the information which I received was, "No, there is no new information here. The information is simply cumulative, and it is a matter which you need not worry about, new information not being provided to the Board as we have the responsibility to do."

Hence we made the determination that we would not introduce it as evidence.

Now if Mr. Fleischaker has his own reasons for getting into the Pegro report or introducing the Pegro report for his case, I don't have any particular objection at this time. But I do object to the characterization, the implication of the characterization that he is the one who is bringing this to light because maybe the Staff should have done something about it themselves.

I don't think it's a fair way to proceed and I don't think the characterization reflects the circumstances

eb6

of the case.

MRS. BOWERS: Well, as you know, each party determines what it will present in the way of witnesses and evidence. Now both Applicant and Staff have said that they do not feel this report would add information to the record that is not already there, and it would be repetitive. It would be duplicating.

Mr. Fleischaker, if you want to sponsor it, that's your decision, but let's get on with it.

MR. FLEISCHAKER: Well, I'm going to take up cross-examining Mr. Willingham on the basis of his examination of the data in the Fugro report. That's where we left off.

MR. NORTON: All right, Mrs. Bowers. And where we started and where we left off was my objection that if they're going to do that, supply copies for the record and for the Board of any map they're talking about. That's the basis of my objection. I won't argue it again but there is that objection pending.

MR. FLEISCHAKER: I didn't bring out any map. I don't need any map.

MRS. BOWERS: Well, earlier in this proceeding when we were dealing with environmental issues there were certain learned treatises that were referred to in part or quoted that the witnesses were familiar with, and of course

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they were asked their opinion as to whether they agreed or disagreed, and there were notes offered in evidence. The whole article wasn't offered. It's just that the witness was questioned as to whether he or she agreed or disagreed with Dr. Bryant's opinion in a certain matter.

How here do we have something similar?

We have a report that the witness has a copy of, and he ordinarily is free to give his opinion, based on data reasonably relied upon as long as he identifies the source.

MR. MORGAN: Absolutely no problem with that, but what we did here was the map was being pulled out and there was going to be questions about the map. That was my objection. I have no objection to questions about his opinion or the reports at all.

MR. SCHMIDT: But he may be using the map.

MR. MORGAN: That's what my objection is.

MR. SCHMIDT: You think any source that is referred to by an expert witness must be brought in as an exhibit?

MR. MORGAN: I think if Mr. Fleischaker was going to proceed with that map as he has done with the Frain maps then it indeed must be in the record. Otherwise the record has absolutely no meaning when you refer to -- well, this red line on the map that is marked L or D or whatever. I mean that has absolutely no meaning in the record.

eb8

But if he's just going to ask general questions without specific locations and indications on the map in question, then that's fine. Or if he wants to use one of the maps already in evidence, that's fine.

But where we left off was we were going to be asking questions about the map in the Fugro report.

MR. FLEISCHAKER: Are you prepared to --

MRS. BOWERS: Address the Board, please.

MR. FLEISCHAKER: I unfortunately don't have a clean copy of the map with me. I'll take my copy and mark it as Joint Intervenors' Exhibit and offer it into evidence at this time.

MRS. BOWERS: You have to come up with the three copies as exhibits to hand to the Reporter. Now that could be done a little later.

MR. FLEISCHAKER: I'll be happy to do that, and I'll get clean copies for the record. And I'll give the Board my copy for purposes of the remainder of this....

MR. NORTON: Mrs. Bowers, I have a feeling we'll have no objection to the exhibit when that's done but of course it's premature to offer it into evidence at this moment because there's been no testimony about it whatsoever. But I assume once that's done we'll have no objection but I think it's premature to offer it into evidence before there have been any questions about it.

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MRS. LOWINS: Can you share with Mr. Tourtellotte so that one copy can come up here?

MR. NORTON: I think we gave you our copy. We don't have one.

2g

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BY MR. FLETCHER:

Q Mr. Willingham, I'm not certain where we left off, but I think we left off talking about faults penetrating into the post-Wisconsinian sediments and any conclusions that you might have drawn from the Fugro data.

A (Witness Willingham) As I said earlier, I've had little time to review the Fugro data, and I would not like to make any definitive statements about it until I've had time to do such.

I do have a general conclusion about the report, based upon one quick reading of it and a quick review of the profiles. And with those qualifications, I will state my opinion.

Q Fine.

A The report seems to indicate that there are short stretches of discontinuous breakup of the post-Wisconsin unconformity in the vicinity of Point Sal and southward toward Purisima Point. And that is the conclusions that I have reached, based upon my view of the Fugro Report.

In that reach, there was no indication of sea floor offset. We're talking about post-Wisconsin disruption of the unconformity.

Q Now I have a map before me that is entitled, the Geologic Map of the Point Sal to Point Conception Offshore Area, California by Payne, Swanson, Shell, dated 1970.

eyo2

Is that the same map that you have in front of you?

A If that reads, "Plate One," then I think we're in agreement.

Q Okay.

Can you designate for me where these penetrations into the post-Wisconsinan sediments were interpreted by the authors of the Fugro Report?

A Well, by looking at the map, they have indicated by a dashed line immediately adjacent to Point Sal that they had identified disruptions of the post-Wisconsin unconformity on Lines 41, and I can't read the other line number. This is a reduction of the original map. Perhaps you could identify it better yourself. I'm speaking of the lines immediately adjacent to Point Sal now.

I'm afraid to do that, we would need a full-sized copy which we don't have.

MR. NORTON: I have an original of that, and I believe it is Line 101 and Line 030, if that would assist Mr. Fleischaker.

BY MR. FLEISCHAKER:

Q And Line 41?

A (Witness Willingham) The one I'm looking at distinctly says Line 41.

Q I think they all three: Line 41, Line 101 and

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Line 39.

A Now on Line 101, I take exception with what they have drawn on the map and, indeed, what they show in their cross-section does not conform to what they indicate on their

9.030 map.

Q So you have looked at it to some extent?

A Oh yes, sir, I already stated that.

Q With respect to the conclusions that they draw on Line 41 and 39, are you in agreement, given the caveats about the degree of your examination?

A Yes.

Q Now these dashed lines, do they fall in this shaded area, are those the heavy dashed lines that we are referring to?

A Yes, those are the heavy dashed ones, the line within the shaded area indicated as the Hosgri Fault Zone.

Q And do you have an opinion as to whether -- do you agree with that designation of the shaded area as the Hosgri Fault Zone, would you so characterize it?

A I had not considered that aspect of the Fugro data, so I would not like to comment on it.

Q You've reached no conclusions as to whether the structures they've located out there should be a part of the Hosgri Fault Zone?

A I've reached no conclusion as to the validity of

A I've reached no conclusion as to the validity of the boundaries that they have placed on the Hosgri fault zone on this map.

Q Well do you have an opinion as to whether the structures themselves that they've identified here are part of the Hosgri Fault Zone?

A Yes, I believe the structures identified as the dashed, the heavy dashed lines that we were just discussing are part of the Hosgri Fault Zone, yes.

Q On the basis of your examination of the data and your prior work in the field, do you feel that this map then with the exception that you've noted there is a reasonable characterization of the data and of the area?

A Well I would like to note one more exception.

And that is on line -- it looks to me as if it is line 29 -- it is the southernmost heavy dashed line drawn within the shaded area.

If somebody could check that line number, I'd appreciate it.

MR. NORTON: That looks like line 29 on the original.

WITNESS WILLINGHAM: I'm not certain that the indication of disruption of the post-Miocene unconformity on that line is a valid interpretation.

BY MR. FRITSCHMANN:

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Q Have you examined that data?

A (Witness Willingham) Within the stipulations that I previously made, I have carefully looked at it.

Upon looking at it, I feel they may have misinterpreted the structure. I cannot definitely say they did until I've had more time to review it, but it appears to me there may be a problem with that one.

Q So, at this time, your examination of the matter is incomplete?

A That's very correct.

Q And I take it that's the same with respect to the structures that have been inferred on Lines 101, 41 and 3S also? That is, your examination is incomplete?

A Yes, I believe that's what I stated earlier, that I have not completed reviewing this report.

MR. FEINSCHMIDT: I'd like to have this Plate One marked as Joint Intervenors' Exhibit Number 16 and I would offer it into evidence at this time and will get three copies for the record.

MR. NORTON: We've absolutely no objection.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No objection.

MRS. BOWERS: Well the exhibit that you've identified will be accepted into evidence.

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(Whereupon, the document referred to as Intervenors Exhibit 16 was marked for identification and received in evidence.)

MRS. BOWERS: Mr. Fleischaker, I have some problem with you proceeding with this witness when he has made it very favorable that as just like the carbon of this document was burned and incomplete. And, you know, it's certainly not the usual situation.

MR. FLEISCHAKER: Well, he certainly is going to tell me that, I would think, in the record, and I think he brought up the Fugro data in his response to my first question now 2, and I felt it appropriate to probe the limits of his knowledge.

MRS. BOWERS: Well be made it very clear that he qualifies himself with extreme limitation on this report.

MR. FLEISCHAKER: I think the record speaks for itself.

BY MR. FLEISCHAKER:

2 Q Was there any other instance where you have interpreted faulting in this area difficult by Plate Two of Appendix 2.5(c) in the post-discontinuance submittal?

1 (Witness Billingham) No.

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Q Okay let's move to Plate 2N of Appendix 2.5(a).

Now, if I could ask you to get out both Plate 2N and ther plate -- no, with respect to any of the answers you're going to give here, you have a Plate A3 in Appendix 2.5(d), and you have some bars across that, I think, that indicate --

MRS. LOWERS: Wait a minute, let everybody get ahold of this.

MR. FLEISCHAKER: We have two plates in front of us now, Plate 2N of Appendix 2.5(c), and also Plate A3 of Appendix 2.5(d).

MRS. BOWERS: Does the Board have that?

WITNESS WILLINGHAM: A3 of 2.5(d)?

MR. NORTON: We don't have that out yet.

Mrs. Bowers, could I make a request that we deal with one map at a time? These things are big, and I don't understand -- we can only ask the question on one map at a time anyway. Can we deal with one at a time?

MR. FLEISCHAKER: I'll be happy to do that. I was trying to expedite the thing.

Basically what I want to do is this, Mr. Norton, or Mrs. Bowers, I was going to ask the same set of questions that I asked on Plate 2, which covered the south part of the Rosgri Fault Zone, with respect to the north part here as portrayed in Plate 2N.

We also find here, though, on Plate 3A, a different

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plate, that the Applicant has certain profiles that he has identified along this plate and he has copies of these profiles in his testimony.

And so, with respect to those instances where Mr. Willingham could identify either a sea floor rupture or a fault in the post-Wisconsinian sediment, I was going to ask him if that was designated also or identified on Plate A2, so we could go look at the profile itself.

MRS. BOWERS: So your point is you really need these two documents side-by-side?

MR. FLEISCHAKER: I think it would be quicker, I really do.

MRS. BOWERS: You have a little skinny version, you see, and other people have the whole thing.

Well let me ask the witnesses: Do you have the room there, can you physically handle hopping from one to the other?

WITNESS WILLINGHAM: We have no problem.

MRS. BOWERS: Why don't you proceed, Mr. Fleischaker?

MR. FLEISCHAKER: Thank you.

BY MR. FLEISCHAKER:

Q Mr. Willingham, could you identify those instances where you have interpreted sea floor features as faults that break the sea floor surface?

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A. (Witness Willingham) Yes, there was only one location where that's the case.

Q Could you give us the track and the line?

A. Track Line 27, between shot points 32 to 30.

MR. NORTON: May we ask which map you're referring to now?

WITNESS WILLINGHAM: We're referring to -- I'm sorry, that's not my question, or is it?

MRS. BOWERS: Well, what did you look at?

WITNESS WILLINGHAM: I'm looking at Plate 2N of 2.5(c).

MR. FLEISCHAKER: I'm having a hard time finding that. Is there any way you could help us locate this point?

WITNESS WILLINGHAM: There's an annotation off to the left that says, "Possible offset of sea floor indicated by five-foot stepup of...' -- and then it continues on with a large arrow pointing directly to the location.

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BY MR. TRISCHMANN:

Q Did you date the age of that feature, the recency of faulting?

A (Witness Willingham) Recent.

Q How recent?

A Let me confer with Mr. Hamilton on that for a minute.

(The panel conferring.)

All we can say about it, because we don't have any recent overburden there, is that it's Post-Wisconsin, some time between the Post-Wisconsin erosional epoch and the time the profile was taken.

Q So there is no sediment over that which you could go down and get samples of and date? Is that the problem?

A That's correct, yes.

Q Did you attempt-- Did DG&E attempt to go down and lift out sediments to do a dating on it?

A Yes.

Q Let me see. You scooped out some sediments and-- You did not find any sediments to date? Is that correct?

A That's right. There were no sediments to yeild a date. These are older rocks exposed at the surface so they give us no tie on the age.

Q And you actually went down there physically and tried to obtain some sediments to date?

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A Well, we attempted to make dart cores which-- Yes, physically we attempted to sample the sea floor.

Q Have you associated that offset with any particular features-- Strike that question. I'll come back to that.

Do you have an opinion as to the amount of vertical offset that is revealed by --

A Well, again, examination of Figure 11-A of Appendix 2.5-D-- Well, let's see. I see we don't have....There it is. Yes. Okay.

The estimated offset is 5 feet, which is stated in the right-hand frame of that figure.

Q Which figure is this?

A This is Appendix 2.5-D, Appendix A, Figure 11-A, right frame.

Q Is that the same figure as Figure 9-A? Is that the same feature that is portrayed in Figure 9-A?

A Yes, it is.

Q So Figure 11-A is a high resolution picture of the same thing?

A That's correct.

Q And do you have an opinion on the amount of horizontal displacement that can be associated with that feature?

A Horizontal displacement? Again there is no evidence provided in these profiles that indicates directly what the horizontal displacement is.

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Q Do you have any other information that would permit you -- any other geophysical information that would permit you to make some estimate as to the horizontal displacement that might be associated with that feature?

A There is no geophysical information associated with this particular area that will yield any information of that sort. We have to then go to a regional analysis before we can begin to make those kinds of treatments.

Q Do you have any geological evidence that will permit you, within the local area there -- I'm not talking about a regional analysis --

A Within the local area on the sea floor, no.

Q Okay.

Have you associated that feature, that offset, with any feature here on Plate 2-X?

A It seems to lie within what we would call the Reagan Fault Zone.

Q Is there any technique by which you can map the fault with which that feature is associated?

A All right. Here's what we attempted.

The feature was revealed on a DBRN line and at a later date, we had another geophysical ship run side-scan sonar, which is a technique for acoustically developing pictures of the sea floor, search for the scarp. We had them run several lines in the immediate vacinity of the scarp --

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If you examine the plate, that is, Plate 2-N, you will notice that there are three very closely spaced lines given the designation SS1, SS2, and SS3 -- trying to extend the area over which this scarp was mapped. All of those efforts failed to locate the scarp.

In short, we conducted a very extensive study, trying to relocate the feature and we were unable to do it, thus leading us to the conclusion that it was a very localized phenomenon.

Q Let me take a look at this map here. Excuse me, I'm referring now to Plate A-3, Appendix 2.5-D.

MRS. BOWERS: Wait a minute. Give everybody a chance to get the map.

MR. FLEISCHAKER: Plate A-3, Appendix 2.5-D.

WITNESS WILLINGHAM: Yes.

BY MR. FLEISCHAKER:

Q Now just off Point Buchon you have this bar that has an 11-A on it.

A (Witness Willingham) Correct.

Q Which numbers there designate the profiles here?

A The 9-A-- Oh, okay. Which numbers designate the profiles?

Q Yes, the profile that we've just been talking about.

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A Okay. The profile, the BB&' profile that we're looking at that's shown in Figure 11-A is designated as 27.

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B-A shows Line 802.

Q Now 13-A, again referring to Plate I-XIII, you have there a circled 13-A, and then if you turn to the figures in the back of the PSAR you find the profile 13-A.

Now you have indicated-- Does that profile generally cover this area with that black heavy line that's indicated on Plate I-3?

A The black heavy line is designed to designate precisely the area covered by the plate.

Q Okay.

Now you've got some faults. It would appear that you've inferred some structure there.

A Yes. That's correct.

Q And your interpretation is that none of that structure breaks the sea floor. Is that correct?

A We see no sea floor breakups except on the one line designated or shown on Plate II-3. In extensive attempts to expand the area over which that rupture was observed we have failed.

Q Could you describe-- How have you interpreted the faults that are shown on 13-A there, Figure 13-A?

A I'm afraid the question, how have I interpreted that faults, has no meaning for me. They have been interpreted as faults.

Q Do they extend into the Fort-Hueneme sediments?

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A Well, they don't seem to be-- If any, there is a very thin carapace of Post-Wisconsinian sedimentation in that area. The faults do seem to extend to the surface.

Q Are you able to make any interpretation as to how close those faults extend to the sea floor?

A Well, as shown in the plates, we have interpreted that they extend to the sea floor.

Q And it is your interpretation that they do not offset the sea floor?

A Except along that one profile, that is correct.

I think again it must be pointed out that it is not a sampling problem that makes the sea floor offset appear over such a short range of the map.

Q Is it your conclusion then that there is no connection between the features-- Do you have any conclusion as to whether the features revealed in 13-A and those that are revealed in 9-A and 11-A are related?

A I believe the features are related and I believe the sea floor offset only occurs over a very short distance immediately adjacent to profile 11-A.

Q What's the relationship?

A They appear to be the same fracture.

Q Let's look up at plate A-3. This is number 22-A, Figure 22-A.

What is your interpretation of the structure there

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that you've inferred?

A I'd like to have a minute to refresh my mind about this particular profile.

MRS. BOWERS: Why don't we take a ten-minute recess, since it was previously agreed that we would adjourn at four o'clock, or shortly thereafter?

(Recess.)

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MRS. BOWERS: Let's resume, please.

BY MR. FLEISCHAKER:

Q Mr. Willingham, before we broke you identified, I believe, that the faults that you indicated on line 13A and those that were shown up on 9A and 11A were part of the same fracture.

A (Witness Willingham) Yes.

Q What do you mean "fracture"?

A Fault, a break in the earth's crust.

I really had no ulterior motive in using the word "fracture". You can substitute "fault" for it and it doesn't bother me at all.

Q Do you have any opinion as to whether those -- the features there have moved during any single event together?

MR. NORTON: I'm going to have to object because I don't understand what you say "those features have moved in any single event together". I don't understand any of that sentence.

MRS. BOWERS: Could you be more explicit, Mr. Fleischaker?

BY MR. FLEISCHAKER:

Q When you say they're part of the same fracture, do you mean the same continuous fracture, or are they part of a zone of fractures?

A (Witness Willingham) In this case it appears

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that we're looking at a single fracture.

Q To use Dr. Jahns' description, a knife-edge sliced through the earth?

A We're looking at something that closely approximates the ideal definition of a fault.

Q Were you able to gather any additional information to help you determine the extent of that single feature?

A As I previously stated, we ran the additional lines and you can see the coverage that is already displayed on the plats. That is the extent of the information we have. And you can also see the extent of the distance over which we interpreted the fault to exist.

Q Okay.

As you go from line 13A there toward shore, do you have any evidence that would support a -- excuse me -- do you have any opinion as to whether that feature extends toward shore, that single feature, toward the shoreline, toward Point Bouchon?

A No, not if we're talking about the same fracture that we were previously discussing.

Q We are.

A Okay.

Q You have no opinion?

A No. There is no evidence indicating that it does extend toward shore. Quite the contrary, there seems to

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be a good deal of evidence indicating it extends parallel to the Hosgri Fault trace, which definitively does not extend toward the shoreline in that area.

Q Let me ask you to describe the fault that's revealed in 22A, Figure 22A.

A All right.

The primary purpose of Figure 22A was merely one of instruction, to show people the relationship between the side-scan sonar picture and the sub-surface geology associated with the surficial outcrops. There's no particular significance placed on the fault shown in that picture. It seemed to be a very minor feature.

Q How do you reach that conclusion?

A By the amount of apparent displacement indicated in the side-scan sonar picture, and by the lack of any indications of major displacement on the vertical profile.

Q How far up into the strata does that fault extend?

A Oh, that fault definitely extends completely through to the sea floor. Because you can see it in the side-scan sonar.

The side-scan sonar is an actual acoustic photograph of the sea floor. You see the fault in the side-scan sonar picture. Therefore if you were to put on the appropriate scuba gear you could look down and see the fault

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in the sea floor.

Q This is another instance of a fault breaking the sea floor surface?

A Yes, this is an instance of a fault visable on the sea floor. I do not like the use of the term "breaking" because it implies some kind of dynamics in the situation.

Q What do you mean by "visable"? You mean you can see it there?

A I mean you could walk up to it and look at it, just as you could walk into any hillside and find a fault somewhere. It is something exposed at the sea floor.

Q Okay.

We'll use that term "exposed" then.

A This is the better one.

Q Okay.

What's the amount of vertical displacement on that fault that's exposed at the sea floor surface?

A I see no evidence to determine that.

Q How about horizontal displacement?

A Again there is no direct evidence to determine horizontal displacement.

Now, within -- I previously stated that it is in my interpretation a minor fault. I see no seismic evidence that would lead me to believe that it had major extent. So my responses now are couched with that stipulation. I

apn5 see no direct evidence indicating the amount of relatively minor displacement that could exist on this fault.

Q Would you characterize the fault that we observed down on 91 and 11A as a major disturbance?

A No, I would consider it to be one of the minor faults in the Hosgri fault system -- excuse me, fault zone.

Q Let's go up to 6A.

What does Figure 6A represent?

A I haven't yet reviewed it.

Figure 6A is another side-scan sonar record.

Q How far does the -- is there a fault inferred in that figure?

A Yes, to the right of the figure there is a dark line with the word "fault" pointing to it, and we've inferred a fault to exist along that line.

Q I don't have the figure in front of me.

A Oh, I'm sorry.

There is indeed a fault inferred in that figure.

Q Okay.

And how far does that penetrate?

A Just a minute.

Q Toward the sea floor, I'm sorry.

A If a fault appears in a side-scan sonar rendition, when it is exposed at the sea floor. So the fact that they are indicated on this diagram indicates that they are exposed

mpb2

at the sea floor.

Q Mr. Willingham, I'm a little bit confused. Perhaps you can help me on this.

The first question I asked you when we went to this plats was could you identify every instance in which you inferred a fault to break the sea floor surface, and my understanding was that you said that there was one example off Point Buchon.

Did I misunderstand that, because you've now just identified two others?

A All right.

I guess that I was actually interpreting your use of the word "break" to mean any fault which in a time frame of concern to this study may have broken the sea floor. And that was the context within which I answered that question.

There are innumerable faults exposed on the sea floor. Any place where we have older sediments exposed on the sea floor we will see faulting. That is the nature of the kinds of rocks we're dealing with here.

Q How do you date those?

A It's often very difficult, if not impossible, to date exactly when the faulting occurred. If, however, the sea floor has been planed over them, the faults show no indication of rupture of the sea floor itself.

lf 160

mgb1

If they show no indication of being major features that extend over more than a very short distance, then we can I think quite safely conclude that they are essentially not capable -- within any of the legal terminology we are accustomed with here, and from a geologic circumstance would not be of concern to us -- would not be of importance in establishing the geologic structure in the area.

Q I take your answer to be that from your point of view they are not important.

But is there any way that you can date when they actually cut the rock, how?

A If we're talking about faults on the sea floor, I suppose a kind of any bodily way in which we can date them other than to say that we can preclude them from having had movement in Post-Miocene time.

Q On what basis?

A On the basis that they have not appeared that unconformity on the sea floor.

Q I thought they appeared on the sea floor. I thought you were able to see them.

A I was making a general statement.

All right. If they appear on the sea floor, then we obviously are not looking for post-Miocene disruption. We are dealing with hard rocks. And we are looking -- if we are looking at rocks that do not have geologic origin

npb2

sedimentation over the top of them because of the regional geology, the types of formations exposed here -- we are dealing with rather hard rock, and rates of erosion beneath the sea floor are very low.

So had there been any movement -- and now again I would probably defer a more detailed discussion to Mr. Hamilton or to Dr. Jones of this aspect of things -- but if there had been any Holocene or perhaps even late Pleistocene movement on these faults we might still expect to see the scarps expressed in the sea floor.

Q Let me see if I can get at it this way:

You've identified two features that we've discussed, 22A and 6A.

A Yes.

Q Do you have an opinion as to the recency of movement on those features?

A My opinion is that those faults have had no recent movement.

Q Okay.

And the basis for that is?

A They are small features; they show no sign of having broken the sea floor, that is, displaced the sea floor.

MR. NORTON: Excuse me.

While Mr. Fleischhauer is taking a moment:

Mr. Bowers, we have a geologic time scale, and I

have warned my witnesses over and over again when they use terms like "Holocene", "Pleistocene", "Pliocene", and so on, to try and put that in the framework of time.

It's very hard, obviously, for the geologists to do that because they're familiar and use those terms all the time. I was indeed chastised in a written opinion by an appeal board for findings of fact that were couched in terms of Holocene, Pleistocene, and so on.

I have a geologic time scale here with me which perhaps we could give to the Board members and maybe include in the record so that reader of the record can then, when they see those words and are really interested in how many years it is, can, you know, look to it, if the Board thinks that's a good idea, because it is a problem and it was specifically referred to by an appeal board in an earlier decision.

MRS. BOWERS. Is it anyplace else in the record? Is it in the text?

MR. NORMON: I believe not, but I could be corrected on that.

MRS. BOWERS: Mr. Hamilton?

WITNESS HAMILTON: I believe we included a glossary of geologic terms that had been used in the text of our direct prepared testimony, and I think that in names that correspond to epochs of geologic time that there was an equivalency years indicated in the glossary.

mpb10

I would hope at least that you would find Holocene and Pleistocene and Wisconsin and so on.

MR. NORTON: Yes, that is an alphabetic glossary, but it contains an awful lot of words that are not time related.

This little geological time scale -- I don't know, it came from Blume and associates. Maybe Mr. Fleischaker would have an objection to its use, but it is a handy little guide to give you of the years in millions of years and so on.

MR. FLEISCHAKER: Do you have three copies for the record and a copy for the Board and everybody else?

MR. NORTON: I'm sure we have sufficient copies. I wouldn't dare do otherwise.

MRS. BOWERS: Would it be helpful if it were physically inserted? No, that would call for 30 copies in the transcript.

MR. NORTON: We could make 30 and perhaps give them to Mr. Bloom, and he can insert them in the transcript. And it might be a good place because when Dr. Smith starts after this testimony he too will be talking in those times.

It just makes it a lot easier if something is available to tie down.

MRS. BOWERS: Well, let me check.

Any objection, Mr. Fleischaker?

mpb11

MR. FLEISCHAKER: No.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No.

MRS. BOWERS: Well, the document that you described, then, will be physically inserted in the transcript.

MR. NORTON: Perhaps it could be physically inserted as the last page of today's transcript. That way it could be easy to find for people, and that way we'd have time to get the sufficient copies to Mr. Bloom.

MRS. BOWERS: Fine.

BY MR. FLEISCHAKER:

Q Let me move on to the next family of features.

Would you identify those instances where you have interpreted sea floor features as differential erosion?

A (Witness Willingham) There are a number of those features along the coastline adjacent to Point Buchon.

Q Can you identify those? How many of those are there?

A Numerically I would have no idea, now, without going back to the FSAR and tediously counting them all.

Could you clarify that?

Q Well, let me ask you this:

In any of those cases where you interpreted the sea floor -- some sea floor feature as differential erosion,

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did you have any questions as to whether there was faulting, and in how many cases did you have questions as to whether there might be faulting involved?

A Well, if we interpreted them as differential erosion, then we didn't have too much of a question.

Q No question at all.

A I hesitate to say no question at all because if you have a displacement and a fault beneath it, then you could have.

Q Okay.

Let me move on to the third category.

In how many instances have you interpreted faulting to penetrate into the post-Wisconsonian sediments?

A In which areas?

Q In the --

A Referring to Plate 2W?

Q Yes, I'm referring to Plate 2W.

3D agbl

A I don't recall any areas on this particular plate where we have interpreted faulting to disrupt the post-Wisconsin.

MR. NORTON: Excuse me, Mrs. Bowers.

I don't know where we're going with this because, if it has been once on a fault it can obviously happen again, so you only have to find it once, it's been found a couple of times.

I just don't understand where all of this goes. We've literally spent now a couple of hours -- you found it once, that means -- it's got legal meaning. That's why we're here.

Maybe Mr. Fleischaker is going to have a witness come in and say, Aha, we found it again. But that doesn't mean anything, as I understand it. We're just grinding this thing into the dirt.

MRS. BOWERS: Mr. Fleischaker, can you tell us where you're going?

MR. FLEISCHAKER: Yes, it seems to me that an awful lot of the Applicant's case rests on the conclusions that they've drawn from their seismic reflection profiles, namely, their conclusions that there's only minor displacement and that permits them to say something about the magnitude or the probability that large events have occurred offshore on the Hosgri Fault, and also it permits them to date. So

agb2

they have drawn conclusions both with respect to likely size of events that have occurred and a date.

And I'm examining the data upon which they draw those conclusions, and that data is primarily seismic reflection profile analysis.

BY MR. FLEISCHAKER:

Q Your answer was that you have -- that there is no evidence, you have no interpretations in this map of Plate 2N of faults penetrating into the post-Wisconsinian sediments?

A (Witness Willingham) There is no place on this map where, in my judgment, we have a situation similar to those that we examined previously on Plate 2 where the post-Wisconsin unconformity has been disrupted but not the sea floor.

Q Well I don't want to limit the inquiry to those instances where you have a penetration of the post-Wisconsinian sediments up to sea floor disruptions.

A Okay, I'm sorry, I don't want to seem evasive at all, there's just so much information that we're being asked to drag out right now that it's difficult to instantaneously recall six years' worth of work, and so I have to very methodically and carefully go through and try to answer your specific questions as best I can.

If you'd care to elaborate, I'd be happy to answer.

agb3

Q Well let me reask the question.

The question is, with respect to Plate 2 here, Plate 2K, in how many instances have you interpreted faults to penetrate into the post-Wisconsinian sediments?

A None.

Q Okay.

A Again, in terms of the discussions that we previously had where we had clear-cut disruption of the post-Wisconsin in Plate 2.

Q Well are you specifically recalling any instances where you may have inferred a fault penetrating? I mean, is there anything specific in your mind?

A No, the reason I'm putting the qualifier on is not because I have something in my mind that your words didn't quite match, I'm just trying to be very explicit as to what I am answering so that it does not appear that I'm contradicting myself later on.

MRS. BOWERS: Well it appears to me that I'm hearing the same question and the same answer over and over.

Now it may be that you're dealing with different plates, different maps or different areas.

WITNESS WILLINGHAM: Am I permitted to agree with that?

(Laughter.)

MR. PLEISCHAKER: I just wanted to make sure we

agb4

had a meeting of the minds.

MR. NORTON: We may all be here long enough to see the Big Bang and the Garlock.

(Laughter.)

BY MR. FLEISCHAKER:

Q Let me direct your attention to Figure 11, Appendix 2.5(e). I think that's in your testimony.

MR. NORTON: May I ask if that's the one we put up on the screen this morning with the slide?

MR FLEISCHAKER: That's correct.

WITNESS WILLINGHAM: It's Figure 45 in the testimony.

MR. FLEISCHAKER: Figure 45, right.

BY MR. FLEISCHAKER:

Q Have you, in referring again here to the SER, Supplement 4, CS, I note the USGS has given that a different interpretation from yours.

A (Witness Willingham) Yes, they have.

Q Okay.

What is the USGS interpretation of that?

A I believe they interpret that as showing a sea floor displacement -- not sea floor displacement but, rather, a post-Wisconsin displacement, a displacement of the post-Wisconsin deformity.

Could you give us the page of the SER?

agb5

Q C5.

Did you discuss this with the USGS, the particular interpretation?

A It's rather vague in my mind, but it seems to me I recall discussing this one with Holly Wagner.

Q Are there any other instances where you've had discussions with USGS where they have interpreted a profile to display either sea floor displacement or penetration into the post-Wisconsinian sedi ents where you've disagreed with USGS?

A Yes, there were several.

Q Several.

Can you identify those instances of differences of opinion?

A I can really not specifically recall. Actually, Mr. Hamilton was more involved in that phase of the interpretation than I was.

Q Mr. Hamilton, can you recall -- let me be specific now -- can you recall those instances where USGS interpreted a profile as revealing a fault in the sea floor surface and you disagreed?

A (Witness Hamilton) I can't at this time remember the USGS having specified any faults in this region as offsetting the sea floor.

Q Now, can you identify specifically those profiles

agb6

in which the USGS interpreted faults to penetrate to the post-Wisconsinian sediments and you disagreed?

A When you say "penetrate to the Wisconsinian sediments," most of the faults in the area do that, that is, those of the older rocks extend up to the unconformity at the base of the post-Wisconsinian section. And that's more a matter of structural interpretation without the implication of age. So in some cases, the USGS structural interpretation has differed somewhat from ours.

Q I'm talking about penetration through that unconformity and into the sediments.

A I see.

I would have to review a report that was prepared by Holly Wagner in 1974. I remember that he made some interpretations and it's my impression, at this point, that we didn't agree with all those interpretations as to the post-Wisconsin age implications of faulting, but I can't recall that without examining the report.

Q So there are instances where you disagreed with USGS regarding faulting into the sediments?

A It's my present recollection that there were some instances, aside from the one that we've just been discussing represented on Figure 45.

MR. NORTON: Excuse me, Mrs. Bowers, again I would like to have this question, this line of questioning

agb7

put in a proper framework. This goes back to perhaps disagreements that have been clarified by later work done by both USGS and others in profiling. And I'm not sure whether Mr. Fleischaker's question is intended to cover up to the present or was limited to the disagreements in 1974.

The only reason I say that is, I have some vague recollection that many of those disagreements disappeared with further data collection later.

BY MR. FLEISCHAKER:

Q Do you have disagreements that continue to the present with USGS interpreters?

A (Witness Hamilton) I've not been aware of a detailed report that includes illustrations of seismic profiles having been issued subsequent to the one that Holly Wagner did in 1974.

That report was issued in late summer of fall of '74, and it has not been either withdrawn or modified to my knowledge, nor am I aware of its having been supplemented by any other interpretations in the same area.

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Q And that report has conclusions that are different from the one that you've drawn. Is that correct?

A My recollection is that there were some differences in relatively minor details. It does not, to my recollection again, present a substantially different picture of either the distribution of faults nor of the recency of tectonic activity on those faults, or of recent breakage, let's say.

Some of the details in that report differ from the details of interpretation that we have made but the overall conclusion I believe that one would draw from that report is the same that one would draw from our conclusions.

c11

Q You and the USGS have the same conclusion that the Hosgri should be designated as capable of a 7.5 magnitude event?

A That conclusion is not stated in that report. That's an altogether different conclusion, and that really is a seismologic conclusion.

My own conclusion would relate more to the amount of surface displacement that might be expected in a episode of fault movement on the Hosgri Fault in the present tectonic environment.

Q Do currents, strong currents, tend to eradicate the evidence of surface floor displacement?

A I think there are circumstances in which currents might locally either create additional deposition over a

eb2

small offset or they might create an erosional effect and tend to remove a small offset in a local area.

Q In the course of these studies did you get any measurements as to the currents in the region of interest, the region of study here?

A We know that there are some local current effects because we've seen records of some very local scouring in the soft deposits, for example in Estero Bay. We don't have any direct bottom current measurements.

On the other hand we have an indication of their general effect in this area from the chanenors with which various kinds of sea floor expressions, either of differential erosion during the Post-Wisconsin and return of sea level, or difference in erosion just because the changes

542 of resistance in the rocks are preserved.

So I think from that we are able to say with some confidence that there is not a wide-spread current effect in changing the sea floor morphology once it is at the depth that the Hosgri Fault, for example, is submerged below sea level now.

Q Well, let me ask you what tends to be the-- Strike that. Let me ask you a different question.

Do large, significant storms -- I'm talking about ones that are 200-year storms -- tend to eradicate sea floor displacement?

eb3

MR. NORTON: Excuse me. May we have a limit as to location? Are we talking about 20 feet off the shoreline? Are we talking about 10 miles out to sea? May we have a location as to that question?

MR. FLEISCHAKER: Well, the question --

MRS. BOWERS: While this interruption has happened, I wonder, Mr. Norton, if one of your people will be so kind as to check with the Inn and see if things can be left here over the weekend.

MR. NORTON: I believe we had this reserved over the weekend, but we'll check.

MRS. BOWERS: Well, I know we arranged for Saturdays but not Sundays.

MR. NORTON: We'll check.

Excuse me.

WITNESS HAMILTON: Am I correct in recalling the question as being would large storms create effects that would tend to obliterate sea floor features?

MR. FLEISCHAKER: That's correct.

MR. NORTON: Excuse me, Mrs. Bowers. Did we have a ruling on my objection, that we don't have any distance parameters? You know, how deep is the water? I don't know if it makes any difference but --

WITNESS HAMILTON: I was actually going to specify to my understanding or lack of it on that issue.

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First I would like to state that I'm not an expert in oceanography and so I can't speak with confidence in what the general experience in either depth of storm wave erosion or what the theoretical basis for sub-sea currents might be.

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In this case I think it is safe to say from kind of an empirical or observational viewpoint that the effects in several hundred feet depths of water are going to be rather small. And it's our experience in looking at the sharpness of preservation of features in the exposed sea floor area around where the Rosgri Fault trace is, to say that we have not had substantial effects either from large storm waves or apparently any other kind of sub-sea current or erosive agencies.

MR. FLEISCHAKER: I think we're finished with the maps. We can fold them up.

MRS. BOWERS: Mr. Fleischaker suggested we take a few minutes' break while the papers are being collected.

(Brief recess.)

MRS. BOWERS: Are we ready to proceed?

BY MR. FLEISCHAKER:

Q Let me turn back to page 4418 of the transcript and ask you, Dr. Jahns, in response to a question by Mr. Norton which is:

"Could you tell us, Dr. Jahns, what conclusions you would draw?"

eb5

You say:

"First, the Hosgri Fault, in terms of the criteria which most geologists would use in defining a fault, is about 145 kilometers long."

Do you have an opinion as to what the maximum earthquake is that one could expect to see on a strike-slip fault 145 kilometers long?

MR. NORTON: I object. Is this a hypothetical question as to any strike-slip fault in the world 145 kilometers long, or is this a site-specific question as to the Hosgri Fault?

BY MR. FLEISCHAKER:

Q Let's just take a strike-slip fault on the plate boundary between the Pacific Plate and the North American Plate. Do you have an opinion as to what kind of maximum earthquake one could expect to see?

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MR. NORTON: Same objection. Again the testimony was very clear that it depends where in the system you're talking about. If we want a site specific, I have no objection whatsoever. But otherwise I object to the question.

MRS. BOWERS: Mr. Fleischaker, do you have any objection to being more specific?

MR. FLEISCHAKER: Let me ask a different question.

BY MR. FLEISCHAKER:

Q Dr. Jahns, are you aware, or do you have knowledge of correlations that have been done between magnitude and fault length for strike-slip faults?

A (Witness Jahns) Yes, I do.

Q Of what correlations are you aware?

A Well the classic series is the one by Bonilla and Buchanon-Banks of the U.S. Geological Survey. They have had several passes at compiling information for both strike-slip and predominantly dip-slip faults in which they attempt to make empirical correlations between fault length and magnitude and between rupture length for a given earthquake and it's magnitude.

Q And what's the data base that they're drawing from there?

A Very carefully analyzed records.

By analysis in this instance I mean not merely casual reading of the literature, but a very serious attempt

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to evaluate the data themselves. In other words, what they've been trying to do is establish some fundamental relationships to which referral can be made in appraisals.

Q How large is the data? Do you have any knowledge of how large the data base is in terms of earthquakes for strike-slip faults that is utilized by Bonilla, Buchanon-Banks?

A I couldn't give you the exact number of data points, but the total number is rather impressive. Not merely as many as all of us would like, but impressive nonetheless. I know I, for one, had not realized how many reasonably well documented cases there have been.

Q Do you view the conclusions that one can draw from these correlations, do you view them as being reasonably useful?

A Under some circumstances, yes. I suppose, ideally, one would like to see a clustering of the plotted points along a line of some kind, so one could examine fault length and read off with confidence directly expectable earthquake magnitude.

Unfortunately, the data plots look very much like the pattern one would get from shooting a shotgun against the wall of a garage, the scatter is considerable.

Q Have Buchanon and Banks done a main correlation?

A Yes, things of that kind have been attempted.

agb3

Q I think I used the wrong term, a regression analysis. I know what you mean, yes, regression analysis.

An alternative approach, of course, is to envelope all of the data and take a maximum, in order to be very conservative, to take something at the margin of the envelope.

This becomes very awkward -- this is addressed to your question about usefulness -- when one approaches a given problem from one direction with an input of magnitude, for example, to predict rupture length or something of that sort, and then approaches it from the other direction trying to get magnitude from one of the other parameters.

And because one is enveloping something that's really a great big area of a plot, the results are crazy and leads you to the tentative conclusion that the whole works isn't worth doing.

Q Is that a short way of saying that there is uncertainty in the conclusions you can draw from that regression analysis?

A One could include that, yes, because there is a tremendous spread in the data.

3F wb1

Q Do you have any recollection as to the -- as to what kind of magnitude the Buchanan and Banks regression analysis would lead you to expect on average, given a 145 kilometer strike-slip fault?

MR. NORTON: Excuse me; I object, Mrs. Bower. We have no foundation here whatsoever to draw such a conclusion from that report. Again, we are not being site specific. There has been no foundation by this witness that he agrees with an answer from that report -- which I have no idea what it is; that he agrees that it applies to the Hosgri Fault, or that he agrees that you can apply it to a 145-Km length fault without further foundation of identifying where you're talking about the fault being.

It's the same objection to the original question. The past questions have not added to the foundation in any way.

MR. FLEISCHAKER: That objection I don't think is well taken. Dr. Jahns may have an opinion as to why the conclusions you would draw from this correlation may or may not be applicable to the Hosgri Fault. But Dr. Jahns has testified that there has been a correlation between -- that these researchers have drawn between fault length and magnitude. The earthquakes are from strike-slip fault, the same kind as the Hosgri.

And, in addition, the data base apparently is

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substantial.

What I am seeking right now is whether Dr.Jahns is aware of what the mean value would be, given a 145-Km fault for the magnitude one could expect on a strike-slip fault if one were to consult the Bonilla, Buchanan-Banks regression analysis. It seems to me that's a perfectly legitimate question.

Now if Mr. Norton wants to refine that, or wants to discredit it, wants to say it's not applicable, he has plenty of time on redirect to do that.

MRS. BOWERS: Well, Mr. Fleischaker, are you avoiding naming this the Hosgri Fault for a specific reason?

MR. FLEISCHAKER: The whole point of this is that you're trying -- the point of doing these kinds of analyses is that it is oftentimes difficult to predict for a specific fault the maximum earthquake you can expect. So what you do, you consult a data set, a large data set, and you say: on the average if we had 15 faults of a strike-slip nature 145 Km long, or whatever, we could expect to see an earthquake of this size. That's the kind of analysis that's been performed by Buchanan and Banks. Buchanan and Banks haven't analyzed the Hosgri Fault; they've given a regression analysis which relates to a large worldwide data base of strike-slip faults primarily, of different lengths.

MR. NORTON: Mrs. Bowers, Mr. Fleischaker has

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just stated my objection very well. They have not studied the Hosgri Fault. They're talking about a hypothetical fault out there in the middle of noplace. And that makes it not relevant to those proceedings. There's no foundation for this question. We're here to discuss the Hosgri Fault.

Now if there's a specific fault that can be related that they want to ask Mr. Jahns about and compare and say, Yes, that fault is just like the Hosgri, and ask Mr. Jahns if that isn't true -- or Dr. Jahns, that's fine. But we have some hypothetical fault now suddenly, and there's no foundation for it, and it's not relevant.

MR. FLEISCHAKER: Apparently it was relevant enough, Mrs. Bowers, for the USGS to cite in their appendix, Appendix C to Supplement 4. They felt that the correlation analysis that had been done by Bonilla and Buchanan was sufficiently relevant to the conclusions that they were drawing concerning the maximum earthquake potential of the Hosgri to cite that reference specifically in Appendix C to Supplement 4.

MRS. BOWERS: Mr. Tourtellotte, would you care to comment?

MR. TOURTELLOTTE: I was going to add that I think we've been through this business on hypothetical questions before. And the Appeal Board has spoken on it. There must be a relationship between the facts in evidence and

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the hypothetical question that is asked: that's the simple legal rule. It doesn't seem to me that thattrelationship has been made here yet.

While I understand Mr. Fleischaker's comment about making some reference to some Bonilla report in the SER it seems to me that that's a question he would want to ask of the USGS. Because we don't know why they made any reference to it, and whether they made reference to it because they relied upon it or whether they made reference to it just to show that that was something that they had read. And I think the proper people to ask those questions of are the USGS.

MR. FLEISCHAKER: Well the first thing is that there are two facts that are relevant, and they're the two most important facts in terms of this correlation.

The first fact that has been established is that we're talking about strike-slip fault, not thrust fault, not reverse fault. Strike-slip faults. That's the first fact.

The second fact is that we're talking about a fault 145 kilometers in length.

Both of those facts are directly applicable to the Hosgri. Given those two facts, the hypothetical is exactly on target. And the point of the kinds of studies by Buchanan and Banks and Bonilla, the point of those studies is, when we know fault length and when we know the motion, the

wb5

kind of motion we can expect, is there some correlation as to the kind of magnitude earthquake we can expect?

Now I'd also like to point out that, as to relevancy, on Page C-10 of the SER, it states:

> "Although we believe that the 1927 earthquake should be used to estimate the safe shutdown earthquake, fault length-magnitude relationships have also been considered."

So the USGS apparently thinks that those kinds of relationships are relevant, according to their own evaluation here.

It seems to me that they are relevant here. And if Dr. Jahns has knowledge about these correlations I ought to be able to ask him this kind of question.

MR. NORTON: Mrs. Bowers, excuse me; I'd like to terminate this.

I don't understand why he can't be asked if that relationship -- if that study has any relationship to the Hosgri Fault; and, if so, what?

I don't know why we have to talk about some fault that we remove from the relevant tectonic site.

MRS. BOWERS: Dr. Martin informs me that you really are talking about a statistical concept.

DR. MARTIN: I suspect. I wanted to ask some questions to determine whether that's true.

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MR. NORTON: Excuse me, Dr. Norton; I'm also informed by Mr. Smith that that is his field of expertise. He's the seismologist, a witness on the next panel. And it's really his field of expertise, in any event. And it's probably better to be in front of him than Dr. Jahns.

But, go ahead; excuse me.

DR. MARTIN: Very well.

I still have a few questions, and I'd like to direct them to Dr. Jahns.

I believe a paper was mentioned by Buchanan and Banks. Is that the correct paper? Is this the one that deals with the correlation between fault length and earthquake magnitude?

WITNESS JAHNS: Bonilla and Buchanan-Banks. Buchanan-Banks is one person.

DR. MARTIN: I see.

Well I'm looking through the B's in your references cited, and I don't see anything that seems to correspond. Is that paper among your citations in your written testimony?

WITNESS JAHNS: I don't believe it is in the written testmony.

DR. MARTIN: Did you rely on it in drawing any of your conclusions?

WITNESS JAHNS: No.

DR. MARTIN: Then it seems to me that you're not

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the witness to be questioned about it.

It seems the point Mr. Fleischaker is trying to make is that some correlation has been established. And you feel it has been used to judge, or evaluate the Hosgri Fault. But the witness at hand has not relied on that relationship.

MRS. BOWERS: The objection is sustained.

MR. FLEISCHAKER: Just a technical thing: Is the question overruled because this witness isn't relying on it or because the question isn't relevant?

MR. NORTON: Mrs. Bowers, let me short circuit it.

Dr. Smith does cite that paper in his work. He'll going to be on the stand -- hopefully -- in the next couple of days. And he'll be glad to answer questions about it. It's his area of expertise.

MRS. BOWERS: There's nothing in the direct testimony that would show that this witness has relied on it or has expertise in the area. And we've been told the next witness does. So this is just not the proper witness.

MR. FLEISCHAKER: Very well.

End 3F

3g WRB/mpbl

So that I understand exactly where this 145 -- how you defined this 145 kilometers, before we move on to the next conclusion, can you find a figure in here where you could demonstrate how you've defined the extent of the Hosgri fault in terms of the 145 kilometers that you indicated here in your testimony?

A (Witness Jahns) Yes. One moment, please.

(Pause.)

c12

In response to your question, for a relatively simple presentation, I would call your attention to Figure 44 in the direct testimony. And in that figure the Hosgri fault zone is indicated as extending from points offshore south of the San Simeon area in a south-southeastward direction to a position at a general latitude not far from the northern boundary of the transition zone between the Coast Ranges and the Transverse Ranges provinces.

Then, for a somewhat more detailed presentation, I would refer you to Figure 29. On this figure the northwesterly end of the fault zone would be opposite and perhaps slightly north of San Simeon, and would extend in the southsoutheastward direction to the bend-like termination just north of the Transverse Ranges.

Q I'm sorry to belabor this, but I lost you here.

The reason is that I see the fault zone extending south down to -- down below Point Sal, and then I see

mpt2

this fault that curves around and comes in onshore.

Q that part of the Hosgri fault zone that you defined, the 145 kilometers? Does it end there?

A To which figure are you referring?

Q Figure 29.

A Okay.

On Figure 29 the Hosgri would extend in that south-southeastward direction beyond the Oceana Well for a distance of about an inch and a quarter on that figure, and would terminate offshore from the Purisima trend.

Q I see.

Just a little bit north of Point Sal?

A Yes.

Q Okay.

Now, the northwest part up here, can you tell me specifically where that ends, then?

A Well, as one traces the Hosgri zone north-northwestward it takes a somewhat northwesterly bend near the north end and and then appears to splay not too far from the western border of the map area. And one can note there a prominent solid line fault that terminates in a north-northwestward direction, and that might well be taken as that end of the Hosgri zone.

Q Is that just a little bit south of Cape San Martin that you're talking about, that solid line there?

mpb3

A Yes, that's correct.

MR. FLEISCHAKER: Mrs. Bowers, it's about two minutes until four. I thought we were going to quite at four.

I'm about to go into the last area of questioning, continuity, and the whole thing ties together, hopefully. And I was wondering if it would be just as convenient to quit now.

MR. NORTON: Excuse me, Mrs. Bowers.

You had a request to find out some information from the hotel about this area.

The note I have is that the Inn has no other commitments for this room for the duration of the hearings. The room will be locked, but we leave our materials at our own risk.

MRS. BOWERS: Mr. Fleischaker, Mr. Bloom tells me that we have two Intervenors' number 16 exhibits. The first is the location of the boundary of the Transition Zone with the ten mile boundaries approximated. The second is Appendix 2.5-A.

MR. FLEISCHAKER: The first one was marked as Intervenors' Exhibit and turned down after further discussion with Dr. Johns. We can leave that marked as an exhibit and recognize that it was turned down.

And we can mark -- I believe it was Plate 1,

mpb4

which was part of the Fugro data, and we can mark that as Exhibit 17 for clarification.

MRS. BOWERS: That will be better.

MR. FLEISCHAUER: Okay.

(Whereupon, the document previously marked Joint Intervenors Exhibit 16(E) was remarked as Joint Intervenors Exhibit 17 for identification.)

MRS. BOWERS: We're adjourned for the weekend.

(Whereupon, at 4:00 p.m., the hearing in the above-entitled matter was adjourned, to reconvene at 8:30 a.m., Monday, December 11, 1978.)

GEOLOGIC TIME SCALE

Relative Geologic Time			*Atomic Time
Era	Period	Epoch	
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3
	Tertiary	Pliocene	12
		Miocene	26
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous	Late Early	136
	Jurassic	Late Middle Early	190-195
	Triassic	Late Middle Early	225
Paleozoic	Permian	Late Early	280
	Carboniferous Systems — Pennsylvanian	Late Middle Early	
	Carboniferous Systems — Mississippian	Late Early	345
	Devonian	Late Middle Early	395
	Silurian	Late Middle Early	430-440
	Ordovician	Late Middle Early	500
	Cambrian	Late Middle Early	570
Precambrian			3,600+

*Estimated Ages of Time Boundaries (Millions of Years) USGS 4-1-69

FIGURE 3