

POOR ORIGINAL

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of:

PORTLAND GENERAL ELECTRIC COMPANY,
et al.

(Trojan Nuclear Plant)

Docket No. 50-344

(Control Building
Proceedings)

Hearing Room A,
State Capitol Building,
Salem, Oregon.

Friday, November 3, 1978.

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

BEFORE:

MARSHALL E. MILLER, Esq., Chairman,
Atomic Safety and Licensing Board.

DR. KENNETH A. M-COLLON, Member.

DR. HUGH C. PAXTON, Member.

APPEARANCES:

On behalf of Licensees:

ROLAND F. BANKS, Esq., Souther, Spaulding, Kinsey,
Williamson & Schwabe, Standard Plaza,
Portland, Oregon 97204.

MAURICE AXELRAD, Esq., Lowenstein, Hawman,
Reis and Axelrad, 1025 Connecticut Avenue,
Washington, D.C. 20036.

RONALD JOHNSON, Esq., Portland General Electric
Company, 121 S.W. Salmon Street, Portland,
Oregon.

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1 On behalf of Bonneville Power Administration:

2 WILLIAM KINSEY, Esq., 1002 N.E. HOLLADAY,
3 Portland, Oregon.

4 On behalf of the State of Oregon Department of Energy,
5 Oregon Public Utility Commissioner:

6 JOHN H. SOCOLOFSKY, Esq., Department of Justice,
7 State Office Building, Salem, Oregon.

8 On behalf of the Nuclear Regulatory Commission:

9 JOSEPH GRAY, Esq., Office of Executive Legal
10 Director, United States Nuclear Regulatory
11 Commission, Washington, D. C.

12 On behalf of Columbia Environmental Council,
13 Intervenor:

14 GREGORY KAFOURY, Esq., Kafoury & Hagen,
15 202 Oregon Pioneer Building, 320 S.W. Stark
16 Street, Portland, Oregon.

17 On behalf of Coalition for Safe Power, Intervenor,
18 and pro se:

19 EUGENE ROSOLIE, 3926 N.E. 12th Street,
20 Portland, Oregon.

21 On behalf of Consolidated Intervenor, and pro se:

22 NINA BELL, 2016 N.W. Everett, Portland, Oregon.
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C O N T E N T S

1				
2	<u>Witnesses</u>	<u>Direct</u>	<u>Board</u>	
3	Richard C. Anderson)	2332	2350	
4	William H. White)			
5	(Recalled)			
6	<u>Exhibits</u>		<u>Iden.</u>	<u>Evi.</u>
7	Lic. 19 Broehl ltr of 10/27/78 to NRC		2334	2336
8	Loc. 20 Broehl ltr of 11/2/78 to NRC		2335	2336
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P R O C E E D I N G S

CHAIRMAN MILLER: Good morning.

MR. KAPOURY: Good morning, Mr. Chairman.

CHAIRMAN MILLER: Any preliminary matters or are we ready to start?

MR. BANKS: Well, I suppose there's still a preliminary matter of this -- if Ms. Bell still wishes to present this matter of official notice as their evidence.

CHAIRMAN MILLER: Yes.

MS. BELL: I am withdrawing the section 7 which was attached; but I'm still interested in pursuing the Board taking official notice of Section 6 on earthquakes.

The name of the document from which Section 6 comes from is Risk Assessment Review, Group Report to the U.S. Nuclear Regulatory Commission, NUREG CR-0400. And the fact that I'm interested essentially in having the Board take official notice of is that there are differing opinions being presented on the use of -- well, the consideration of earthquake risk in nuclear power plants, and that is why I wanted to present this.

CHAIRMAN MILLER: Any objections?

MR. BANKS: Yes.

Mr. Chairman, there are a couple of them.

Number one, under the Official Notice section it would be our position that the only thing that could be

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1 noticed are facts; and it's our position that this Section 6
2 from this report -- which incidentally is an ad hoc committee
3 report, which I guess the Commission may always do this,
4 but inside the front page there's a disclaimer by the Commission
5 that any of the material herein states any position by the
6 Commission.

7 It's our position that the material in Section 6
8 as a whole is not a fact. It consists of opinions and con-
9 clusions which are not facts, and therefore should not be
10 subjected to official notice in this bulk offering.

11 If there is some particular fact in it that
12 she wishes to offer, that may be a different point.

13 Secondly, even if the Board were to grant that
14 this is subject to official notice, we would take the posi-
15 tion that it is not relevant. It goes into the seismology
16 question which has been already ruled as not a part of this
17 hearing.

18 It goes into matters which have already been
19 considered and already determined in the licensing procedure
20 of this plant.

21 CHAIRMAN MILLER: What is this section, part 2,
22 that refers to official notice? Do you have that?

23 MR. BANKS: I think it's 2.742.

24 MR. KAPOURY: Subsection I.

25 MR. BANKS: Subsection I?

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1 Yes, 2.743, Subsection I, Subpart 1. It
2 talks of technical and scientific facts within the knowledge
3 of the Commission as an expert body.

4 CHAIRMAN MILLER: What are the facts, Ms. Bell,
5 that you ask the Board to take official notice of, assuming
6 that you're proceeding under the official notice section?

7 MS. BELL: Well, essentially it's the fact that
8 this paper exists within the NRC, has been produced by people
9 who have been working for the NRC. It was prepared for the
10 NRC. And it's the fact that they are taking exception to
11 the way earthquake risk has been used in the past in deter-
12 mining the earthquake risk of nuclear power plants.

13 And it's the fact that there are differing
14 opinions is what I want to be included.

15 CHAIRMAN MILLER: Staff, what's your position
16 on this?

17 MR. GRAY: Mr. Chairman, we basically have the
18 same position as the Licensee, that official notice must be
19 taken of facts, not opinions. We can cite --

20 CHAIRMAN MILLER: Well, what is the status of
21 this document, NUREG CR-0400? Are you familiar with it? Who
22 put it out?

23 A NUREG it would seem has been put out by --

24 MR. GRAY: I believe it was put out with --

25 CHAIRMAN MILLER: A staff publication?

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MR. GRAY: With a consultant.

CHAIRMAN MILLER: With a consultant? I don't know. Wouldn't that be subject to official notice? We take official notice of our own files, records, and the like; why wouldn't this be part of it?

MR. GRAY: Mr. Chairman, reading Section 6, it looks like it's generally opinion here and not necessarily statements of fact. And I'd refer you to Niagara Mohawk Power Company. That's actually a licensing board position.

It indicates that official notice should only be taken of facts, and I think that comes from the plain language of the regulation here also.

CHAIRMAN MILLER: We're not talking about official notice now. I'm talking about the power of the Board to take cognizance of not only the records and files of a particular case, but I think of those of the Commission. I mean, that's a little broader than official in the sense of judicial notice.

Now that's been, I think, mentioned by the appeal board several times, hasn't it?

MR. GRAY: Yes, Mr. Chairman.

CHAIRMAN MILLER: Since it appears in the files of the Commission, it seems to be appropriate.

MR. GRAY: But then, Mr. Chairman, I believe we get into the question of extra record or off-record documents

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1 if it is going to be considered as evidence. That would be
2 statements that have not been tested under cross-examination.

3 CHAIRMAN MILLER: Well, that's true. That's why
4 it would be brought to your attention.

5 The statements of whom, though? How did they
6 get into NUREG if they're just musings? That's what disturbs
7 me. If it's NUREG, the Staff has obviously given it some
8 attention.

9 Are we going to disclaim all paternity of it
10 when we get to a hearing and we're asked to take notice of a
11 particular section?

12 I don't think it's a great issue, but I think
13 that the Staff did put on direct written testimony which
14 went into some aspects of seismic, even probability. Now
15 the fact that it was supposed to be based general knowledge
16 -- I suppose if you get into a meteorological question that
17 you wouldn't offer it based on the Old Farmers' Almanac or
18 something; it would have to be a little more solid than that.

19 This indicates that there's some thought and
20 some study, but not the official notice of facts because we
21 do agree with the objections to those.

22 MR. GRAY: I was going to suggest that if the
23 purpose of this is to take notice of the fact that there are
24 differing opinions, the Staff would have no objections for
25 that purpose.

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1 CHAIRMAN MILLER: Well, that's about the positio
2 the Board believes that you should taken, frankly.

3 Do you understand the ruling, Mr. Banks?

4 MR. BANKS: I think I understand -- well, let
5 me see if I understand.

6 MR. SOCOLOFSKY: Mr. Chairman?

7 CHAIRMAN MILLER: I'll recognize you.

8 MR. SOCOLOFSKY: Well, is this supposed to be
9 the testimony from some other case?

10 CHAIRMAN MILLER: No.

11 MR. SOCOLOFSKY: Just a report filed by the
12 Staff, or prepared by the Staff?

13 CHAIRMAN MILLER: We'll let the Staff explain it
14 It's a NUREG publication.

15 MR. GRAY: This is a NUREG publication, which
16 is actually the product of studies done for the Staff by
17 contracting agents. I believe this particular one was a
18 study which critiqued the WASH-1400 Reactor Safety Study, at
19 least in certain aspects of it. And it was published by the
20 Staff as a critique of that study.

21 It was done for the Staff through contracting
22 agents.

23 MR. SOCOLOFSKY: Was this -- when you say a
24 "NUREG publication" what do you mean?

25 MR. GRAY: A NUREG publication is actually a

mpb7 1 publication generally put out by the NRC Staff. Quite often
2 -- in some instances it contains regulatory guidance. But
3 they are put out by the Staff as part of its regulatory function in regulating power plants.
4

5 And quite often there are studies on various
6 aspects of interest for the operation and building and construction of nuclear reactors.
7

8 MR. SOCOLOFSKY: Do you mean that this type of
9 material is something that may or may not have actually
10 resulted in changing the regulations?

11 MR. GRAY: Ultimately I suppose that that's
12 possible.

13 MR. SOCOLOFSKY: And if they were to propose a
14 change in regulations, would the same notice be given that is
15 given in the other proposed regulations and opportunities for
16 comments?

17 MR. GRAY: In accordance with rulemakings, yes.
18 That's not to say, of course, that every NUREG
19 document has -- is aimed toward changing the regulations.

20 CHAIRMAN MILLER: Yes. Some do; they cover a
21 wide variety of matters. It's part of the ongoing information, obtaining and dispersing by the Staff, the Regulatory
22 Staff, and not tied to any particular case, Mr. Socolofsky.
23

24 MR. SOCOLOFSKY: It doesn't appear to me that
25 the document could be officially noticed for any purpose

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1 other than to establish the fact that the document was pub-
2 lished by the NRC, and that's about it. I don't think any
3 weight could be given to the document so far as establishing
4 any facts in this case.

5 MR. BANKS: That's kind of what --

6 CHAIRMAN MILLER: As far as establishment of
7 facts, yes. As far, however, as being the kind of background
8 information that the Staff used in the direct testimony of
9 one of its witnesses, it would be comparable; no greater, no
10 less. That's the basis.

11 MR. BANKS: Yes.

12 I understood the Chairman to say the Board was tak-
13 ing notice of the fact that the document exists, and that it
14 might have differing opinions in it, but was not taking
15 notice of the actual material in the exhibit or whatever it
16 is she's handed you as actual evidence, is that correct?

17 CHAIRMAN MILLER: Well, it's correct in a sense.

18 It's correct in the sense that we're not taking
19 official notice of the facts as we would if we were filing
20 an official notice section which is based upon judicial
21 notice; it will not have that effect.

22 On the other hand, it will constitute background
23 information of the same quality as that which was general
24 knowledge, or whatever it was, that the Staff used in its
25 direct testimony which also went into general knowledge,

mpbs 1 because they did not purport to make seismic studies --

2 MR. BANKS: I understand.

3 CHAIRMAN MILLER: And we feel it's a fair
4 counterpart and it will stand on the same basis.

5 MR. SOCOLOFSKY: Mr. Chairman?

6 CHAIRMAN MILLER: Yes.

7 MR. SOCOLOFSKY: If we assumed that this were
8 sworn testimony from another case by the Staff, even then
9 it would be inadmissible in this case except to impeach the
10 Staff on this or something similar.

11 CHAIRMAN MILLER: Well, that may well be. But
12 why didn't you move to strike that portion of the Staff's
13 direct testimony which offered no higher basis?

14 MR. SOCOLOFSKY: I'm just trying to establish
15 the weight that will be given to this.

16 CHAIRMAN MILLER: It will be given exactly the
17 same weight as the testimony and the direct written testimony
18 of the Staff witnesses who alluded several times to probabili-
19 ties of earthquakes and that kind of thing which was not based
20 on studies, as they said. I think, to be frank, I think
21 slight, if any, weight should be given to either; but I
22 think they should be comparable.

23 MR. SOCOLOFSKY: I see.

24 MR. KAFOUR: There's another separate issue,
25 Mr. Chairman.

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1 CHAIRMAN MILLER: Yes?

2 MR. KAFOURY: It might as well be raised at this
3 point.

4 CHAIRMAN MILLER: All right.

5 MR. KAFOURY: Counsel for the State of Oregon
6 a couple of days ago suggested that it was possible that since
7 there were questions raised by the STARDYNE analysis as to the
8 floor response spectra with regard to the control building,
9 that similar problems might possibly exist with the contain-
10 ment building which has safety equipment at least as import-
11 ant.

12 That issue has to some extent awaited further
13 consideration since then and at that time I made the comment
14 that it seemed to me that the Licensee had waived whatever
15 objections might otherwise have been proper to such an inquiry
16 because they had ventured into areas which made the issue
17 relevant. And I have located evidence of such waiver and
18 would like to point it out to the Board, that being in the
19 Licensee's testimony of the Bechtel witnesses. Appendix A,
20 reading Related Investigations, page 32 -- that's 32 of the
21 Testimony of the Bechtel witnesses, where at the bottom of the
22 page it reads:

23 "All other Trojan Category 1 structural
24 designs were investigated during the reevalua-
25 tion study to determine if similar design

mpb11 1 deficiencies existed that would in any way
2 affect the continued safe operation of this
3 facility. It was found that no problem
4 existed in other structures and that they
5 meet the requirements for seismic design."

6 It would seem to me that by voluntarily placing
7 that in the record, PGE has waived what objections they might
8 have to the Board inquiring further into the question of
9 whether or not there are floor response spectra issues with
10 regard to the equipment in the containment building. And I
11 would ask that the Board, since it is clearly a safety issue,
12 since it is relevant, and since objections, if any might
13 otherwise have been raised have been waived, I would ask that
14 the Board advise PGE that the Board would like to see evidence
15 on it at the next hearing so that the issue can be laid to
16 rest.

17 CHAIRMAN MILLER: Which issue is this, now.

18 MR. KAFOURY: The issue is the floor response
19 spectra with regard to the containment building.

20 CHAIRMAN MILLER: Well, why would -- unless that
21 is related to the issue of safe operation, interim or other-
22 wise, of the control building, why would it be relevant?

23 MR. KAFOURY: It's relevant to safe operation of
24 the plant, would be my first argument.

25 And the issue, by the May 26 order, which the Board

mpb12 is to consider, on page 9 of that Order reads as follows:

"The issues that may be raised within the scope of this Order are, one, whether interim operation prior to the modifications required by this Order should be permitted..."

CHAIRMAN MILLER: Yes.

MR. KAPOURY: So first I would think in any safety issues that arose during the course of the proceedings could be followed where it naturally led.

CHAIRMAN MILLER: Well, if it related to the control building, yes.

MR. KAPOURY: Well, since the standard is simply whether or not interim operation should be permitted, I read that to say all things considered, should it be permitted.

CHAIRMAN MILLER: I read it to say all things should be considered that relate to operation in the interim while modifications are being made, and, hence, are related to the modifications, the nature, the causes, and that kind of thing. It is not of the buildings necessarily.

MR. KAPOURY: If we assumed that that were in fact the case, nonetheless PGE has voluntarily placed in the record its evidence and assertion that all other Trojan Category 1 -- which includes the containment building --

"...structural designs were investigated during the reevaluation study to determine if

mpb13 1 similar design deficiencies existed that
2 would in any way affect the continued safe
3 operation of this facility."

4 CHAIRMAN MILLER: I would simply say immaterial
5 matters do not become material by reason of being injected by
6 any party. And your remedy is plain: move to strike that,
7 and I'll grant it.

8 MR. KAFOURY: I'll leave it in the record, thank
9 you, Mr. Chairman.

10 CHAIRMAN MILLER: We don't want to get into
11 immaterial matters, and I believe you're tending toward that
12 direction, Mr. Kafoury. Although there's no reason -- if
13 that's related we'll give you ample latitude.

14 MR. KAFOURY: Thank you, Mr. Chairman.

15 CHAIRMAN MILLER: Thank you.

16 Some of these matters may have a little more
17 body for us to consider as we get into this testimony too.
18 I think they would be a little more concrete.

19 Are you ready to proceed?

20 MR. BANKS: I have one more thing to bring up,
21 and then I am ready to proceed.

22 Since we are at this point -- I think we have
23 at least concluded those issues that we all thought we were
24 coming here for a month ago, and we still have remaining one
25 other matter to consider this morning and possibly later on,

mpb14

I would like to ask and request of the Chair that maybe we consider at this point the Chair's comments a week ago that at least as to the stage that we've now completed, that the parties present to the Board within the week referred to by the Chair -- or, say, a week from next Monday -- their proposed findings on the issues that we've now decided, so that during the interim of the delay that we have we can be expediting the actual decision of the Chair.

Everything has been decided now --

CHAIRMAN MILLER: Yes, we did intend to take that up. We did intend to take that up, Mr. Banks, at this time too.

We would like to request proposed findings of fact and conclusions of law upon those matters which are reasonably the subject of our evidentiary hearing to date. We would make that in the form of a request instead of an order, as we often do, because it might be a hardship to some of the pro se Intervenor.

We would hope that Mr. Rafoury, however, as Counsel, would be able to present proposed findings of fact and conclusions of law, as well as all other Counsel for the parties in the case. And if any of the Intervenor wish to we'd be happy to have them. We just didn't want to impose a burden that might be undue hardship at my point.

MR. ROSOLIE: Can I ask the Chairman a question?

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CHAIRMAN MILLER: Yes.

MR. ROSOLIE: Is the -- the burden would be I guess in doing that in seven days.

CHAIRMAN MILLER: Well, we're going to give 14 days, two weeks. We'll give two weeks from this coming Monday.

I'm mixed-up on what the dates are now. Is this the 3rd?

MR. AXELRAD: That would be the 20th.

CHAIRMAN MILLER: Say the 20th.

MR. GRAY: Mr. Chairman?

CHAIRMAN MILLER: Yes.

MR. GRAY: May I suggest that for appeal purposes there is some doubt as to the parties' ability to appeal if they do not file proposed findings --

CHAIRMAN MILLER: Yes. That's why I put it in the form of a request and not an order, so that it would not impair the status of any of the parties. And I had in mind the individual intervenors for appeal purposes.

MR. KAFURY: Mr. Chairman, would I have the PGE proposed findings of fact and conclusions of law some time prior to that as is contemplated by the statute?

CHAIRMAN MILLER: Well, I think that the order is discretionary.

We normally ask for simultaneous so that nobody has an edge either way, and you'll have the benefit of all the

mpb16 1 evidence. I mean, it's not like someone holds back on you.

2 And I will say now: remember you're going to
3 have the opportunity to file additional or supplemental when
4 we conclude the evidentiary portions, however, whenever that's
5 done. So you're not foreclosed either.

6 Say this covers two-thirds of the evidence in
7 the conclusions of law that you want; you will still have an
8 additional opportunity.

9 MR. BANKS: But that would be on the other
10 evidence, I assume.

11 CHAIRMAN MILLER: Yes.

12 Or insofar as this would be modified -- we don't
13 know the nature of the other evidence. If it did have an
14 impact upon in some way that we can't predict, we'd be fair
15 so that people get to say their say on the full record as
16 they see it.

17 MR. BANKS: All right. We'll be glad to comply.

18 CHAIRMAN MILLER: Is there anything further?

19 MR. ROSOLIE: Yes.

20 CHAIRMAN MILLER: Yes.

21 MR. ROSOLIE: A little clarification again.

22 It's my understanding -- and I've been giving
23 this some thought -- it seems to me that out of this hearing
24 the only thing that I could really file facts and findings
25 on is the -- probably the fact that whether or not the

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control building shear walls meet the SSE or the CBE.

CHAIRMAN MILLER: Well, you're getting into ultimate facts. I'm talking about evidentiary.

Findings of fact normally recite the facts as you understand them to be made up by the record. You're going to have a pile of transcripts. There's going to be some kind of facts. Your views of what they establish may be different.

And may I point out also that on this deferred matter, once upon a time there was no STARDYNE in this case, and so what we're asking you to do now is essentially to tally what you would have been doing had it not been for the STARDYNE matter which came about I think in August. So it's not really a new concept and it doesn't wipe out everything it may interact with.

But STARDYNE is a later development, and it is still evolving. But nevertheless there are substantial issues of fact, we believe you will find when you go through the transcript -- which is to say the direct testimony and the exhibits. And from your point of view you're going to be presenting I suppose one way; and from someone else's point of view it will be presented another.

MR. ROSOLIE: I guess the concern I had is that I didn't want to foreclose anything in the future.

CHAIRMAN MILLER: You're hardly foreclosed from

mpbl8 1 anything.

2 MR. KAFOURY: Mr. Chairman?

3 CHAIRMAN MILLER: Yes.

4 MR. KAFOURY: Is what remains today the inquiry
5 by the Board of the various witnesses of PGE on the floor
6 response spectra? Is that the remaining matter?

7 CHAIRMAN MILLER: Yes, it will be their testimony,
8 partly read and partly oral, I suppose, and then the Board's
9 questions which would be deemed to be of the same quality
10 or nature. So this -- it will be actually as though it were
11 written direct testimony when you get it from the transcript
12 on the portions covered.

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1 MR. KAFOURY: I'm wondering whether I might
2 be able to make a strategic retreat at this point, and rely
3 simply upon the transcript for my preparation for the later
4 hearing.
5

6 CHAIRMAN MILLER: Certainly you may.

7 Very well, anything further?

8 MR. GRAY: Mr. Chairman, there was one additional
9 item.

10 Yesterday, Dr. Paxton requested a reference.
11 This was to the Trifunac and Brady study on the correlation
12 of Modified Mercalli intensity with peak ground acceleration.
13 And we do have that reference.

14 CHAIRMAN MILLER: Very well. You may supply it.

15 MR. GRAY: It's in the Bulletin of the Seismological
16 Society of America, Volume 65, 1975. And it begins at
17 Page 139.

18 DR. PAXTON: Thank you very much.

19 CHAIRMAN MILLER: Thank you.

20 We'll take a short ten-minute recess. You may
21 get your witnesses together.

22 Thank you.

23 (Recess.)

24 MR. BANKS: Mr. Chairman, I asked Mr. Kafoury
25 to come back just briefly because I did not want to have him
not here if something else came up.

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1 And frankly, after the Board had an opportunity
2 to hear the testimony that we're going to put on now and
3 had an opportunity to ask questions, I had intended to discuss
4 with the Board the scheduling problem from here on in,
5 whether it be by deposition, whether it be by hearing,
6 whether possibly it could even be done under the quorum
7 rule. And I didn't think it was fair for Mr. Kafoury to be
8 leaving if I was going to bring that up.

9 CHAIRMAN MILLER: That's true. I'm glad you did.

10 Why don't we take that up now then so we can
11 cover it while Mr. Kafoury is here?

12 MR. KAFOURY: Thank you, Mr. Chairman.

13 MR. BANKS: Mr. Kafoury has indicated to me that,
14 for the purposes of any stipulations that might relate to
15 depositions, that all of the intervenors have agreed to
16 work through him on a consolidated basis.

17 CHAIRMAN MILLER: That's helpful, to have
18 centralized authority.

19 MR. BANKS: Up to this point -- And I know we
20 haven't discussed it with Mr. Kafoury because he was not
21 here when we discussed it yesterday evening or this morning
22 when I discussed it with Ms. Bell and Mr. Rosolia -- But up to
23 this point, we have not been able to come to any such agree-
24 ment. Maybe we will be able to next week.

25 But my client is very concerned, as I'm sure the

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1 Board is aware from the previous statements I've made, about
2 this five-week delay. And we would like to do anything we
3 can to shorten that, if possible. If we could work on a
4 deposition --

5 CHAIRMAN MILLER: If I may interrupt, for a
6 reason.

7 The first thing is to know when, if by now they're
8 going to have the studies, restudies, refinements -- you see,
9 this has been going on and going on.

10 And until we really know with precision and
11 finality when is D-day on that. We need, as an anchor point,
12 even to talk about --

13 MR. BANKS: I understand that.

14 And that's why I preferred to bring this up
15 after we made our presentation today and after you had had
16 a chance to talk to these gentlemen. Because I think every-
17 body, after the board has had an opportunity to question
18 these gentlemen, will have in more perspective exactly what
19 we're talking about, in the way of whatever problem might
20 exist.

21 We heard testimony yesterday from Mr. Herring
22 that there is no problem insofar as the equipment is concerned
23 that basically, if it is a problem, it's a problem with the
24 piping. These people have done a tremendous amount of work
25 in studying this.

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1 I think the Staff is becoming more and more --
2 I'm not speaking for the Staff, but I think they're becoming
3 more and more satisfied with the work that has been done.
4 And we really think the matter that we're going to see when
5 we get done today is a very limited matter.

6 CHAIRMAN MILLER: Well limited or not, my question
7 is one of finality.

8 MR. BANKS: I understand that.

9 CHAIRMAN MILLER: What do you have to say with
10 absolute assurance that it's final at that point or, if it
11 isn't, we're just going to reject any further consideration
12 of it. I mean, ironclad finality.

13 Now, what are you prepared to commit to? You
14 and the Staff are going to have to concur on this.

15 MR. BANKS: We're prepared to commit to presenting
16 our testimony today.

17 CHAIRMAN MILLER: In its totality with all refine-
18 ments and everything else that are going to be supplied,
19 according to your original statement?

20 MR. BANKS: According to -- I'm sorry?

21 CHAIRMAN MILLER: Well, whatever you filed last
22 Friday did refer to some small refinements.

23 MR. BANKS: That's all prepared and ready to be
24 submitted.

25 CHAIRMAN MILLER: In other words, you've got all

agb5

1 refinements, you're ready to go?

2 MR. BANKS: We're ready to go.

3 CHAIRMAN MILLER: And completed?

4 MR. BANKS: Yes.

5 CHAIRMAN MILLER: Staff, what about that?

6 MR. GRAY: The Staff is not ready to go and be
7 completed today.

8 CHAIRMAN MILLER: Can you give us a commitment?

9 Now, since some of these things are triggered by
10 further questions, we have to rely upon you, not only to give
11 us your best judgment, but if we're going to use this as
12 anchoring purposes for scheduling, then we've got to have an
13 absolute commitment.

14 MR. GRAY: I guess I'm not in a position to give
15 an absolute commitment at this time. Although it's quite
16 possible that next week, by means of written communication
17 to all parties, we may be able to do that.

18 CHAIRMAN MILLER: All right.

19 Then you can see how this bears upon our
20 scheduling.

21 MR. BANKS: I might add that the additional material
22 mentioned in the submittal last week is all covered in the
23 answers to those questions that we submitted a day or so
24 ago.

25 CHAIRMAN MILLER: Well like the marriage, it takes

agb6

two. And you may be the ardent groom but --

(Laughter.)

CHAIRMAN MILLER: -- the bride has just a few little questions yet.

MR. BANKS: I understand.

I've been discussing it with him, and we have -- and I understand what his situation is. But I have the feeling, as he has expressed it now, that they're about ready to present it. And I just -- I'm concerned about our people, as we will indicate, are prepared to do whatever modifications are going to be necessary from this testimony.

And, if the plant is found from all of these hearings to be truly safe for interim operation, of course, we're very concerned that we have an opportunity to get to that stage. We're getting into the area in this part of the country where power is an important thing, a very important thing.

CHAIRMAN MILLER: Well we consider all the issues raised by all the parties as important. We recognize that.

The Board is prepared, short of being able to schedule when it can't schedule, to give the utmost expeditious consideration consistent with a sound result, which is our charge from the Commission.

We were prepared to do so September 6th. In order to do so on September 6th, we had to unschedule other hearings

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1 we're engaged in which are just as important to those people
2 on all sides too. And we did that.

3 And you can very readily see that when you
4 unschedule and set aside time on a substantial basis, that
5 there is rescheduling someplace and obviously that rescheduling
6 somewhere is, largely, November.

7 In other words, they gave way for the September 6th
8 clearance that we gave to this case. Now we're going to do
9 the best we can and continue expeditiously.

10 But we cannot for the second or third time
11 tell people who are ready for trial also that, sorry, problems
12 have come up. We must be fair to all parties.

13 And that's the reason we've given you the
14 earliest date that we as a Board and the members thereof
15 can schedule it. That date was, I think -- what? -- December
16 12?

17 However, in other cases, we've done this. There
18 is no reason because there's no prejudice to anyone to pro-
19 ceed by way of liking it to deposition, liking it to direct
20 testimony, if you will, because all parties have the opportunity
21 to present full, whatever they want, make objections, have
22 everything noted.

23 The Board will then, as a Board, go over it page-
24 by-page, rule and so forth, just as though we were here.
25 So we don't really think anyone would be prejudiced technically

agb3

or otherwise by proceeding on that basis. It would also be a convenience, I think, to be scheduling these things at your mutual availability, documentation and that kind of thing.

So we suggest and we would encourage it if the parties could agree. Obviously, it requires the agreement of all the parties, though.

MR. BANKS: If we're not able to get the agreement of the parties, would there be any chance to proceed under the quorum rule with an earlier date than December 12?

CHAIRMAN MILLER: Well, a quorum of one is rather rough. The problems I have involved both myself and Dr. McCollum, substantially. And then there are additional matters which involved Dr. Paxton. So we operate on different Boards, you see.

MR. BANKS: I understand. I'm not familiar with the --

CHAIRMAN MILLER: We also have to schedule meetings that are imperative that we attend with the Commission, so that's pretty important to us.

What's the maximum guaranteed length of time it would take to go into these additional matters of whatever they may be.

Staff, Intervenor and whatnot -- and the Licensee, what minimum is it, one day, is it two days?

agb9

MR. BANKS: He'll be done, I think --

CHAIRMAN MILLER: No, no, I mean, on which we could complete, if the Board comes back. One that everyone could agree on --

MR. BANKS: I would think we would be able to do in it a day.

CHAIRMAN MILLER: What do the rest of the people think about it?

MR. KAFOURY: We're entirely unprepared to make any kind of a commitment, Mr. Chairman. Ms. Bell expects to have an expert witness highly knowledgeable in such matters. The Staff is ready to proceed at this point, the areas of uncertainty are enormous, I don't pretend to have even a small grasp of the issues involved. It seems highly technical and I would want to proceed with an expert holding my hand each step of the way -- to make a commitment on how long such a matter might take, or even how soon it could be initiated since the Staff is unwilling to make any kind of a commitment within a week even, is certainly beyond us at the moment.

I'll be available -- you know, I'm going to be in Portland, and any approaches that are made will be treated seriously. And that's as far as I'm prepared to go at the moment.

CHAIRMAN MILLER: The Staff?

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MR. GRAY: Mr. Chairman, I would certainly think, however, that it would not take on the order of a week. I would think it may range from one to three days.

CHAIRMAN MILLER: How about the State of Oregon?

MR. SOCOLOFSKY: We don't have any other testimony to present at the present time and we don't plan on having any.

One to three days seems like a reasonable estimate to me. And I wouldn't be taking up one to three days, myself, just probably a half an hour.

CHAIRMAN MILLER: Would there be additional testimony which, unless the Board uses its discretion, would require 15 days advance filing as direct written testimony?

MR. GRAY: The Staff would intend to have an additional short written testimony.

CHAIRMAN MILLER: So you see you are building 15 days and from whatever this happens already. You're not going to be far off in December just in the normal course of events, I'm afraid.

You say one to three days. You worried us a little bit. We were talking about Tuesday, weren't we, the 12th? We'd better make that Monday, the 11th of December. We're not going to get caught short on time.

If it goes three days -- and the estimates are necessarily a little coarse at this time -- we will reschedule

agb11

1 the hearing unless the parties can agree by proceeding by
2 stipulation or some type of agreed procedure. If they can,
3 fine, the parties can indicate their agreements, the stipulation
4 by a letter, we don't care how formal, providing they're all
5 in agreement. Short of that, then, we will reconvene our
6 evidentiary hearing on Monday, December 11th.

7 MR. KAFOURY: Thank you, Mr. Chairman.

8 CHAIRMAN MILLER: Don't forget the 15-day rule,
9 if it should apply to any of your testimony, Mr. Kafoury.

10 MR. KAFOURY: Yes, sir.

11 CHAIRMAN MILLER: And all parties.

12 You may proceed. Do you have your witnesses?

13 MR. BANKS: Yes.

14 I call Mr. Anderson and Dr. White.

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Whereupon,

RICHARD C. ANDERSON

and

WILLIAM H. WHITE

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

FURTHER DIRECT EXAMINATION

BY MR. BANKS:

Q Do you have before you, Mr. Anderson and Dr. White, the materials submitted with the letter of PGE of October 27th, 1978, referring to the floor response spectra?

A (Witness Anderson) Yes, we do.

A (Witness White) Yes.

Q And are you both personally familiar with that material as submitted?

A Yes.

A (Witness Anderson) Yes.

Q And did you participate and supervise the preparation of this material as submitted?

A (Chorus of Yes.)

Q And is the material as submitted true?

A (Chorus of Yes.)

Q And do you propose to present this along with certain other matters as your direct testimony on this

eb2

1 particular issue --

2 A (Chorus of Yes.)

3 Q -- as portions of your direct testimony?

4 Did others participate with you in connection
5 with the preparation of this material?

6 A (Chorus of Yes.)

7 Q Could you just briefly describe to what extent?

8 A (Witness Anderson) We had a team of people in
9 San Francisco working on this: a stress analyst, struc-
10 tural engineers, equipment specialists, people reviewing
11 the response spectra and the response of equipment.

12 Q And was there, in the process of preparation --
13 in the process of the preparation of this material and the
14 discussions that went on, was there any dissenting group or
15 dissenting opinions expressed insofar as this material is
16 concerned?

17 A No, there was not.

18 MR. BANKS: Mr. Chairman, I would like to have the
19 letter and the materials attached thereto, which have been
20 previously supplied to the Board and the parties, the letter
21 dated October 27th, 1976, marked as Licensees' Exhibit Number
22 19.

23 CHAIRMAN MILLER: It will be so marked.
24
25

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(Whereupon, the documents referred to were marked as Licensees' Exhibit 19 for identification.)

BY MR. BANKS:

Q Mr. Anderson and Dr. White, do you also have before you additional materials concerning this issue attached to a letter dated November 2nd, 1978, from Portland General Electric?

A (Witness Anderson) Yes, we do.

Q And did you again participate and supervise the preparation of this material?

A (Chorus of Yes.)

Q And again, was there input supplied or assistance supplied by others within the Bechtel group, or other in PGE insofar as the preparation of this material?

A (Witness Anderson) Yes, there was.

Q Will you describe in general what that participation was?

A This participation was by essentially the same team that worked on the earlier submittal, a team of structural engineers and stress analysts.

Q What is the status in connection with the dissenting situation on this material?

A There was no dissenting opinion on the preparation

ab4

1 of this material.

2 Q I should have asked you this about Exhibit 19. Do
3 you desire to make any corrections or additions to the
4 material contained in Exhibit 19?

5 A No.

6 MR. BANKS: I would ask that this November 2nd,
7 1978, letter and the materials attached, which have been
8 previously supplied to the Board and the parties, be marked
9 as Exhibit 20.

10 CHAIRMAN MILLER: It will be marked Exhibit 20.

11 (Whereupon, the documents
12 referred to were marked
13 as Licensees' Exhibit 20
14 for identification.)

15 BY MR. BANKS:

16 Q Do you desire to make any additions or corrections
17 to the materials contained in Exhibit 20?

18 A (Witness Anderson) No.

19 Q I think there's a typographical error. Would you
20 take a look at the response to Question 7? It's the second
21 page, which happens to be the last page in the exhibit, line
22 4. The first word is "los."

23 A (Witness White) It should be "low," l-o-w.

24 Q Thank you.

25 And do you likewise wish to adopt, as a portion of

NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PORTLAND GENERAL ELECTRIC COMPANY, et al.

(Trojan Nuclear Plant)

Docket No. 50-344

(Control Building Proceedings)

Place - Salem, Oregon

Date - 3 November 1978

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eb5 1 your direct testimony on this issue, the materials contained
2 in Exhibit 20?

3 A (Chorus of Yes.)

4 MR. BANKS: We would offer as a portion of the
5 direct testimony of these two witnesses on this issue Exhibits
6 19 and 20.

7 CHAIRMAN MILLER: Any objection?

8 (No response.)

9 Licensees' Exhibits 19 and 20 are admitted into
10 evidence.

11 (Licensees' Exhibits 19 and
12 20, having been previously
13 marked for identification,
14 were received in evidence.

15 BY MR. BANKS:

16 Q Mr. Anderson and Dr. White, could you explain in
17 general for the Board and the parties how these particular
18 exhibits and the materials in them happened to be developed,
19 and could you also explain in general for the Board and the
20 parties the significance of this material, and the matters to
21 which they are addressed?

22 A (Witness Anderson) I think I can give a brief
23 description of what is contained in these materials, and how
24 this information was developed. And then I would like to
25 call on Dr. White to explain, in a little more detail, how

eb6

1 the new response spectra was developed.

2 We have always considered the effect of any changes
3 in this building on equipment, piping, and electrical cable
4 trays. In the original re-evaluation in May, we looked at
5 the effect on equipment as would be brought about by the weight
6 reduction and the changes in stiffness in the building, and
7 we concluded at that time that there would be no effect on
8 previously qualified equipment, piping, and electrical systems.

9 Late in August, as you know, we completed the
10 STARDYNE analysis and the STARDYNE analysis, although it was
11 primarily developed to determine loads on the various parts
12 of the building, the STARDYNE analysis also allowed us to
13 look at other things, the effects on natural frequency
14 of the building.

15 We investigated as part of the STARDYNE analysis
16 work the effects of inelastic behavior and we have testified
17 that we do expect some inelastic behavior, we expect some
18 cracking, we expect some higher damping, we expect some
19 redistribution of load, we expect some you might say more
20 relaxation of the building. The building is less stiff;
21 it's more relaxed than we had originally thought it was.

22 And what this results in is a shift in frequency
23 to the left, a lower frequency of the building. If the
24 building is less rigid, it has a lower natural frequency.

25 And so we reviewed the equipment, piping, and

eb7

1 electrical cable trays against lower natural frequencies of
2 the building.

3 We also could run and did run the STARDYNE analysis
4 assuming that this inelastic behavior did not take place,
5 that the building remained in the elastic range, and that the
6 damping values that were specified and put into the STARDYNE
7 analysis were correct, a very low damping value of 5 percent,
8 and we ran the STARDYNE analysis as if the building, in a
9 very academic sense, remained strictly elastic.

10 Now if that happens then the natural frequencies
11 of the building shift to the right, or to the higher side
12 and they become higher.

13 And so we have developed then, after this analysis
14 work, new floor response spectra for each floor of the
15 auxiliary, control and fuel buildings in the north-south and
16 east-west directions that describe the buildings' behavior,
17 assuming that it is entirely in the elastic range and that
18 the damping remains at 5 percent.

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19 Now what this has done, it has given us a very
20 broad response spectra, a response spectra that has to be
21 broadened on the left side to accommodate lower frequencies,
22 natural frequencies of the building, and a response spectra
23 that has to be broadened on the right side to accommodate
24 higher frequencies of the building.

25 And we have taken that broadened response spectra

eb8

1 as developed for each floor of the building, and we have
2 reviewed the equipment, the piping, and the electrical cable
3 trays against that broadened -- those broadened response
4 spectra.

5 Now when we did this we found that this had very
6 little effect on equipment and we would expect that this kind
7 of a frequency shift would have very little effect on equip-
8 ment. Equipment is generally qualified in the rigid range;
9 it's qualified to very high frequencies. Equipment generally
10 has very high natural frequencies, and usually equipment is
11 qualified to accommodate many different plants and many
12 different seismic conditions. So it's generally qualified
13 above the response spectra that we are investigating here
14 and that we have here.

15 We have gone back and reviewed each piece of
16 equipment, including electrical equipment and mechanical
17 equipment, in these three buildings above elevation 45, above
18 the ground level where these changes take place, and we find
19 that the equipment still remains qualified, based on the
20 original qualification of the equipment.

21 We have also reviewed electrical cable trays and
22 generally cable trays are qualified to broad spectra, and
23 we have found that the cable trays also still remain
24 qualified to this broadened response spectra.

25 However, when we reviewed the piping, we find that

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1 the broadened spectra results in some piping systems that are
2 overstressed under these very conservative conditions. And
3 the conservatism is in a way compounded in the piping systems
4 because we are dealing not only with the building and the
5 conservative factors that have been built into the building
6 analysis involving the damping values and the more sophisti-
7 cated STARDYNE analysis and the widening of these response
8 spectra curves, but we also have a requirement in the FSAR
9 that states that piping systems must be evaluated based on
10 very low damping characteristics of a half a percent, .5
11 percent damping.

12 Now the latest Regulatory Guides indicate that
13 3 percent damping for large piping, over 12 inches, and 2
14 percent damping for smaller piping, under 12 inches, is
15 acceptable for newer plants. However, this commitment in the
16 FSAR was used to re-evaluate the piping systems, so we have
17 that additional factor of conservatism that we are using
18 very low damping values for the piping systems.

19 We have completed now this re-evaluation for the
20 piping systems and that is all piping that is above eleva-
21 tion 45 in this three-building complex, and we have found,
22 as we reported in the answer to Question 7 of Exhibit Number
23 20, that 18 additional restraints need to be added to the
24 piping systems as listed in that response.

25 Now we already have some 772 supports and restraint

eb10 1 in those systems, so this is, percentage-wise, a small addition
2 tion but nevertheless, it shows that 18 restraints need to
3 be added to these systems.

4 Now in addition to that we have re-evaluated the
5 loads on existing restraints and we find that some 65 of the
6 existing restraints need to have some minor modifications.
7 These modifications would involve maybe stiffening of the
8 support with a steel plate or an additional anchor bolt, or
9 something of that nature, to strengthen the existing supports
10 in the case of these 65 supports.

11 We have evaluated small piping, that is, 2 inches
12 and under, and we have determined that no additional work
13 needs to be done to the safe shutdown systems and the emergency
14 core cooling systems. However, there are some peripheral
15 systems, these room coolers that have been discussed,
16 that have copper pipe. They are kind of secondary systems
17 and we have to add some additional holddown clamps on that
18 small copper piping. I think it's in the range of 15 additional
19 holddown clamps.

20 So these are the results of these additional
21 studies and we are proceeding to install these additional
22 restraints and to make these modifications.

23 At this point I think I would like to call on
24 Dr. White to explain some of the processes used in determining
25 the new response spectra, and see if we can develop

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1 a better understanding and perspective as to what has gone
2 into the development of this additional work.

3 DR. MC COLLOM: Dr. White, when you do this, will
4 you be sure and carry us through step-by-step from back in
5 the very beginning and show what each one of those response
6 spectra is?

7 WITNESS WHITE: That's exactly what I have in mind,
8 to start from the very beginning and progress all the way
9 through to the point where we have essentially determined
10 the broadened response spectra that is shown in the report.

11 Okay. Along with that there are several figures
12 and that kind of information that is presented in these
13 two documents, Number 19 and Number 20, and I think that
14 by referring to these we'll be able to see exactly what
15 pieces we used in order to generate these response spectra.

16 Now the starting point in developing the floor
17 response spectra is the time history that you use to excite
18 the building. So Figure 1 in Document 19 shows the arti-
19 ficial time history that was used in the preparation of these
20 floor response spectra.

21 If you gentlemen have ever seen any acceleration
22 time histories from natural earthquakes, there's a very
23 definite difference between the time history from a natural
24 earthquake as opposed to what we have here.

25 Notice that there is strong motion, in other words

eb12 1 big acceleration peaks, going from about 2 seconds all the
2 way out to 20 seconds, so it's a very long duration of strong
3 motion. A natural time history does not show this duration
4 of strong motion.

5 Now the reason it's necessary in the synthetic
6 time history is to develop a response spectra from this time
7 history which envelopes the ground response spectra.

8 DR. MC COLLOM: The one that is already specified?

9 WITNESS WHITE: Already specified.

10 So that's the main function, the main acceptance
11 criteria for the usefulness of this time history.

12 Now Figure 4 in the same document shows, for
13 comparison purpose, these two response spectra. The smooth
14 line is the design response spectra. This is the one that
15 shows in the FSAR. And this is the 5 percent damping which
16 is consistent with what is being used for structural damping
17 for the SSE.

18 Now the jagged line is the response spectra of
19 the synthetic time history.

20 Now the important part of this response spectra
21 comparison is from, say, 4 cycles per second to higher
22 frequencies. This is where our structural frequencies are,
23 and the portion of the curve below the structural frequencies
24 is of little importance, so the important part is from 4 cps
25 on to higher frequencies.

eb13 1 Notice that the response spectra from the time
2 history is always above the design response spectra, and in
3 many frequencies, above quite a bit. This is our first level
4 of conservatism.

5 DR. MC COLLOM: You say "always above," but there
6 are some places where it drops below.

7 WITNESS WHITE: Not of frequencies associated with
8 the structural frequency areas. In other words, if you go
9 from 4 cps into higher frequencies, there is no place where
10 it drops below the ground response spectra.

11 There are a couple of cases like at 1 cps and maybe
12 1.5 where it dips below a little bit, but there are no
13 structural responses in that area so it doesn't make any
14 difference one way or the other.

15 The important part is the portion of the response
16 spectra associated with the structural responses which is in
17 the 4 cps and higher area.

18 Okay. So I've gone through the necessary steps to
19 generate the synthetic time history whose response spectra
20 envelopes the ground response spectra. That takes us through
21 Figures 1 and 4.

22 Now we subject the finite element model to this
3.240 23 time history, sticking it at the bottom of the building and
24 this thing shakes. Now what we've done from that point,
25 if we turn to Figure 9, this shows a plan of a typical floor

eb14 1 of the three-building complex.

2 Now just for simplicity, I would like to talk
3 about the control building, although anything I say about
4 the control building was also done for the other two build-
5 ings, but just to narrow our attention a little bit here.

6 When the building is subjected to the ground
7 acceleration time history, the motion of the points in the
8 control building are determined. The five points that were
9 monitored are shown as Point 32, 26, 63, 69, and then the
10 one in the middle, 174. So while the building is shaking,
11 we actually determine the acceleration time history at these
12 individual points.

13 Now for each individual point like Point 32, we've
14 got the acceleration time history at that point so now we
15 determine the response spectra for that particular point.
16 And we will do that for every point on the structure where
17 we have a black dot.

18 So for the control building we are determining
19 the response spectra at the four corners and a typical point
20 in the middle of the slab.

21 So at this stage we have, for this particular
22 floor of the control building five different response
23 spectra, all different.

24 Now in order to determine the design floor res-
25 ponse spectra, we envelope all five of them and let me

eb15 1 explain the enveloping process.

2 We've got these five spectra. We laid these down
3 on a light table so you can see through all five of these
4 sheets, get them all lined up so it's the same scale, put
5 another sheet down on top of that, and then draw a line that
6 includes every point of all of these, so we have a single
7 response spectra model for this particular floor for this
8 particular building, which envelopes all five of these points,
9 the four corners-- The four corners were chosen so as to
10 include any effect of torsion, and then you throw in a point
11 in the middle, just to pick up another point that may show
12 something a little bit different than the other four points.

13 This is our second level of conservatism. The
14 design floor response spectra envelopes essentially every
15 motion on that particular floor.

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1 Now, this envelope curve is broadened to take
2 into account variations in mass and stiffness and this kind of
3 thing. Normally this is broadened plus or minus 10 percent.

4 Now, that takes us to Figure 11. And the solid
5 line represents the envelope of this elastic response
6 spectra. If we saw the raw spectra, it would be a bunch
7 of jagged lines. We have broadened it, smoothed it out,
8 so now this is another level of conservatism.

9 Now as I mentioned earlier, the solid line is
10 the response spectra associated with elastic behavior,
11 assuming that the thing remains uncracked. This gives us an
12 upper-bound on the frequency. The structure can't get any
13 stiffer than what we've got here, so we've got something
14 located on the high side.

15 Now, as we discussed last week, there is the
16 possibility of some stiffness decrease during an SSI event.
17 Now the dotted line or dashed line shown there in Figure 11
18 is a decrease in natural frequency due to this potential
19 decrease in stiffness. Now that broadens the curve to the
20 low frequency side, as Mr. Anderson mentioned earlier.

21 Now, the method, or the decrease in stiffness
22 is given back in Table 4. There it gives a wall was decreased
23 to 60 percent of its original stiffness, 50 percent of its
24 original stiffness, whatever, the whole thing is laid out
25 there as to the kinds of decreases considered. And basically,

agb2

1 the reduction factors were determined as a function of the
2 expected load level in these walls. So this is how the
3 second frequency was determined.

4 I might mention for the elastic system, the
5 frequency was 6.8. And by including the decrease in stiffness
6 the frequency dropped down to 4.9, so that's quite a reduction
7 in frequency.

8 Now you see on Figure 11, there's a third set
9 of curves or a third line. And this is a dot-dash line.
10 And this is a further widening of the curve to include
11 possible non-linear behavior.

12 Now when the non-linear behavior starts in,
13 there is also a decrease in peak acceleration, so this is
14 why the step stops at about seven g's, rather than going up
15 to approximately 10 g's associated with the elastic response.

16 Now, the final curve that we used for evaluation
17 of the equipment and the like is the solid line on the
18 high frequency side, the dashed line for that portion, and
19 then going to the dot-dash line. So this is what was used for
20 the equipment evaluation, piping evaluation and everything
21 else, a very conservative curve.

22 Now the other locations in the structure, the
23 rest of these figures, were developed on the exact same idea.

24 DR. PAXTON: How is the inelastic portion taken
25 into account?

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1 DR. WHITE: This was done using some methods
2 developed by Professor Newmark, which goes back to a ductility
3 kind of ratio, that kind of thing, and were developed along
4 those lines.

5 That gets us from, starting with the synthetic
6 time history, all the way through to the broadened design
7 floor response spectra that were used.

8 CHAIRMAN MILLER: Thank you, you may continue.

9 DR. WHITE: That's all I have at this time.

10 BY MR. BANKS:

11 Q The only thing further I wanted to ask -- and I
12 think you've covered this, but I just wanted to be sure:
13 In doing this, you assumed and used the 0.5 damping requirement
14 of the FSAR, is that correct?

15 A (Witness Anderson) Yes, we did.

16 Q But the present Reg. Guides would have allowed
17 a damping factor of, what, three?

18 A Three for the large piping and two for the
19 smaller piping.

20 Q So what you've done is, you have studied this on
21 an extremely conservative basis?

22 A Yes. The piping has been evaluated on a very
23 conservative basis. As you can see from the curve on
24 Figure 12, there is a great difference in accelerations
25 between 0.5 percent damping curve that has 10g as a peak

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1 and the five percent damping curve that has, oh, between
2 three and four g acceleration as the peak. Two percent
3 damping or three percent damping would be somewhere in
4 between somewhat proportionally to what has been represented
5 here.

6 MR. BANKS: I guess they're all yours.

7 EXAMINATION BY THE BOARD

8 BY DR. MC COLLOM:

9 Q I think I have a little problem in knowing all
10 the analyses that were made.

11 For instance, when you say -- let me take another
12 tack.

13 How many, and on what basis were the floor response
14 spectra made to investigate equipment behavior from the very
15 first of the design of this building until the present?
16 How many times, and on what bases were response spectra
17 created and then equipment investigated? I presume that
18 the first one is the STICK model?

19 A (Witness White) Right. The STICK model was the
20 first set of response spectra that were used. And, in the
21 error of May 5, May 24 submittals, the changes that were
22 considered at that time were the changes due to mass changes
23 and stiffness changes.

24 And those changes did not cause any change of the
25 response spectra that would be outside the broadened response

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1 spectra, so essentially everything that was qualified prior
2 to that time was still qualified.

3 Q And at that time you did make another response
4 spectra investigation, or you just reassured yourself that
5 the old response spectra was satisfactory?

6 A Yes, we reassured ourselves that the old spectra
7 was satisfactory.

8 Q So you've still only done one -- well, let me
9 ask a question about the STICK model and getting response
10 spectra. Did you have to have an acceleration time history
11 to do that?

12 A Yes.

13 Q All right.

14 I do not understand why we had to create another
15 one. Can you give me some help on that? You have now
16 created a new acceleration time history.

17 A The method of developing artificial time histories
18 in the 70-71 era was not advanced or progressed to the point
19 where it has today. So the original time history wasn't
20 nearly as good as this time history -- I wish I had some
21 figures to show the comparison.

22 It was not a good comparison between the time
23 history and the design response spectra. So we've made some
24 improvements as far as that's concerned.

25 Q And what is the effect of that change, of changing

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1 from the old time history to this new one?

2 A The old time history was much higher than the
3 design response spectra. This one provides a closer en-
4 velope, so there is some reduction in response, if you want
5 to look at it that way. Yet, as we have noticed, there is
6 still a generous envelope of this time history's response
7 spectra versus the design response spectra.

8 Q All right.

9 A I might mention that, since the 70-71 era,
10 this is the only regeneration of response spectra, starting
11 at the point of the time history at the base of the structure.

12 There were efforts to modify the existing
13 response spectra by including peaks associated with the
14 STARDYNE frequencies, but this is the first one where we
15 have gone back and rerun the finite element model to generate
16 response spectra.

17 Q Why did you do this? Why did you start back
18 and re-do it then, what was the reasoning that said we had
19 better do it again?

20 A We found that it was very difficult to modify
21 the existing or the response spectra from the STICK model,
22 we found it very difficult to modify those in a way that we
23 felt was conservative without being terribly conservative.

24 In other words, there are no readily available
25 techniques for doing what we wanted to do. And, as such, we

agb7

1 would have had to take a very conservative position. So this
2 gave us more realistic response spectra, even though these
3 themselves are still quite conservative.

4 MR. BANKS: May I ask a question on this while
5 we are on it?

6 Before making this study for the new response
7 spectra, you did talk to the Staff about it in order to
8 determine whether they thought this would be appropriate,
9 did you not?

10 WITNESS WHITE: Developing these time histories,
11 yes.

12 BY DR. MC COLLOM:

13 Q I presume they encouraged you to do it?

14 A (Witness White) Yes.

15 Q Was your statement about Figure 4 saying that
16 the important part is above four cycles per second, do you
17 have similar statements on the other important diagrams
18 previous to that, Figures 2 and 3?

19 A These response spectra here are for damping
20 values other than SSE conditions. In other words, one percent
21 is just shown for comparison purposes and would not be used
22 in any analysis at all.

23 Figure 3, this would be a response spectra
24 consistent with the CBE condition. And for the structural
25 frequencies, again, this is a satisfactory envelope of the

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1 response spectra from the artificial time history.

2 There is one extremely minute peak that goes
3 down below, and that is of no significance. And then at five
4 percent damping, a very conservative envelope.

5 Q And, again, you could say on this chart for the
6 OBE, that the pertinent frequencies are those at four cycles
7 per second and greater?

8 A Yes, on all of these.

9 Q Because of the building characteristics, the
10 modal characteristics.

11 A Right.

12 Q On Page Five of your testimony, Licensee's
13 Exhibit Number 19, you indicate that in the STARDYNE spectrum,
14 "the second spectral peak with lower magnitude, exists at
15 the second north-south mode frequency (9.49 cycles per second)
16 of the STARDYNE model. The original spectrum does not reveal
17 a corresponding second peak."

18 The original spectrum is what spectrum?

19 A That goes back to the 70-71 model.
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21
22
23
24
25

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1 Q Why did this exist in this model and it did not
2 in the one in '70 - '71?

3 A I think basically it gets back to the fact that
4 the three-building complex is a very difficult building
5 to model with a stick type model, and the finite element
6 system is a better representation of this over-all behavior.
7 And I think that this particular frequency was one that the
8 stick model was not capable of picking up.

9 Q Did the change in the time history input have any-
10 thing to do with this change?

11 A It would be very doubtful.

12 Q Do you have the Fourier amplitude spectrum of
13 the original time history?

14 A I don't.

15 Q Wouldn't that show you if it were a possible
16 product of the time history if you looked at the amplitudes
17 present in the Fourier spectrum and compared the two?

18 A It might show something.

19 I have seen the response spectra from the original
20 time history and I'm trying to remember if there was a peak
21 out in that area, and I don't recall, but there was no
22 Fourier spectra developed for the original time history.

23 Q When you say that the changes take place above
24 the ground level due to the broadened response spectra, are
25 you saying that there is some difference between the 15-foot

eb2 1 level and the 61-foot level in terms of changes having
2 occurred?

3 A Yes.

4 Q Will you elaborate on that?

5 A Okay.

6 What we're talking about here is response spectra
7 that are different from the ground response spectra. Now
8 if you have a piece of equipment-- And these differences are
9 viewed as structural amplification. If you had a piece of
10 equipment that was supported on the base slab elevation 45
11 which is at rock level, then the structural amplification
12 due to the building does not influence the equipment attached
13 directly to the base slab at all.

14 You can think of the building as a filter. You
15 have the time history coming in and the building filters
16 and amplifies some frequencies, decreases others, and at the
17 ground level, the building is not between the time history
18 and the piece of equipment that you're looking at. So this
19 is the reason that it doesn't reflect everything at ground
20 level or below ground level.

21 Q It's independent of whether the building is
22 there or not?

4.230 23 A Exactly.

24 A (Witness Anderson) I might add, Dr. McCollom,
25 that most of the safety system equipment in this three-buildin-

ab3 1 complex is located either at grade level, at 45, elevation
2 45, or in two basement floors in the auxiliary building and
3 that would not be affected then by any change in the response
4 spectra.

5 The piping that we're talking about here is piping
6 that is above that elevation, supported from parts of the
7 building above that elevation that would see some change.

8 Q To follow that up: If you're in the basement you
9 assume no amplification?

10 A (Witness White) Right.

11 Q Why is that?

12 A The way they constructed that was essentially
13 hollow out a hole in the rock and then the walls are poured
14 directly up against the rock, so for all intents and pur-
15 poses that entire rock mass is moving the same and the walls
16 have to follow along.

17 Q Will you turn to Figure 9 which shows where the
18 nodal points are on the 77-foot level for the response time
19 history output?

20 A Yes.

21 Q Why did you decide on the corners and one point
22 in the center as being typical or extremes or otherwise
23 of the variations that could occur?

24 A Okay. I'll go building by building or at least
25 look at the control building first.

eb4

1 As I mentioned earlier when we were going through
2 these particular points, any influence of torsion will be
3 maximized on the extremity of this floor slab. The slab
4 is fairly rigid and is forcing every point on that slab to
5 essentially move as a common unit. There is some in-plane
6 deformation but it is not terribly significant.

7 So to take the extreme case, a perfectly rigid
8 floor system, every point is moving back and forth and you
9 can decompose that motion into translation and a rotation.
10 The rotation is maximized the further you get away from the
11 rotational center. So this is why the selection of the points
12 on the extremity.

13 On the point in the middle, we probably could have
14 gotten by with only those four corners. I don't know of any
15 response spectra where the point at the middle controlled
16 any frequency range in developing the over-all envelope. It
17 may have, but by and large the corners are the ones that
18 control.

19 Q I think that we can go to Exhibit Number 20 shortly
20 and look at the individual nodes. Didn't you put them in a
21 table there?

22 A Let's see. We do have the individual accelerations
23 yes.

24 Q And we can find out then by looking at that.

25 A Right.

eb5

1 Q Before we go there --

2 A Now the same logic follows in the other buildings
3 as well, taking points at the extreme to maximize the in-
4 fluence of torsion and, in the auxiliary building, the slabs
5 are even thicker there. They are 2-1/2 to 3 feet thick, so
6 again the points on this floor you can break down into
7 essentially a translation at a location.

8 Q Just as curiosity, in the fuel building why did
9 you choose 241 and not the corner, which does not have a
10 node on it there? 241 of course is the corner of the auxi-
11 liary building but you did not choose the corner of the fuel
12 building. There is no node on that one corner of the fuel
13 building.

14 A I'm trying to remember if there is an opening in
15 the slab at that point.

16 Q There may be because if you look at the 23-foot
17 level, they did choose the node on that corner.

18 A I think there is some sort of local disruption
19 that keeps that floor slab from being continuous. It seemed
20 to me there is a fuel handling cask pit or something over
21 there that makes that an area where the floor slab is not
22 tied in.

23 And again at elevation 61, that corner is back.

24 Q Let's go to the table in Exhibit 20 which is
25 Table 3-1.

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1 A Yes.

2 Q Will you explain that table to us so that we know
3 what each heading is?

4 A Okay. This is a table of maximum accelerations
5 and starting from the left edge and moving across, first
6 is the building designation, followed by an elevation of
7 the floors within that building, and then the nodal points
8 on that particular floor level, and then some accelerations
9 broken down into north-south accelerations and east-west,
10 two columns for each direction, the first one being the
11 acceleration associated with the time history method of
12 analysis and the second one, an acceleration associated with
13 using the ground response spectra, the smoothed response
14 spectra as input.

15 So that's how these various numbers were deter-
16 mined.

17 Q The ground response spectra being the one that was
18 specified in the PSAR?

19 A Yes, and shown in Figure 4 -- no, not 4, but
20 Figure 9 I guess -- no, it is Figure 4.

21 Q Now then, if we compare Figure 8, which is the
22 61-foot level, and the node that is in the middle of the
23 floor is 151 --

24 A Yes.

25 Q -- and that is point 30, which is the smallest

eb7

1 one there, even though the corner, which is point 25, which
2 I think is a continuous slab right on through the auxiliary
3 building, too, --

4 A Right.

5 Q -- is as low as that is.

6 A Right.

7 Now let me explain a little bit more about this
8 particular elevation because it is one that has a peculiar
9 feature.

10 Notice in the floor designation at 61/65 the
11 northern third of this floor essentially is at elevation 65
12 so, like at nodal point 20, there is a 4-foot change in the
13 floor slab elevation. The slab is not continuous across
14 this entire plan view.

15 Now the reason for the increase in elevation
16 there is the train comes through this portion of the struc-
17 ture so you need a little extra clearance. And as you can
18 see, the accelerations on that upper level, given by points
19 61 and 91, are higher than the accelerations associated with
20 points 25, 97, and 151.

21 If that slab were continuous, we would not see
22 as much variation across that slab, but it isn't, and this
23 is at least a partial explanation as to why such a big
24 variation across the over-all slab, plus the fundamental
25 mode of this structure system is somewhat of a rotation

eb8

1 about the fuel building end.

2 So in general, the accelerations on the western
3 part of the structure are somewhat higher than ones to the
4 east of those points.

5 In general, that's the situation. There are a few
6 exceptions.

7 Q To go to Figure 10 in Exhibit 19 you'll find
8 point 189 in this case is the highest of the five, being
9 equal to one corner, but it is the highest.

10 A Right.

11 Q That doesn't quite fit with the simple model
12 that you suggested a while ago, that the highest point is
13 on the outside corners.

14 A Well, that's why we put one in the middle, just
15 to make sure that we haven't missed anything.

16 Q Now I think you're getting to my point. If that
17 one is higher, how do I know one halfway in between the two
18 might not even be higher?

19 A We can't say with absolute certainty that there
20 isn't a point on here someplace that does get a little bit
21 above the points that have been selected. But let's go back
22 to the over-all process that we use in order to generate the
23 design floor response spectra.

24 First, we determine the individual floor response
25 spectra that we have here, and then we envelope all five of

ab9 1 those, or however many there should happen to be.

2 Then, on top of that, we broadened this entire
3 response spectra so in order for the response of some addi-
4 tional point on this floor to peak out from under the
5 broadened response spectra is extremely unlikely with the
6 selection of these points.

7 Q All right.

8 Now accepting that fact, let's compare Table 3-1
9 that we're referring to here with Table 5 in Exhibit Number
10 19. I'm not sure that this has any particular validity to
11 Table Number 5. Can you tell me? I see the comparisons of
12 the specific points, the nodal points, and the time history
13 and the spectrum.

14 Does this just average all of those, or does it
15 take a maximum, or what? How did you get from the table
16 in Table 3-1 to Table 3-5?

17 A That is an average. Like at elevation 61, 65,
18 the 39 is the average of all those.

19 Q What does this table then tell you? What am I
20 supposed to judge from Table 5?

21 A Let me go back to why it was even put in at all.

22 When you make a time history analysis and response
23 spectra analysis, one of the natural things to do is to make
24 a comparison of the two analyses and see how they compare,
25 and that is an attempt to do that at this level.

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1 A more detailed comparison was made in Exhibit 20
2 in Table 3-1.

3 Q So if I want to compare and see how well they
4 compare, I really ought to look at Table 3-1 and not Table 37

5 A If you want to get down to point by point. Table
6 5 gives more of a global comparison; for a point by point com-
7 parison, then you do need Table 3-1.

8 Q As a matter of information, are you surprised or
9 not that they're so close together?

10 A The comparison isn't particularly surprising. I
11 wouldn't have been surprised if the time history solution
12 would have been perhaps a little bit higher, based on the
13 comparison of the response spectra going back to Figure 4
14 where we've got the response spectra from the time history
15 and the ground response spectra.

16 But this is typical of the kind of comparisons
17 that one finds going through this process.

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Q Do both of these have the conservatism we've been talking about built into them, or does just the time history acceleration, the so-called broadening of the --

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4

A If you use -- I'm not really clear. Do you want to give me the question again?

5

6

Q I think I'm trying to mix two things together that shouldn't be, and that's what I'm trying to get you to tell me.

7

8

9

We talked about the response spectrum curves for the control building and having broadened those curves.

10

11

A Right.

12

Q What relationship does this have?

13

A To the information in Table 5?

14

Q Right.

15

A None. I thought that's where we were.

16

Q Okay.

17

CHAIRMAN MILLER: We'll have a recess at this point.

18

(Recess.)

19

CHAIRMAN MILLER: Dr. McCollom.

20

DR. MC COLLOM: I concluded while I was out that that Table 3-1 is just to reassure us that we are in a realistic situation.

21

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23

BY DR. MC COLLOM:

24

Q Is that correct?

25

A (Witness White) Right.

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Q On page 3 of Exhibit 19, what is the implication under Paragraph C, the fourth line from the bottom where you say in the STARDINE program you use the La Place transform method, but no numerical damping is introduced.

A In the process of determining the response spectra you integrate from -- let me back up a minute.

The synthetic time-history is defined as acceleration versus time at discrete points. These discrete points are 1/100dth of a second apart, .01 seconds apart. So in the process of determining the response spectra for this particular time-history you integrate from one time step to another.

There are various numerical processes that do this kind of integration. Some have round-off error and this kind of thing, and this is a process that tends to eliminate or reduce this kind of round-off error and the numerical error introduced through the step-by-step integration process.

This is sometimes referred to as the exact method but that's more in quotes than anything else.

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Q Would you explain the stiffness reduction factors as you used them in Tables 11 through 14, and compare them and show what you did to respond to the Staff's question which resulted in Exhibit number 20, Figure 4-1 through 4-4?

A Okay.

Let's take a one-to-one comparison. If we

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1 compare Figure 11 in document number 19 and Figure 4-1 in
2 document 20, those are companion response spectra.

3 MR. BANKS: I'm not sure the record is going to
4 be right on that.

5 You're comparing Figure 11 in 20 with 4-1 in 19--
6 I mean Figure 11 in 19 with 4-1 in 20?

7 WITNESS WHITE: Right.

8 The difference between these two response spectra
9 is a little tiny corner between the broken line and that
10 dot-dash line at essentially four cps. Notice that in Figure
11 11 at four cps there's a little step or a shelf, where on
12 Figure 4-1 there is a transition rather than a step function,
13 so to speak.

14 Now the reason -- how that transition was develop-
15 ed is the lower level shown in Figure 11 is for a ductility
16 factor of 1.5. And the smooth transition goes from a ductil-
17 ity factor of 1, 1.1, 1.2, and that's how that was established.

18 BY DR. MC COLLOM:

19 Q If I look at that and say that's how it was
20 established, does that mean that I could have a fourth
21 column in the table?

22 Two pages earlier in that same document as
23 Figure 4.1 that has ductility ratio as one column, frequency
24 reduction factor in the next, and spectral peak reduction
25 factor in the next, can I have just a frequency column on

mpb3

1 that too? Is there a one-for-one relationship between where
2 the ductility ratio changed and the frequency?

3 A (Witness White) Let me explain how we go about
4 doing this.

5 The frequency that gets multiplied by the re-
6 duction factor, that would be the frequency at the upper
7 left-hand corner of the dashed line, which is approximately
8 5, it's like 4.9.

9 Q Now, I'm sorry -- where are you now?

10 A This is on Figure 11, Document 19.

11 Q Now would you go over that again?

12 A The frequency that is used as part of the
13 frequency reduction factor -- in order to use these frequency
14 reduction factors you have to have some frequency to multiply
15 by, okay? That frequency is the upper left-hand corner of
16 the dashed line, which is -- reading from the chart -- about
17 4.9 cps, okay?

18 Q All right.

19 A So now that's the frequency that we will use
20 as the starting point.

21 So if you multiply that by .95, this would be
22 the frequency associated with the ductility of 1.1. So,
23 take 4.9 multiplied by .95, now we have a frequency. And
24 then the spectral acceleration associated with that will
25 take the spectral acceleration of that upper corner, which

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1 is -- I don't know -- maybe 9.7, something like that, multi-
2 ply that by .91. It gives us another point.

3 So you just keep plotting these points, and that
4 will take you from the upper left-hand corner of the dashed
5 line to the upper left-hand corner of the dot-dashed line.

6 Q But you always use the frequency of 4.9 cycles
7 per second for each one of these multiplications, though?

8 A Right.

9 Q But that results in another frequency, and that's
10 the one you plot?

11 A That's correct.

12 Q And that gives you the slanted line.

13 A Right.

14 If we wanted to show the actual coordinates,
15 so to speak, of each of the additional points, we would need
16 the frequency, the new frequency and the new spectral acceler-
17 ation to have the coordinates of each of those points. But
18 that basic information is in that table.

19 Q Why is that -- or is that a more realistic
20 assumption than the one you used when you said it was 1.5?

21 A Showing the results from 1.5 only, here we're
22 characterizing the extreme case, and perhaps for completeness
23 the transition to close off that little pocket in there, it's
24 more conservative. If something were to fall in that pocket
25 and there was no transition --

mpb5 1 Q Is that why you said these revised response
2 spectra had no impact on the results of analyses is that
3 nothing fell into that little pocket?

4 A Right.

5 And even if it did the systems we're talking
6 about are not that sensitive; but we know of nothing that
7 falls in that pocket.

8 Q I believe that this is the time for you to tell
9 me, now that I know that -- Figure 11, I presume, is the one
10 that you have used in your actual analyses of the equipment,
11 or did you use the one that has been modified, like Figure
12 4.1?

13 I don't guess it matters, but I would like to
14 know which one you used to look at your equipment capability.
15 Both of them?

16 A I said earlier that we used Figure 11. For all
17 of them, I'm not sure what we did. We did use with one with
18 the slanted curve filled in there.

19 Q So that is the one you used to make your final
20 investigation?

21 A I take that back.

22 Q Should we have someone else up here who knows a
23 little more detail about this? Would this be helpful?

24 A I can confer with him, if that would help.

25 Q All right. Why don't you? And make sure of the
answer on it.

(Pause.)

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1 Figure 11 and those type figures were the ones
2 that were used in the evaluation for equipment, piping,
3 cable trains and the like.

4 In the piping analysis, they have gone back and
5 looked at whether or not a piping system has a frequency
6 that will fall into the pocket, and there are none, so it
7 won't have any impact on piping.

8 The electrical equipment, its frequencies are
9 on the high frequency side of this response spectra and,
10 as a result, will not be affected.

11 Cable trains are in the same situation as piping.
12 There isn't anything that falls in that particular pocket.

13 Q All right.

14 Now I'll go back to Figure 11. That is the
15 curve the outside envelope of which was used to look at the
16 qualifications of the equipment?

17 A Yes.

18 Q Would you describe for us in a qualitative way
19 how you go from this to a valuation of the equipment under
20 the steps that are undergone, we have now generated this
21 response curve?

22 A Okay. As far as the equipment is concerned, the
23 response spectra that was used for qualification of that
24 equipment, is compared with this curve.

25 Q Do you have another curve that says this is what

agb2

1 the response spectrum of that equipment is, each piece?

2 A In many cases, that's exactly what we have.

3 Q What happens in the other cases? You say in
4 many cases that you have this.

5 A I think for all the equipment supplied by
6 Westinghouse, we do have that kind of response spectra.

7 A (Witness Anderson) There are other pieces of
8 equipment that were qualified maybe on a generic basis for
9 a maximum acceleration, or there are pieces of equipment like
10 a large tank that actually has supports that have to be looked
11 at.

12 The original calculations are looked at and
13 checked against this kind of acceleration, the forces that
14 would result from this kind of acceleration at these
15 frequencies.

16 Q And whenever equipment is generically approved,
17 if you wish, for certain maximum accelerations, does frequency
18 enter into that same generic evaluation?

19 A It can if it was approved based on a response
20 spectra. If it was approved based on just a maximum
21 acceleration, then the frequency doesn't.

22 Q How does that fit, though?

23 If, say, a maximum acceleration -- Does that imply
24 that it doesn't matter what frequency that acceleration occurs
25 at?

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1 A (Witness White) Let's say we qualify the piece
2 of equipment to 20 g's, for instance. And some little pieces
3 of gear, you know, could take that very easily.

4 And the highest -- that would be a response spectra
5 essentially a horizontal line right across at all frequencies,
6 at 20 g's.

7 Now you compare that with the input response spectra
8 that it has to survive in order to behave properly in the
9 Trojan complex, that's the requirement. And as long as this
10 thing is below that, no problem.

11 Q I was just trying to make sure that the line
12 was flat, and in the frequency versus acceleration plot
13 that the qualifications of equipment has been done generically
14 as being a straight line --

15 A All generic qualification is not for a horizontal
16 response spectra. They have a response spectra which is a
17 function of frequency.

18 Q They can have that?

19 A Right.

20 Q They can have the other?

21 A Yes.

22 Q And one or the other of these was compared to
23 this plot here?

24 A Right.

25 Q -- depending on where the equipment is, on what

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1 floor, and all of them either will or are underneath the
2 spectrum for which they are qualified?

3 A Well I think they are, because there is no
4 modification required for the equipment.

5 Q I guess I was thinking of the broader terms.
6 Now then, let's go to piping.

7 A Okay.

8 Q Tell us the mechanism by which you compare
9 the piping here on this.

10 A Okay.

11 I think the simplest is to talk in terms of the
12 big pipes. And in the big pipe category is 2.5 inches or
13 more.

14 A full-blown dynamic analysis is made of the
15 piping system. In other words, it's the identical process
16 as used for the building analysis.

17 You build the mass model. You determine the
18 frequencies, the mode shapes, participation factors, this kind
19 of thing, and then go to the response spectra to determine
20 the spectral acceleration associated with each mode of the
21 piping system. So the process is exactly the same as in the
22 building analysis.

23 When you go through that process, you come up
24 with stresses and deflections in the piping network. You
25 compare these against code allowables, and that's

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essentially how the piping system is qualified relative to
these kinds of spectra.

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1 Q Look at Figure 31 in Exhibit number 19.

2 This, I believe, is the only one of these
3 figures where you placed and compared the original and the
4 STARDYNE spectra on any of these curves.

5 A Yes.

6 Q You said something in here about the fact that
7 there was a shifting --

8 A Yes.

9 Q -- to a higher frequency. And that this 15
10 second peak -- and I presume that's that flattened off area
11 on the STARDYNE linear elastic spectrum -- was in the appro-
12 priate spot to reflect -- what? -- that other peak that's
13 in the original?

14 A I didn't follow that.

15 Q Let me get back to your statement.

16 Look at page 6 of Licensee's Exhibit number 19,
17 the second paragraph in that page. It says:

18 "The STARDYNE spectrum in Fig. 31 also
19 shows a third spectral peak at about 13 cycles
20 per second, which corresponds well with the
21 second peak of the original spectrum, but has
22 a lower peak amplitude than that of the ori-
23 ginal spectrum."

24 A Right.

25 Q Now will you show me which ones are which on

mpb2 1 this?

2 A Okay.

3 We have the dominant peak for the particular
4 floor response spectra at 6.97, somewhere around in there.

5 Q That's of the STARDYNE?

6 A Right.

7 Okay. What I want to do is to find a third
8 peak on the STARDYNE and then we'll go to the second peak
9 on the stick, okay?

10 Q All right.

11 A So as you move to the right on higher frequency
12 you run down the steep side, you find a little plateau
13 centered about 10 cps. Okay. You keep going and there's
14 another plateau very low, like maybe 1.5g's or something like
15 that. Okay. That's the third peak. It's not much of a peak,
16 but that's the peak.

17 Q And it compares to the second peak --

18 A Right.

19 Q -- of the original.

20 A Yes.

21 That's the third plateau or the second plateau,
22 whichever one you want to call it, and about 15 cps is the
23 influence of this higher mode whose frequency is about 15.

24 Now, while we're on this, I might mention a
25 little bit about the comparison between the stick and the

mpb3 1 STARDYNE model on a more general basis. And, as has been
2 mentioned earlier, one of the influences, one of the major
3 influences that has resulted in these different frequencies
4 has been the lack of symmetry of the three building complex.
5 And this is something that is difficult to model with a
6 stick model.

7 Another aspect of the problem is the short
8 squatty nature of this three building complex. You're
9 looking at a beam essentially that's 93 feet deep in one
10 direction, and about 250 feet deep in the other direction,
11 and 90 feet long, or 72 feet long. Again, these are the
12 main differences.

13 Now if we were to take the tall building all
14 by itself, separate it from the other structures, now there
15 would be very little difference between the response of that
16 building characterized by the stick model versus a finite
17 element mode., the reason being it's a nice, clean symmetric
18 structure. And the responses of the two are very comparable.

19 There have been studies made on symmetric struc-
20 tures modeled by the stick model technique and the finite
21 element technique, and they compare very well.

22 Q In Table 1 of Exhibit 19, where and when are
23 these 72 frequencies used in this calculation?

24 A Okay.

25 Going back to the ideas we were talking earlier

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about, how one goes about developing a response spectra, we were talking about a single degree freedom system subjected to this acceleration time-history.

Now you can think of each of these frequencies corresponding to an individual or isolated single degree of freedom system. So we're going to have 72 of these little single mass systems, and we excite each of these with the same time-history. From each of these we get the maximum acceleration. So this gives us two coordinates essentially: a frequency and an acceleration.

So we go to the response spectra and plot that point which corresponds to a single piece of information from the frequency input.

Q So this is the table that is used to create the floor response spectra from the time-history analysis?

A Yes.

Now in addition to these, and probably the most important frequencies of them all, this list is supplemented by the natural frequencies of the structural model. And if we chose only those, we'd have a pretty good response spectrum. These others are for general background information.

The other structural frequencies are the most important.

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1 DR. MC COLLOM: I guess I'm finished.

2 DR. DAXTON: Again, my questions have been
3 answered. Thank you.

4 DR. MC COLLOM: I'm sorry; there is another
5 thing I want to go into.

6 BY DR. MC COLLOM:

7 Q I wonder, on page 6, under (f) in Exhibit 19--

8 A (Witness White) Page 6, under....?

9 Q Under paragraph (f). You say,

10 "Based on the new horizontal spectra
11 and the original vertical spectra for each floor
12 the qualifications were reviewed."

13 "Now tell us a little bit in general about this
14 vertical spectra and why it was used as compared to making
15 further changes in that as compared to the horizontal spectra
16 which you did make changes in?

17 A The vertical spectra, if you are going to identify
18 a single most important parameter it would be the vertical
19 flexibility of the floors. This would be a drumming kind
20 of behavior. That aspect was included in the development
21 of the original response spectra. And there is nothing that
22 we have come across that would change -- none of the
23 deficiencies or anything else affect the behavior of the
24 floor itself. So we feel no reason to question that.

25 We've come back and looked at it, and they have

wb2 1 included the single most important effect, the drumming.

2 Q How does that effect compare to the effect of
3 the forces on the building compared to the horizontal,
4 what is the order of importance as far as putting stresses
5 on the equipment and the piping?

6 A So far as the vertical response on equipment is
7 concerned, most things -- it's under load already vertically.
8 So normally things are built to handle dead load, so normally
9 vertical is not a real major problem with equipment.

10 In terms of piping, the vertical acceleration
11 and the horizontal acceleration are somewhat similar, and
12 the piping is designed to accommodate it. So there really
13 isn't a problem.

14 Q The horizontal acceleration of the piping would
15 be movement this way (demonstrating) --

16 A Right.

17 Q --and the vertical -- the effect of the vertical
18 seismic action would be moving it this way (demonstrating)?

19 A Right.

20 Q The piping is under -- hanging, let's put it
21 that way, by gravity. Is that taken into consideration when
22 you make your calculations; or is it negligible?

23 A Well I don't know if it's negligible or not.
24 It depends on the circumstances. But the two are included.
25 There is a load combination which includes dead load, seismic

wh3 1 and the rest of the information.

2 Q I do understand that the equipment and piping and
3 components in all three buildings have been rechecked by
4 this same technique since we've been discussing it for
5 the control building.

6 A Yes. We have generated new response spectra
7 for the entire complex.

8 CHAIRMAN MILLER: I believe that's it at this
9 time, then, unless there is further examination by you,
10 Mr. Banks.

11 MR. BANKS: None.

12 CHAIRMAN MILLER: Thank you. You're excused at
13 this time.

14 (Panel excused)

15 CHAIRMAN MILLER: Well I believe that concludes
16 the evidentiary portion of this hearing.

17 MR. ROSOLIE: Mr. Chairman, I was wondering about
18 the possibilities of discovery on this issue. Is the
19 Board going to allow discovery?

20 CHAIRMAN MILLER: I would doubt it. You're in
21 hearing now. If you need information I think you can probably
22 obtain it by request. But your opportunity is here now, you
23 see, on this portion. The other is on-going. So in view
24 of the fact that this is an expedited evidentiary hearing
25 you're getting discovery as you go, really. Or you can

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1 anticipate if you want. But I would not think the rules of
2 discovery would apply now, since we have conducted a very
3 substantial evidentiary hearing, and the other matters are
4 tendered to you, in effect. If you want discovery you can
5 start asking right now. It's your option.

6 I suppose, since you raised the question, you
7 should indicate for the record whether or not you wish to
8 ask questions of these witnesses.

9 MR. ROSOLIN: No, not at this time.

10 MR. GRAY: Mr. Chairman, with regard to discovery
11 there was one matter which unfortunately I neglected to bring
12 up while Mr. Kafoury was here.

13 The Staff on the Friday before this evidentiary
14 hearing commenced received from the Columbia Environmental
15 Council a set of interrogatories. We have attempted to
16 assemble answer to those while we have been out here at the
17 hearing but have been unsuccessful in getting complete answer
18 to all the interrogatories because of the fact that some of
19 the resources are back in Washington, and so on.

20 The interrogatories I believe relate to matters
21 which have already been considered. But what I intend to
22 do is to -- well, let me backtrack a minute.

23 The responses, under the rules, would be due
24 this coming Monday, November 6th. What I'm requesting at this
25 time is an extension of time until next Friday, November --

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1 whatever next Friday is.

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2 CHAIRMAN MILLER: The 10th, I believe.

3 MR. GRAY: --the 10th to respond to those inter-
4 rogatories. In the meantime I will contact Mr. Rafoury to
5 inquire as to whether he actually desires responses to the
6 interrogatories since, in fact, they do deal with matters
7 which have already been considered.

8 CHAIRMAN MILLER: All right.

9 Leave is extended to the Staff to file the
10 responses to the interrogatories filed -- was it on the eve
11 of the hearing they were filed?

12 MR. GRAY: They were received by the Staff on the
13 20th of October. I believe they were filed by mail on the
14 18th.

15 CHAIRMAN MILLER: All right. The Staff is given
16 an extension of time to and including Friday, November 10th,
17 to respond to those interrogatories.

18 Are there any other interrogatories outstanding
19 which have not been responded to that anyone knows of?

20 MR. BANKS: We got the same interrogatories, but
21 we have responded.

22 MR. SOCOLOFSKY: We got two questions from the
23 Environmental Council that we have yet to answer. The
24 reason that we didn't answer them earlier is because apparently
25 they used the spent fuel service list and they want to the

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wh6 1 wrong person. But I have the questions now and will provide
2 the answers.

3 CHAIRMAN MILLER: Yes. I might say there was a
4 problem with service. There are two lists of parties who
5 are on the service list. And there was, I know, one event
6 where the wrong service list was used.

7 MR. BANKS: Mr. Chairman, there was one other
8 thing that somebody has raised. I think it is clear, but
9 I thought if somebody-- Well, my people had a question about
10 it and I thought I had better explain it again. That is
11 that we do intend to proceed with these modifications that
12 have been discussed here, and we expect to have them done
13 within three or four weeks. I'm talking about the improve-
14 ments in the piping supports.

15 CHAIRMAN MILLER: The improvement in the piping
16 supports.

17 Let me ask the staff: Is that included in any
18 way in the original order of the Commission, or in any
19 matters before the Board?

20 MR. GRAY: Mr. Chairman, provided that those
21 improvements don't weaken the walls of the control building,
22 I believe that was included in the original order. I guess
23 I would have to say that is the only provision of the order
24 which would seem to be affected.

25 The other thing I would say is, those modifica-

wb7 1 tions, of course, will be at the risk of the Licensee. And
2 if this proceeding determines some different modifications
3 should be made, or that none should be made, or whatever may
4 be determined, it may well be that that work would have to
5 be undone.

6 MR. BANKS: We understand that. And, of course,
7 when I made the statement I made it in the context of what
8 we have already told the Board insofar as the fact that we
9 intend to abide by the conditions in that order and all the
10 regulations.

11 CHAIRMAN MILLER: Yes. We appreciate the fact
12 that you have, and are keeping the Board as well as Staff
13 informed of all matters.

14 MR. BANKS: We'll keep everybody informed as to
15 what we're doing.

16 CHAIRMAN MILLER: Are there any other matters
17 that any of the parties or counsel wish to raise or go into?

18 With reference to the proposed findings and
19 conclusions, that's under Section 2.754, there now you will
20 note that any party to a proceeding may or, if so directed
21 by the presiding officer, shall file proposed findings of
22 fact and conclusions of law, briefs and so forth.

23 We have requested the filing of proposed findings
24 of fact and conclusions of law on the substantial portions of
25 the evidentiary hearings which have been conducted to this

wbs 1 this time. We have not directed, in the sense of the
2 regulation, because of not wishing to impose undue burdens
3 on individual pro se intervenors. As I said, we would like
4 to have them, but we're not making it part of the order,
5 making it an order at this time.

6 Now when we conclude the evidentiary hearing
7 itself, which will be either by deposition procedures or as
8 agreed to by the parties, or by our resumed hearing commencing
9 on December 11th, 1978, we will enter an appropriate order.
10 It may be that-- Well, we will have Staff counsel at that
s 11 time explain to the intervenors the consequences in terms of
12 matters that you might wish to raise on appeal and the like.

13 So you are now requested. There will come a
14 time, however, when there will be an order, at the conclusion,
15 which will require compliance. We will try to tailor it to
16 those things which are within your capabilities and your
17 desires. But you will have explained to you at that time
18 by Mr. Gray the implications in terms of the appealability of
19 issues of that kind. And you can confer with him in the mean-
20 time, of course.

21 In other words, we're trying to protect your
22 rights. And we'd like to hear from you on proposed findings,
23 if you wish to submit, and conclusions of law, either one.
24 We would find it helpful, just as we told Mr. Kefauver yester-
s 25 day, in understanding your theory of the case as it applies now

who 1 to the evidentiary record as developed. It is helpful to
2 the Board and helpful in seeing that your point of view is
3 both understood and your application of it to the facts is
4 developed.

5 Anything further that we need to consider at
6 this time?

7 (No response)

8 We wish to thank all counsel and all parties.
9 You've been very helpful. And we think that there have been
10 important significant aspects of the record developed by
11 all counsel and the intervening parties. We appreciate your
12 cooperation. We think we're getting a record from which a
13 decision can be made with as much input as is possible,
14 and, in the ultimate decision, public safety is paramount,
15 as you know.

16 Thank you. We'll look forward either to hearing
17 from you or seeing you on December 11th.

18 We're adjourned.

19 (Whereupon, at 11:30 a.m., the hearing in the
20 above entitled matter was adjourned.)
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