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NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PACIFIC GAS & ELECTRIC COMPANY

(Diablo Canyon Units 1 and 2)

Docket Nos. 50-275
50-323

Place - Avila Beach, California

Date - 6 January 1979 **Pages** 7603-7697

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UNITED STATES OF AMERICA

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PACIFIC GAS & ELECTRIC COMPANY : Docket Nos. 50-275
50-323

(Diablo Canyon Units 1 and 2)

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

Saturday, January 6, 1979.

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

BEFORE:

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

DR. WILLIAM E. MARTIN, Member.

GLENN O. BRIGHT, Member.

APPEARANCES:

On behalf of Applicant, Pacific Gas & Electric Company:

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

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

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On behalf of the Joint Intervenors:

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

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

On behalf of the Regulatory Staff:

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

C O N T E N T S

WITNESS:	DIRECT	CROSS	REDIRECT	RECROSS	EXAM BY BD.	CK ON BD.	VOIR DIRE
H. James Gormly) Thomas C. Esselman) Wilmer C. Gangloff) Panos G. Antiochos) (resumed)		7608	7653		7652		
H. James Gormly) Thomas C. Esselman) Wilmer C. Gangloff) Richard E. Bacher)	7658						
H. James Gormly) Thomas C. Esselman) Wilmer C. Gangloff) Robert A. Young)	7683	7687					

1A wrb/agbl

PROCEEDINGS

MRS. BOWERS: Mr. Kristovich, are you ready to continue?

MR. KRISTOVICH: Yes.

Whereupon,

H. JAMES GORMLY,

THOMAS C. ESSELMAN,

WILMER C. GANGLOFF,

and

PANOS G. ANTIOCHOS

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

CROSS-EXAMINATION (Continued)

BY MR. KRISTOVICH:

Q Mr. Antiochos, I'd like to direct your attention to Table 7-7A of the Hosgri Report.

For the equipment listed in that table, was an OBE analysis required?

A (Witness Antiochos) I would ask Dr. Esselman to respond to this question.

A (Witness Esselman) Yes, sir. That was the table that we had discussed last night before we recessed.

Q Table 7-7A? I believe last night when we ended, we were discussing Table 7-7.

WRB/agb2

A That's correct. I'm sorry.

Q Mr. Esselman, maybe we should start with Table 7-7 then.

A I believe we adequately covered that last night.

Q But I'm confused now what we were covering last night.

MR. NORTON: Well the transcript says you covered 7-7, the questions and answers were asked. He thought it was. 7-7A, and it wasn't, it was 7-7. So I don't understand way you don't proceed. Why go back to 7-7 if it has been covered?

MR. KRISTOVICH: I thought he just said that last night we had covered 7-7A. So perhaps he was looking at that. If that's not the case, he can tell me that right now.

BY MR. KRISTOVICH:

Q Mr. Esselman, which table were you discussing when we ended the proceedings yesterday?

A (Witness Esselman) Last night when we ended we were discussing Table 7-7.

Q Thank you.

I'd now like to direct your attention to Table 7-7A.

For the equipment listed in that table, was an OBE analysis required?

A The requirement at the time was for a design

kB/agb3

earthquake analysis.

Q How is a design earthquake analysis different from an OBE analysis?

A It was primarily in terminology at the time.

Q And at this time how is it different?

A The FSAR still only refers to a design earthquake analysis. The OBE is terminology that has come into use since then and has been commonly transposed.

Q So the analysis is the same and the terminology is the only thing that's different?

A Yes, sir.

Q Well, was an OBE analysis performed for the equipment listed in Table 7-7A?

MR. NORTON: Object, asked and answered. Twice.

MR. KRISTOVICH: May I respond?

MRS. BOWERS: Respond to the objection.

MR. KRISTOVICH: My previous question was whether an OBE analysis was required, not whether it was performed.

MR. NORTON: I think the first question of the morning was whether it was performed in 7-7A and he said yes. I'll withdraw the objection. Let him answer it again.

MRS. BOWERS: Go ahead.

BY MR. KRISTOVICH:

Q Mr. Esselman?

A (Witness Esselman) Will you repeat the question

WRB/agb4

again?

Q Was an OBE analysis performed for the equipment listed in Table 7-7A?

A The qualifications that were performed for the valves in 7-7A did cover the OBE or the design earthquake case.

Q How?

A The original specifications for the valves in this table required seismic qualification. The manner in which the specifications addressed that was by specifying a single seismic acceleration with stress limits set according to the specifications.

In terms of the OBE requirements, the stress limits that were set in the specification were essentially identical to the OBE stress limits that are in use today. A single seismic criteria -- a single seismic acceleration was set with stress limits that are essentially the same as OBE requirements today. The double design earthquake and the design earthquake were both adequately considered simultaneously in the original specifications.

Q For any of the items, was the OBE limiting?

A The evaluations, as I stated, were performed essentially at the same time. Which is limiting is not possible to say, because the evaluations were performed simultaneously.

WRB/agb5

Q I'd like to direct your attention to Table 7-8 of the Hosgri Report.

Was an OBE analysis required for the equipment in that table?

A The valves in this table are similar to the valves in Table 7-7A, and the answers I made for the valves in Table 7-7A would also apply here.

Q So an OBE analysis was required for the equipment in Table 7-8?

A Yes, sir.

Q And an OBE analysis was performed?

A Yes, sir.

Q And for any of the items, was the OBE limiting?

A For the same --

MR. NORTON: Excuse me, Mrs. Bowers.

He just said the answers to the questions for Table 7-8 are the same as they were for 7-7A and Mr. Kristovich is proceeding to ask each and every question again.

MRS. BOWERS: It is repetitive.

MR. KRISTOVICH: Mrs. Bowers, I'm not sure if he remembers each and every question that was asked on the previous table.

MRS. BOWERS: He has the transcript, and you just covered it this morning. He attempted to give a rapid answer for 7-8 by saying his answers would be identical to the

WRB/agb6

answers he just gave for 7-7A, so why repeat the question?

MR. KRISTOVICH: I just want to make sure.

MRS. BOWERS: Well the objection is sustained.

BY MR. KRISTOVICH:

Q I'd like to turn your attention now to Table 7-5. For the items listed in that table, if the OBE were increased to 0.25g, would the OBE be limiting?

A (Witness Esselman) I have no way of being able to tell that now without going back and making a detailed review of the analyses and the margins and such things as that.

Q Have you ever done any study on what would be the consequence of increasing the OBE to 0.25 for those items?

A (Witness Antiochos) I have looked at at least three items.

Q Which three items?

A Okay, I'll tell you: the diesel generators, the diesel generator fuel oil filter--Items Number 3, 5, 6, 7, 8 and 19.

Q Could you explain how you looked at these items?

A Yes. Either the items themselves or components of the items were in the rigid region of the spectrum. Which means that the accelerations applied for the analysis were those that are not affected by any amplification, and the Hosgri

WRB/agb1

is the limiting condition of analysis in this particular case because the accelerations are approximately 2.5 times higher than the OBE values.

(Pause.)

MR. KRISTOVICH: Perhaps this discussion by the witnesses should be on the record if they each have different things to say.

MR. NORTON: If counsel would ask a question, we'd be glad to put the answers on the record.

MR. KRISTOVICH: I asked a question. The witnesses are conferring.

MR. NORTON: No, the witness answered the question. I think the record will reflect that. There is no question pending. The witnesses can talk to each other if they want to.

BY MR. KRISTOVICH:

Q Mr. Esselman, do you have anything to add to Mr. Antiochos' answer?

A (Witness Esselman) No, sir.

Q Do you have anything further to add, Mr. Antiochos?

A (Witness Antiochos) No, sir.

Q Was a study made of any of the other items listed in Table 7-5 of what would be the consequences of raising the OBE to 0.25g?

A I don't know of any more items.

WRB/agb8

Q Mr. Esselman?

A (Witness Esselman) No, I know of none.

Q I'd like to direct your attention now to Table 7-6.

And Mr. Antiochos, what would be the consequence of raising the OBE to 0.25g for the items listed in that table?

MR. NORTON: Excuse me, Mrs. Bowers.

I don't understand the relevancy of these questions. The OBE that was done was at 0.2g. Obviously, if you change values of different analysis, you're going to get different numbers. And to ask somebody what these numbers would be when it's an analysis and they obviously can't give a number, there's no way, and obviously the numbers would change. What's the relevancy of all this? Where are we going?

MR. KRISTOVICH: Mrs. Bowers, I'll withdraw the question and rephrase it and narrow the question. The question was overly broad.

MRS. BOWERS: Well, will you be able to establish the relevancy?

MR. KRISTOVICH: I believe so.

BY MR. KRISTOVICH:

Q Mr. Antiochos, for the items listed in Table 7-6, would an OBE of 0.25 be limiting?

WRB/agb9

MR. NORTON: Same objection, same reason.

We can put in any numbers we want. We can make an OBE of, instead of 0.2, 1.5 or any numbers anybody wants to pick. There's no relevancy and no basis and no foundation for 0.25.

MRS. BOWERS: Mr. Kristovich, could you tell us why it's relevant?

MR. KRISTOVICH: Yes.

10 CFR Part 100 Appendix A, Section 5, Subpart A --

MRS. BOWERS: Wait a minute.

(Pause.)

All right. Part 100, Appendix A, and then what else did you say?

MR. KRISTOVICH: Part 5, Subpart A, Subpart 2, entitled "Determination of Operating Basis Earthquake."

The last sentance in the first paragraph of Subpart 2 states:

> "The maximum vibratory ground acceleration of the operating basis earthquake shall be at least one-half the maximum vibratory ground acceleration of the safe shutdown earthquake."

MR. NORTON: And would Mr. Kristovich relate that number of 0.25, and tell me how 0.25 is relevant to his interpretation of that statute -- Excuse me, that regulation?

WRB/agb1

MR. KRISTOVICH: Well Mrs. Bowers, if we assume -- what I've done -- 0.25 is very conservative. If we start out with peak instrumental acceleration of 1.15 and then go down to effective acceleration of 0.75, one-half of 0.75 is 0.375. I could ask the same questions for 0.375. I was taking a more conservative approach and asking 0.25.

MR. NORTON: Well, Mrs. Bowers, the statute also says -- excuse me, the regulation:

> "If an Applicant believes that the particular seismology and geology of a site indicate that some of these criteria or portions thereof need not be satisfied, the specific sections of these criteria should be identified in the license application and supporting data to justify clearly such departures should be presented."

And that's exactly what's been done in this case. Now if they want to argue that it should be something else, fine. But to go through this silly exercise of saying if you change the numbers in the formula are the answers going to be different is -- that's a given, of course they are.

MRS. BOWERS: Does the Staff have a position on this?

MR. TOURTELLOTTE: We think the line of questioning is not relevant in that an adequate basis has not been established because what they're talking about hypothetically

kB/agb11

is a situation which we know does not exist. Namely, they are talking hypothetically about adherance on a design basis, adherance to that particular last sentence of Subparagraph 2 when in fact we proceeded under another paragraph which says roughly what Mr. Norton was talking about.

MR. KRISTOVICH: What is that --

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: Well I would like a citation to the paragraph Mr. Tourtellotte just referred to, and I would also like to refer to Appendix A of 10 CFR Part 100, Subpart 1 -- Subpart 2, excuse me, the second paragraph, the second sentence states:

> "Additional investigations and/or more conservative determinations than those included in these criteria may be required for sites located in areas having complex geology or in areas of high seismicity."

MR. NORTON: And I would like to know where in the record this is an area of high seismicity? In fact, the evidence in the record is totally to the contrary. The testimony has established it's an area of low seismicity. Those were the exact words of the seismologists who testified.

MRS. BOWERS: Well the Board has determined that the objection would be sustained, that this line of questioning is not relevant. It seems to us an exercise in

RB/agb12

futility. You could assign a series of numbers to each item and we'd be here for all of 1979.

end1A

B WRB/wb1

BY MR. KRISTOIICH:

Q Mr. Antiochos, directing your attention to page 1 of the written testimony, lines 24 and 25, does the ASME code for valves address the structural integrity of valves under earthquake loading?

A (Witness Antiochos) The earthquake loading is taken into account in the equations that determine the allowable stresses.

1.280

Q Is that a yes answer, then?

A Yes, sir.

Q Thank you.

Does the ASME code for valves address the functional operability of valves during and following earthquake loads?

A No, sir.

A (Witness Gormly) I might add one thing.

I believe we indicated here that the applicable regulation is 50.55A, and I think we said we evaluate our plant in accordance with that regulation.

Q Mr. Antiochos, what additional analysis or testing have you done for functional operability of valves?

A (Witness Antiochos) We have done two types of tests besides the analysis, of course. The first one is testing of valves in place as they are installed on the piping systems with conditions that simulate the actual

WRB/wb2

conditions of the valves on that particular system; which means it is pressurized, it is stroked -- opened and closed -- and at the same time we impose on the valve loads, forces which correspond to the forces equivalent to those that would be exerted on the valves when the earthquake happens.

The second method of qualifying the valves is in the laboratory, testing them on the shaker table with simulation, again, of conditions of performance, that is, pressurizing the valves, stroking them, opening and closing all the time, and subjecting them to vibration in single frequency, multi-frequency and biaxial random motion.

Q Okay, Mr. Antiochos.

In your revised analysis of the component cooling water heat exchanger were the supports overstressed?

A Are you referring to before or after the analysis?

Q You can answer before the analysis first.

A If we modified something, that is indicative that it was overstressed. And as it was modified, or actually is being modified, the stresses are within allowables.

Q Is it currently being modified?

A Yes, sir.

Q And can you describe that modification?

A In how much detail would you like to have it?

Q Well can you just describe the modification, please?

WRB/wb3

A Basically the modification consists of reinforcing the two supports of the heat exchanger by adding braces in both horizontal directions, which are going to relieve the stresses on the pipes that previously were overstressed.

Q Mr. Antiochos, is the structural integrity and operability of safety valves required during and following a Hosgri earthquake?

MR. NORTON: Excuse me, Mrs. Bowers. May I ask what the term "safety valves" means in this question?

MRS. BOWERS: Could you identify, Mr. Kristovich?

MR. KRISTOVICH: Category 1.

WITNESS ANTIOCHOS: Mr. Kristovich, could you please repeat the question so I understand it thoroughly?

MR. KRISTOVICH: Yes.

BY MR. KRISTOVICH:

Q For the valves in Table 7-5 through 7-8 of the Hosgri Report-- Those are the valves I'm referring to.

A (Witness Antiochos) There are no valves in 7-5.

Q Okay. Well, then, 7-6.

A There are no valves in 7-6 either.

Q There are no valves in Table 7-5?

A No, sir.

Q 7-6?

A No, sir.

Q 7-7?

WRB/wb4

A Yes.

Q 7-7A?

A Yes, sir.

Q 7-8?

A Yes, sir.

Q Okay. For the valves in those last three tables is structural integrity and operability required during and following the Hosgri earthquake?

MR. NORTON: Excuse me, Mrs. Bowers.

The problem I have with that question is, when he says "required during the Hosgri earthquake," required for safe shutdown? required for hot shutdown? required for cold shutdown? required for operability? required by regulations? required by what? required for what?

MRS. BOWERS: Mr. Kristovich, could you be more specific?

MR. KRISTOVICH: Yes.

MRS. BOWERS: And when you say "during the earthquake," aren't you talking about seconds?

MR. KRISTOVICH: Yes. Some of these valves have to operate during an earthquake.

MR. NORTON: Is that testimony, Mr. Kristovich?

MR. KRISTOVICH: I think that statement is similar to statements you've made, whether you're statements were testimony or not.

WRB/wb5

(Laughter)

Haven't you wound down yet?

(Laughter)

MRS. BOWERS: Can you break out the question?

MR. KRISTOVICH: I'll try to.

BY MR. KRISTOVICH:

Q Perhaps, Mr. Antiochos, it would be easier to direct your attention to page 3-33 of SER-8. And I can just read the relevant section to you.

MRS. BOWERS: Where are you, Mr. Kristovich?

MR. KRISTOVICH: Supplement 8, 3-33.

MR. NORTON: What paragraph?

MR. KRISTOVICH: 6 and 7.

MR. NORTON: Thank you.

BY MR. KRISTOVICH:

Q The first line of 6 and 7 states "Submittal of information concerning qualification documents for remaining valves demonstrating functional operability and updating Table 7-5 through 7-8 of Amendment 50."

A (Witness Gormly) What is the question, mr. Kristovich?

Q I haven't asked the question yet.

Have you provided the documentation for Valve 9351A as described in the second paragraph of Section 6 and 7?

WRB/wb6

A (Witness Esselman) It is not clear to me at this time that that documentation has been provided. I do know for a fact that those analyses have been completed.

Q And is that for each and every one of those valves listed in that paragraph?

A That's correct.

Q So you don't know, then, whether the NRC review of these items has been completed?

A No, sir, I don't.

Q Directing your attention to page 2 of the written testimony, lines 25 and 26, does all the auxiliary mechanical equipment that is addressed in your testimony satisfy the design requirements of the ASME code?

MR. NORTON: Excuse me, Mr. Kristovich. In terms of that question are you asking if that statement is true, because I wasn't sure by the words you used in your question-- This is a longer question than the question and I wasn't able to pick up whether you were just rephrasing that or asking something different; I'm sorry.

May I have the question repeated or read back. I was trying to read this at the same time the question was being asked.

MRS. BOWERS: Can you repeat the question or do you want the reporter to read it?

MR. KRISTOVICH: I can repeat it.

WRB/wb7

BY MR. KRISTOVICH:

Q Does all the auxiliary mechanical equipment that is addressed in your testimony satisfy the design requirements of the ASME code?

A (Witness Esselman) The current requirements of the ASME code were used with regard to the stress limits of the auxiliary components for structural integrity. As was mentioned previously, the ASME code does not specify requirements for functional operability assurance of an active valve or pump. For those cases we have exceeded the ASME code requirements by making the requirements more restrictive.

MR. NORTON: Excuse me, Mrs. Bowers. May I ask if the answer to the question is Yes?

MRS. BOWERS: Can the witness respond to that?

MR. KRISTOVICH: Has he become a hostile witness?

(Laughter)

MR. NORTON: I'm not sure I understood the question or the answer. That's what I'm trying to find out.

WITNESS ESSELMAN: The question, if I recall correctly, was whether we met all of the requirements of the ASME code for....

BY MR. KRISTOVICH:

Q ....auxiliary mechanical equipment that is listed in this written testimony.

A Was that an accurate restatement of the question?

WRB/agb1

flwsWRB/wb7

Q Yes. Not only those listed but that is addressed in this testimony.

A The design codes that were used for the valves and pumps were not the current edition of the ASME code. The codes that were used to design the equipment were the codes that were available at the time of the procurement.

In direct answer to your question then, the answer would be no. My statement that I've made in the first response to your question was that we did take those portions of the code that applied to stress limits for assurance of the capability of the valve to retain its pressure boundary integrity. In those cases where we had a valve which was required to operate, we were more restrictive in our choice of criteria.

end1B

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Q Directing your attention to page 3 of the testimony, at line 17, Mr. Anticchos, could you describe the on-site testing?

A (Witness Anticchos) Yes, sir.

Basically, it consists of forced vibration of certain equipment with various means. The most common is the application of excitation by the eccentric mass vibrator and determination of the natural frequencies of vibration, the mode shapes of response, and determination of damping values for those modes.

C-6

Q And how is this accomplished?

A Which part of it?

Q Finding the damping value in the modes.

A That could be a lengthy discussion, but I will very briefly tell you how.

The first thing that is done is to excite with a proper means the equipment, and by strategically locating accelerometers on certain points of the structure you can, in varying the frequency of the excitation, you can detect those points that have resonance.

Of course, we do not go to infinity, but we just search the region of the spectrum that we are -- that is significant for the analysis, usually between 2 and 33 or 35 hertz, sometimes a little bit higher.

The mode shape determination, when you reach

resonance the structure shows some kind of significant displacement at certain points in stagnant or steel points, or in other areas, and by moving the accelerometers and recording the response you can determine the way the shape of the structure deforms for that particular frequency.

Now, the third part, the critical damping, is determined by methods that are described in engineering manuals or in codes like perhaps the IEEE-344, and the discussion of that is rather cumbersome at this level, unless you want me to refer to formulas and methods of determining the damping.

Q What is the level of excitation that's used?

A Usually it is low, and the reason is that, first of all it depends on the item you are going to test. If you have a 200,000 pound heat exchanger you apply different excitation. If you have a 300 pound small vessel, tank, or valve, the excitation is small.

Q How small?

A Usually it might be of the order of between, say, .01 g up to .3 g, even more. We have cases we have recorded up to.5 g, but for very heavy items.

Q .5 or .05?

A 5.

Q .5?

A .5, half a g.

Q

Q Thank you. How is the low excitation sufficient to determine damping?

A Perhaps going through all this enlightenment by your counsel you have found out that damping is a function of the excitation. It is not a clear-cut case. However, the experimental data indicate that when you have low excitation usually you measure lower damping. And there are mathematical ways to extrapolate and get from that small excitation, and the damping you obtain for that excitation what is the reasonable value of critical damping for excitation which is much higher than the one you apply on the item, that you are going to expect in the case of a strong earthquake.

Q Can you give an example of about how you go from correlating low damping to high damping, the extrapolation? What I'm asking is to describe the procedures.

A One easy way is to excite the same item with different values. For example, with .1 g, .2 g, .3 g, something like that, and you create a series of damping values versus excitation. And you plug these values on two axes, which is damping versus excitation, and with mathematical means you can extrapolate the curve.

Q Is this a lineal relationship?

A As far as I can tell, no, it is not.

Q Moving to page 3 of the written testimony, at

lines 21 to 23 you state:

"In a few cases, mathematical models were refined with information based on the experimental data."

Could you list each and every case where you refined the mathematical models?

A Really that is not easy right now, because I don't have all the documents with me. But I can look very briefly and I'll give you one or two examples of how I did it.

Is that going to be enough?

(Pause.)

If you look on Table 7-5 --

Q Just a second, please.

Okay.

A Table 7-5, which is the summary of seismic qualification of Class-1 equipment required for following Hosgri event, one item that the model of which was refined based on the information obtained from the test is item number 4, the diesel generators.

Q Can you describe how the model was refined?

A Yes. On that particular item, the assumption was that the hold-down bolts were providing practically infinitely rigid attachment to the concrete floor. Actually, it's a floor with an inch of plate, steel plate. And it

seems that this assumption was not 100 percent accurate, that the hold-down bolts really do not provide -- on that particular item -- very infinitely rigid connection.

We tested that item, and the mathematical model we run this assumption was giving more rigid behavior. However, the test proved that due to this kind of assumption that it was not correct, and the test data we obtained enabled us to refine the model by introducing some kind of flexibility there, where previously it was assumed infinitely rigid. And it came to perfect agreement with the test results.

May I proceed now to the next item?

Q Yes.

A Okay. Another item is number 10, again the same reason there was this kind of slight discrepancy. It was assumed that the tank, which is supported through a skirt and flange with 36 bolts, it was really infinitely rigid, which is another case. And we refined the model in such a way that it agrees with the test. And then we analyzed it with this refined mathematical model, and we obtained stresses that were below allowables.

In both of these cases, the margin of safety was so big that we didn't have any trouble. The assumption of rigidity being made here, although it didn't prove accurate, didn't affect it. I mean we stayed below allowables

even after we introduced the real constant inflexibility at the base of the tank.

I probably have one or two more, but unless you want me to look at my papers I probably will not be able to give you exact descriptions of the reasons why they did not match.

But I recall those two.

Q Which two are those?

A Excuse me?

Q Which two are those?

A Which two are you referring to?

Q I thought you said there were one or two others you could recall.

A I might have, but I am not -- even if I mentioned the items it might not be -- I would have to stretch my memory to think what was the reason for not agreeing.

Q Okay. Well, you don't have to give us the reason, but just refer us to those.

A All right. I'll give those.

(Pause.)

The next item probably is number 18, the component coolant heat exchanger, which was one of the items that we modified. I don't remember anything else right here.

Q Okay. When you state in line 21 of page 3, "in a few cases," approximately how many cases are you referring

wel 7

to?

A I would say three or four. I mentioned already three.

Q Mr. Antiochos, does this statement on lines 21 to 23 only apply to the items in Table 7-5?

A There probably are one or two items in 7-6, but I can't recall right now, because there are almost 40 of them there, and it might be hard to give you an answer to that.

Q Were there items in the other tables in the Hosgri Report that you referred to earlier this morning?

A There might be, but I don't remember. There are so many items, really, it's very hard to identify them.

Q I'd like to direct your attention to page 6 of the written testimony, where you have listed the items tested on laboratory shaker table.

Could you describe this procedure?

MR. NORTON: Excuse me, Mrs. Bowers. I didn't object to the last line, but this information is all contained in the Hosgri Report that was submitted to Intervenors a long time ago.

A description of the procedure is there.

Are we playing a game where we're supposed to check his memory against the procedures listed in the Hosgri Report, or what's the purpose of this line of questioning?

The information is there in the Hosgri Report, obviously in far more detail than someone can sit there and remember off the top of their head.

I just don't understand what we're doing.

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: Is that an objection to my question to describe the shaker table procedure?

MR. NORTON: Yes, it is.

MRS. BOWERS: Does the Staff have --

MR. KRISTOVICH: I have a position.

MR. TOURTELLOTTE: I assume the basis of the objection is that this line of questioning is cumulative and repetitive and, therefore, should not be allowed to continue.

My understanding is that a question has been asked for an explanation to show that it isn't cumulative and repetitive, and I would tend to agree with that and would be interested in an explanation, if there is one, and if there isn't, then I think we should move on to something else.

MRS. BOWERS: Mr. Norton, you have submitted -- your witnesses have submitted direct testimony. Now, are you taking the position that whatever is in the Hosgri Report need not be explained, or --

MR. NORTON: No. No, not at all. If there needs

to be an explanation, fine. But in the Hosgri Report, at 7.6.2, it's got laboratory testing, and it starts explaining in detail all the tests.

The testimony just says that there were items tested on a laboratory shaker table, and the description of all that is right here.

I mean, I don't understand why they want a description of the testing. Now, if they want to read the description, and there's something in there that bothers them, or something that doesn't make sense to them, or something they don't understand -- whatever -- then questions about that would seem proper.

But to ask the witness to say off the top of his head what the testing was, when it's all set forth in great detail in the record already, it seems cumulative. I mean it's in the record, it's in evidence.

MRS. BOWERS: Well, in other matters, when questions have come up there have been specific references to the Hosgri Report or the FSAR. The witnesses have not -- of course they haven't had an opportunity in this particular situation to give a reference to the Hosgri report. You have.

MR. NORTON: Yes. You know, if the question were asked, "Is that procedure described in the Hosgri Report?" "Yes, it is," and so on, that's all right. But to have

him do it again, when it's all written out here in great detail, just doesn't seem to accomplish any purpose.

MRS. BOWERS: Well, you made a point yesterday that someone reviewing the record might not get into the Hosgri Report or the FSAR. So we think the witness can briefly describe what the Shaker table is, so it will be a part of the transcript.

MR. KRISTOVICH: Thank you.

BY MR. KRISTOVICH:

Q Mr. Antiochos, could you describe the Shaker table test?

A (Witness Antiochos) I could read it if you could understand my accent.

(Laughter.)

Q We're merely interested in a brief explanation for the record. You can just hit the high points.

A Okay. Are you referring to the Shaker table testing?

Q Correct.

A Okay. I have witnessed this, and really can tell you perhaps much more than time allows here.

I will tell you this:

Basically it consists of the following: The item that is going to be tested is mounted on the shaker table. The shaker table is really a steel table which could move in

two directions, one horizontal and one vertical.

The way that it moves on these directions is controlled by electronic equipment which simulate the movement that creates, with proper controls, the response that resembles very closely to the floor response spectrum where the item is located.

The item is mounted as realistically as possible on the table, and it is instrumented with accelerometers in special locations that, either by experience or by intuition, you feel this is a weak point or the point it is going to respond most.

In addition to that, you can put strain gauges or other equipment, if you wish, to measure stresses. And there is some kind of preliminary surge of the natural frequencies of the item in one axis at a time. The frequency of excitation starts from, say, 2 hertz and goes up to 35, very slowly, in a way prescribed in the code, and by observation of the responses from the accelerometers you can tell if you have reached a resonance somewhere in between, and you record it.

Then you will take the item, or if the table is capable to have the other axis activated, you repeat that on each particular axis, major axis, of the equipment, and you record the natural frequencies.

The second step after that is to subject the item

in specific frequencies of vibration. We are still in the one-axis domain. And you vibrate the table -- I forgot to tell you something basic, that the resonance surge is done with very low excitation, but after that you apply excitations on particular frequencies of interest with an input that is going to create on the table conditions simulating the conditions that it is expected to encounter on the plant.

After you have done the single-frequency test per axis, the third step is to subject the item in bi-axial excitation, which means one vertical and one horizontal, in such a way -- full blast now. The code allows, before you do that, to subject it to five OBE's before you apply the full excitation level.

Then you will take the equipment in the other major axis and you repeat the bi-axial random test.

That is very briefly the way they test it.

And at the same time -- excuse me, I forgot to tell you this -- the item, if it is supposed to act, for example a valve, to open or close, during this kind of test it is always opened and closed. The valve actuator, for example, opens and closes the valve as if the valve was called upon to function during shaking conditions.

Q What code were you referring to when you mentioned five OBE's?

A Excuse me. It's IEEE 344-1975 standard.

Q Did you qualify the equipment, then, to an IEEE standard? Mechanical equipment?

A We just tested the items according to that.

Q Did you use actual plant equipment for these shaker table tests?

A Yes. In some cases we had extra components that we tested that are not in the plant, but they are identical items.

Q But the other items you re-installed in the plant?

A Excuse me?

Q Were some of the items you tested reinstalled in the plant?

A Yes.

Q Which items?

A The items listed under B-1 in the table.

Q Did you verify before re-installing these items that the shaker table test did not provide excess aging to the equipment?

A Yes, sir.

Q And how did you do that?

A The NRC Staff requested that we evaluate the aging of the item, and the effect of the vibratory motion on the two main steam safety valves. There is a procedure within the ASME code which according to the stress levels you have reached during the test and the duration of the test, actually the --

the actual number of cycles the items are subject to. There is a procedure that tells you if you have exceeded any limits that could impair the integrity of the item.

We did that on the request of the Staff, and we have submitted information, and as far as I know, it is accepted.

Q How was aging specifically accounted for in the Hosgri reanalysis for the auxiliary mechanical equipment?

A I don't think that applies to the mechanical equipment.

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Q I thought you just said you provided information to the NRC on aging.

A We went an extra mile. That's all. They asked, and we supplied the information.

Q Well, Mr. Antiochos, correct me if I'm wrong:

Did you not, then, account for aging in the Hosgri analysis of the auxiliary mechanical equipment?

A That is not a requirement.

Q Well, that's not an answer to the question I asked.

MR. NORTON: Excuse me, Mrs. Bowers.

Based on the answer to the question that was asked, the question is irrelevant if it's not a requirement. If there's no requirement under the regulations, Reg Guides, Standard Review Plans or anything else, then it's not relevant.

MRS. BOWERS: Well, I think I asked a question yesterday about what equipment was there a requirement for aging. And it may have been a panel prior to this panel, but consisting of some of the same members. And it was explained that it was required only for the IEEE.

But there was some testimony about giving information to NRC on aging, as I recall.

WITNESS ANTIOCHOS: Yes, Mrs. Bowers.

MRS. BOWERS: And I think that's what Mr.

mpb2

Kristovich is trying to find out about.

MR. NORTON: No, I'm afraid that wasn't his question at all, Mrs. Bowers.

MR. KRISTOVICH: I was asking an additional question.

MRS. BOWERS: Your question was is it required?

MR. KRISTOVICH: No.

The question was: How was aging accounted for in the Hosgri reanalysis of the auxiliary mechanical equipment.

MR. NORTON: The objection was it's not relevant because it's not required, as stated by the witness. The question is not relevant. There is no requirement at all.

MR. KRISTOVICH: Where does it say in the regulations it's not required?

MR. NORTON: Well, I think one does not do everything in the world that the regulations say is not -- that the regulations are quiet about. I think that one does what the regulations require to be done.

MRS. BOWERS: Does the Staff have a position on this?

MR. TOURTELLOTTE: I guess I'd like to know where in the regulations it is required. If there is a basis for it, then I think Mr. Kristovich can state his question in terms of a specified regulation.

mpb3

MRS. BOWERS: Could you identify, Mr. Kristovich, the requirement in the regulations?

MR. KRISTOVICH: One moment, please.

(Pause.)

MR. NORTON: Mrs. Bowers, to proceed along, I think the witnesses can probably answer the question. It's not required; there's no place in the regulations that it is.

I think the witnesses can answer the question anyway. So I think to speed things up, I think we should allow -- I think it's Mr. Gormly who's got the microphone in his hands, or Mr. Esselman, I can't tell which -- to proceed to answer the question so we can speed things along, because they're reading the regulations. I'm afraid they're going to read a long time before they find anything.

(Laughter.)

MRS. BOWERS: You're withdrawing your objection?

MR. NORTON: Yes.

WITNESS GORMLY: I'd be always happy to pass the mike to Dr. Esselman.

I might add, just maybe because Mrs. Bowers has asked this question, that we're having a little problem as mechanical engineers with some people using a term "aging" which is coming out of an IEEE or an electrical code. It is bothering me a little because the implication is that the effect of life or duty cycles on our equipment has not been

mpb4

considered, and that is not the case. And each of our witnesses who have discussed qualifying things to the code -- the consideration of service life is considered in the design of mechanical equipment. But the term "aging" is inappropriate and we don't understand it as it applies to mechanical equipment. That's basically the problem.

MRS. BOWERS: Well, but the specific question is is there a requirement in the regulations.

WITNESS GORMLY: To my knowledge there is no requirement in the regulation to evaluate mechanical equipment for aging.

BY MR. KRISTOVICH:

Q Does mechanical equipment age?

A (Witness Gormly) I think I said yesterday it ages like I do, yes. But in the term you're using it -- we don't understand the term.

Do you understand, Mr. Kristovich, we design our equipment for service life, for the life of the plant. We take into consideration service life, and our codes require it.

And I think Dr. Esselman and Mr. Antiochos can enlarge on how the codes do indeed take into effect such things as repetitive cycles and the rest of it that we expect during the life of the plant.

A (Witness Antiochos) Mrs. Bowers, may I add

mpb5

something on this, just because we promise too many things that we don't deliver.

(Laughter.)

The mechanical equipment, one of the major problems usually is the corrosion, and the ASME code takes into account the fact that things corrode, for example. When you design a tank and it is new you have extra thickness of walls to take into account this kind of degradation of the material.

So in a direct way I think the aging is taken care of. And, of course, if the material is more exotic, if it is stainless steel or an alloy steel or something that doesn't corrode, we have one more reason not to worry about it. But for those cases that there is something, that something can degrade, by that time we take care of it.

In the meantimes, of course, the engineers will age more than the degradation of the equipment.

(Laughter.)

Q Well, Mr. Antiochos, could you amplify a little more on how you take into consideration service life of the equipment?

A Dr. Esselman would like to respond to that.

A (Witness Esselman) The additional evaluation which was performed for the Staff on this item that was tested was the fatigue analysis that calculated the damage or usage

mpb6

factor that was induced in the component because of the additional testing that was done on it.

The codes as they were developed take into account the service life of the component. The ASME boiler and pressure vessel code does this and it does it differently for different classes of components.

For instance, class 1 components in the primary system, specific fatigue analyses are performed for the cycles that would occur, both seismic and operating type transients that would occur over the life of the plant.

For this type of auxiliary mechanical equipment the stress limits in the code are set at a point such that fatigue is not required to be considered or evaluated specifically or explicitly, but it is inherently included in the way the code sets up the stress allowables and the way you combine stresses and the way you limit the stresses in the component.

A (Witness Gormly) I think the summary, Mr. Kristovich, is the way we understand aging, aging was considered.

(Pause.)

MRS. BOWERS: Mr. Kristovich, do you have considerable more examination?

We're thinking in terms of the mid-morning break.

MR. KRISTOVICH: Right.

mpb7

Actually this would be a good time for a break.

MRS. BOWERS: I never heard anyone say it would be a bad time for a break.

(Laughter.)

MRS. BOWERS: Ten minutes, then.

(Recess.)

MRS. BOWERS: Are you ready to continue, Mr. Kristovich?

MR. KRISTOVICH: Yes.

BY MR. KRISTOVICH:

Q Mr. Gormly, I would just like a little clarification.

How is aging for electrical equipment different from service life for mechanical equipment?

A (Witness Gormly) Mr. Kristovich, I'm really not an expert on codes which are not applicable to this plant. And I believe that the word "aging" is some new version of some code which is not a requirement on this plant.

There is going to be a later panel of people that may be a little more familiar with that code.

But I believe you're talking about the word "aging" as it somehow or other appears in some new code, some '74 or '75 version of IEEE 323.

IEEE 323 1971 is the code or the standard that we are required to meet.

mpb8

MR. KRISTOVICH: No further questions.

MRS. BOWERS: Mr. Tourtellotte?

BY MR. TOURTELLOTTE:

Q Dr. Esselman, earlier Mr. Kristovich was asking you questions about certain tests, specifically with reference to the SER, to a paragraph in the SER. He asked about whether or not PG&E had met all ASME Code requirements for auxiliary mechanical equipment. And I'm trying to give you an idea of the way I understood what happened because it was not clear to me.

It seems like you first answered him that you met the code in every respect or did something better. Then the second time around on what I thought was the same question, you answered that no code existed with reference to certain items at the beginning when the plant was designed, and therefore the answer to his question would be no, that you didn't meet all of the requirements.

And then you also said that in some cases you met it, and in some cases you did more than was required. So I guess I'm a little confused about what all that exchange was, and I thought maybe we could give a better elaboration or understanding about exactly what are we talking about when we say "meet all the requirements of the ASME code". Is that really necessary to ensure the plant's safety, or are there certain parts of the code which are really more safety related

mpb9

than others?

A (Witness Esselman) The ASME code is used several times in the process of designing and qualifying a component. In designing a component the ASME has -- the ASME code has rules for, for instance, the shape of the component or the wall thickness of the component.

The current requirements in the ASME code, that would be the 1978 version of the ASME Boiler Pressure Vessel Code, was not available when we performed those functions on the component, when we did the original design on the component.

My previous answer was that the 1978 version of the code, since it was not in existence in 1968 or 1970, was not used. However, we did use the applicable codes that were available at the time. In some cases this was the ASME code, in others it was the Pump and Valve Code, et cetera.

The second way in which you would use the ASME Boiler and Pressure Vessel Code in the sequence of events that occurs on a component is in qualifying that component for offnormal events, such as the seismic conditions that we're discussing here.

In the evaluation of the Hosgri earthquake, which was done in the 1978 time period, we used the code requirements from the most currently available code in that evaluation. My answer was no, we did not meet all the requirements of the

mpb10 current code, as when some of the steps were taken the current code was not available.

However, in performing the Hosgri evaluation we did meet all of the current requirements of the code for the evaluation. In particular, that was the stress limits.

Q There's a statement in the SER, Supplement number 73-65, Paragraph 3.9.3.7 --

MRS. BOWERS: Would you run through that again?

BY MR. TOURTELLOTTE:

Q And that's the fourth paragraph --

MRS. BOWERS: Well, but what page?

MR. TOURTELLOTTE: Supplement 73-65 is the page.

MRS. BOWERS: Okay.

BY MR. TOURTELLOTTE:

Q The fourth paragraph says "For analytical procedures"--

A (Witness Anticchos) Excuse me, could you wait a minute?

(Pause.)

MR. NORTON: Excuse me.

It's also quoted in the testimony, at the bottom of page 2 of Mr. Anticchos' testimony, for quick reference.

BY MR. TOURTELLOTTE:

Q Do you agree with that paragraph?

A (Witness Esselman) Yes, sir.

mpb11

MR. TOURTELLOTTE: No other questions.

EXAMINATION BY THE BOARD

BY MRS. BOWERS:

Q I have a question that goes to what was really a series of questions and answers between Mr. Kristovich and the panel. And it may well be that there was an explanation.

But the questions I'm concerned about to make sure that the record is explicit, the panel was asked a number of times if the OBE was limiting for certain items. And now, could you respond to exactly what is meant by the term "limiting"?

A (Witness Gormly) Mrs. Bowers, I really think that was Mr. Kristovich's word. It wasn't ours.

Q Well, but you answered.

A We attempted to answer the question by saying that to our knowledge the DE stresses were not controlling, were not controlling this.

The stress levels that we were getting in the DE analysis in general to the best of our knowledge, the panel's knowledge -- we keep seeing that the Hosgri stresses are controlling our design. I think we're answering the question in that context.

We keep looking at things and saying No, the most critical stresses we're seeing are the result of Hosgri type inputs we're getting, not the old DE stresses that we saw.

mpb12

A (Witness Gangloff) I think there are probably two ways to consider the word "limiting", at least in the context of limiting a design.

One way to look at it would be is the configuration of the item determined by the calculation in question? In other words, does the OBE or some other condition determine the size, shape, strength, whatever, of the item. And I think our answer was no; in all these cases, no, that wasn't the thing that determined what size it was.

The other way is is it a limit on the design? And the answer to that, of course, is yes. We have to meet that limit and many other limits. We have several conditions for which we have to show satisfactory results, and the OBE is a limit in that sense. It has to be satisfied.

But it didn't govern the configuration, in other words. Now that's another way of saying 'which event brought you closest to your limit', and I guess that's what Mr. Gormly was talking about. The Hosgri, in all the cases that we've looked at here, brings you the closest to your limits.

MRS. BOWERS: The Board has no further questions.

MR. NORTON: I have just a few.

REDIRECT EXAMINATION

BY MR. NORTON:

Q You were asked questions about the testimony on page 1, line 22, where it says:

mpb13

"Stress limits and other associated criteria were selected to meet or exceed 1978 requirements."

You were asked a few questions about that.

Let me ask you this, either Mr. Antiochos or Dr. Esselman or both:

Were the stress limits and other associated criteria selected to meet or exceed all applicable requirements, whether they be 1978 or 1971 or 1974, in other words, whatever was applicable at the time?

As the Board is well aware, there was a great deal of discussion about what was applicable for this plant; and what I'm really asking is:

This sentence doesn't meet that you didn't meet other applicable requirements, is that correct?

A (Witness Esselman) That's correct.

Q All right.

Now, Mr. Antiochos, there were two pieces of equipment you identified in the tables, Table 5 and 5A, that an OBE analysis was not done per se, Item number 6 in Table 7.5, which was the diesel generators fuel oil priming tank.

Can you tell the Board which event controls in that situation?

A (Witness Antiochos) Before I answer the question, I should point out that this item was introduced to our

mpb14

systems after the word "Hosgri" was introduced to our vocabulary.

Q In other words, the fuel oil priming tank didn't exist at the time of the DE analysis, is that correct?

A Correct.

Q All right.

And it was introduced after the Hosgri analysis was started, is that correct?

A Correct, for reasons independent of the seismic qualification. It doesn't have anything to do with Hosgri. It was not introduced because of Hosgri.

Q It was introduced for other reasons?

A For other reasons.

Q All right.

And a Hosgri analysis was done on it?

A Yes, sir.

Q All right.

Now, would a DE or an OBE analysis be a limiting condition vis-a-vis the Hosgri analysis?

A No, sir, the Hosgri is the limiting.

Q All right.

And what do you base that opinion on?

A The reason is that this item, since we are in the post-Hosgri, we designed everything in such a way that it meets the Hosgri criteria, first.

mpb15

Secondly is that the item, per se, as it is designed and installed, is a rigid item, which means that there is no effect on the analysis by where the item is -- by the rigidity of the item, which is very high. Which means, again, that the 7.5 -- the .75g earthquake is by far higher than the .2g originally stipulated.

Q All right.

Now the next item was from Table 75A, item 2, which is the auxiliary feedwater pump motor.

The same series of questions, of course, for that item, which event controls and why?

A Again, in this case the Hosgri event controls because the item, as you can see from the table, is a rigid item, from the frequencies. And the stress levels of the motor bearing -- that is the most stressed part -- is much lower in the case of the OBE.

Q All right.

Dr. Esselman, I believe yesterday that you testified something about the 33 hertz, which is what is listed for the diesel generator fuel oil priming tank, and the 37 hertz, which is auxiliary feedwater, as to why the Hosgri would control vis-a-vis the OBE.

Could you amplify on that again today in relationship to these two items we just talked about?

A (Witness Esselman) Yes, sir.

mpbl6

For a piece of equipment which has a frequency which is greater than 33 hertz, the component is considered rigid, there is no amplification within the component, and therefore damping does not have an effect. In a flexible component the damping differences between OBE and the Hosgri earthquake in some cases would make the relative accelerations smaller.

For a rigid component this is not as significant because the damping does not have any effect.

Q Then would you agree with Mr. Antiochos that these two items, that the Hosgri event would be controlling?

A Yes, sir, I would agree with that.

Q All right.

MR. NORTON: That's all I have, Mrs. Bowers.

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: No further questions.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: One moment.

(Pause.)

MR. TOURTELLOTTE: No questions.

MRS. BOWERS: The Board has no further questions.

MR. NORTON: We would ask that Mr. Antiochos be excused.

And we would like to call Mr. Bacher, who was sworn -- was it the day before yesterday when we swore all

mpb17

those witnesses? It was either the day before yesterday -- yesterday morning, okay.

(The panel excused.)

Whereupon,

H. JAMES GORMLY,

THOMAS C. ESSELMAN,

WILMER C. GANGLOFF,

and

RICHARD E. BACHER

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

DIRECT EXAMINATION

BY MR. NORTON:

Q Mr. Bacher, you reviewed your professional qualifications and they are true and correct copies that have been placed in evidence, is that correct?

A (Witness Bacher) Yes, they are.

Q All right.

Dr. Esselman, would you now summarize the written testimony on Class 1 Piping systems -- or Other Class 1 Piping Systems, I should say.

A (Witness Esselman) This testimony prepared by Mr. Bacher and myself describes the analysis of piping other than the reactor coolant system, which we covered in earlier

mpb18

testimony.

The testimony describes the piping that is included and describes the codes and analyses that were performed to evaluate that piping. The testimony describes the response spectra that were used in the evaluation of the piping, and it concluded that as a result of the analyses performed that the other piping, that is piping other than the reactor cooling loop, is adequate for the Hosgri event and will retain its structural integrity.

MR. NORTON: Mrs. Bowers, at this time we'd ask that the prepared testimony of Dr. Esselman and Mr. Bacher be placed in the record as though read.

WITNESS ESSELMAN: We have two corrections.

MR. NORTON: Oh, excuse me. I forgot to ask for the corrections.

MRS. BOWERS: Right.

WITNESS ESSELMAN: On page 2, line 24, there is a comma after the word "fuel" which should be deleted. It should read "the spent fuel pool cooling systems".

And on page 7, line 2, the word "approximately" should be replaced with "at least". That will read:

"At least 900 or 5000 piping supports have been or are being modified."

MR. NORTON: Mrs. Bowers, we would now ask that this testimony be placed in the record as though read.

mpbl9

MRS. BOWERS: Mr. Norton, if you don't ask it, Mr. Kristovich will:

Does the entire panel adopt this testimony?

MR. NORTON: Mrs. Bowers has already asked it. And I think the witnesses are assenting.

WITNESS GORMLY: Yes.

WITNESS GANGLOFF: Yes.

MRS. BOWERS: Any objection to the testimony being inserted?

MR. KRISTOVICH: No objection.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No.

MRS. BOWERS: Well, the testimony will be physically inserted in the transcript as if read.

(The testimony on Other Piping Systems follows:)

TESTIMONY OF
RICHARD E. BACHER
AND
THOMAS C. ESSELMAN
ON BEHALF OF
PACIFIC GAS AND ELECTRIC COMPANY
DECEMBER 4, 1978
DOCKET NOS. 50-275, 50-323

OTHER PIPING SYSTEMS

The purpose of this testimony is to briefly summarize the content and extent of the work performed by Pacific Gas and Electric Company and Westinghouse Corporation to qualify the piping systems in the Diablo Canyon plant. This testimony will cover all necessary piping except for the reactor coolant loop piping which was the subject of previous testimony presented by Dr. Esselman.

These piping systems in the Diablo Canyon plant are designed to meet all the appropriate requirements of 10 C.F.R. Part 50, 10 C.F.R. Part 100, and the applicable related codes and standards.

The piping systems at Diablo Canyon that were evaluated and qualified for the Hosgri event can be classified into four categories:

Steam Cycle - Those piping systems that deliver water to the steam generators and then carry the steam to the turbine. It is that piping necessary to operate the turbine (Condensate, Feedwater, Main Steam, Reheat Steam, Extraction Steam, Heater Drains, Make-up and Clean-up, Salt Water for cooling, Auxiliary Steam--all of which are part of

the traditional steam cycle). They are mostly Design Class II and are common to any power plant.

Reactor Operation - Those piping systems that are used to control the operation of the reactor during normal operation (Pressure Relief Piping, Residual Heat Removal, Chemical Volume and Control, Charging, Resistance Temperature Detectors). These are integrated with the various emergency systems used to shut down the reactor (Safety Injection, Boron Injection, Accumulators, Relief Valve Piping).

Reactor Auxiliaries - The secondary, or auxiliary piping systems, that provide heat sinks to the reactor systems (Component Cooling Water, Containment Spray, Make-up Water, Auxiliary Feedwater, Auxiliary Steam).

The Reactor Operation and Reactor Auxiliaries systems are Design Class I Systems with the exception of portions of the make-up water system. These were originally classified as Design Class II, but its design and analysis has been upgraded to Design Class I. Thus, a much larger source of water in a seismically qualified piping system is provided to assure long-term cooldown capabilities for the reactor.

Other Piping Systems - The other piping systems that were included in the qualification evaluation are Spent Fuel, Pool Cooling Systems piping, fire system piping, Containment Hydrogen Purge piping and the Radwaste piping.

The design class and code class delineation of the specific pieces of equipment and its associated piping is shown in the equipment tabulations in the FSAR, Chapter 3.2.

The seismic analysis for the Reactor Coolant System Branch Piping was performed by Westinghouse from data supplied by PGandE. The remaining analyses were done by PGandE.

The evaluation of the piping is performed per the requirements of the ANSI B31.1 code entitled, "Power Piping". The piping system must meet the Equation 11 of B31.1, i.e., that sustained load bending stress plus longitudinal pressure stress shall be less than or equal to the code allowable stresses at maximum operating temperature. Generally, the dead load bending stresses are kept below 1500 psi per the recommendation of B31.1. Thus, excessive sag between the supports is prevented and a considerable margin remains to allow for other loading conditions. Furthermore, all piping subjected to thermal expansion and/or differential anchor movements will meet the requirements of Equation 13 of B31.1 which establishes that the expansion of the piping caused by temperature changes plus any differential terminal point movements (such as connections to equipment or buildings) be less than or equal to the allowable stress range, S_A. S_A is defined in Equation 1 of B31.1.

The allowable piping stresses for seismic design are shown in equation form in Chapter 8 of the Hosgri Report.

An allowable is established for each earthquake intensity such that the sum of the primary stresses (dead load, pressure and seismic) are less than or equal to a factor, k, times S_h, the allowable stress at maximum temperature per B31.1, Appendix A, for the material involved. The value of S_h is the lesser of 25% of the ultimate strength, or 67% of the yield strength. The k factor is 2.4 for the Hosgri event.

The Hosgri evaluation required reanalysis with a whole new set of response spectra. The spectra used in the analyses were developed from the spectra in Chapter 4 of the Hosgri Report in the manner shown in Figure 8-2 of the Hosgri Amendment. The damping used is tabulated in Table 5-1 of the Hosgri Report.

Dead load analysis can be done either by simplified techniques or by detailed computer analysis. The objective is to assign support locations on the piping that supports the pipe for all sustained loads and are located in an accessible area for construction.

Parallel with this work, the thermal expansion analysis is used to determine the flexibility requirements, anchor locations, and whether rigid or spring supports should be used to control the dead load. The analysis techniques used are generally by detailed computer analysis. PGandE has used techniques identical to those used on Diablo

Canyon for dead load and thermal analysis on approximately 20 power generating units. Experience has shown reliable results.

Seismic analyses have been accomplished by one of two methods: either by detailed computer analysis or by a "rigid" free span spacing criteria. Chapter 3.7 of the FSAR and Chapter 8 of the Hosgri Amendment describe in detail how each technique is used.

The computer analysis is a modal superposition spectral analysis involving both the horizontal and vertical response spectra. Hosgri response spectra are applied along the North-South and East-West directions. A description of the computer programs used in the Hosgri analysis is found in Chapter 8 of the Hosgri Report.

The alternate analysis technique is a span length method based on the size of the pipe involved. Chapter 8 of the Hosgri Report describes that for each run of pipe, supports are placed at a distance which will generate a natural frequency of the pipe between supports at 15 Hertz, or higher. This technique was used for piping whose temperatures will not exceed 200 degrees Fahrenheit at diameters up to 6 inches. The supports themselves are arranged so that: (a) lateral translation of the pipe at each support is fixed, (b) each length longer than one span is fixed axially, and (c) concentrated loads (such as valves) are supported directly. Consequently, the response of the

piping to seismic excitement will be well within the allowables prescribed by the Codes without requiring detailed seismic analysis. The parameters used for this spacing criteria were checked against the Hosgri spectra by making several detailed computer models of actual plant piping and supports. The piping stress levels and support loads were found to be significantly lower than the predicted stresses and loads used for design purposes. Piping systems designed by this method were, therefore, adequate for the seismic loads.

A major step for piping design is the execution of detailed design of the component supports. Component supports can be segregated into categories: springs, snubbers, constant supports, rigids, and anchors. Their use depends upon the degrees of freedom that the engineer intends to control. Standard supports are used wherever possible to reduce specialized design.

The stress criteria described were utilized in the analysis of piping systems. The complete results of these Hosgri analyses are tabulated in Chapter 8 of the Hosgri Report as a comparison of the Hosgri pipe stress to the available seismic allowable. Table 8-3 of the Hosgri Report verifies that the Hosgri calculated pipe stresses are all lower than the code allowable stresses. Substantial modifications were required in the supports of the piping systems to accomplish a satisfactory stress state. The

modifications are documented in Chapters 8 and 13 of the Hosgri Report. Approximately 900 of 5000 piping supports have been or are being modified.

These analyses have verified that piping systems which are required to maintain the reactor coolant pressure boundary to shut down the plant, to maintain it in a safe condition, or to mitigate the consequences of accidents will be available to provide flow and will retain their pressure integrity in case of a postulated seismic event.

mpb1

MR. NORTON: The panel is available for cross-examination.

CROSS-EXAMINATION

BY MR. KRISTOVICH:

Q Okay, Mr. Bacher, directing your attention to page 1, lines 14 to 17, you state that these piping systems are designed to meet all the requirements of 10 CFR 50 and 10 CFR 100, and the applicable related codes and standards.

First of all, what are the applicable codes and standards?

A (Witness Bacher) B31.1, ANSI B31.1.

Q And what are the appropriate requirements you're referring to?

MR. NORTON: Excuse me, Mrs. Bowers.

The sentance says:

"...the appropriate requirements of 10 CFR Part 50, 10 CFR Part 100..."

Is he asking him to go through those two sections of the codes and detail each and every requirement from the code that is a requirement?

MR. KRISTOVICH: Well, I'll narrow it to:

BY MR. KRISTOVICH:

Q What specific sections of 10 CFR Part 50 are you referring to here?

A (Witness Esselman) Repeat your question, I'm

mpb2

sorry.

Q Which appropriate sections of 10 CFR Part 50 are you referring to?

A There are a variety of places where requirements apply to piping. One would be 10 CFR 50.55A, which requires -- which would specify the general codes. The General Design criteria would be used. 10 CFR Part 100 specifies that systems must remain integral in order to perform a shutdown function, et cetera.

There's a variety of places.

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Q Mr. Bacher, what was the floor response spectra that was used?

C7

A (Witness Bacher) The floor response spectra used was the one that we received from the Blume organization.

Q And was that the one that had been reduced from 1.15 peak instrumental acceleration to 0.75 effective acceleration and then further reduced for tau effect and damping?

MR. NORTON: Mrs. Bowers, every panel has been asked this question and every panel refers to the ones that were supplied. These people are not seismologists. They were supplied with a floor response spectra that's been identified as Chapter Four of the Hosgri Report.

These people don't -- you know, they may have sat here and heard that it was this, that and the other thing but they're not experts in that area and they don't know how that floor response spectra was derived.

MRS. BOWERS: Mr. Kristovich, do you want to respond to the objection?

MR. KRISTOVICH: No, I think Mr. Norton just testified and gave us the answer.

MRS. BOWERS: ARe you withdrawing the question.

MR. KRISTOVICH: No.

MRS. BOWERS: Well the objection is sustained. These people have said it's not within their expertise.

MR. KRISTOVICH: I never heard that from this panel.

WRB/agb2

MRS. BOWERS: They said they were given the information. They did not develop it themselves.

MR. NORTON: I'll object insufficient foundation and let Mr. Kristovich establish that these people have the expertise to establish a floor response spectra if he thinks he can, however, they stipulate that they can't.

MR. KRISTOVICH: That's not necessary. It's only if they cannot answer the question, if they don't have the knowledge, they can say so. They do not have to look to you to have you tell us they don't know it, they can tell us that and it would be a lot quicker if they did that.

MRS. BOWERS: Well, go ahead with your questioning on it but we certainly think it should be brief.

BY MR. KRISTOVICH:

Q The question is a yes or no question.

Do you remember the question or do you want me to repeat it?

A (Witness Gormly) Yes, I wish you'd repeat the question.

Q Fine.

Mr. Bacher, was this floor response spectra the spectra that started out originally as 1.15g peak instrumental acceleration and was then reduced to 0.75g effective acceleration and then further reduced for tau effect and damping?

A (Witness Gormly) Let me start here at this end

WRB/agb3

of the table and we will all answer it.

So we do not know and we do not have the expertise to determine that. We are given spectra, they are listed in Chapter Four of the Hosgri Report. We used the appropriate floor spectra for the place where the analysis is being conducted.

Q Thank you.

Mr. Bacher, what damping values were used?

Or Mr. Esselman, do you have something to add to Mr. Gormly's comment?

A (Witness Esselman) I think Mr. Gormly's statements would apply for the rest of the panel.

Q Mr. Bacher?

A (Witness Bacher) Indeed.

Q Mr. Gangloff?

A (Witness Gangloff) I agree.

Q -- I don't want to leave you out.

A Thank you.

Q Mr. Bacher, what damping values were used in the piping systems which your testimony addresses?

A (Witness Bacher) May I ask for which earthquake?

Q For the safe shutdown earthquake.

A For the Hosgri earthquake, we used 2 percent and 3 percent, per Reg. Guide 1.62.

Q Do you mean 1.61?

WRB/egb4

A 1.61, I'm sorry.

Q And what did you use for the OBE analysis?

A Half percent.

Q And was that in accordance with Reg. Guide 1.61?

A No, it's far less.

A (Witness Gormly) That's 50 percent of Reg. Guide allowable. And I think 25 percent, isn't it, Rich, for piping over 12?

We used half percent all the way through, is that correct?

A (Witness Bacher) Yes.

A (Witness Gormly) So it is 50 percent, 25 percent of allowable Reg. Guide damping.

Q Mr. Bacher, how were the seismic stresses combined with normal operating loads and stresses?

A (Witness Bacher) The seismic stresses, as they're combined, are described in the testimony, namely that the dead load stress plus the pressure stress plus the seismic stress are added together absolutely and then they are compared to an allowable.

Q Is this method for combining loads in accordance with Reg. Guide 1.92?

MR. TOURTELLOTTE: I'll object to that question, because it's not really relevant. 1.92 doesn't have anything to do with the subject matter at all.

WRB/agb5

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: I haven't heard a reason yet why it doesn't have anything to do with the subject matter.

MRS. BOWERS: Well could you tell us why it does?

MR. KRISTOVICH: I think that's what the expert witnesses are here for.

MR. NORTON: Mrs. Bowers, there's an objection pending and Mr. Kristovich's manner of handling objections is to let the witness answer the question and that'll somehow take care of the objection. Thus it doesn't make a very good ruling on the objection.

MR. KRISTOVICH: Mrs. Bowers, Mr. Norton objects because it's not relevant because it has nothing to do with this. I say it is relevant because it has something to do with this.

MRS. BOWERS: I think Mr. Tourtellotte objected.

MR. KRISTOVICH: Excuse me.

MRS. BOWERS: Mr. Norton, who do you agree with?

MR. NORTON: Well I don't know what Reg. Guide 1.92 says so I can't take a position until I look at it. I've got to get it. Unfortunately the witnesses have it.

Mrs. Bowers, I would think the matter could be handled very quickly by Mr. Kristovich saying does Reg. Guide 1.92 apply to the piping, and they could answer yes or no.

NRB/agb6

MRS. BOWERS: Well you're following his idea.

(Laughter.)

MR. NORTON: Well they've got the Reg. Guide in front of them and I don't, and they're capable of reading it and I think they could answer that question.

MRS. BOWERS: Let's go back to Mr. Tourtellotte. Why do you think it's not applicable?

MR. TOURTELLOTTE: It doesn't apply to the combination of normal loads with other loads, that's why it doesn't apply. And my understanding --

MR. NORTON: Excuse me, Mr. Tourtellotte. To short-circuit this, the witnesses are all shaking their heads yes and agreeing with what Mr. Tourtellotte said.

MR. TOURTELLOTTE: I was going to say I'm not sure that I agree with the way Mr. Norton would phrase the question. The question could be asked of these witnesses as to whether or not 1.92 does apply to the subject matter of their testimony. I guess if they have the Reg. Guide in front of them, they can read the title and it'll explain why it doesn't apply.

MRS. BOWERS: Well the objection to the earlier question is sustained.

Now if you'll lay a foundation for this, Mr. Kristovich.

BY MR. KRISTOVICH:

WRB/agb7

Q Mr. Bacher, does Reg. Guide 1.92 apply to the piping?

A (Witness Bacher) No, sir.

Q Why not?

A (Witness Esselman) We were not required to meet this Regulatory Guide in the analysis of the piping. It post-dated the piping criteria and the implementation allows for substitution of alternative methods of analysis.

Q So then, if I understand you correctly, Reg. Guide 1.92 is applicable to piping, but you just used a different method?

A (Witness Gangloff) No, I believe what he said was the implementation section of the Reg. Guide spells out the plants to which this Regulatory Guide is applicable, and Diablo Canyon is not one of those.

Q I thought that's what I had said.

MR. KRISTOVICH: May I have a moment, please?

MRS. BOWERS: Surely.

(Pause.)

BY MR. KRISTOVICH:

Q Mr. Esselman, does Reg. Guide 1.92 apply to piping?

MR. TOURTELLOTTE: That question has been asked and answered, Mrs. Bowers. The answer is yes, it applies to piping, but it doesn't apply to Diablo and it also doesn't

WRB/agb8

apply to combined and other loads.

MRS. BOWERS: Well can you move off 3.92, since it doesn't apply to --

MR. KRISTOVICH: Since I can't move to strike counsel's testimony, I'll move on.

(Laughter.)

MR. NORTON: I don't think a lawyer reading the Reg. Guide, which I suggest Mr. Kristovich do, is testimony.

BY MR. KRISTOVICH:

Q Mr. Bacher, how are the stress limits determined?

7.130

A (Witness Bacher) The allowable stress limits that we designed to?

Q Yes.

A They were determined by code values.

Q B-31.1?

A That's one of them, yes.

Q And what were the other ones?

A We also used a portion of Section Three because B-31.1 does not allow any guidance for what is know as the faulted condition.

Q How about B-31.7?

A 31.7 was not used for design.

Q Were measured material properties utilized in the analysis?

A No.

WRB/agb9

Q Mr. Bacher, in some cases, did the Hosgri loads turn out to be less than the original DDE loads?

A Excuse me, would you repeat that again, please?

Q In some cases, did the Hosgri loads turn out to be less than the original DDE loads?

A You did say stresses, Hosgri stresses?

MR. NORTON: No, he said loads.

WITNESS BACHER: Yes, there are places where Hosgri loads were less than the DDE loads.

BY MR. KRISTOVICH:

Q Can you give us some examples?

A (Witness Bacher) No, I can't. I don't try to memorize where they're located.

Q Do you know what percent of the times this occurred?

A It's a small percentage.

Q Can you give us a number for small?

A Not logically, no.

Q Well could you explain why this occurs, why in some cases the Hosgri loads would be less than the original double design earthquake loads.

A The output load from the analysis is the result of the response of the piping to the input spectra and due to the same set of curves themselves, there are times when the excitation of the pipe creates a different array of loads

WRB/agb1C

at the support points.

Q Was an OBE analysis performed for the piping systems?

A Yes.

Q And was the OBE controlling or limiting anywhere?

A There may be a few instances where it was, stress values in the pipe.

and1C

WRB/wbl

Q Could you give us those examples?

A No, sir. Again, I don't memorize that. The stress levels are below the allowables that we need to judge the pipe against. And that's kind of where it ends.

Q Do you have a percentage of how many times that occurred?

A No, sir, but it would probably be small.

Q When you say "small," do you mean less than five percent?

A Well, the same as before: it's very difficult to put any kind of numerical value on it. It's little.

Q Were the input spectra to the OBE analysis of the piping based on a vertical dynamic analysis?

A Excuse me, sir. Mr. Gangloff was speaking to me and I missed your question.

Q I'll repeat.

Were the input spectra to the OBE analysis of the piping based on a vertical dynamic analysis?

A Yes, we had vertical spectra in our analysis.

Q Well was this accelerated up by elevations, or did you use the floor level at all elevations?

A Well the derivation of the vertical spectrum was used two-third of the floor. --excuse me; two-thirds of the horizontal; excuse me, I'm sorry.

Q Of the horizontal at the floor?

WRB/wb2

A (Witness Esselman) For much of the piping the vertical spectra used was two-thirds of ground. For some of the piping the vertical spectra that was used was two-third of the floor acceleration.

Q Mr. Eacher, are there any pipe snubbers in these piping systems?

A Yes, sir.

Q How was snubber failure included in the models, in the seismic models?

A The seismic models we did for our piping analysis did not include snubber failure.

Q Directing your attention to page 2, line 15, how do you class A, B and C piping systems referred to in FSAR Section 3.2 to correspond to design class 1 and 2?

A (Witness Gormly) Mr. Kristovich, let me help hRichard here. He doesn't do that.

Q Could you answer, Mr. Gormly, then, or could one--

A We had a panel here before where we discussed how systems are selected and which become vital systems and which piping systems must be used. That panel, the people on that panel provide the guidance for the piping group in selectinn of what classification they would then use. Then based on, given the classification he would take over and do the analysis and evaluate it against the appropriate stress

WRB/wb3

levels for that class of piping. He would not determine whether apipe ought to be a Class A or a Class B pipe.

Q Maybe I was unclear in the question. I just want to know -- and any panel member can answer this: Is there a correlation between Class A, B and C piping systems and design Class 1 and 2?

A (Witness Esselman) Yes, sir. Class A, B and C piping make up the Design Class 1.

Q So they're all Design Class 1?

A Yes, sir.

Q Directing your attention to page 3 of the written testimony, at line 13, you begin a sentence on that line and you state, "Generally the deadload bending stresses are kept below 1500 psi per the recommendation of B-31.1." And I'm a little unclear by your use of the term "generally." Do you mean in every case?

A (Witness Bacher) There's a recommendation in B-31.1 to maintain the deadload bending stress at approximately less than 1500 psi. But the requirements of the code are that the deadload stress plus the pressure stress be less than or equal to the term S_h which Dr. Esselman described yesterday.

Q I'd like to direct your attention to page 4 of the written testimony at line 7. You state, "The K factor is 2.4 for the Hosgri event." And then at page 8-8 of the Hosgri Report....

WRB/wb4

Do you have that there?

A (Witness Esselman) Will you repeat the page again, please?

Q 8-8.

Under Section 2 on page 8-8, the second sentence states, "The allowable combined stresses were currently accepted values for faulted conditions, 2.4 S_h for Class B and C piping per ASME Code Case 1606-1, and 3.6 S_h for Class A piping, unchanged from the FSAR Table 5.2-13."

Could you explain this apparent contradiction?

MR. NORTON: Excuse me, Mrs. Bowers. That's the second time Mr. Kristovich has said "this apparent contradiction." It may not be an apparent contradiction to engineers who understand the terminology. It may be an apparent contradiction only to Mr. Kristovich. And I think it's an improper question. I haven't objected to it before, but the question can be asked in a way which will prove whether or not there's a contradiction.

MR. KRISTOVICH: I'll rephrase the question.

MRS. BOWERS: Well the objection is sustained. You need a foundation here.

BY MR. KRISTOVICH:

Q Is there a contradiction between these two statements that were read?

A (Witness Esselman) No, sir. This was discussed

WRB/agb1
flwsWRB/wb4

yesterday and the criteria is correctly stated on Page 8-8 of the Hosgri Report. The testimony indicates that we did not exceed a value of 2.4 S_h.

Q Mr. Bacher, are there any cases where the pipe is allowed to go into the inelastic mode?

A The piping codes that were used have stress limits which do exceed the yield stress. These are allowed by the codes that were used.

Q I'd like to direct your attention to page 7, lines 8 and 9.

How did you verify that piping will retain their pressure integrity in case of a postulated seismic event?

A The piping codes that we use assure this. By meeting the codes which are designed to protect the structure integrity of the piping, we assure that the pressure integrity of the piping will be maintained.

Q Mr. Bacher, was aging accounted for in the Hosgri re-analysis of piping?

MR. NORTON: Same objection as before, there's no foundation that aging is a requirement. I thought Mr. Gormly and Dr. Esselman laid that to rest on the last panel.

MRS. BOWERS: Well the objection is sustained, and primarily because of the use of the word "aging." Now you may be able to get where you want to go.

BY MR. KRISTOVICH:

WRB?agb2

Q Mr. Bacher, is aging required as part of the Hosgri re-analysis?

A (Witness Bacher) No.

Q Is a re-analysis valid for 40 years?

A Yes.

Q Could you describe how service life of the piping is taken into consideration?

A (Witness Esselman) As we described in the discussion on this subject from the last panel, this code, as well as other codes, have built into it in the stress limits and in the way the loads are combined and in the stresses that need to be compared to the loads, a protection against cyclic service, cyclic life and transients over the life of the plant. Protection against that event is inherent in the codes that we used.

MR. KRISTOVICH: No further questions.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No questions.

EXAMINATION BY THE BOARD

BY MR. BRIGHT:

Q I just have a minor clarification.

On Page Seven, you say:

"At least 900 to 5000 piping supports have been or are being modified."

Is it fair to assume that, at most, the 4100 that

WRB/agb3

are not being modified did not need to be modified and were shown to not need it because of your analysis?

A (Witness Gormly) I think those numbers came out of the first-day testimony. And I think what we're saying is that all these pipe supports have been evaluated, they have been verified, they do meet the criteria. We have to modify at least 900 of them to meet the Hosgri-type loading.

Q But not the other 4100?

A Well I think that's right, yes, not the other 4100. They have been verified, we don't think we have to modify them.

Q All right. Thank you.

MRS. BOWERS: The Board has no further questions.

Mr. Norton?

MR. NORTON: No redirect.

MR. KRISTOVICH: No further questions.

MRS. BOWERS: Mr. Tourtellotte, did the Board's questions stimulate you to vigorous further cross-examination?

MR. TOURTELLOTTE: Well it certainly stimulated me, but not to vigorous further cross-examination.

(Laughter.)

MRS. BOWERS: Is that the last word?

MR. TOURTELLOTTE: I hope so.

(Laughter.)

MR. NORTON: Mr. Tourtellotte is a man easily

WRB/agb4

stimulated, I can see.

(Laughter.)

MRS. BOWERS: Mr. Norton, this appears to end the panel.

MR. NORTON: No, we have one more panel, Electrical Equipment and Instrumentation.

MRS. BOWERS: Oh, yes.

MR. NORTON: We'd like to take five minutes while we change panels.

MRS. BOWERS: When you say five minutes, I hope you mean five minutes. Everybody seems to go see other-looking.

MR. NORTON: I mean it, but I have no control over the others.

(Witness panel excused.)

MRS. BOWERS: Well, we'll take a five-minute recess.

(Recess.)

MRS. BOWERS: Can we proceed? May I have your attention, please? We'd like to proceed.

MR. NORTON: Mrs. Bowers, I don't want to get into a protracted discussion, but I thought we were going to hear about Dr. Brune. It really doesn't do us any good to not hear about Dr. Brune until Monday sometime, because we have to get our people here and we have to notify them so they can make plane reservations, and so on.

Based on yesterday, we called last night and told them it looks like you should be here Tuesday late afternoon or Tuesday evening, because Dr. Brune will go on Wednesday morning. And unless we get a change now, we certainly can't call and notify them on Monday to be here Monday.

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: Mrs. Bowers, Mr. Fleischaker made efforts yesterday afternoon and evening. He tried to contact Dr. Brune's office and could not reach the secretary.

He contacted Dr. Brune's home. Dr. Brune's wife wasn't there. Mr. Fleischaker spoke to his child who did not know where Dr. Brune was.

MRS. BOWERS: I thought Dr. Brune was in Texas.

MR. KRISTOVICH: But we're trying to figure out where in Texas, and Mr. Fleischaker wasn't able to ascertain that. So as of now, the situation is still the same.

MR. NORTON: I thought Mr. Fleischaker said he had

talked to Dr. Brune yesterday, or day before yesterday, when he was in Texas.

MR. KRISTOVICH: I think it was before he went to Texas.

MR. NORTON: Oh, okay.

MR. KRISTOVICH: So Mr. Fleischaker tried, but there's no change.

MR. NORTON: Well, then, we assume Dr. Brune will be here Wednesday morning and we'll have our people here Tuesday. Because, you know, there's no way we can --

MRS. BOWERS: Was he going to continue to try to reach Dr. Brune?

MR. KRISTOVICH: I'm sure he will. But as of now, I can only say the situation is the same.

MR. NORTON: Our problem, Mrs. Bowers, is that if we don't notify them now, there's no way they can get here Monday to be ready for Tuesday morning.

MRS. BOWERS: Well, he's in Houston?

MR. KRISTOVICH: I believe so. He's in Texas.

(Laughter.)

MRS. BOWERS: Well, so many of the scientific assemblies are at the Shamrock Hilton in Houston. And of course at a meeting like that I'm sure there's a bulletin board for messages.

Well, you know, keep trying, and if you are able

to get in touch, do you know how to contact Mr. Norton?

MR. NORTON: I'm in California.

(Laughter.)

MR. NORTON: All right. This is the final panel, Electrical Equipment and Instrumentation. It is the same three gentlemen we've had before. In addition, we have R. Alyn Young as the panel member who is going to summarize the testimony.

MRS. BOWERS: Is he the same person as Robert A. Young?

MR. NORTON: Yes. That's Alyn.

(Laughter.)

WITNESS YOUNG: May I comment that that's Alyn with a "y."

Whereupon,

H. JAMES GORMLY

THOMAS C. ESSELMAN

WILMER C. GANGLOFF

and

ROBERT A. YOUNG

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

DIRECT EXAMINATION

BY MR. NORTON:

Q Alyn, would you summarize the testimony, please?

A (Witness Young) The purpose of the testimony is to summarize the programs undertaken by Pacific Gas & Electric Company and Westinghouse to qualify the electrical equipment for service at Diablo Canyon.

The equipment included in the program ranged from power handling equipment, such as large circuit breakers and transformers, through safety function controlling equipment, motor starters, et cetera, and instrumentation and alarming systems.

In 1968 and 1969 PG&E was preparing specifications for equipment that included seismic qualifications which we felt were appropriate at the time.

We have lived always in a seismic zone, and have always been aware of seismic concerns.

Westinghouse at that time was also developing programs to qualify electrical equipment.

Around 1973 and 1974 the IEEE was developing a new standard upgrading to current technological standards, and included the advancements in technology to more adequately and realistically qualify the equipment.

The new procedures in general included multi-frequency, multi-axis testing, more detailed monitoring and more documentation.

When the Hosgri reevaluation program began, both

PG&E and Westinghouse undertood to reevaluate the existing documentation to ascertain its relevance to the new situation and what qualifications it did provide.

These programs basically were conducted in two phases. The first phase was to review the existing documentation in light of the Hosgri requirements, and if found lacking a program was undertaken to demonstrate the adequacy of the equipment, using later technology and programs.

Part of the Westinghouse included justifying all of the existing testing which they had done previously. This was done generally under the scrutiny or observance of the NRC to demonstrate or to show that the testing that they had done was, indeed, adequate.

The second phase of their program included verification to the NRC that their tests did, indeed, provide qualification for the equipment specifically installed at Diablo Canyon.

Most of this work has all been reviewed by the NRC Staff. They conducted thorough audits at both our facilities and at Westinghouse to verify this program and the results.

In addition to testing the electrical equipment, we reanalyzed the supports for our raceway system, which sort of makes the system complete, so that we felt we could, indeed, demonstrate that the total electrical equipment and

appurtenances would be satisfactory.

The conclusions of all of this reevaluation we feel demonstrates that the equipment is suitable for service at Diablo Canyon.

Q Mr. Young, are there any corrections to the testimony?

A No, sir.

Q Does each member of the panel adopt the testimony as their own?

A (Affirmative indications from all panel members.)

MR. NORTON: Let the record show that they all said yes.

Mrs. Bowers, at this time we'd ask that the testimony entitled, "Electrical Equipment and Instrumentation" be physically placed in the record as though read, and the panel is passed for cross-examination.

MR. KRISTOVICH: No objection.

MRS. BOWERS: Mr. Tourtellotte, the testimony has been offered.

MR. TOURTELLOTTE: No objection.

MRS. BOWERS: The testimony will be physically incorporated within the transcript as if read.

(Document follows:)

TESTIMONY OF
THOMAS C. ESSELMAN
AND
ROBERT A. YOUNG
ON BEHALF OF
PACIFIC GAS AND ELECTRIC COMPANY
DECEMBER 4, 1978
DOCKET NOS. 50-275, 50-323

ELECTRICAL EQUIPMENT AND INSTRUMENTATION

The purpose of the testimony is to briefly summarize the content and extent of the work performed by Pacific Gas and Electric Co. and Westinghouse Electric Corporation to qualify the safety-related electrical equipment in the Diablo Canyon Nuclear Power Plant for the postulated Hosgri earthquake. A program was undertaken to use current technology to seismically qualify all safety-related electrical equipment. This seismic qualification program and associated activities meet the applicable requirements of 10 CFR 50 and 10 CFR 100. The program included various categories of equipment such as power handling equipment (i.e. circuit breakers, power transformers), power and safety function controlling equipment (i.e. motor control, reactor control and protection systems), instrumentation, including sensors, transmitters and indicators, as well as emergency lighting and warning and alarm equipment. A complete list is shown in Figure 1. The details of the qualification program are provided in Section 10 of the Hosgri Report.

Background

In the late 1960's, PGandE engineering began writing specifications for electrical equipment for Diablo Canyon. Specifications written at that time included requirements for seismic qualifications of all safety-related equipment. Specifications were written in a manner reflecting the state of the art for seismic qualification at that period in time. At approximately the same time, when the need to demonstrate the seismic adequacy of electrical equipment became an industry wide requirement, Westinghouse initiated the development of test methods to seismically qualify this class of equipment. The methods developed by Westinghouse ultimately became the national IEEE-344-1971 Standard and were adopted throughout the industry as the method used to qualify equipment for nuclear power plant applications.

Electrical equipment and instrumentation furnished with the Nuclear Steam Supply System (NSSS) and similar equipment and instrumentation in the balance of plant was subjected to tests consisting of vibration testing of representative types of each major category of equipment -- such as switchgear, process control cabinets, transmitters, etc. The test inputs were severe, single frequency, single axis inputs using a sine beat wave form.

The procedure for demonstrating seismic adequacy of the Diablo Canyon equipment was to take the peak floor

acceleration in units of "gravity" (g's) at the equipment mounting location and compared that value to the largest test acceleration input applied near the building dominant resonant frequency. If the test acceleration was higher than the original Double Design Earthquake, the equipment was considered qualified. Figure 2 shows a comparison for the original seismic requirements at Diablo Canyon. Other equipment was considered qualified to the original requirements as a result of various testing and analytical methods employed at that time.

In late 1973 and early 1974 the Institute of Electrical and Electronics Engineers began a major rewrite of Standard 344 and the revised standard was formally issued as IEEE Standard 344-1975. The revised standard reflects the advancement of the technology in the area of seismic qualification by test which occurred between 1969 and 1975. Briefly, the new requirements include: 1) multi-frequency, multi-axis inputs which envelope the required response spectra; 2) more elaborate and sophisticated electrical circuit monitoring during the test; and 3) extensive documentation for both the generic tests and later for the application of the generic tests to specific plant requirements. The major differences are summarized on Figure 3.

Hosgri Evaluation

As a result of the NRC requirements related to the postulated Hosgri event, PGandE and Westinghouse undertook a

re-evaluation of all safety related equipment to current seismic standards. This re-evaluation was done in two phases. This is shown in Figure 4. Phase I consisted of reviewing the documentation which had been originally furnished by vendors to demonstrate seismic adequacy. This review consisted of comparing the existing documentation with the new requirements generated as a result of detailed structural analysis of the building and structures for the postulated Hosgri spectra (Chapter 4 of the Hosgri Report). This phase of the re-evaluation also included some in-situ testing at the plant.

Phase II of the re-evaluation program consisted of seismically testing in a laboratory that equipment for which adequate qualification could not be demonstrated by review of previously available documentation. Equipment was removed from Unit 2 at Diablo Canyon and delivered to a testing laboratory. Typical components representative of equipment installed at Diablo Canyon were included in this program. Types of equipment included in this program varied from 4,000 volt switchgear to dc batteries to control board push buttons. Approximately 25 different components were included in the test program. These components were divided into seven groups and each group was tested to the required response spectrum which was derived from the analysis of the various buildings and structures at Diablo Canyon and were

representative of the location of the equipment in the plant. Figure 5 shows the equipment and groupings.

This re-testing program was conducted in accordance with current standards for seismic qualification testing which are IEEE Standard 344-1975, and Regulatory Guide 1.100. Each piece of equipment was mounted on a shake table in a manner representative of its actual mounting configuration in the plant and subjected to multi-frequency, multi-axis test input vibrations. The response spectra of the shake table motion enveloped the required response spectra which was generated by the computer analysis of the plant structures and is representative of the expected floor motion at the location in the plant where the equipment is located. Each piece of equipment was subjected to five tests simulating the operating base earthquake (OBE) and two tests simulating the postulated Hosgri earthquake and was then rotated 90 degrees on the table and the tests repeated. During all of these tests the equipment was monitored for proper electrical operation. After this series of tests, each piece of equipment was checked and verified to be in correct operating condition before being re-installed in the plant. The guidelines for this post test check-out are shown in Figure 6.

Prior to the Hosgri re-evaluation program and as a result of revision to IEEE Standard 344, the NRC began a supplemental review of all phases of the previous generic qualification tests performed to IEEE Standard 344-1971.

The questions raised included: adequacy of the previously used single frequency and single axis tests, adequacy of the monitoring of electrical circuits during the tests, and also the application of the tests to individual plant requirements. To resolve the first two issues which apply to the generic test methods applicable to any site, Westinghouse proceeded with a supplemental seismic qualification program, which was started in the spring of 1975 and completed in May of 1976. The program, which is summarized in Figure 7, re-established the adequacy of the prior generic tests as meeting the intent of IEEE Standard 344-1975. However, the NRC did require an additional effort to establish the adequacy for an individual plant application, such as Diablo Canyon. This was applied for equipment qualified by the "existing documentation" option of Figure 4. The additional requirements were that the prior tests, in terms of test response spectrum (frequency content and amplitude), be adequate for the Diablo Canyon requirements. A comparison of the test response spectra and the required response spectra was made and the results for each equipment design are summarized in Section 10 of the Hosgri Report. Figure 8 presents a typical comparison that shows the severity of the generic qualification levels relative to the Hosgri requirements. The generic qualification in general is greater by a factor of 2 at the peak of the required floor response spectrum.

In addition to the past generic reviews, for the Diablo Canyon equipment designs, a special review was conducted by the NRC Staff. This special review consisted of a new review of the past qualification reports and a review of the plant specific comparison of the test response spectrum for each equipment design. Also, in January, 1978, the NRC Staff performed a detailed audit on specific equipment designs which involved a detailed review of actual test data and calculations. A summary of both the generic and plant specific program for NSSS scope equipment for the Diablo Canyon Plant was presented at the ACRS Subcommittee Meeting held in Los Angeles in June of 1977, and by the NRC Staff at the August, 1978 ACRS Subcommittee Meeting.

In addition to the testing and qualification program which we have just outlined for electrical equipment and instrumentation, we analyzed the capability of the supports for electrical raceways to withstand the postulated Hosgri earthquake. As a result of such analyses, modifications were made to 19 out of approximately 600 electrical raceway support details.

The conclusions from all of these various technical reviews and the various testing programs conducted to the latest industry standards are that it has been demonstrated that the equipment can perform its intended safety function both during and after the occurrence of the postulated

Hosgri earthquake and that the qualification conforms with the regulatory requirements.

FIGURE 1

SUMMARY - SEISMIC QUALIFICATION OF CLASS IE INSTRUMENTATION AND ELECTRICAL EQUIPMENT

PARAGRAPH IN HOSGRI REPORT	ITEM	EQUIPMENT
10.3.1	1.	ANNUNCIATOR, MAIN
10.3.2	2.	AUXILIARY SAFEGUARDS
10.3.3	3.	BATTERY CHARGERS
10.3.4	4.	STATION BATTERY BATTERY RACKS
10.3.5.1 10.3.5.2	5.	DC MOTOR CONTROL CENTER SWITCHGEAR
10.3.6	6. 6a. 6b.	DIESEL GENERATORS EXCITATION CABINET ENGINE CONTROL CABINET
10.3.7	7.	ELECTRICAL PENETRATIONS
10.3.8	8.	FIRE PUMP CONTROLLER
10.3.9	9.	HOT SHUTDOWN PANEL (FISHER CONTROLLER)
10.3.10	10.	STATIC INVERTER
10.3.11	11.	INSTRUMENT AC PANEL (BREAKERS)
10.3.12	12.	INSTRUMENT PANELS PIA, B&C
10.3.13	13.	LOCAL INSTRUMENT PANELS (INCLUDES SOLENOID VALVES)
10.3.14	14.	LOCAL STARTERS
10.3.15	15. 15a.	MAIN CONTROL BOARD SWITCHES AND INDICATORS

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FIGURE 1 (CONT'D)

SUMMARY - SEISMIC QUALIFICATION OF CLASS IE INSTRUMENTATION AND ELECTRICAL EQUIPMENT

PARAGRAPH IN HOSGRI REPORT	ITEM	EQUIPMENT
10.3.16	16.	NUCLEAR INSTRUMENTATION SYSTEM
10.3.17	17.	P & ΔP TRANSMITTERS
10.3.18	18.	P & ΔP TRANSMITTERS
10.3.19	19.	PROCESS CONTROL & PROTECTION EQUIPMENT
10.3.20	20.	REACTOR TRIP SWITCHGEAR
10.3.21	21.	SAFEGUARDS RELAY BD.
10.3.22	22.	SOLID STATE PROT. SYSTEM
10.3.23	23.	VENTILATION CONTROL, LOGIC
10.3.24	24.	VENTILATION CONTROL, RELAY PANEL
10.3.25	25.	VITAL LOAD CENTER
	25a.	AUXILIARY RELAY PANEL
	25b.	FAN COOLER STARTER
	25c.	4160 - 480 VAC TRANSFORMER
10.3.26	26.	VITAL SWITCHGEAR (4.16KV)
10.3.27	27.	RESISTANCE TEMP. DETECTORS
10.3.28	28.	SAFEGUARDS TEST CABINET
10.3.29	29.	CABLE TRAYS
10.3.30	30.	LIMIT SWITCHES
10.3.31	31.	POTENTIAL TRANSFORMERS
10.3.32	32.	EMERGENCY LIGHT BATTERY PACK

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FIGURE 2

EQUIPMENT MOUNTING HORIZONTAL ACCELERATION VERSUS FREQUENCY FOR TESTING - PG&E PLANTS

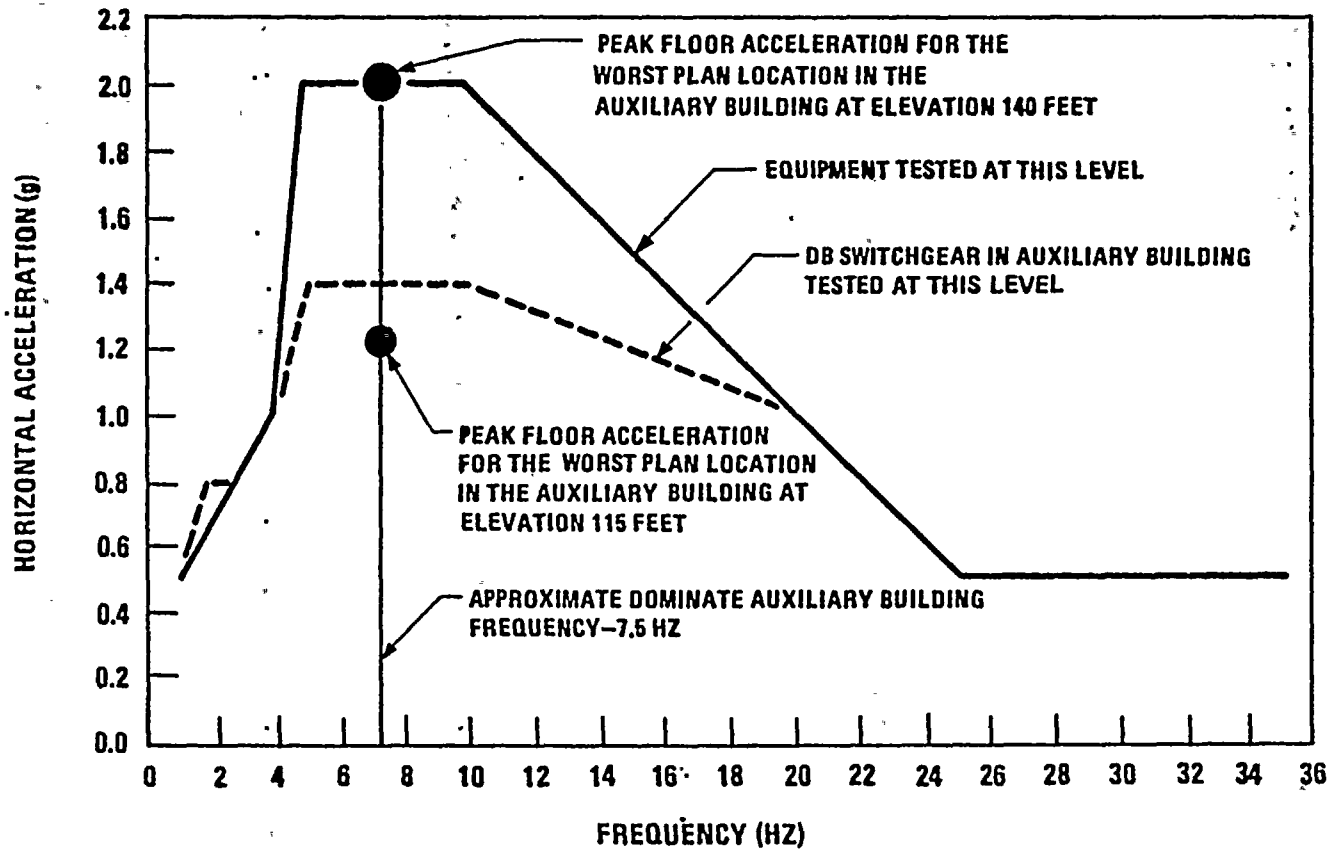

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FIGURE 4

REQUALIFICATION PROGRAM

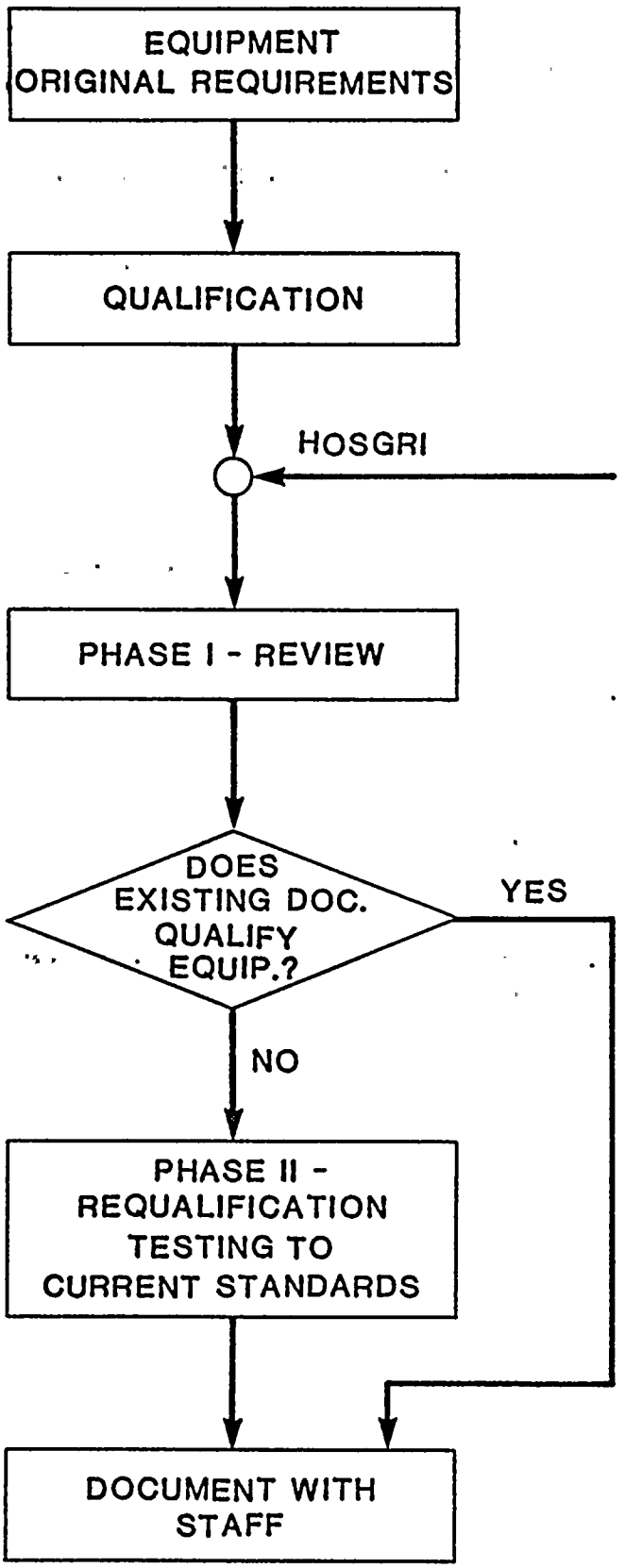

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FIGURE 5

PHASE II REQUALIFIED EQUIPMENT BY TEST GROUP COMPOSITION BY GROUPS

GROUP I

4.16KV Switchgear
Safeguard Relay Board
Emergency Light System

GROUP II

Diesel Generator Excitation Cubicle
Diesel Generator Control Panel Door
Diesel Generator Control Cabinet Sub-Panel with the following items mounted on the panel:

1. Differential Pressure Switch (two)
2. Contactor (one)
3. Switching Tachometer (one)
4. Time Delay Relays (two)
5. Relays (four)
6. Industrial Control Relays (four)

GROUP III

Ventilation System Relay Sub-Panel
Ventilation System Printed Circuit Board and Power Supply
Annunciator Components (11)

GROUP IV

DC Distribution Panel
Battery Charger
Turbine Lube Oil Starter
Fire Pump Controller
Local Starter (LPF 37)
Battery Cells (two)

GROUP V

Vital Load Center (480v)
Fisher Controller
Local Starter (LPG66)
100amp Breakers (two)
Starters (seven)
Auxiliary Relay Panel (480v Bus 2H)
Auxiliary Relay Panel (Bus G)

GROUP VI

Local Starter (LPF 36)
Snap-Lock Limit Switch (two)

GROUP VII

Switches (six)
Ammeter

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FIGURE 6

GUIDELINES FOR POST TEST CHECK OUT

The following guide lines were implemented prior to the Reinstallation of equipment which was seismically tested in off-site laboratories.

All non-functional portions of equipment were checked and, when necessary, repaired for any of the following which may have occurred during testing or shipping:

1. Check for any deformation of equipment or housing.
2. Check for indications of broken welds, such as cracked paint.
3. Check all screws and bolts for tightness.
4. Check for any frayed wire near sharp edges.
5. Check for any wires which may have loose terminations or are disconnected.

All functional portions of equipment were checked and tested as described below:

1. Check trip settings of all relays.
2. Check calibrations on all meters and instruments.
3. Check physical operation of all switches.
4. Check that all relays and printed circuit boards are properly connected in their sockets.
5. Do any special testing as required by the engineers (i.e., 8 hour discharge test on batteries)
6. Perform a Dry-Run-Test and Start-up test as a final check to assure that all equipment is fully operational in its' plant function.
7. Document everything which was checked, found in error (including the actual setting value) and all corrective actions taken.

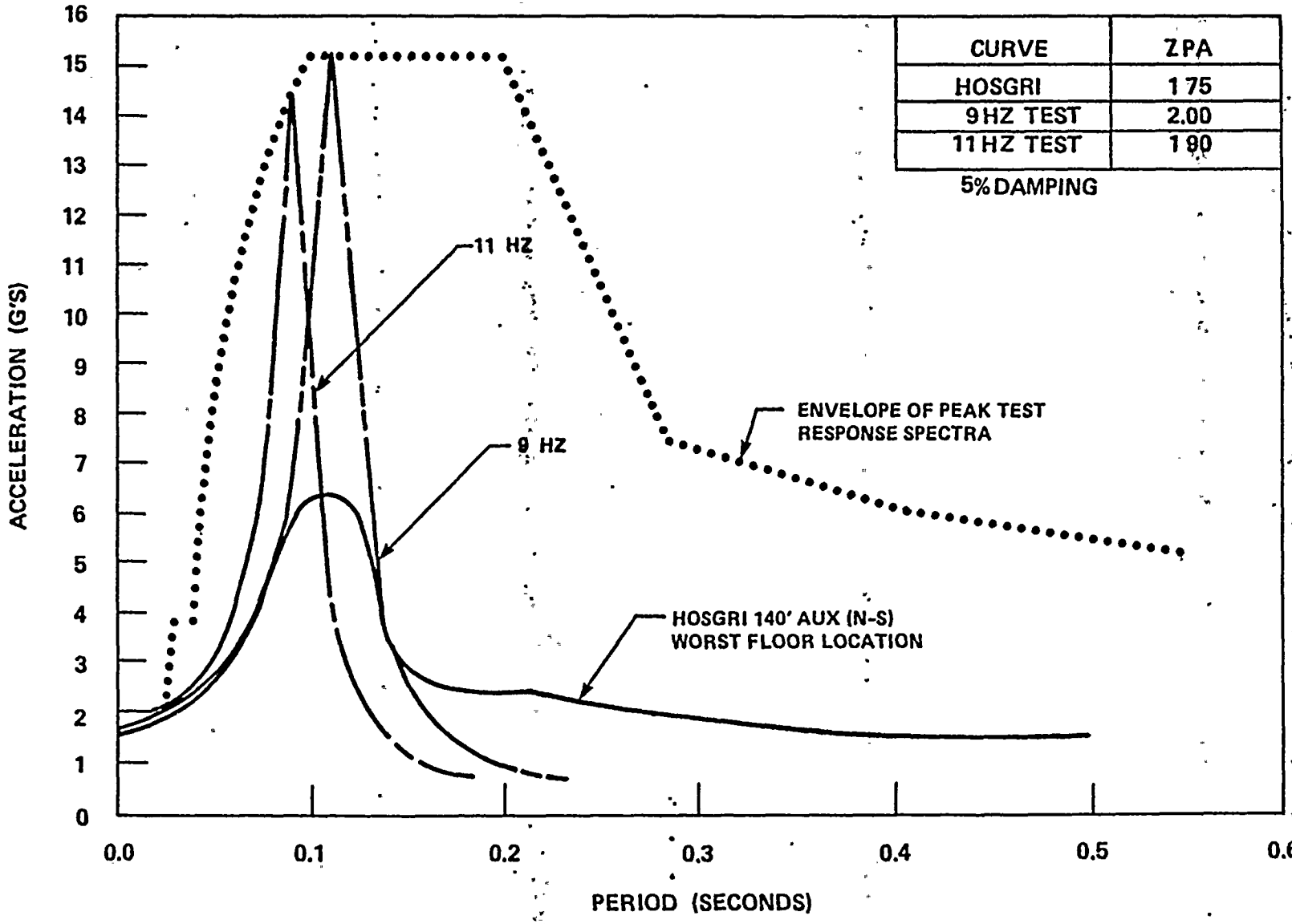
FIGURE 7

SUPPLEMENTAL QUALIFICATION PROGRAM FOR GENERIC EQUIPMENT

- DEMONSTRATE THE ADEQUACY OF THE 10 CYCLE PER BEAT SINE-BEAT
- NRC STAFF FIELD INSPECTION OF "AS-INSTALLED" EQUIPMENT
- DEMONSTRATION TEST PROGRAM
  - STATIC INVERTER AT 85% POWER WITH BI-AXIAL SINE-BEATS (1975)
  - FOXBORO PROCESS CONTROL EQ. BI-STABLES MULTI-FREQ. & AXIS (1975-76)
  - WCID 7100 PROCESS CONTROL EQ. BI-STABLES MULTI-FREQ. & AXIS (1975-76)
  - WCID 7300 PROCESS CONTROL EQ. BI-STABLES MULTI-FREQ. & AXIS (1975-76)
  - NIS CABINETS BI-STABLES MULTI-FREQ. & AXIS (1975-76)
  - TYPICAL RELAY REPORT
- COMPARISON OF SINE-BEAT RESPONSE SPECTRA TO ACTUAL INDIVIDUAL PLANT REQUIREMENTS FOR PLANTS REQUIRING CERTIFICATION TO IEEE-344-1975

FIGURE 8

RESPONSE SPECTRA COMPARISON - NUCLEAR INSTRUMENTATION SYSTEMS AND SSPS



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MRS. BOWERS: Mr. Kristovich?

CROSS-EXAMINATION

BY MR. KRISTOVICH:

Q Mr. Young, directing your attention to page 7, line 13, of the written testimony, what August 1978 ACRS Subcommittee meeting are you referring to?

A (Witness Young) That was the one held in Washington, D. C.

Q Could it possibly have been in July, June or July, maybe?

A Possibly. There were like three meetings right in close proximity there.

MR. NORTON: So what?

BY MR. KRISTOVICH:

Q Directing your attention to page 5 of the written testimony at line 15, could you describe the OBE values utilized in the testing?

A (Witness Young) The OBE value used in the testing was taken to be 60 percent of the SSE value.

Q And how did you arrive at the figure 60 percent?

A It was felt by the specialist at the testing laboratory to be an adequate value, and we concurred.

Q What was the basis for your concurrence?

A It's my understanding that a 50 percent value is an adequate one. So 60 seemed to be even better.

Q And what is the basis for the 50 percent figure being adequate?

A The SSE value for which we took the 60 percent was the floor response spectrum developed by the Blume organization. And certainly 50 percent, or even 60 percent, was an adequate value to represent an OBE.

Q Were DDE loads in some cases greater than Hosgri loads?

A I don't understand that particular question. We didn't evaluate the system on the basis of loads.

Q Mr. Young, were the DDE response spectra in some cases greater than the Hosgri response spectra?

A I cannot answer that question. I was given the response spectra that we used for the test by the Blume organization.

Q Can any other panel member answer that?

A (Witness Esselman) For this equipment, I can't answer that without going back and reviewing it. I don't have that information here.

Q Mr. Gormly?

A (Witness Gormly) To my knowledge, I can't answer the question any better than Bob did. No, I really don't know.

A (Witness Gangloff) I think there may be a problem with the question. Inasmuch as this equipment was tested to

a required response spectrum early on in the game, and then that required response spectrum is compared with the floor spectrum for whatever earthquake.

In some cases it was found necessary in the Hosgri reevaluation to retest to a new higher required response spectrum. That means that the floor response was higher not only than the DDE, but also than the required response spectrum used in the original test.

It's very difficult at this juncture for us to remember whether or not the particular floor spectra were higher. In some cases we had to change the test basis, and in other cases the original test basis was suitably conservative.

Now, whether that was because the DDE was higher than the Hosgri, or whether it was because we were sufficiently above the original DDE, it's difficult to answer that.

A (Witness Gormly) I might add, I think I like Wil's answer better than mine.

What you're trying to say is that the response spectra was enveloping what any of these test spectra these people use, is that what you're saying?

A (Witness Gangloff) That's right. More or less.

(Laughter.)

We specified originally for the electrical equipment a required response spectrum which would hopefully

envelope all the earthquakes associated with this, and in the case of Westinghouse equipment a bunch of other plants. When you get to a particular plant with a particular earthquake you look at the floor response spectrum and say, is the input required now higher or lower than the test input? If it's lower, you say, fine, I'm qualified. If it's above, you say, I need to test to a higher test response spectrum.

In some cases we had to retest equipment for the Diablo Canyon plant when we came upon the Hosgri earthquake. In other cases, we did not.

It's difficult for us to sit here and say whether the cases where we did not have to retest it was because the Hosgri spectrum was lower than the DDE, or it was because our envelope that we originally selected was sufficiently above the DDE that even though the Hosgri was higher, it still was within the envelope.

Q Mr. Young, directing your attention to page 7, line 17, -- well, actually lines 14 through 18, you talk about raceway supports.

Are some raceway supports currently being reexamined due to the possibility of inadequate material certifications for the support material?

A (Witness Young) I have no knowledge of that.

Q Mr. Gormly?

A (Witness Gormly) I'm not aware of any investigation

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of that nature.

Q Directing your attention to page 7 of the written testimony, line 23, with regard to latest industry standards which you mentioned there, does the seismic testing program include the aging requirements as described in IEEE-323, 1974?

A (Witness Young) No, it does not.

Q Still on page 7 at line 23, and at the same time I'd like you to get out SER Number 8, page 3-41, and on page 3-41 I guess I'm concerned with the last three lines of that page.

On page 7 of the written testimony, beginning on line 21, you state:

"The conclusions from all of these various technical reviews and the various testing programs conducted to the latest industry standards are that it has been demonstrated that the equipment can perform its intended safety function..."

and then you continue.

And I'm wondering if, by the term "demonstrated" you mean that various items are yet to be resolved by -- and then on page 3-41, SER-8, "submittal of additional information or if necessary additional testing, or if necessary modification or replacement of the equipment."

A It's quite a complex question. Can we shorten it

up, or put it all together?

Q Sure. I guess I'm asking: Does "demonstrated" as you use it mean outstanding matters can be resolved by submittal of additional information or additional testing or modifications?

A Yes, it does.

MR. KRISTOVICH: No further questions.

MRS. BOWERS: Mr. Tourtellotte?

MR. TOURTELLOTTE: No questions.

3WEL/mpb1

MRS. BOWERS: The Board has no questions.

MR. NORTON: No redirect.

MRS. BOWERS: May the panel be excused?

(Laughter.)

MRS. BOWERS: I mean, are you asking?

MR. NORTON: Yes, yes to both questions.

MRS. BOWERS: You're the one that knows whether some of them are going to be in attendance.

MR. NORTON: No. That concludes our direct case. The ball is now in Intervenors' court.

MRS. BOWERS: The witnesses are excused.

Any objection, Mr. Kristovich?

MR. KRISTOVICH: No objection.

MRS. BOWERS: Mr. Tourtellotte, any objection?

MR. TOURTELLOTTE: Certainly not.

(The panel excused.)

MRS. BOWERS: Is there any other matter that we could take up at this time?

MR. NORTON: I don't believe so.

MR. TOURTELLOTTE: Have we decided what we're going to do next week, then? Are we going to start out with Mr. Hubbard Monday morning?

MR. KRISTOVICH: That's our intention.

MR. TOURTELLOTTE: And then ever how long that takes, we'll go to Dr. Brune, if and whenever he gets here?

WEL/mpb2

MR. NORTON: Am I to understand that we're going to start with Mr. Hubbard Monday morning and then we only have Mr. Hubbard until Wednesday morning? I mean, then we have Dr. Brune and there's nothing in between?

MR. KRISTOVICH: That's our understanding.

MR. NORTON: Well, we're going to have a lot of dead time.

MRS. BOWERS: It's not dead time for us. We're going to be preparing for cross-examination of Staff witnesses.

Well, we suggested that there might be a possibility that Dr. Brune, if contacted, could get here earlier than Wednesday morning.

MR. KRISTOVICH: Well, I have nothing to add to what I said before.

MRS. BOWERS: And the Staff is still of the opinion that they want to proceed with their entire case without interruption?

MR. TOURTELLOTTE: Well, we're really in a position where we have noone available on those days, Monday and Tuesday.

The one person that we discussed having available with Mr. Fleischaker, although Mr. Fleischaker didn't really know whether he even had any questions for him, was Dennis Allison, and he has pneumonia, and I can't do anything about that. It's a little late in the game to change project

mpb3

managers for purposes of getting the SER in the record.

And I asked David yesterday, David Fleischaker, if there were any questions for Dennis, because we have actually stipulated that the SER is in the record. So if he has no questions for Dennis, that has some bearing upon who I put on first.

There's no reason to put Dennis on if there are no questions, unless the Board wants him on, or the Applicant wants him on.

So I really have to --

MRS. BOWERS: But he won't be here until Wednesday anway, right?

MR. TOURTELLOTTE: Right.

The doctor told him not to travel until Wednesday. And he agreed, however, that he would be here Tuesday night anyway, against his doctor's orders. So he will be here and available on Wednesday.

MRS. BOWERS: I don't know what else to do except plan to start out with Mr. Hubbard Wednesday morning, and than hopefully contact can be made with Dr. Bruno and he can pull up a day or so, a day anyway, on his appearance.

But of course, Mr. Norton and Mr. Tourtellotte need to be informed if that's possible.

MR. KRISTOVICH: Fine.

MR. TOURTELLOTTE: And another thing is, like, if

WEL/mpb4

Dr. Brune comes on Tuesday, I have some technical people who will be in Las Vegas, and they will have to cancel out of their meetings in Las Vegas.

If, on the other hand, he's not going to be here on Tuesday, they won't cancel out of their meetings. So it's important to --

MR. NORTON: Yes, that's the same with us. Our people have other things to do, of course, but they will stop doing those things and be here if Dr. Brune is going to be here. But we've got to know that. We can't tell them to cancel and then come here and sit and wait for Dr. Brune for two days.

MRS. BOWERS: I don't know that anything further can be accomplished now.

But you will get in touch if you find that the schedule changes for Dr. Brune.

MR. KRISTOVICH: Yes.

MRS. BOWERS: Is there any other matter before we recess for the day?

(No response.)

MRS. BOWERS: Mr. Norton, any other matter?

MR. NORTON: No.

MRS. BOWERS: Mr. Kristovich?

MR. KRISTOVICH: We have no other matters.

MRS. BOWERS: Mr. Tourtellotte?

WEL/mpb5

MR. TOURTELLOTTE: No.

MRS. BOWERS: We will recess for the day.

And I didn't check, but I think we can leave our things here for the weekend.

(Whereupon, at 11:35 a.m., the hearing in the above-entitled matter was adjourned, to reconvene at 8:30 a.m., January 8, 1979.)