NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

PORTLAND GENERAL ELECTRIC COMPANY
et al.

(Trojan Nuclear Plant)

Docket No. 50-344SP

Place - Salem, Oregon

Date - Wednesday, 13 December 1978 Pages 2739 - 2982

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:	
PORTLAND GENERAL ELECTRIC COMPANY, et al.	Docket No. 50-344SP
(Trojan Nuclear Plant)	

Hearing Room A
State Capitol
Salem, Oregon

Wednesday, 13 December 1978

The hearing in the above-entitled matter was reconvened, pursuant to adjournment, at 9:00 a.m.

BEFORE:

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

DR. KENNETH A. MC COLLOM, Member.

DR. HUGH C. PAXTON, Member.

APPEARANCES:

On behalf of Licensee:

MAURICE AXELRAD, Esq., Lowenstein, Newman, Reis, Axelrad & Toll, 1025 Connecticut Ave., N.W. Suite 1214, Washington, D.C. 20036.
ROLAND F. BANKS, Jr., Esq., Souther, Spaulding, Kinsey, Williamson & Schwabe, 1100 S.W. 6th Avenue, Portland, Oregon 92704.
RONALD JOHNSON, Esq., 121 Southwest Salmon St., Portland, Oregon.

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APPEARANCES: (Continued)

On behalf of Bonneville Power Administration:

WILLIAM KINSEY, Esq., P.O. Box 3621, Portland, Oregon 97208.

On behalf of the State of Oregon:

JOHN SOCOLOFSKY, Esq.

On behalf of the NRC Regulatory Staff:

JOSEPH GRAY, Esq., and MARJORIE ULMAN, Esq., U.S. Nuclear Regulatory Commission, Washington, D.C.

On behalf of Coalition for Safe Power and pro se:

EUGENE ROSOLIE, 215 SW 9th Street, Portland, Oregon.

On behalf of Consolidated Intervenors and pro se:

NINA BELL, 632 SW 16th Street, Portland, Oregon.

On behalf of Columbia Environmental Council:

ELIZABETH SCOTT.

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C O N T E N T S

WITNESSES:	DIRECT	CROSS	REDIRECT	RECROSS	BOARD	CROSS BOARD
Richard C. Anderson) William H. White) John L. Frewing)	2754				2798	--
Ted Bushnell) K. M. Cooke) R. E. Shipley)		2836	--	--		--
John L. Frewing) K. M. Cooke)	--	--	--	--	2858	
		2860				
Bart D. Withers	2870	2878			2875	

EXHIBITS:	IDENTIFICATION	EVIDENCE
Licensee Ex. No. 23 (Confirmation Seismic Qualification of Equip., Components & Piping in Trojan)	2760	2764
Staff Ex. No. 10 (Mech. Engineering Branch Report Seismic Audit, Westinghouse Elec. equipment, 7/76)	2790	

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P R O C E E D I N G S

CHAIRMAN MILLER: The evidentiary hearing will resume.

The Board has reviewed the limited appearance statement, the discussion we had with counsel and parties. There are certain questions or matters that the Board would like to have addressed both by counsel and in terms of evidence that may be applicable thereto.

Dr. McCollom will indicate to you the nature and scope of some of the questions that we have in mind.

Dr. McCollom?

DR. MC COLLOM: I think probably the first thing we would like to have is to have Staff address some of the general background of the bases and status of the approval methods as they are applicable to the electrical and mechanical equipment at Trojan.

What standards are appropriate and were used to assure the seismic capability of the electrical and the mechanical equipment.

What specific electrical equipment at Trojan, that has not been tested according to the guidelines that you operated under.

I would say that I assume that we would bring this document that you handed us last night into evidence very quickly, so that this will be a reference for that kind

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of discussion.

There is an area of seismic qualification of the engineered safeguard -- ESF -- engineered safeguard features of the switch gear as shown, I believe, in the Safety Evaluation Report, Section 8.3.2. And in that statement it does say that there will be a supplement to that Safety Evaluation responding to that. And we would like to know how that was resolved.

And as a final point that I presume would have included thatone, is that any unresolved safety issues related tothe seismic capability within the building complex of safety-related equipment to shut down the reactor in case of a seismic event.

I think it would probably be appropriate at this time to make two other comments with respect to a qualified review of the fire protection capability.

I think that the fire control equipment that might be included in the list of equipment already in the safety-related equipment should be identified. And if there happens not to be any in there, I think it would be helpful to identify any fire protection system and equipment in the building complex and determine if any evaluation has been made of the possibility of a fire being initiated by any seismic event.

I think the last, but somewhat unrelated tothe

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previous ones is one other reference that was brought to our mind that I think probably should be addressed specifically. And that is the control system capability under the various maintenance conditions that can be placedinto operation, such as the so-called dummy signals that were being used at Zion when the control signals did not result in a reaction as appropriate when a control action was called for.

Maybe in more simple terms, is there any reason to think that any procedures that the Licensee has for maintenance during the operation of the plant, would prevent plant shutdown in case it was called for.

I think after that we would be ready to address the specific requests that were made last night to the Licensee.

CHAIRMAN MILLER: All right.

ARe there any comments from counsel before we proceed with this inquiry?

(No response)

I suppose since most of this is addressed to the Staff, the Staff would go first on these matters, and then the Licensees?

Or, do you have some other arrangement in mind?

MR. GRAY: Mr. Chairman, the Staff has been in contact with our headquarters, and are attempting to get persons who can address questions, many of which are included

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in what Dr. McCollom just listed.

At this time they are not yet enroute, but they will be. The information I have is that they will not be here before this evening, so that we will not be prepared to address these during today.

CHAIRMAN MILLER: Do you have any witnesses today who could get started on some of these matters, or must you await the arrival of t' people that you had contacted, Mr. Gray?

MR. GRAY: Well, now that we have a more specific list here, I think we would want possibly a few hours to evaluate and see.

There is a possibility that Mr. Trammell can address some of the fire protection questions, for example. But, I would have to check.

CHAIRMAN MILLER: Let's check with the counsel for the Licensees. It may be that there is some information, witnesses or whatnot, that you gentlemen are prepared to start with, at any rate. We understand the situation with regard to the Staff.

How are the Licensees situated?

MR. AXELRAD: Mr. Chairman, we spent much of last night and this morning preparing for the questions that were addressed to us yesterday.

I could consult with the Licensee and the

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technical people that we have to see whether we would be prepared to address any of these.

But, it might be more efficient in terms of time since we have prepared on yesterday's questions, if we proceeded with those, and then let the --

DR. MC COLLOM: I think that is appropriate.

Let me just say that we felt that it would be -- if possible -- to set the stage with the Staff's addressing these questions, it would then be more logical and appropriate to hear how the Licensee reflects on those requirements.

MR. AXELRAD: I understand that.

I was wondering, could we recess for, perhaps, a half an hour, and let me talk to the people. It may be that some of these matters already addressed -- it may be that we would prefer to go ahead even without the more appropriate framework that Dr. McCollom suggests, just for the purpose of going ahead.

CHAIRMAN MILLER: It may well be. We don't know how long it would take, until afternoon, possibly. And so, seeing the framework questions, it was our belief -- perhaps erroneously -- that much of the information we had discussed last evening when we first reflected upon this, would be contained in what you were prepared to go forward with.

But, in other words, we are trying to be the most efficient, as well as helpful to the witnesses and all parties

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because we realize that you are having to work, and that you worked late. We appreciate that. We want to at least accommodate you as far as we can.

A half hour recess would certainly be appropriate to enable you --

MR. AXELRAD: Can I ask just two questions as a matter of clarification?

CHAIRMAN MILLER: Let's cover whatever you wish to have covered before the recess.

MR. AXELRAD: The last question with respect to control system capability, was that related in any fashion to seismic?

DR.MC COLLOM: On fire?

MR.AXELRAD: No, control system capability, the various maintenance conditions, the dummy signals at Zion, was that just at any time during maintenance?

DR. MC COLLOM: I think any time you can cause any kind of perturbation, if you wish, to the control system as it was intended to be, my immediate reaction was that the only time that really happens is in some kind of maintenance format where some piece of equipment needs to be withdrawn -- it may be a redundant channel-- and it is possible with the appropriate bypass to pull that, so the right reactor can continue to operate.

And the question is, has there been an appropriate

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analysis such that none of those conditions would prevent the reactor from shutting down if a seismic event occurred during those occasions.

CHAIRMAN MILLER: So in that sense it is related to the seismic events as the occurrence, I believe.

DR. MC COLLOM: From that viewpoint, yes.

CHAIRMAN MILLER: I think that was your question?

MR. AXELRAD: Yes.

CHAIRMAN MILLER: Any more questions?

MR. AXELRAD: Not at this moment.

CHAIRMAN MILLER: Mr. Socolofsky?

Intervenors?

Anything that you wish to suggest now before we take the half-hour recess to enable the parties to get themselves into position to go forward with the evidentiary hearing?

MR. SOCOLOFSKY: No, I don't think there is anything I have to add.

MR. GRAY: Mr. Chairman, one further question in line with what Mr. Axelrad just asked with regard to Zion-type concerns.

Are you concerned with spurious signals caused by the seismic event itself, for example; or are you more concerned with maintenance activities which would disable some system such that if while maintenance was going on and some control system or signalling system were disabled because of the

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maintenance, and then a seismic event occurred, that you would be unable to shut down?

DR. MC COLLOM: I am interested in both of them.

The first one, I assume, is covered by the seismic capability of equipment. That is, I presume, for instance, a relay control panel won't chatter such, or have to be reset or something like that once the seismic event has happened. But rather will continue to be in operable modes such as to allow shutdown reactor.

Now the other is a more general question which I would like for somebody to address, because it appears to me that this is a facet, and that is that indeed you might be able to shut down enough if the seismic capability of the remaining equipment is not appropriate, it might not shut down the reactor.

I don't expect this, you understand, but I think we should address that.

MR. GRAY: Thank you.

CHAIRMAN MILLER: Any other questions?

(No response)

VEry well, we will recess. Is a half hour sufficient time? We are not trying to rush you. We know you have a problem assembling this.

MR. AXELRAD: Where will the Board be so we can report to the Board if more time is necessary?

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CHAIRMAN MILLER: We will be in our chambers. I think it is Room S.

(Recess.)

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CHAIRMAN MILLER: Are we ready to proceed?

MR. AXELRAD: Yes, Mr. Chairman.

We've reviewed the questions proposed by Dr. McCollom prior to the recess, and we would propose that we go ahead at this time with the information that we have developed in response to the questions that the Board addressed to us yesterday.

In the course of that, we will cover one of the questions which Dr. McCollom raised, and that is the question with respect to the seismic qualifications of the switchgear referred in SER 8.3.2. We'll be able to describe the information that the Licensee provided in response to that concern in the SER.

With respect to all of the other questions, we would suggest that if we had more opportunity -- perhaps over lunchtime -- we could review whether we could present information as to those matters after lunch, or whether it might be best to wait until after the Staff presentation is made.

But we do think that would be useful from both the standpoint of the Board and the rest of the parties to proceed with the information which we do have available at this point.

CHAIRMAN MILLER: Very well, you may proceed.

MR. AXELRAD: Yesterday Dr. McCollom and Dr. Paxton expressed a desire to hear more information from the Licensee

and the Staff regarding the seismic equipment qualification based on the revised floor response spectra.

Specifically, the Board members requested at transcript 2724 and 27 that a list of the safety-related equipment which was evaluated be provided for the record, that we describe the function of this equipment, that we provide more detailed information on the methods used to evaluate the various classes of equipment to the revised response spectra, and that we provide the opinions of experts that on the basis of the evaluations the safety-related equipment will function in the event of an earthquake up to and including a 0.25g SSE.

In response to that request we endeavored last night to muster more of the individual experts from Bechtel and PGE who have been involved in evaluating the adequacy of safety-related equipment in the Control/Auxiliary/Fuel Building complex.

We are prepared this morning to present a panel of experts to address these questions, first by providing additional information for the Board, and then providing the witnesses for any additional questions on these matters which the Board may have, particularly with respect to the seismic qualification of the existing equipment in the complex in light of its as-built condition and the floor response spectra based on finite element analyses.

For these purposes, I would now like to recall three witnesses, and call three additional witnesses as a panel of six.

We will need six seats, so perhaps if the Board could move down . . .

(Pause.)

CHAIRMAN MILLER: All right, Mr. Axelrad, call your witnesses.

MR. AXELRAD: I would like at this time to recall Mr. Anderson, Dr. White and Mr. Frewing, who have previously been sworn, and to additionally call Mr. Bushnell, Mr. Shipley and Mr. Cook, who have not testified before in this proceeding.

Whereupon,

RICHARD C. ANDERSON

WILLIAM H. WHITE

JOHN L. FREWING

TED BUSHNELL

K. M. COOKE

R. E. SHIPLEY

were called as witnesses on behalf of the Licensee and, having been first duly sworn, were examined and testified further as follows:

DIRECT EXAMINATION

BY MR. AXELRAD:

Q For the benefit of the court reporter, I will just

ask the witnesses, from left to right, to identify themselves by name.

A (Witness Anderson) Richard C. Anderson.

A (Witness White) William H. White.

A (Witness Frewing) John L. Frewing.

A (Witness Bushnell) Ted Bushnell.

A (Witness Cooke) K. M. Cooke.

A (Witness Shipley) R. E. Shipley.

Q Mr. Shipley, will you please state your address?

A (Witness Shipley) 37 Spindrift Passage, Port of Madera, California.

Q Will you please state for us your present employment?

A Bechtel Power Corporation, San Francisco.

Q And your position?

A I'm the Supervisor of the Piping Stress Analysis Group.

Q Will you please describe for us your educational background?

A Yes. I graduated in 1965 with a BSME from the United States Merchant Marine Academy at Kings Point.

For two years after graduation I served as Engine Room Operations Officer aboard various ships in the Merchant Marine.

I joined Bechtel in 1967, with the piping stress

group, where I've been ever since.

I've been involved in the design of nuclear power plants, specifically with regard to piping analysis in some nine now operating reactors.

As I said, I'm currently the supervisor of the piping stress analysis group, and am a member of the ASME Committee to define requirements for piping vibration, as well as a member on an ANS committee currently investigating piping concerns.

Q Are you a registered professional engineer?

A Yes, I am.

Q In what State?

A State of California.

Q Any specialty?

A Mechanical engineer.

Q Thank you, Mr. Shipley.

Mr. Cooke,will you please state your address for the record?

A (Witness Cooke)1729 Terrace Road, Walnut Creek, California.

Q And your current employment?

A I am a senior electrical engineer with Bechtel Power Corporation.

Q And in that capacity could you tell us what your functions are?

A I am responsible for the technical electrical design and electrical systems on the Bechtel Trojan project team.

Q And can you describe for us your previous background and experience?

A I received a Bachelor of Science degree in electrical engineering at Long Beach State University in 1972.

I am a member of IEEE. I have worked since 1972 on the Trojan design, electrical design. I was in the early stages of the electrical design on the Trojan plant. I was in the phases of construction, startup and the recent design changes on the plant.

Q And can you describe for us in more detail your relationship to the Trojan project over the past few years?

A For two years I was an electrical design engineer. For four years I was a senior electrical design engineer, and for the past year I've been serving as Deputy Group Supervisor to the Electrical Group on the project team.

Q Thank you.

Mr. Bushnell, would you state your full name and address for the record?

A (Witness Bushnell) Yes. Theodore A. Bushnell. My business address is 121 SW Adams Street, Portland, Oregon.

Q Will you please state for us your present

occupation?

A Yes. I'm employed with Portland General Electric Company in Generation Engineering. My position is Supervising Civil Engineer.

Q Can you state for us your educational background?

A Yes. I received a Bachelor of Science degree from California State University, San Jose, and a Master's degree from Stanford University.

Q And can you give us your previous background and experience?

A Yes, sir. Portland General Electric Company, approximately five years.

Prior to joining PGE I was employed with E.R.S. Bloom Associates, a consulting firm in San Francisco.

My primary duties there were project engineer and project manager on projects including nuclear power plants and other such projects, where my emphasis was in the seismic or dynamic analysis area, analysis design, and evaluation of equipment.

Q Mr. Frewing, since, unlike Dr. White and Mr. Anderson, you did not testify yesterday, but you last appeared in previous hearing sessions, it might be useful for you to indicate again for the record what your employment is.

A (Witness Frewing) I'm employed at Portland General Electric Company as Manager of the Generation, Licensing and

Analysis Group.

Q Can you describe for us briefly what your functions entail?

A It involves supervision of a number of analyses for PGE's nuclear projects and coordination of much of the licensing documentation which is passed between PGE and regulatory bodies.

MR. AXELRAD: Mr. Chairman, I'd like to explain briefly how we plan to proceed.

Obviously, we did not have an opportunity to prepare anything in written form. What we would like to do is, first of all, to have Mr. Anderson describe briefly what this panel will do.

There will be one additional document that we will be introducing into evidence as a matter of convenience. The document is an internal document that was prepared by Bechtel, and not for purposes of introduction as an exhibit. We are going to use it solely because it contains a convenient list of the equipment involved.

An earlier version of this document has been in the discovery room since sometime in November. As a matter of fact, Ms. Bell received a copy of that when she visited the discovery room a few days before the hearing.

But we would just like to make sure that the Board understands, we will introduce this exhibit solely as a matter

of convenience, and not because we wish to get into a lot of details as to what the textual material involves.

At this point, for purposes of simplicity, I would like Mr. Anderson to describe what the panel will do when they proceed with the rest of the presentation.

CHAIRMAN MILLER: Very well.

WITNESS ANDERSON: As you can see, we've assembled a larger group of qualified engineers to talk more specifically to the seismic requirements and qualification for equipment, piping and electrical cable trays.

In the course of offering these more detailed descriptions and comments we will be referring to several lists.

Maybe I should take some time to describe these lists, and where they are, and how they will be used.

First of all, we will be referring to the question and answer known as 3.B to the September 20 response to the NRC Staff's questions. I believe this is Exhibit 9.D.

This question covers only equipment located in the control building, and it was stated further in Exhibit 19, paragraph F, on page 7, that the equipment listed in the answer to question 3.B was still qualified to the broadened response spectra that was identified in that exhibit.

But again I want to emphasize that that list is

only for equipment in the control room.

Then we will be referring to this document that we prepared in the course of developing our work on review of equipment, piping and electrical cable trays.

CHAIRMAN MILLER: What is the title of that document?

WITNESS ANDERSON: The title is, "Confirmation of Seismic Qualification of Equipment, Components and Piping in the Trojan Nuclear Plant."

CHAIRMAN MILLER: That document may be marked for identification as Licensee Exhibit 23.

(The document referred to was marked for identification as Licensee's Exhibit 23.)

MR. AXELRAD: Just as an item of identification, the document is dated November 29, 1978, and is marked as Revision Number 2, 1978.

(Documents distributed.)

WITNESS ANDERSON: Now this document, as Mr. Axelrad has said, was first issued November 29, and these subsequent two revisions were made to update the numbers, the specific numbers of the piping systems that were involved, the additional restraints and modifications to existing seismic supports.

Now, this document supplements the listing in

question 3.B to include equipment, piping and electrical cable trays in the remainder of the complex. That is, the Fuel and Auxiliary Buildings.

And it includes equipment above elevation 45 and in the systems that are required for safe shutdown, for emergency core cooling and for mitigating the consequences of accidents of offsite releases to the requirements of 10 CFR Part 100.

Now, there is some duplication in this document in the electrical equipment area with the list given in 3.B, and this was done because we wanted to show more information than was shown in question 3.B.

So you will see some equipment in this document that was originally listed in 3.B in the control building, and this is in the area of electrical equipment.

Now, the engineers on our panel will each address specific areas involving the reevaluation or reanalysis work. There will be, I think, some repetition of parts of our testimony and parts of the cross-examination, but we want to do that to provide in one place a more complete summary of the seismic equipment qualifications.

Now, if I could just briefly outline who will talk about each specific area, Mr. Frewing will first start by briefly describing the systems and their location and their function.

And then we'll ask Dr. White to describe again the effect on equipment below grade elevation 45 and lower, and why the effect was just on equipment above grade, the effect of the STARDYNE analysis and reevaluation.

Then we will ask Dr. White to speak specifically to the kind of information that is provided by the civil structural seismic analyst to the people that do the evaluation on the equipment.

Then we'll ask Mr. Shipley to speak more specifically to how piping was reevaluated and reanalyzed.

And we'll call on Dr. White again to speak further on the seismic qualification of cable trays, and we'll ask Mr. Bushnell to address seismic qualification of mechanical and electrical equipment.

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And we'll ask Mr. Cook to further describe the seismic qualification of electrical equipment from the point of view of an electrical engineer. He will deal with the functionality of such equipment.

With that brief outline, then, I think we will begin with Mr. Frewing, who will discuss the systems and their location and their function.

Q Before we get to Mr. Frewing, I think we need to ask Mr. Anderson several questions in order to have the exhibit introduced into evidence.

Mr. Anderson, do you have before you the document entitled "Confirmation of the Seismic Qualification of Equipment Components and Piping of the Trojan Nuclear Plant", dated November 29, 1978, Revision 2 dated December 11, 1978, which has been marked for identification as Licensees Exhibit number 23?

A Yes.

Q Were you involved in the preparation and did you supervise the preparation of this document?

A Yes.

Q Did you briefly describe for us previously what the document contains?

A Yes.

MR. AXELRAD: Mr. Chairman, I ask that the document identified as Licensees' Exhibit number 23 be

mpb2 1 accepted into evidence.

2 CHAIRMAN MILLER: Is there any objection?

3 (No response.)

4 CHAIRMAN MILLER: Licensees' Exhibit 23 will be

5 admitted into evidence.

6 (Whereupon, the document

7 previously marked as

8 Licensees' Exhibit 23 was

9 admitted into evidence.)

10 MR. AXELRAD: I might point out, Mr. Chairman,

11 we also have additional copies of Table 3B1 and Table 3B2,

12 which are the portions of the answer to Question 3B previous-

13 ly mentioned by Mr. Anderson for those individuals who may

14 not have copies readily available and might want to use

15 this for reference during this testimony.

16 CHAIRMAN MILLER: Does anybody need a copy?

17 MS. BELL: Yes.

18 (Document handed to Ms. Bell.)

19 CHAIRMAN MILLER: Can we have one, please?

20 (Document handed to the Board.)

21 DR. MC COLLOM: Would you give the Board two

22 copies, please?

23 BY MR. AXELRAD:

24 Q Mr. Frewing, are you familiar with Table 3B1 and

25 3B2 from Licensees' Exhibit 9D, previously alluded to in

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Mr. Anderson's testimony?

A (Witness Frewing) Yes.

Q And are you familiar with Licensees' Exhibit number 23?

A Yes.

Q Can you tell us where in Exhibit number 23 there is identified the safety-related systems within the Trojan control auxiliary fuel building complex which are required for safe shutdown, for the ECCS, and for mitigation of accident consequences within the limits of 10 CFR Part 100?

A Yes.

That list of systems is provided on the third sheet of Exhibit 23, which is headed 1. The list appears in the center of the page.

Q Is that Table 1?

A No, it's not Table 1. It's on the third sheet of the document. That is in Section 1.2.

Q That is the list of systems.

A Correct.

Q Would you please describe for us the function of those systems?

A Yes.

We're interested in the mechanical, the electrical, and the structural supports of these systems that are important to safety. These systems have parts of them in the

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control, auxiliary and fuel building complex. And I'll just go down the list and indicate the significance of the system to safety and what parts of the system are in the complex.

The service water system provides river water to cool the safety-related equipment, heat exchangers, pumps, and things of that sort, and also cool room coolers which provide habitability to enable an operator to shut down the plant and enable proper environmental protection for safety-related electrical equipment.

In the complex the service water items of interest are largely small piping, that is, less than six inch piping, which serves room coolage.

The component cooling water system is an intermediate system for removing heat from safety-related components which are important to safety. The component cooling water system takes heat from the reactor systems and gives it up in a heat exchanger to the service water system. The component cooling water system is provided as an intermediate system so that there are multiple barriers against the release of any radioactive material that might be in the reactor coolant systems itself.

In the complex, the component cooling water items of interest include a surge tank for the system, that is a storage tank to make sure that the system is always full, and also a number of pipes which go to specific

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components. Most of these components, I would add, are below grade level, or elevation 45 feet, and so are not of primary interest. And the material that is above grade level is, again, generally small piping.

The safety injection system is a standby system which is provided to inject water into the core in the event of a major loss of coolant accident in the core. Recall that the core, of course, is not in the complex, but is in the containment.

The safety injection equipment which is in the complex is piping from the pumps which are in the below-grade portion of the auxiliary building to the reactor coolant system which is in the containment. There are also, of course, instruments and controls which control the operation of the pumps which are in the control building and run from the pumps up to the control room.

The residual heat removal system is a system which provides low pressure safety injection water to the reactor.

Perhaps I should have mentioned that the safety injection system operates with high pressure, in the range of 1500psi. The residual heat removal system takes over and provides large volumes of water to the core in event of a loss of coolant accident at low pressures, in the range of a couple hundred psi.

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The residual heat removal system is important, as its name suggests, to remove decay heat from the reactor following normal shutdown, and therefore is important to safety for that reason.

In the complex the residual heat removal components that were necessary to look at for the seismic qualification again were principally electrical instrumentation control components. There is some piping which traverses the building as it goes from the residual heat removal pumps, which are in the below-grade part of the auxiliary building, as they go into the containment. So there's only a small bit of piping, but a good bit of the instrumentation and controls involved.

In the auxiliary feedwater system -- well, let me say the auxiliary feedwater system provides water to cool the secondary side of the steam generatorr. Recall that the core heat is in the primary coolant syst is normally transferred to a secondary system in stea ors. The auxiliary feedwater system provides a to the steam generators to remove decay heat if ca

It is a diverse system from th tion system which assists in core cooling fo ypothetical loss of coulant accident.

The auxiliary feedwater syste t in the control auxiliary fuel building comple umentation

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and control and power for the auxiliary feedwater system runs through the complex.

The containment spray system is an engineered safety feature which provides chemically treated water to the top of the containment to spray down through the containment to remove heat from the containment so as to keep the containment pressure below allowable limits. The equipment itself is in the below-grade portion of the auxiliary building, but as with the residual heat removal system, some of the containment spray piping traverses the lower levels of the auxiliary building as it goes into the containment.

And, of course, the instrumentation and controls of that system are in the complex.

The containment isolation system is a group of sensing and signaling instrumentation which tells containment isolation valves to close when an adverse situation is detected. The containment isolation valves themselves are on piping connected to the containment, and is not in the complex of interest.

However, the instrumentation and controls are in the complex of interest.

The centrifugal charging system is -- excuse me -- performs a function much like the safety injection system. I should note that part of the centrifugal charging system is in operation during normal power operation to control

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coolant chemistry and volume; but its safety function is to inject water into the core following a loss of coolant accident.

As with the safety injection, residual heat, and containment spray system, the major components, that is pumps, are in the below-grade portion of the auxiliary building, but the pipe does traverse -- does come up above grade level as it goes into the containment.

The items of interest in the complex are the instrumentation and controls associated with that system.

The chemical and volume control system is a system of tanks and chemical control elements, principally boric acid, which control the reactivity of the reactor during normal operations. In an emergency this system has a safety function of providing concentrated boric acid to the reactor coolant to assure its safe shutdown.

The components of the chemical and volume control system that are in the complex are largely instrumentation and control, but as with several of the other systems mentioned previously, some of the pipe does traverse the building itself.

Perhaps I should note that several of these systems are redundant, that is there are two trains in each system, and the systems themselves in several cases are redundant with regard to providing ability to remove decay

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heat so as to allow safe shutdown.

The final system of importance is the waste gas decay system, and it simply holds up radioactive gas which has been extracted from the primary coolant until it has decayed to acceptable levels to discharge to the environment. The components of interest in this system which we reevaluated were the waste gas tanks themselves and instrumentation and control.

These systems are detailed in the Trojan Final Safety Analysis Report, where considerable discussion is provided of their function and their safety analysis. These systems were selected because they are important in performing safety-related functions which cope with accidents which are hypothesized according to NRC regulations and are described in FSAR Chapter 15.

I believe that is a summary of one level of the systems, their function, and their location in the complex which we examined to ensure their seismic qualification under the revised floor response spectra.

Q Mr. Frewing, and these are the systems which are required for safe shutdown,ECCS or to mitigate or prevent consequence of accidents beyond .100 guidelines?

A Yes.

Q Mr. Anderson, with respect to the systems which have been described by Mr Frewing, could you just identify

mpb10 1 for us the cables within Licensees' Exhibit 23 which identify
2 the piping, cable trays, and equipment that were reviewed in
3 the reevaluation?
4 A (Witness Anderson) Yes.
5 Table 1 identifies the seismic qualification of
6 equipment in the complex. And you'll notice in Table 1 there
7 are many pieces of equipment listed that did not require
8 reevaluation because they are located at or below elevation
9 45.
10 And Table 2 gives a further breakdown of the
11 equipment, the mechanical equipment in the complex that is
12 above elevation 45. These are all tanks.
13 Then several pages later, on page 3, we identi-
14 fied the piping systems by isometric number that were re-
15 evaluated, and a description of the requirements for accep-
16 tance.
17 In table 4 we identified cable tray supports
18 in the area that would be affected by a change in the response
19 spectra.
20 And, finally, in Table 5, we identified the
21 electrical equipment. And as I mentioned before, most of
22 this equipment is located in the control building. One of
23 the other reasons for including this particular table was
24 that the qualification method here has been described in
25 the same way as the qualification method in the FSAR for
and 3 consistency purposes.

Q Thank you, Mr. Anderson.

Dr. White, you have previously testified in this proceeding as to the reason why the reevaluation involved equipment and components above elevation 45 feet.

Could you summarize for us your previous testimony in that respect?

A (Witness White) Yes; as we have discussed on other occasions, the floor response spectra gives a measure or indication of the amplification of the ground motion within the structure.

A piece of equipment that is not supported on the structure, where it is free to vibrate, will not see any amplification. Part of the auxiliary building is in a rock cavity down below elevation 45, and therefore moves with the ground. And there there will be no amplification of that motion.

Any equipment that is supported directly off the floor slab at elevation 45 is, again, tied in directly with the ground and we'll see no amplification in motion. It will see the ground motion.

So the pieces of equipment that we have looked at have been the ones that will experience some amplified motion due to the structure being between the ground and the location of that equipment.

Anything tied to elevation 45 or below doesn't see

any increased amplification.

So, therefore, the previous qualification was unchanged.

Q TXank you.

Dr. White, you participated in the reevaluation that was performed of these systems, as testified to in your previous testimony?

A Yes.

Q Could you describe for us what type of information you provided to those individuals who perfcrmed the actual analyses of piping cable trays and equipment?

A Yes. The civil group is the one that does the structural analysis. We are the ones that developed the STARDYNE model, performed the analysis, and developed the floor response spectra.

Now, the floor response spectra provided other disciplines to do their qualification analysis, or the broadened response spectra that have been discussed and documented in Exhibits 19 through 22.

These are the ones that the civil group generated. This information was supplied to the other disciplines to perform their evaluation.

Q Thank you, Dr. White.

Mr. Shipley, could you summarize for us your previous and current involvement in connection with the Trojan

plant?

A (Witness Shipley) I am the Piping Stress Group Supervisor at Bechtel, San Francisco; and some of my people work on the Trojan project, and I had daily contact with them recently, directed their work in technical areas and have followed this work quite closely.

Q Are you familiar with the Trojan plant? Do you visit it on occasion?

A Yes, I have.

Q Can you describe for us briefly over what period of time that has extended?

A Oh, approximately 1973 to 1976, I would guess, perhaps four to five times, both during construction and after construction.

MR. BANKS: Can everybody hear Mr. Shipley all right?

I wonder if you might be able to get the other microphone?

BY MR. AXELRAD:

Q And did you supervise the analysis of piping by Bechtel?

A (Witness Shipley) Yes, I did.

Q Can you tell us where the piping systems that were analyzed, or identified, in Licensee Exhibit No. 23 -- is that in Table 3?

A. Oh, yes, it is.

Q. And can you describe for us how the analyses were performed and the results of that analyses?

A. Yes. Section 2 of this report gives a brief summary of the techniques we used for seismic analysis of piping systems.

We basically used the response spectra technique. If you recall, the response spectra technique was described by Dr. White previously as the same type of technique they used for building analysis.

It basically calculates -- computational technique is to calculate frequencies and mode shapes and then using floor response spectra to calculate the accelerations and loads on the piping system.

Piping is a three-dimensional type of configuration, and it must be modeled as such to properly represent the dynamic characteristics of the system.

Included in this three-dimensional model of the system are such piping fitting as elbows, Ts, branch connections, reducers. In addition, valves are modeled into the piping system.

The model of the valve includes the motor operator, which extends above the valve itself. Equipment anchors are likewise considered, and they consist primarily of pumps, tanks, heat exchangers.

Once the system has been modeled, a computer analysis is made, using a response spectra technique. And the results obtained are compare with -- both with the industry codes -- that would be primarily for stress levels -- as well as to manufacturers allowables for forces and moments on equipment, valves, accelerations on valves.

There is a summary of the results of the analysis and precisely what needed to be done to qualify the piping in Table 3, as we indicated.

Briefly though, the additional supports for the large piping that were required were 20. There are 19 of these supports indicated in the table. There is an additional one that is not in the seismic Category 1 piping system, and therefore wasn't indicated here.

There were 43 additional small pipes -- supports -- required, and there were 52 modifications to existing supports and restraints required.

I think that briefly summarizes what we did.

Q. Those last two numbers, with respect to small pipes, 43 additional clamps for small pipes and 52 modifications of existing supports; are those reflected in the listing on Table 3?

A. Yes. The number 43 -- there are 37 of those new supports listed in the table. And, again, six of them are not on safety-related systems and therefore were not included.

The modifications -- 51 were included in the table and one was on nonsafety-related system.

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Q Mr. Shipley, in your opinion, in light of the results of the analyses that were performed, is each piping system capable of withstanding an earthquake up to and including the .25G SSE?

A Yes, it is.

DR. PAXTON: May I ask a question of Mr. Shipley now, please?

MR. AXELRAD: Certainly.

DR. PAXTON: You refer to large pipe and small pipe, Mr. Shipley.

Would you give us a range of diameters for thoso two categories, please?

WITNESS SHIPLEY: Yes, sir.

The large pipe I referred to is 2 1/2 inches and larger, and the small pipe would be 2-inch and smaller.

DR. PAXTON: How far up does the large pipe go?

I think 10-inch pipe was mentioned recently.

WITNESS SHIPLEY: Yes. But it would go substantially above that. Up in the general range of 26-inch. We could check, if you would be interested, for exact size.

DR. PAXTON: I just wanted an approximate number.

Thank you.

BY MR. AXELRAD:

Q Mr. Shipley, I would like to ask one additional question.

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There has been reference to systems and components of systems at 45 feet and above. With respect to piping systems, has there been any analysis of anything below 45 feet?

A Yes, there was. When I mention the modeling of the system, I mention Ts and branch connections as part of the things that were modeled into the analysis.

Where we have a safety-related system above 45, if a branch connection from that system goes down below 45, it would have to be included in the dynamic model, and therefore in some cases you find that there are systems below 45 that are also included in our calculation.

Q And you mention the standards to which the piping was to be reevaluated.

Could you identify the standards that were used in that reevaluation?

A ANSI B31.7.

Q Does that have a date?

A Yes, 1969.

DR. MC COLLOM: What, may I ask -- when you said that is the standard, what is that standard for?

All of the piping? Does it include all of the piping that you have been referring to?

WITNESS SHIPLEY: Yes, sir, it does.

MR. AXELRAD: May I have one minute?

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CHAIRMAN MILLER: Surely.

BY MR. AXELRAD:

Q Dr. White, are you familiar with the analyses of cable trays that were performed by Bechtel?

A (Witness White) Yes.

Q Are the cable trays that were analyzed, identified in Table 4 of Licensee's Exhibit 23?

A Yes.

Q Will you please describe for us how the analyses of cable trays were performed and the results of those analyses?

A Yes.

I think along with that a descriptionof the structural configuration will help indicate why this kind of analysis is appropriate.

Cable trays end up being an 8- to 10-foot span, and the connection at the end of these spans is a bolted connection, and normally there is a vertical support at these locations. So the trays are analyzed as individual trays. Of course you have at a support a number of these supported on the same support. So the support is designed for a combination of the loads coming from all trays.

So first you start off with looking at an individual tray. The frequency of that is determined. The loads are obtained from the response spectra. And this

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indicates the kind of load that the tray sees.

Once the tray loads have been determined, now we are able to determine the loads on the supports from all the trays coming to that support.

Now that we know the loads that exist on the support, now we are able to go to the connection of the support to the structure.

Those are basically the elements that fit within the cable tray system.

I might indicate that the Table 4 indicates a support number, and that doesn't mean that the only thing that was looked at was the support. This is just a short-hand way of describing everything at that support.

In other words, at a given location, for instance the first item there, Support S-7, that would mean all the trays supported at S-7, the support itself, as well as the connections at that point. So it is just a short-hand notation for everything within the cable tray system.

So basically you go through a dynamic analysis of the trays tied in with the support, the flexibility of the supports are included in determining the frequency of the system. And then going back to the connection.

In terms of the criteria used to judge the adequacy or base of the design, the tray itself is based on manufacturer's recommendation in terms of the load capacity of

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the tray itself. And this varies from manufacturer to manufacturer and from tray type to tray type.

Most of the trays are the ladder-type trays. There are a few pen kind of trays where you don't have holes in the bottom. Those are the two basic kind of trays that we have.

The supports themselves, this is a pipe, circular pipe, and are designed to the AISC standards, just as any other structural element would be.

The connections themselves, if it is a cinch bolt kind of connection, then this is again designed relative to the manufacturer's specifications, and this is basically the way the analysis is done and then the basis for the subsequent design once the loads have been determined.

Q And, Dr. White, the result of the analysis was that no additional modification was required?

A Yes.

CHAIRMAN MILLER: Was that "no additional modification"? I didn't catch the word.

MR. AXELRAD: No modification was required.

WITNESS WHITE: The results of the analysis indicated that the cable trays, as originally installed, required no modifications due to the new response spectra.

BY MR. AXELRAD:

Q And, therefore, Dr. White, in your opinion, and by

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the results of the analyses that were performed, is each cable tray capable of withstanding an earthquake up to and including a .25G SSE?

A (Witness White) Yes.

Q Mr. Bushnell, could you describe for us briefly your association and involvement with the Trojan Nuclear Plant over the past few years?

A (Witness Bushnell) Yes.

My duties as a supervisor, civil engineer, are primarily directed towards the analysis, review, and so forth, regarding nuclear power projects.

My primary effort over the last few years has been with the Trojan Plant and the Pebble Springs Plant.

The specific areas where my responsibilities extend to include the civil structural aspects of the major structures themselves, the seismic area both from the setandpoint of the structures and equipment qualification requirements. And basically represent -- the objective of our group is to represent the company technically in the area of civil engineering for generation engineering.

Q Were you responsible for the Licensee for the evaluation of the mechanical and electrical equipment within the complex, which are listed in Table 3-B1 and 3-B2 of Licensee Exhibit 9-D, and for the review of the results of the evaluation performed by Bechtel for any of the additional

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equipment listed in Tables 1, 2 and 5 of Licensee Exhibit No. 23?

A Yes.

I would like to clarify further, if I may, that I was directly involved along with four engineers under my supervision, with the independent review of material that is listed in Tables 3-B1 and 3-B2 of Exhibit 9-D, as well as review of Bechtel prepared responses in Exhibit 23.

Q Would you please describe for us how the evaluations of electrical and mechanical equipment were performed, and what the results of those evaluations were?

A Yes.

I would like to refer you to page 3-B-25, which is the last page of Table 3-B2. There is a list there of the qualification method used in preparation of this response to NRC Question 3-B.

And as Mr. Anderson pointed out earlier, the qualification method described in Exhibit 23 is different only in the format of the FSAR. This particular qualification method table here is a little more detailed. I would like to just go through briefly this list.

Qualification Method 1 is a method of qualifying by generic testing. Generic meaning a test that is not site-specific. It is typically the large manufacturers of equipment that sell their equipment to many, many areas of

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the country and qualify to levels exceeding the requirements as best as they can anticipate them, so that they don't have to requalify on a case-by-case basis.

Method 2, qualification by testing to specific floor response spectra.

There are many different types of tests that one might perform that would be suitable to demonstrate that the equipment will withstand specific demands of floor response spectra such as -- well, different wave forms and so forth.

Method 3 is an analytical method which, if it can be shown by methods of analysis that the system is rigid, meaning that its response is not amplified in comparison with the information from the floor response spectra, then the demand on the system is only that that is associated with the response of the floor itself.

Method 4 is a method of qualification by just using the highest value of the floor response spectra as input to develop inertial load, and then qualify it by further analysis to assure that the stresses and so forth remain on acceptable levels.

Method 5 is similar to Method 4, but Method 5 goes one step further. It analytically -- it is a method to analytically determine the natural frequencies of the system.

In most cases the types of things that we are concerned with are fairly simple things that have the

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predominant fundamental frequency. Then with that frequency known, one can go directly to the floor response spectra and again pick off the spectral acceleration which can then be used to determine the stresses and assure that they remain within allowable limits.

Method 6 is similar to Method 5 as described, but the difference is that the qualification is done by testing. Method 6 is probably the predominant method used by many manufacturers. It is essentially what is recommended by the IEEE-344 standard, or one of the methods recommended.

The particular piece of equipment might be put on a test table and a low frequency side sweep applied as input motion with recording devices in order to be able to determine where the equipment responds. That would be indicated as an amplified response somewhere in the frequency range.

Then the qualification test part of it, once those frequencies are known would be to put in a different kind of a signal, perhaps at levels where the amplification that the equipment would see would be equal to or greater than that required from the floor response spectra.

Method 7 is merely a combination of Methods 4 and 5. And the reason it is in there that way is that this really relates to more cable trays than anything else. Cable trays were analyzed for -- one method for part of the spectra, and another method for the other part.

I might go through an example of the specific, say, detail of how one of these items here in Table 3B-2, for example, was qualified.

I guess we can do it generally. It would be just as well. The list itself was developed based on information from the FSAR from PNIDs and from other sources.

And when the equipment was identified with an equipment number, then the files for that piece of equipment were obtained. Those files included the seismic response -- excuse me, seismic qualification method that was used originally.

With that information, if I may take the example of a generic test, the information that one would obtain from the qualification report of a generic test would be -- usually was, I should say -- the input data that was used at the base of the Shaker Table. in some way normally, at a sine beat.

With this information then, with additional information concerning damping and other things, one can construct a qualification response spectra, which means the spectra to which that piece of equipment was, in fact, qualified.

Then, by comparing the floor response spectra associated with that piece of equipment's location in the plant, it is merely then a matter of comparison of two curves to assure that the qualification exceeds the demand for that

particular piece.

Q And the qualification methods listed in Table 3B-2, or the equivalent qualification methods in Licensee Exhibit 23 were then used to evaluate all of the equipment listed in those tables?

A Yes.

Q And the results of the analyses, with respect to all the equipment -- tell us what the results were.

A Yes. We found, as reported in 3B and elsewhere, the equipment remained qualified for seismic motion -- excuse me, the response spectra resulting from seismic motion, up to and including the SSE.

I would like to make one further clarification in the broadened response spectra.

DR. PAXTON: I would like to ask Mr. Bushnell -- concerning your reference to IEEE 344 --

WITNESS BUSHNELL: Yes.

DR. PAXTON: -- are you referring to the 1971 version or the 1975 version?

WIT. BUSHNELL: In that context, I was referring to it in general, as the reference document that would list suitable means of testing. You might be aware that the 1975 version does have a number of acceptable methods that can be used to qualify equipment.

The 1971 version is not as broad, being of earlier

vintage. I was referring generally to that standard.

DR. PAXTON: I see.

Are you acquainted with this document that was handed to us by the Staff? It has not been introduced yet, but Mechanical Engineering Branch report on seismic audit Westinghouse Electric equipment, July 1976?

WIT.BUSHNELL: I have seen the document, yes.

CHAIRMAN MILLER: Pardon me.

Would the Staff like to put an identification number on that document?

MR. GRAY: Yes. I believe that would be Staff Exhibit 10 for identification.

CHAIRMAN MILLER: Thank you.

(The document referred to was marked Staff Exhibit No. 10 for identification.)

DR. PAXTON: Well, this document refers a method of sort of updating the testing of equipment, or analysis of the equipment, that satisfies the IEEE 344, 1971 version, but not the 1975 version.

And I guess my question is whether -- if you are aware of the content of the document -- of this document -- whether you can then say, in effect, whether the requirements here are satisfied for the equipment, the Westinghouse equipment that was qualified under the 1971 versior of this document.

WIT.BUSHNELL: I am not sure of the question.

DR. PAXTON: You are not sure about the question?

WIT.BUSHNELL: Yes.

DR. PAXTON: Maybe I can simplify that.

If I understand this document correctly, the Staff had certain objections to the Westinghouse equipment that was qualified under the 1971 standard, which, I judge, had to do with application of individual test frequencies, rather than a combination of frequencies such as called for in hte 1975 version.

WIT.BUSHNELL: Yes.

DR. PAXTON: And some of the Westinghouse equipment was reexamined, Westinghouse equipment in certain plants, reexamined by the Staff, if I understand correctly, to decide whether, although it was tested according to the 1971 version of the standard, whether it would satisfy the 1975 version.

And I guess my question is whether your analysis was really updated in a similar fashion?

WIT.BUSHNELL: We used the data that was contained in our quality assurance files for the original qualification. In some cases, I would say that the qualifications method -- excuse me, qualification methods used were of such a severe nature and such a severe input motion, and demand on the equipment, that they would, in fact -- I should qualify that one step further to say that in many cases elements involved

are single frequency sensitive and single duration sensitive anyway, such as relay -- is quite a good example, so that there would be little difference, if any, between the 1971 and 1975 versions of IEEE 344.

DR. PAXTON: Right. This is one of the criteria that Staff actually used in its generally reevaluation, if I understand correctly, according to this document.

WITNESS FREWING: Let me clarify what the requirements that were imposed on Trojan were -- in the beginning, at our FSAR submittal to the NRC, we indicated that we would qualify our equipment according to IEEE 344, 1971.

In the course of questions and answers between PGE and the Staff, they developed some poisitons that we should do more than that. They asked us that in a particular question, which they transmitted to us on June 29, 1973. That question was known as Question 3.33.

That question said that PGE should do some things beyond IEEE 344, 1971; and they outlined them, and they specified those to us. We did thore things in the original case at Torjan, and Mr. Bushnell and Mr. Cooke have looked at those things again in the reevaluation.

Those things which they required beyond IEEE 344, 1971, are the same things that the Staff has looked for for those plants which were licensed in that interim period, and we meet the five points on page 12 of the NRC's audit report.

DR. PAYTON: Fine. Thank you. That answers my question.

BY MR. AXELRAD:

Q Just one last item as an item clarification, Mr. Bushnell -- in the work that was done, as reflected in the tables, the method of qualification that was used was one of the seven methods identified. It wasn't a matter of using all of the methods for the equipment; it was whichever method was pertinent to the particular equipment involved; is that correct? And that is listed in the tables?

A (Witness Bushnell) Yes, sir.

Q Mr. Cooke, what has been your involvement with the Trojan nuclear plant over the last few years?

A (Witness Cooke) I have been involved in the electrical design of Trojan from the early stages to present day. That includes also the review of the seismic qualification, as related to function of the electrical components involved.

Q So you are deeply familiar with the electrical components of the plant?

A Yes.

Q And what was your responsibility in connection with recent evaluation by Bechtel of the electrical equipment you have been discussing here?

A My responsibility was to reevaluate the electrical

equipment, seismic qualification as compared to the STARDYNE response spectra and to determine whether the electrical components will function properly in the safety-related circuits that they are utilized in.

Q Is the equipment which you reevaluated listed in Table 5 of Licensee Exhibit 23?

A Yes.

Q And would you please describe for use the evaluation that you performed from an electrical engineering standpoint and the results of that evaluation?

A Each electrical item and its seismic qualification report was reviewed from the standpoint of the various characteristics of the electrical component as to its function during and after the seismic test that was performed on the component.

I looked at each component on how it was utilized, and safety-related circuit, and determined whether that component, under a seismic condition, would perform its function.

That briefly summarizes what was done.

Q And as a result of the evaluation that you performed, in your opinion, is each item of equipment capable of withstanding an earthquake up to and including a .25g SSE?

A Yes.

MR. AXELRAD: Mr. Chairman, we were not certain as

to the detail of information the Board desired as to all these matters. We tried to summarize what was performed, to bring the experts here who were involved in the performance of that work.

CHAIRMAN MILLER: Yes, we appreciate that, and we wish you to continue with your summary, or at least until you reach the end of your presentation. Then there will be perhaps some questions, but we would prefer, I think, for you to complete it, as you have.

MR. AXELRAD: Yes, I understand.

CHAIRMAN MILLER: Are you ready?

MR. AXELRAD: This concludes our general presentation, but we do want to ask Mr. Frewing, with respect to the specific question Dr. McCollom asked this morning.

BY MR. AXELRAD:

Q Mr. Frewing, could you describe for us what PGE has done in connection with the seismic qualification of the switch gear that was referred to in SER 8.3.2, as inquired by Dr. McCollom this morning?

A (Witness Frewing) Yes. Dr. McCollom asked the question about SER Section 8.3.2, I believe, based on the information in an attachment to Mr. Pollard's limited appearance statement of yesterday.

That attachment apparently was Mr. Pollard's input to the Staff's safety evaluation report. It is not the

safety evaluation report itself you understand.

Mr. Pollard reviewed the seismic testing of some ESF switchgear and protective relays, and he indicated that the staff informed the Applicant of the Staff's position. And then he indicated several ways in which the Applicant was responding, but it appeared that some items were left open.

Specifically, he noted that the Applicant stated that some types of relays that did not meet the Staff's level of acceptability will be replaced. And then he also stated that we understand that the Applicant is considering automatically blocking certain other relays.

And then he went on to say that additional information can be found in Section 3.10 of the safety evaluation; and he concluded, saying that the results of our evaluation will be reported in a supplement to the safety evaluation.

Mr. Pollard provided that to the Project Branch on some date -- I am not sure. The Project Branch, in turn, conferred with the Applicant and said, well, now, this is what the NRC is lining up to say in the safety evaluation report, and do we, the Applicant, have any reaction to that?

And our reaction was to make further commitments which resolved the concerns that Mr. Pollard notes. So that the safety evaluation report, as published, repeats verbatim most of Mr. Pollard's input, but modifies it slightly to note that the Applicant will replace certain relays.

That coincides with Mr. Pollard's statement. The SER goes on to say that certain relays will be automatically disconnected or blocked.

Now, that is a commitment from the Applicant, and we have done that.

And then the safety evaluation report goes on to say that other relays which might misoperate, in the sense that the NRC saw these relays, at worst could only cause a visual or audible alarm. That is, they would not affect the course the performance of the safety equipment during or following an SSE.

Am I clear that I am distinguishing between something that lights up and something that prevents a pump from starting?

CHAIRMAN MILLER: Yes.

WITNESS FREWING: The SER, as issued by the NRC, concluded with the following paragraph:

"We find that the modifications proposed by the Applicant will provide reasonable assurance that the occurrence of an SSE will not result in a loss of capability to perform the safety functions provided by s t y-related el ctric systems. Therefore, we conclude that the seismic qualification of the engineered safety features switch gear meets the requirements of the Commission's regulations and is acceptable."

So, in summary, I would tell you that Mr. Pollard's

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material in his limited appearance statement was preliminary and was not the final safety evaluation report published by the Commission.

EXAMINATION BY THE BOARD

BY DR. MC COLLOM:

Q Would you describe what you mean by "blocked relays?"

A (Witness Frewing) Let my friend, Mr. Cooke, respond to that.

A (Witness Cooke) This relay pertains to the emergency diesel generator --

CHAIRMAN MILLER: Could you get close to the microphone, please.

WITNESS COOKE: Sure.

This particular relay that we are discussing is dealing with the emergency diesel generator. The relay performs the function of protecting the emergency diesel generator from an over-current situation that could occur in the generator itself.

Since the relay did encounter some chattering during its seismic test, in order not for the emergency diesel generator to be affected during the auto-start signal, this particular relay is automatically taken out of the starts, or the tripping circuit, of the emergency diesel generator, so that when an auto-start signal comes to tell the diesel to

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start during an emergency condition, it also tells this relay, "Don't trip the diesel generator. It is not part of the circuit to trip the diesel generator."

BY DR. MC COLLOM:

Q And that relay was the one that -- what was its function?

A (Witness Cooke) Its function was to protect the emergency diesel generator from an over-current situation.

Q What happens now with respect to an overcurrent situation?

A It is bypassed during an auto-start signal.

Q Is there any condition that would cause you to have overcurrent during this period when it is blocked?

A Not unless there was an extreme malfunction of the diesel generator.

Q Does that mean that there is no load on the diesel generator at that point?

A That is correct. It has not been put on the emergency bus. It is just starting.

Q And that over-current relay, is it added back on before the diesel generator is put on to the bus?

A No, it is blocked completely.

Q For how long? Is it as if it no longer exists?

A That is correct.

Q Does that provide any hazard that you can conjure

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up with respect to safety-related equipment?

A. Well, if the over-current was excessive, then there would be other things that would trip the diesel.

Q. Give me an example.

A. High temperature winding in the generator -- that would trip the diesel, because the generator has an excessive heat.

Q. Okay.

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(Board conferring.)

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Q That is the only relay that we're talking about that was to be blocked?

A Yes.

Q I guess this might go back to Mr. Frewing, although I don't know, and that is:

Were all of those relays in the Safety Evaluation Report that were identified as problem relays that shattered, were they all replaced?

A (Witness Frewing) There were two classes. One class involved replacement; the other class involved analysis to show that the only cause of a -- the only result of a relay malfunction would be an alarm, if you recall.

But those which were to be replaced were replaced. That was a condition of the license.

Q And were they replaced with relays that had qualifications that would not shatter under the design basis earthquake?

A Yes. That was the purpose of replacement.

Q I realize that was the purpose of it, but did it happen?

(Laughter.)

I guess I would ask the qualifications of that relay, and I believe we must be back to Mr. Cooke.

A (Witness Cooke) Yes.

Q Can you give us some idea of why that relay was

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all right and what its qualifications were? I am now getting back to sort of a generic understanding of the qualifications of relays for seismic load.

A Could you repeat that, please?

Q We have substituted one relay for another. Wasn't it because this one didn't shut and that one did?

A Correct.

Q I'd like to know how we know that this one does not shatter?

A Because it was placed on a shaker table and tested to the accelerations that it would see in the switch gear, and it was electrically monitored to see if the contents would shatter or not.

Q Was this a manufacturer's test, a generic test?

A Yes.

Q I believe, Mr. Cooke, I would still like to talk about the electrical equipment, and let's look at Table 5.

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WEL flws

Q Is this all electrical equipment in Table 5? Did I understand that correctly?

A In the Control Building complex?

Q Yes, the total building complex, what we've been referring to as the building complex, which includes Control, Auxiliary and Fuel.

A Right.

Q I notice that in the qualification methods it's predominantly Number 1 as the method. Now, that is the manufacturer, is that not correct, that has done this testing?

A Either it's the manufacturer or PGE did their own test in a private testing lab.

Q How do we know which one? Can we tell that from this table, as to whether it was the manufacturer's test or whether it was a PGE test?

A No, you can't tell from the table.

Q What does the asterisk mean there, can you tell me that, next to the 1? Does that mean what you just said, that it's either the manufacturer's test or PGE's?

A Yes, that's correct.

Q Are we still referring to the table in the back, table 3.B-1 or 3.B-2 as our qualification method? Would you refer me to the place where I could find the table that corresponds to this table?

A Yes. The page preceding the table at the bottom

of the page. The item with the asterisk indicates it was done on a generic basis.

Q Would you describe to me what a generic basis means for this test?

A Basically we're talking about pieces of equipment that were supplied by Westinghouse that could be supplied to many other sites, other than just Trojan.

Q If you have just the 1, without the asterisk, then that is a dynamic analysis performed by PGE?

A Yes, that's correc t.

Q All right, that is the way that you tell the difference. All right.

CHAIRMAN MILLER: Let me be sure I understand this:

The number 1, followed by an asterisk, does that mean it was done on a generic basis by Westinghouse in all cases?

MR. AXELRAD: If I may make a suggestion, Mr. Chairman, on the table itself is a reference to the qualification document that was used. Perhaps be glancing through the qualification document references you could distinguish between WCAP numbers and the lab report. There might be some basis for distinguishing which work was done by whom.

CHAIRMAN MILLER: I understood the previous answers to be that the 1, followed by an asterisk, meant

testing had been done on a generic basis by either the manufacturer or by Westinghouse. I wasn't sure in that respect whether there were other manufacturers besides Westinghouse involved, or Westinghouse only.

WITNESS COOKE: It's Westinghouse only.

CHAIRMAN MILLER: Then the same asterisk denotes that the tests were done only by Westinghouse, and not by either any other person, manufacturer, PGE, or anyone else, is that correct?

WITNESS COOKE: That's correct.

CHAIRMAN MILLER: I see. Thank you.

BY DR. MC COLLOM:

Q Is there no other electrical equipment that are in the safety-related electrical equipment group except that manufactured by Westinghouse?

A (Witness Cooke) I don't understand.

A (Witness Frewing) The answer is no. There's a number of electrical equipments that are qualified by other people. For example, the ANIMET Lab report.

Q I see.

MR. AXELRAD: Can I just make sure that the question and the answer are clear?

CHAIRMAN MILLER: Yes, let's see that they match up.

MR. AXELRAD: Right. The question was, if I

understand it correctly:

Did Westinghouse supply all the electrical equipment that's listed in this table?

And I believe the answer was no.

WITNESS FREWING: Correct.

CHAIRMAN MILLER: That's my understanding of the record. Do we all agree?

(Witnesses Frewing and Cooke nodding affirmatively.)

BY DR. MC COLLOM:

Q I believe that I'd like to talk to Mr. Shipley now, about the piping.

You said that the standards that you used were ANSI-B?

A (Witness Shipley) B as in Boy.

Q Has there been -- what would you use today if you were going to use the Standard?

A You would use ASME Section 3.

Q Can you identify the differences that that might be between 69 and the model that you're talking about?

A The basic concepts of the two codes are the same for the piping that we're discussing. They are essentially the same.

There have been some minor modifications, some refinements, but they're basically the same.

Q Do you view that if you were redesigning Trojan

wel 5

today that the design that you would put out would result in the same qualifications for the seismic effects as the ones that you used then?

Another way of putting it would be, the same requirements to design to.

A No. In fact, were you to design to today's codes, the allowable stress that you would use for these piping systems is substantially higher than the one that we used for Trojan.

Q So it would be within the same standards, then?

A That's correct.

Q Your comment there tells me that it actually is better able to withstand the seismic event than if you literally went by the standards of today.

A Yes.

There were some other refinements, but I believe overall the single largest most difference is the increase in allowable stress in today's codes.

Q Now, that's on the piping.

Now, what about the other equipment that's connected to the piping? What standards did you use there? Is that included in this same standard? Like valves, et ceteras.

A Okay. Valves are not. They have a separate manufacturer's standard. Other in-line components, such as

wel 6

elbows, tees, reducers, branching actions, that type of thing, are included and described in the standard.

Q What about other mechanical equipment that would be involved in your area of jurisdiction here? What else would be there? I presume valves is one. Are there other things?

A No. Merely valves, because a valve is an in-line component, in that a valve is not normally anchored in the sense that a pump or a vessel would be anchored to the floor.

Q Am I supposed to talk to Mr. Bushnell, then, when we're talking about mechanical equipment?

In other words, I'm looking for who to talk with when I say I want to know whether the valve is going to work.

A I believe I can address the valves.

Q All right. Are there other mechanical equipments then, that are connected to the system called piping, besides the valves?

A No, sir.

Q -- that would be susceptible to seismic activity?

A No.

Q No? Did I understand you right?

A Yes, I believe so. Let me try to clarify it.

By in-line components, I mean in a piping system between two anchor points, such that it sees an amplified acceleration. And valves are the only one.

Q What about the capability of the valves as specified? Can you give me some standard, or what do you use to determine the seismic capability of these valves?

A The valves are bought to an industry stardard. They are purchased to an industry standard which specifies basic configuration, wall thickness requirements, hydrostatic test procedures, and so forth.

In the seismic analysis of the system, we consider the valve as a concentrated mass in the piping system.

In addition, we model the top works of the valves, which would include the operator for the valve itself. That's modeled as an extended mass, and that's all included in the dynamic analysis of the system.

Q If that's true, then the standards to which it was designed are included in the ANSI standards you refer to? If it's part of a mass that puts stresses on the system.

A Yes, sir, that's correct.

Q And that's all except the one last thing: What happens to the valve on top of it?

A Yes, sir, that's correct.

Q And that is in an amplified situation, and I'd like to know how you know that the valve is going to behave properly during a seismic event?

A We have specified to the valve manufacturers that the valves should be capable of accepting a 3g acceleration

wel 8

level at the center of gravity of this extended top works of the valve, and then in our piping system model we determine -- well, the valve is modeled into the piping system model, then the results of the model tell us what the acceleration level at that center of gravity is.

We then compare that to the 3g allowable in our criteria. We must be below the 3g allowable.

Q That 3g allowable is independent of frequency?

A No, it's not. There's a further stipulation that the extended top works that connects the valve and the operator shall be in the rigid range.

Q Now, tell me what that means?

A (Witness White) Maybe I can add a little comment here.

The acceleration that the valve sees does depend on the natural frequency of the piping system. In other words, if the piping system happened to have a frequency right on the peak of the response spectra, it would feel some sort of acceleration.

If it had a frequency such that it did not match up with the peak of the response spectra, it would see a smaller frequency.

So that the acceleration of the valve system, or the valve, does depend on the frequency of the piping system. But the valve itself, if you were to isolate that, fix it so

that it was independent of the piping system, it would be rigid.

So it's moving as a rigid body, so to speak, on the piping system, but it responds to the movement of the piping, which is a function of the frequency.

Q All right. But how does the valve know what the natural frequency is of the piping that it's going to be installed in, when it's evaluated for 3g acceleration by the manufacturers?

A It doesn't, but that's why the stipulation is that it's rigid.

You see, there isn't any further amplification of the acceleration of the pipe by the valve itself. The actual acceleration on the pipe right there is -- well, of the top works -- 3g's. We think it can amplify due to rotation, but that's in the model already.

Q But now I can put that into a piping system that has a natural frequency of the piping system of quite a broad range?

A Yes.

Q Does the manufacturer have a range of these frequencies over which he says that it can accept a 3g acceleration?

A (Witness Shipley) No, the manufacturer stipulates two things: One, that the top works of the valve is rigid,

such that any acceleration that's input from the pipe will not be amplified between the valve and the operator. There will be no amplification there.

And, further, that it should meet a 3g level at the operator.

And when we analyze the -- now, the valve manufacturer gives us a valve that will do those two things. We then analyze the piping system, considering those two aspects of the valve, and determine what the acceleration is. If it's over 3g, we restrain the piping such that the accelerations at the valve operator will come down to the 3g level.

Therefore, what the manufacturer does is actually independent of what system it will be installed in, since we design the system to those requirements.

A (Witness White) If the valve is flexible, then the manufacturer has to know what's the frequency of the piping that I'm going to put my valve in. But being's it's rigid, he doesn't care.

(The Board conferring.)

CHAIRMAN MILLER: All right. We'll recess for lunch until 1:00 o'clock.

(Whereupon, at 11:50 a.m., the hearing was recessed, to reconvene at 1:00 p.m., this same day.

MADELON/
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AFTERNOON SESSION

(1:00 p.m.)

CHAIRMAN MILLER: All right.

Whereupon,

RICHARD C. ANDERSON,

WILLIAM H. WHITE,

JOHN L. FREWING,

TED BUSHNELL,

K. M. COOKE,

and

R. E. SHIPLEY

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

CHAIRMAN MILLER: Everybody all set?

EXAMINATION BY THE BOARD (Continued)

BY DR. MC COLLOM:

Q I believe, Dr. White, you commented about the cable trays.

A (Witness White) Yes.

Q Have the standards for the design techniques either one changed in how support structures and their capabilities to withstand the seismic activity since the original design of Trojan?

A No, it's the same criteria. We use the same

mpb2

criteria now as was used for development of the original configuration.

Q What about the qualifications that the manufacturers use for the cable trays themselves, the part that you rely upon from them?

A That may be changing within the industry. We're using for Trojan-specific the same information that was developed for the original design. So as far as our reevaluation, that has not changed. Within the industry that may be changing, I'm not really sure about that.

Q Would you have any insight as to how the changing might occur, what's happening there? Or do you have that information?

A I think the changes that would be taking place within the cable tray domain, so to speak, is not coming from the manufacturers. Bechtel, ourselves, are doing some testing on the cable tray system. But the manufacturers normally deal with the tray itself and does not extend beyond that point.

And this is why a person or an organization that is dealing with the overall system is in many cases forced to do the testing themselves. So the manufacturers I don't think are changing things very much.

Again, steel is a fairly well-defined material. We know that pretty well. But the testing program that is

mpb3 1 ongoing is showing that the designs based on criteria
2 similar to what was used on Trojan is a very conservative
3 design. The primary difference is in the area of damping;
4 damping that shows up in field installation is much higher
5 than the five percent that's used in Trojan.
6 Q Now I wanted to ask a few questions on the
7 mechanical equipment, which as I understand is in Table 1.
8 Now is this Mr. Bushnell?
9 A (Witness Bushnell) Yes.
10 Q I believe that the qualification methods are
11 at the end of the table here, right, the dynamic analysis
12 method is number one?
13 A Yes, sir.
14 Q One star is done on a generic basis. Two is a
15 pseudo-dynamic analysis method.
16 As we don't have FSAR Section 3.7.3.4 here,
17 would you describe to us what is meant by pseudo-dynamic
18 analysis method?
19 A Yes.
20 It's essentially an equivalent static approach.
21 The qualification studies of the method, as stated in the
22 FSAR, are that the system be dominated by a single frequency.
23 That is essentially a single degree of freedom system. Or
24 that it be rigid. Or further that it be a single degree of
25 freedom system in its fundamental mode and rigid in its

mpb4

higher modes.

The method uses the peak, the highest point on the floor response spectrum as the acceleration input to determine the inertial load on whatever the element is.

Q When you say a single degree of freedom that means it's mounted in such a way that it only has one degree of freedom, is that -- or designed in such a way that a piece of mechanical equipment has only one degree of freedom?

A Well, I guess you could probably characterize it to be more than that, to be dominated by a single mode.

Q Do we have any set of standards to be used at this point for mechanical equipment as to how we should design those for seismic behavior?

A Yes, there are standards. You might refer back to Table 3B1 and some of the qualification methods shown in the right-hand column. Many of the mechanical systems, such as these ventilating systems here, 3B1, -7, and -8, are such that their support system is similar to -- not really like, but similar to -- somewhat like the piping systems. That is, you have long runs of duct work and you would have hangers perhaps supporting duct work.

We'll restrict for the moment just to the duct work.

The qualification of such duct work would really be a matter of qualifying the supports. The codes used for

mpb5

such qualification would normally be the AISC code, and those codes are essentially the same today as they were back in 1971, as far as allowable stress criteria is concerned.

I should point out one more aspect, though. Current Standard Review Plan, Section 3S4 does require the combination of spatial responses by an RMS method. That is to say, you do your analysis for -- I'll use northsouth, eastwest, and vertical, and combine the stresses at some point by a route mean square combination, and compare that against the criteria.

The Trojan approach generally used was two components, one vertical and one horizontal, for example, a north-south plus a vertical by direct sum and an east-west and a vertical by direct sum.

The differences between the two methods by comparison we might make on the duct work here, the response and the stress conditions and a support design is almost entirely dominated by one direction. It's a long run with supports, and you just don't get much motion normal to along the alignment of the duct. And I doubt that there would be significant differences at all between the two criteria.

Q Now that's on that model. That is the log model.

A Yes.

Q Can you go through and take some of the other classes of mechanical equipment and make some general

mpb6

statements about how they have been designed against any particular standard, or the like?

A On page 3B6 another important safety-related item in the plant would be the battery -- the main batteries. These are the backup batteries, of course.

The batteries themselves are, of course, rigid and don't cause any concern. Their supports for Trojan are braced steel framing. Again, I guess that's not all that much different from the example we just talked about. It would be an AISE code. It would be used for the supporting system, and the appropriate code for the anchorages.

Changes to those codes are not significant between 1971 and today.

Let's see. There may be an example.

Q I know there is at least one other that I see in here, and that is the process, INC rack production, these kinds of categories.

MR. AXELRAD: Where is that found, Dr. McCollom, what page?

DR. MC COLLOM: That's on page 3B21. Oh, that's over in the electrical, isn't it.

MR. AXELRAD: Yes.

DR. MC COLLOM: I'd just as soon not get into electrical yet.

BY DR. MC COLLOM:

mpb7

Q Would it help to be back on Table 1 of Exhibit 23 now to find other categories? For instance, tanks; just talk about tanks.

MR. AXELRAD: On Table 2 perhaps.

WITNESS FREWING: Yes.

BY DR. MC COLLOM:

Q And pumps is another catagory.

A (Witness Bushnell) The analysis of such things as tanks and pumps I think, as Dr. White pointed out a day or so ago, is very similar just to a straightforward structural analysis.

Again, the code for steel supported tanks would be back to the AISC, and perhaps for anchorages either a federal spec or some manufacturer's conservative specifications in reference to the federal spec.

The analysis that we did in review of the ones that we did review in parallel with Bechtel was essentially a hand-calculation to determine first the frequencies given a model of the tank, and then in many cases these can be modeled essentially as single degree of freedom systems, a large tank with supports.

After the frequencies are determined then it either is just a matter of going to the response spectrum and picking the acceleration value, and then completing the analysis for stress levels in the support systems and

mpb8

anchorages.

Q How about pumps? Is that any different from tanks?

A Pumps in one degree. The ones that I can think of only now are essentially rigid within themselves, such that the anchorages are the things to be reviewed in most cases.

The pump itself is qualified by manufacturers and floor responses are not normally amplified. I just can't think of an example where one would be. There may be some.

A (Witness White) Normally a pump means it is a moving piece of equipment. The seismic loads normally would not control the size of the components. Its own function is a much more severe kind of condition than a seismic load would impose on it.

So the only thing that is governed by the pump -- or by seismic as far as the pump is concerned is the method of support, and this gets back to anchor bolts, or stresses on the pipe, or something like that.

Q I noticed heat exchangers on this list now. Would you like to address that as any special category different from tanks?

MR. AXELRAD: May I just ask one question for clarification, Dr. McCollom?

DR. MC COLLOM: Yes.

mpb9

MR. AXELRAD: These items like the heat exchangers you're referring to now, aren't those at 45 feet above, or am I reading Table 1 incorrectly?

WITNESS FREWING: Yes, Mr. Axelrad.

MR. AXELRAD: And those were not involved in any reavaluations, is that correct?

end 9

WITNESS BUSHNELL: Yes.

CHAIRMAN MILLER: What does Table 1 cover? Is that the original confirmation, is that a reevaluation, or both?

WITNESS ANDERSON: Table 1 was primarily prepared just to get a total list of equipment, where it was, and to show, to demonstrate clearly that some of this equipment -- some of it, in fact, is down in the lower part of the building.

So it is what gets you into Table 2, that then says what has been done to these tanks that are at the upper level.

BY DR. MC COLLOM:

Q I see. We already have covered tanks, and that looks like that's all that's done, is that right?

A (Witness Anderson) That's correct.

Q Okay. I guess the other question I would ask is:

In your knowledge has there been any significant change in design requirements based on seismic capability of equipment, mechanical equipment, since the original design of the equipment in Trojan?

A (Witness Bushnell) The change I mentioned -- yes, there is a change. One that comes to mind immediately is the one we just discussed, which is the change in the Standard Review Plan that may require consideration of special components, different from what we're considering at Trojan.

My judgment would be on that, after having worked somewhat with both methods, is that the differences would not result in any significant change to the supports. In fact, in some cases the Trojan criteria governs, or is no different.

Q Do you know of any other case?

WITNESS FREWING: Could we consult for a moment?

(The panel conferring.)

WITNESS BUSHNELL: Dr. McCollom, there's one qualification I'd like to add:

The current Standard Review Plan also has other requirements in it. There is one that I probably should mention in connection with these special components, and it would be in the area of damping, wherein higher structural damping is permitted by use of the Standard Review Plan, and also higher damping in mechanical equipment, piping, this sort of thing -- higher damping ratios.

BY DR. MC COLLOM:

Q That's for the current Standard Review Plan?

A (Witness Bushnell) Yes, sir.

Q That is in a safe direction, compared to the design of the components to withstand seismic events? In other words, if you design to a higher damping ratio, that's the safe direction, versus -- no, wait a minute -- I didn't say it right. Would you say it for me?

A (Witness Bushnell) I think what you --

Q Is the design stronger now under those standards, or is the design less strong for a given situation?

A With regard to Trojan, specifically, in the area of damping Trojan is more conservative in that the requirement was half a percent damping in most equipment and piping.

Q Okay. I think that's all on mechanical. I'd like to go to electrical now.

In Licensee Exhibit 23 where you start off with the page of electrical equipment, and we find out the various seismic qualifications that we have, you've listed four there. And the third one, numbered three, is called "testing method."

Would you describe what testing method means?

A (Witness Frewing) Could you indicate again the page you're on?

Q It's just before Table 5. G-23 is the number I see in the lower left-hand corner.

A (Witness Bushnell) Yes, we have the page.

Q I'd like to know, under paragraph C there, where you have the original qualification methods listed, what number 3 is that is described as testing method?

I guess it would help if I'd go through, and find out if it was used. Yes, it was. On the DC control centers, on the 4.16 kv switchgear, and the 480 volt load center and

wel 4

the 480 volt motor control center are the four examples of where the so-called testing method was used.

A Yes. The testing method referred to here as opposed to the one with the asterisk, generic basis, is a test method that meets the equipment specification attachment for Trojan, which was the specification for seismic qualification.

That specification gave the vendor the option of several different methods of qualification. In this event he chose testing.

This is as opposed, though, to the generic WCAP type testing, and in most cases -- and I believe in this case-- the 480-volt load center, the test was performed to the specific floor response spectra requirement, as opposed to any large generic envelope.

I don't recall offhand what the actual methods used. I might describe briefly some of the methods that were used.

The sine sweep and sine beat method we talked about this morning was used quite commonly, wherein you would get your piece of equipment on a test table and do a low amplitude frequency search to identify the resonances the equipment may have, and test at those resonances with a sine beat.

Normally a 10-cycle sine, a series of 10-cycle

sine beats, five or six, spaced by a short time interval, would be used as input motion to the test. And for a piece of equipment with half a p ent damping the response or the acceleration seen by the equipment at a half a percent damping, would be on the order of 18 times the input motion.

Other test methods were used, such as steady-state sine motion as input, wherein, at again a half a percent damping, the amplifying motion that the equipment would see would be approximately 20 times what was put into the table.

Other test methods included -- some of them included more of a random type motion, wherein the amplification is a square root function, and would be on the order of 5 times the input motion.

In each case the vendor, in order to qualify his equipment, would have to demonstrate that the resulting spectra from the response of the equipment at these frequencies exceeded, in every case, exceeded the demand as shown on the floor response spectra.

Q So that really is the criteria that was used? It was to say that you have to make it fit so that the response spectra of the floor was always enclosed within the resulting tested response spectra?

A Yes. In some cases you could qualify that further by saying that at the frequency where the equipment may have had resonances, that is to say that it wouldn't be necessary

wel 6

to test at a very low frequency if the equipment had only high frequency resonances.

CHAIRMAN MILLER: On page 2 of 9, do you see on Table 5, Shutdown on DBA Sequencers? What type of testing was done with that equipment?

WITNESS BUSHNELL: That test was performed by a vendor.

CHAIRMAN MILLER: Which vendor?

WITNESS BUSHNELL: If you give me a moment, I'll try to find that.

(Pause.)

My recollection is that a company named Dalmo Victor in California under subcontract to Animet Labs actually did the test.

The test, again as I recall, was a sine dwell type input motion. They were given a requirement spectra to meet, and used a sine input motion throughout the frequency range to prove that their equipment could withstand levels greater than the requirement given to them.

There is one other limit on the input used, and that is table limiting type motion which governs only the low frequency end of things, with the table displacements called control which you can get into the thing.

But that qualification, again, required that they exceed the requirement given to them.

Now, in these tests I think it's probably worth mentioning . . . well, maybe it isn't worth mentioning.

(Laughter.)

BY DR. MC COLLOM:

Q Let me ask a question here, just out of personal interest, as to how Bechtel and PGE worked on this kind of thing.

Here is a piece of equipment, I presume that was specified by Bechtel, and it needed to be tested.

How do we go about the relationship between Bechtel and PGE in terms of the selection of equipment, and then in terms of evaluating it for seismic capability?

A (Witness Bushnell) During construction phase, the architect-engineer, Bechtel Corporation, prepared specifications, including the attachment specifications, for seismic qualification of equipment to be purchased.

Portland General Electric Company does retain the purchasing responsibility. That's more or less a paper responsibility.

The documents and records and so forth that are required as part of the qualification are submitted to the architect-engineer for review, Bechtel Corporation in most cases.

Since the plant has gone operational, PGE has been purchasing some equipment directly, in which case PGE

would retain the responsibility for reviewing the qualifications.

I believe we . . . I don't know of any exceptions where we do not ask for, though, any comments that the AE may have, whatever it may be, whether it's an AE or NSSS requirement.

end 10
WEL 11
wel 7

Q Originally, when the plant was first designed, Bechtel specified all the original equipment design, and specified --

A To the best of my knowledge, yes.

Q Was it the joint responsibility to have these evaluations such as we've been talking about here, or who was responsible to assure the initial saismic qualification? Who took the responsibility for that?

A The reviews . . . it's kind of a difficult question to answer.

Q Would it help if we got specific on something, maybe, like, for instance, the Animet test reports? Who were the ones that specified what was to be done, and how it was to be carried out?

A To the best of my knowledge, during the design-construct phase, Bechtel Corporation, or in some cases the NSSS supplier, provided the specifications review.

Q Now, I'd like to get to the question which is now becoming rather familiar: According to the standards

today, are there significant changes in any place, if you were building the plant today, in the design of mechanical equipment that are significantly different than they were back when Trojan was originally . . . I'm on electrical now. Did I say mechanical?

I'm sorry. Electrical equipment is what I'm referring to. Just as an example, I know that the IEEE-344-1975 has been mentioned versus 1971, where there might be significant changes that might have been done if you would design Trojan today.

A There would be differences. It would be a matter of looking in some detail at the particular elements involved.

In general, my observations have been that those differences aren't very significant for most categories of electrical equipment.

In other words, they are single access only sensitive, and normally single frequency only sensitive, such as relays and things of that nature.

There are not, to my knowledge, any major categories where the difference' uld be significant.

Q Let me lead you to one estion that occurred to me when you were talking about the sine wave sweeping through and shaking the shake table. What about the more random kinds of more equivalent earthquake motion, I guess is what I

wel 10

would call it, that we've heard about? Is that in the standard now?

A As far as the IEEE standard, yes, it is.

The standard itself is essentially a number of acceptable test methods, one of which is the use of random motion.

Going to the significance, I did want to come back to my comment earlier this morning. One of the bases for that conclusion is the very conservative test amplitudes that result from these tests, such as the Dalmo Victor and others.

That is to say the vendors like to sell their equipment without having to requalify it at every plant and, hence, they try to qualify it to a very high level to begin with, so that they don't have to go through this process each time.

Normally, the response spectra that one can draw from test data show large margins in just about all frequency ranges above a specific plant's requirement.

Q I think I'd like to address this question now to the panel as a whole:

You heard my comment this morning about fire protection equipment. Can you tell me whether any of the fire protection equipment is listed in any of these tables in this Exhibit 23 that we've been reviewing?

A (Witness Frewing) The answer is no, there is no fire protection equipment listed in these tables we've been discussing.

Q Is there fire protection equipment in the buildings?

A Yes.

Q Are you aware if an evaluation has been made specifically taking into consideration the possibility of a seismic event resulting in a fire?

MR. AXELRAD: Excuse me. Dr. McCollom, we were going to be prepared to answer fire protection questions at a later time, unless you specifically want to address these witnesses.

CHAIRMAN MILLER: No. That's right. I recall.

DR. MC COLLOM: I thought that' why we said we were going to have a long noon hour, s. you could do that?

MR. AXELRAD: Oh, but we're not quite there yet.

DR. MC COLLOM: It wasn't a long noon hour, either.

MR. AXELRAD: The long noon hour was going to be so that we could come back and tell you what we could do.

CHAIRMAN MILLER: All right. I believe that's all the questions that the Board has of this panel at this time.

Is there any cross-examination, Mr. Socolofsky?

MR. SOCOLOFSKY: I have none.

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CHAIRMAN MILLER: Intervenors?

MR. ROSOLIE: Well, I'll defer to Ms. Bell.

MS. BELL: The way I see it right now is if I could have the opportunity to cross-examine after I heard the Staff that I might have, that it might be easier for me, that it might be clearer, for the reasons that Dr. McCollom brought up earlier.

CHAIRMAN MILLER: About how much time do you anticipate for cross?

MS. BELL: Well, I don't think that much. It's mostly a matter of wanting to make sure that the questions that I do ask are set in my head. I mean this has obviously just come up, and if I could have more time to prepare I'd appreciate it.

Also, hearing what the Staff would consider requirements and things would help me understand what Bechtel and PGE should be providing. And in that way, I would just be . . .

CHAIRMAN MILLER: Well, let me see if I understand you. You prefer to follow the Staff's examination, assuming there may be Staff examination of this panel?

MS. BELL: No, what I meant was --

CHAIRMAN MILLER: Well, if we can do something to accommodate you, to help you prepare --

MS. BELL: Well, I suppose if I went after the

wel 13

Staff it would give me a few more minutes.

CHAIRMAN MILLER: Well, would you like more time?

MS. BELL: Yes, I would.

CHAIRMAN MILLER: Well, if you can cut down the extent of your cross and focus it, then we'd be glad to cooperate in giving you some time.

MS. BELL: Yes, I would go with that.

CHAIRMAN MILLER: Ten minutes?

MS. BELL: Okay.

(Recess.)

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CHAIRMAN MILLER: Are we ready?

MS. BELL: As ready as I am going to be.

CHAIRMAN MILLER: Oh, yes. Mr. Axelrad, perhaps you can tell us what additional witnesses you have, and what are your timing schedule plans.

MR. AXELRAD: Okay.

What we had planned to do after this panel is complete is to bring back Mr. Frewing and Mr. Cooke to handle the fire protection question and then we will have Mr. Withers with respect to the Zion incident and the operating procedure.

And that would conclude what we have for today.

The other matters, as far as we can see were principally addressed to the Staff. It may be after the Staff testifies on that subject, that we may want to bring back some additional testimony.

DR. MC COLLOM: Will you be ready with the next panel as soon as we get through with this one?

MR. AXELRAD: Yes.

DR. MC COLLOM: Any other preparation will not be necessary?

MR. AXELRAD: That's right. The lengthened luncheon recess by the last ten minutes has enabled us to complete preparations.

CHAIRMAN MILLER: VEry well.

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CROSS-EXAMINATION

BY MS. BELL:

Q I'm not sure if you answered some of these questions before, and I want clarification. So you may decide among you who is going to answer.

I would like to know what electrical equipment is in the complex that requires multi-frequency multi-axis testing?

A (Witness Bushnell) As far as the Trojan requirements are concerned, none that I can think of that was originally tested.

There are some things that would be in that category which were qualified by analysis and do not, therefore, require multi-axis testing per se.

Q How would a cabinet in which relays were placed, affect the relays themselves or their capability to keep on functioning in a standard earthquake?

A In a great many cases the cabinet with the relay or the series of relays installed in it was tested.

In other cases -- so that the effect is included. In other cases the cabinet was tested with data channels, accelerometer channels at the location of the equipment that was to be installed in the cabinet.

Subsequent tests using that input motion, for the element that goes in the cabinet, tests were provided to

mm.3

qualify in that fashion.

I guess I didn't answer your question directly.

The cabinet itself would, in some cases, amplify the motion of the floor upon which it sits, to the location of the relay. In some cases it wouldn't.

Q So, let me clarify.

You seemed to come up with two points,and I am not sure what the difference was.

One case you would put accelerometers where -- let's see -- the sensitive instrumentation would be. And then you would apply shaking to the base of the cabinet?

A Yes.

Q And what was the other one?

You said was tested, I think --

A Merely the entire assembly complete. Namely, the instrument, whatever it might be, already in the cabinet when we test the cabinet.

Q In other words, you would test the instrumentation aside from the cabinet without the cabinet?

A No.

Q I'm not clear on the difference, then.

A (Witness White) The instrument is put in the cabinet. You put the cabinet on the table and you shake everything.

MR. MC COLLOM: As built.

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BY MS. BELL:

Q Okay.

So, one you are talking about in the Trojan plant, and the other you are talking about putting on the table and shaking it?

No? I'm missing again?

A (Witness Bushnell) These type of tests would not normally be done in plant.

In fact, I don't believe I know of any that were done in plant.

Q Okay.

So as far as you know, no tests of relays in cabinets were done at the Trojan plant itself?

A The facility is not suitable. One has to go to a test lab to do this sort of thing.

Q What would be the range of, let's say, the effect or the change in damping that a cabinet could cause on the acceleration?

A No change in damping wouldbe expected to occur due tc the cabinet.

A (Witness White) I might add, if the damping were to do anything, it would increase due to the bolted connection between the floor and the cabinet.

Q I believe -- I'm not sure exactly where in the transcript, but On the last day of the last hearing, November

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3rd, you said, and I may be wrong again, that Westinghouse gave you -- I guess meaning Bechtel -- floor spectra input for equipment.

Is that true?

A Could you say that again?

Q I believe you said that Westinghouse gave Bechtel floor spectra input for the equipment, or some sort of --

A They have within their generic testing program, a set of floor response spectra that they use for the testing of their equipment.

Q Okay.

Could you tell me what the qualification method of dynamic analysis means? I'm not sure if Dr. McCollom asked this or not, but I don't remember.

Who does it?

What does dynamic analysis testing or qualification mean?

A (Witness Bushnell) Are you referring to the footnote?

Q Right.

I guess it is on -- this would be Exhibit 23, page G-23, Section C-1, original qualification method identified in FSAR as dynamic analysis.

It is right before Table 5.

A The most commonly used method of dynamic

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analysis, very similar to what Dr. White has described for the structures.

One again would determine analytically frequencies for whatever gadget it was, and using those frequencies obtain the spectral accelerations from the floor response spectra. And continue the analysis to find loads and stresses, then check those against the applicable codes.

Q When equipment was qualified through analysis by the vendor, if you got a piece of equipment,and I can't -- let's just say it was a piece of equipment and it was considered qualified by the vendor -- had that same, actual same design with the same materials, had that been tested by the vendor?

Do you know what I'm saying?

I can give you an example. Let's say we were talking about a motor and you said, well, this motor has been qualified by the vendor. Could the vendor, let's say, test a smaller motor or a motor of somewhat different -- a different type of motor and still be qualifying the kind that your purchased?

A (Witness White) I think if the item he tested was not identical with the piece of equipment bought for the Trojan plant, it would be his responsibility to show the similarity between what he tested and what he delivered.

Q And where would one find that data?

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A Is this example relevant, were things like that done?

A (Witness Bushnell) I can't think of any particulaar item like that. But the vendor would be required to submit documentation for any safety-related piece of equipment that he was required to qualify. And that documentation would be reviewed against the requirements.

If he didn't make it, it would be rejected.

Q Are you familiar with the status of the WCAP Reports in terms of, not the NRC Mechanical Engineering Branch's Review, but the Electrical Branch's Review?

A (Witness Frewing) Not in detail.

I don't think we can cite those to you. Very obviously, the people most directly aware are Westinghouse people.

Q Okay.

That brings me to one of my major questions. I guess I really wasn't going to ask you, but I was curious. It seems to me at this point you are talking about all equipment both produced by Westinghouse and others, and I am -- this may not be a question for the Applicant, but I don't understand why we don't have Westinghouse people to answer some of those questions. I don't know who to approach.

CHAIRMAN MILLER: Is that a rhetorical question?

MS. BELL: Maybe it is rhetorical. Maybe that is

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all it is.

BY MS. BELL:

Q If you don't have the answer to my question, that is fine.

Was there any difference in the qualification methods used between the original design base accident sequence and the ones that were -- I believe they were replaced at a particular time?

A (Witness Bushnell) Your question was, was there a difference in the test methods?

Q Yes.

A The method was the same, as I recall. It was the one, as described earlier, done by Dalmo Victor.

Q Excuse me?

A The one described earlier this afternoon, that was done by Dalmo Victor as a subcontractor to Anamet.

Q In your opinion, would the way that the DBA sequencers were mounted in the Trojan plant affect their seismic qualification?

A Yes.

Q Was there a difference in the way they are mounted between the first time and the second time? That is the new ones and the replacements?

A (Witness Cooke) Yes, there was.

A (Witness Bushnell) Yes, I believe that is correct.

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Q Do you know what the reason for that was?

A I don't recall the reason.

A (Witness Cooke) Because we enclosed them in a box to protect them from any dust particles, anything like that. And it was more convenient to mount them differently in the box.

Q And the change in mounting, would that have anything to do with the actual performance of the DBA sequencers, aside from the fact that it was a convenience?

A You mean functionally?

Q Yes.

A No.

They were tested with different mountings. In other words, they were tested in three directions, vertically, horizontally and I believe originally they were mounted vertically. And now they are-- I'm fairly sure that they are mounted horizontally, and the seismic tests that were performed on them were performed in those positions.

Q Again, this was just a clarification.

A piece of equipment that had been -- is listed as having a qualification document, as an Anamet Lab report, would that equipment -- could that equipment be Westinghouse manufactured?

A (Witness Bushnell) It certainly could be. Westinghouse in some cases, to my knowledge, does use

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subcontractors as test labs to do some of their work for them.

Regarding Anamet, I have no knowledge of any direct relationship.

Q So given any piece of Westinghouse equipment, it could have been sent to subcontracting lab and tested or it could be -- okay, that's true.

If the reference document is a WCAP report, doesn't that just say basically how it should be qualified? What the testing methods should be?

A What the testing method was. In other words, it is a report of the test itself.

A (Witness White) But it gives the method as well as the results.

A (Witness Bushnell) Yes, it does.

A (Witness White) It does include the results.

MS. BELL: I have no further questions.

CHAIRMAN MILLER: Thank you.

Anyone else?

MR. ROSOLIE: I have a few questions.

CHAIRMAN MILLER: All right.

BY MR. ROSOLIE:

Q I got a little confused during questioning by the Boaad, and I guess I just want to clear it up in my own mind.

CHAIRMAN MILLER: Question the Board. We may

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have caused the confusion, is what I'm saying, Mr. Rosolie.

But I will be happy to have you inquire.

BY MR. ROSOLIE:

Q Okay.

Check me on my understanding now. Dechtel designed the plant and that includes -- you designed all the safety equipment that was required for the plant?

A (Witness Anderson) No, we did not design the safety equipment. We specified some of the safety equipment.

We wrote a specification, the specification was reviewed and approved by Portland General Electric. It was sent out to bid, this kind of thing.

Now much of the safety equipment was purchased as a package with the reactor, from Westirghouse.

Q Okay.

Well, I guess an example would be, since we talked about DBA sequencers, you specify that these would be needed. And then Portland General Electric put out a bid for them?

Is that how that worked?

A (Witness Cooke) They were specified on another specification along with a group of other equipment.

In other words --

DR. MC COLLOM: Let me ask you to explain something.

When you say specified, what does that mean in

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terms of the procedures you go through?

WITNESS COOKE: In other words, we wrote a detailed specification on what this equipment is to be performed to, to be built to, et cetera.

DR. MC COLLOM: It did not include specifying a typical manufacturer, or did it include that?

WITNESS COOKE: No, it did not.

DR. MC COLLOM: So it is a specification of the function that is to be accomplished, into great detail?

WITNESS COOKE: That's correct.

DR. MC COLLOM: And then that's what goes out for bid?

WITNESS COOKE: That's right.

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BY MR. ROSALIE:

Q I guess, since I already mentioned the DBA sequencers, I believe you said that they are now enclosed in the box? Were they tested with that box enclosure -- the seismic capability?

A (Witness Bushnell) I don't believe so.

Q And testing the seismic capability of electric equipment, are the effects of aging taken into account?

A In testing?

Q Electrical equipment -- the effects of aging taken into account.

A There were no requirements that I recall for a combination of aging considerations and seismic testing for Trojan.

A (Witness Frewing) That's accurate.

Q Are there any requirements now?

A The industry and the NRC are adopting standards which suggest additional combinations of environments for the qualification of equipment. The answer to your question is yes.

They are not applicable to Trojan; and, in particular, the aging is not particularly significant for interim operation inasmuch as the plant is only one year old.

DR. MC COLLOM: Does that mean that the aging factors being considered are much longer than one year?

WITNESS FREWING: Yes.

DR. MC COLLOM: What periods of time?

WITNESS FREWING: 40-year lifetime we are looking at.

DR. MC COLLOM: When do they expect aging effects to be occurring in that 40 years of life? Or is it specified that they are not to affect operations within the 40 years of life?

WITNESS FREWING: The design specifications that were described several moments ago talk about provide equipment that is good for 40 years in a given environment, temperature, humidity, radiation, what have you.

BY MR. ROSOLIE:

Q You said that Trojan is only a one-year-old plant?

A (Witness Frewing) It has only been operating for about one year, Mr. Rosolie.

Q Oh, okay. So then, in counting on aging, you only take into effect the time the plant has operated in that?

A I guess I meant that in a pretty general sense. Aging can occur simply as a matter of time, and it can also occur as a matter of being in service, obviously.

Q Is the possibility of battery plate aging -- is there a possibility that that would occur sooner than the 40 years?

A I guess I am not familiar with battery plates. I

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know I replace it in my car more often than 40 years. I guess we are not familiar with that detail.

DR. MC COLLOM: Are there components in the electrical system say, as an example, that you expect to repect to replace periodically, in a maintenance procedure?

WITNESS COOKE: Yes.

DR. MC COLLOM: Give us some examples.

WITNESS FIEWING: Light bulbs.

(Laughter.)

WITNESS COOKE: There is a possibility of relays that are extensively used, from normal daily operation, that could wear out over a 40-year life.

DR. MC COLLOM: What kind of batteries are the batteries that are in the safe battery supply? Do you know what they are lead-acid or what?

WITNESS COOKE: They are lead-acid batteries.

DR. MC COLLOM: Do you know what a typical life of a lead-acid battery is?

WITNESS COOKE: We specified 40-year life.

DR. MC COLLOM: You have specified 40-year life?

WITNESS COOKE: Yes.

DR. MC COLLOM: I'd like to know where to buy one.

(Laughter.)

WITNESS COOKE: They are maintained -- they are tested and maintained to manufacturer's specifications.

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BY MR. ROSOLIE:

Q Maybe you can tell me what IEEE 323, 1975, says about aging.

A (Witness Frewing) I guess I can't recall any words directly out of that test standard. Obviously, they exist in the standard. I don't know if that was something in our document, or not.

Q That's okay.

Now, when you did the reevaluation, you didn't take any of the equipment and reshake or do any new dynamic analysis, you just took what was originally given to you from the vendors and put that against the new floor response spectra?

A (Witness Bushnell) Comparisons were generally made with the original floor response spectra qualification, yes.

You mentioned calculations. Calculations, of course, as Dr [illegible]ita mentioned earlier, cable trays were redone and [illegible]

Q [illegible] the electrical equipment?

A We [illegible] on --

MR. AXELRAD: Well, may we have the question restated, please?

CHAIRMAN MILLER: I am three questions back. I am having trouble following them, and I know the reporter is having difficulty. We are going to have a little better

system here. Let's keep our voices up or work out some system.

Now, what is the pending question, Mr. Rosolie?

BY MR. ROSOLIE:

Q Okay. The question is that you -- for electrical equipment, you just took the original qualifications and compared them against the new floor response spectra?

A (Witness Bushnell) Where appropriate to do so, yes. Floor spectra was involved. That was what was done in general, yes.

Q What equipment did you not do that on?

A For those items of equipment where spectra were not available, such as those that were qualified by calculation. New calculations were performed.

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Q Can you tell me specifically which ones?

A Yes.

The piping's been mentioned, the cable trays have been mentioned here in 3B1, the battery racks is an example.

I believe you could find that information by looking at the qualification method number, and looking at the table you can find which ones were qualified by whichever method.

Q This is backtracking a little bit. But for all electrical cables in the plant, do they have a life expectancy of 40 years?

A (Witness Cooke) Yes.

MR. ROSOLIE: I believe that's all the questions I have at this time.

CHAIRMAN MILLER: Thank you.

Staff?

BY MR. GRAY:

Q Just one or two questions on the DBA sequencers that were raised.

Those sequencers which were replaced were mounted differently than they were mounted before. Are they qualified seismically now as mounted?

A (Witness Bushnell) Yes.

Q And was that qualification based on the original

mpb2 1 qualification tests?

2 A No. There were contacts changed between what
3 was purchased originally and what we have now, and perhaps
4 more than one time.
5 Q You say there are contacts changed? I don't
6 quite understand what you mean.
7 I'm talking about the mounting position.
8 A Oh.
9 Q So originally they were qualified for being
10 mounted one way and now they're mounted somewhat differently.
11 They are now qualified for a new mounting.
12 A Yes, sir.
13 Q This morning there was some questioning on
14 qualification of valves, and discussion of the fact that
15 valves are qualified to a certain acceleration. And then
16 there were some questions with regard to frequency.
17 Is it true that the valve qualification is
18 essentially frequency independent?
19 A (Witness Shipley) That would depend on what
20 type of testing you did.
21 The type of qualification method that we chose
22 required the vendor to supply a valve that had essentially
23 rigid topworks, and that being the case if it is in the rigid
24 range, then it is frequency independent.
25 Q What we're worried about is for valves, what

mpb3 1 acceleration a valve sees, period, regardless of frequency?

2 A That's correct.

.073 3 Q Are all the safety-related valves we are

4 concerned with here now in the rigid response range as

5 originally called for?

6 A Yes.

7 Q There was also some testimony, I believe, as

8 to comparing some standards when Trojan was licensed versus

9 standards today and some discussion of Standard Review Plan

10 standards or guidelines. And I think there was an indication

11 that Standard Review Plan, as it currently exists, allows

12 higher damping values on such things, I think, as piping, is

13 that correct?

14 A (Witness Bushnell) Yes.

15 A (Witness White) When we mention Standard Review

16 Plan, should it be Reg Guide?

17 Q Pardon?

18 I'm just trying to recall what the discussion

19 was previously.

20 A Okay.

21 Q Mr. Frewing, do you understand?

22 A (Witness Frewing) Yes.

23 I think maybe what Dr. White was referring to

24 was that the Standard Review Plans today may reference

25 Reg Guides that have the actual words about damping values.

mpb4

Q Isn't it also true that those Standard Review Plans also reference Reg Guides that -- in combination with the higher damping also requiring a higher ground response spectrum or higher ground accelerations to be applied?

A (Witness Bushnell) Yes.

Q Finally, in Section 1.3A of PGE Exhibit 23, there's a brief discussion -- let's see. This is under the heading Design Basis Earthquake, which I believe we've been also calling the safe shutdown, Design basis earthquake and safe shutdown earthquake being equivalent.

That was an unnumbered page. The section number is 1.3, more specifically 1.3A.2.

I think it's indicated there that the original qualification of mechanical equipment was done by taking OBE forces and multiplying them by a factor of 1.67 to get SSE forces.

Where did the 1.67 come from?

A (Witness White) The SSE, or DBE, is that .25g. The OBE is .15g. And the ratio of .25 divided by .15 is the 1.67. This is an extremely conservative criterion. The actual forces do not increase by this ratio, but nevertheless that was the ratio that was used.

Q Okay.

Now further reanalysis that was done for the new response spectra, I believe that actual SSE forces were

mpb5

used directly rather than taking this method used originally, is that correct?

A Yes.

Q And how does that relate to the method that was used originally?

A The method that we have used in the reevaluation is a conservative approach, but is not as conservative as the approach used in the original design.

Q Also back to damping, isn't it true that damping has really no significant effect on equipment that is rigid?

A (Witness Bushnell) That's correct.

MR. GRAY: The Staff has no further questions.

CHAIRMAN MILLER: Thank you.

Any redirect?

MR. AXELRAD: No, Mr. Chairman.

CHAIRMAN MILLER: Thank you.

You are excused.

Some of you may return, I realize, but this panel is excused.

(The panel excused.)

MR. AXELRAD: Mr. Cooke and Mr. Frewing will return under a different heading.

CHAIRMAN MILLER: Call your next witnesses.

MR. AXELRAD: Yes.

We now call Mr. Frewing and Mr. Cook.

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Whereupon,

JOHN L. FREWING

and

K. M. COOKE

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

CHAIRMAN MILLER: You gentlemen know you have been sworn and you remain under oath.

MR. AXELRAD: Mr. Chairman, I may point out that we are putting these two witnesses on to answer the questions that were raised this morning by Dr. McCollom with respect to fire protection. I would like to point out, as I'm sure the Board understands the comments we made yesterday, that the Licensee does not agree that that subject is within the proper bounds of this particular proceeding.

But in view of the Board's interest, we are pleased to put these witnesses on to answer these questions.

CHAIRMAN MILLER: We understand.

MR. AXELRAD: And I might additionally point out that since our notes are not too clear on the precise question that was asked by Dr. McCollom this morning, that we would simply make the witnesses available for Dr. McCollom to repeat the questions of this morning on this particular subject.

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CHAIRMAN MILLER: Very well.

The Board will recognize Dr. McCollom for the purpose of questioning these witnesses.

(Laughter.)

EXAMINATION BY THE BOARD

BY DR. MC COLLOM:

Q Would you just review some of the fire protection equipment that is in the -- I think if we just settle for the control building, that would be adequate, unless there are some unique characteristics of the other two buildings.

A (Witness Frewing) The fire protection facilities include detection equipment, they include some extinguishment equipment, which is in the form of some sprinkler systems and other systems. And it includes some barrier systems that would segregate different safety trains and also segregate safety-related areas from non-safety-related areas.

And then it also includes certain utility services that facilitate fighting a fire, like communications and the like.

Q You indicated, of course, that in order to have a sprinkler system you have to have the pipes.

Are those designed well to withstand the seismic SSE event?

A They are not Category 1 equipment in the same

mpb9

sense that the safety injection system is a Category 1 equipment.

However, when they run near or over safety-related Category 1 equipment they are analyzed to ensure that they don't fall down on that equipment or damage it.

Q Was there any evaluation made of the potential of fire being caused by a seismic event of the SSE size, 1.25g?

A There was no direct analysis done for that. The philosophy is that the plant was designed to suffer a fire from whatever cause, be it seismic or cigarettes being dropped, or what-have-you. And so a fire caused by a seismic event is not a specific item that is designed against.

(The Board conferring.)

Q What is your best judgment as to the ability of the fire protection equipment within the control building to withstand a .25g earthquake and continue to operate to protect for fire?

A Can we consult on that for just a minute?

Q Yes.

(Pause.)

A Dr. McCollom, our judgment is that the fire protection ability would remain following an SSE of .25g, and our judgment is based on things such as the fact that the detectors themselves are not large masses but would move around very much. The barriers are passive elements

mpb9 1 that would remain in place.

2 There is considerable administrative control on
3 the prohibition of combustible material that could be the
4 source of a fire, things of that sort. And of course there
5 is considerable flexibility in piping. We don't have
6 special technical skills in all the areas required, maybe,
7 to do a detailed review, but that's our judgment.

8 CHAIRMAN MILLER: Mr. Socolofsky?

9 MR. SOCOLOFSKY: No questions.

10 CHAIRMAN MILLER: Ms. Bell, Mr. Rosolie -- oh,
11 I guess I didn't ask the Licensees.

12 I assume since you produced the witnesses,
13 somewhat reluctantly, but nonetheless you would be entitled
14 to interrogate if you wish.

15 (Laughter.)

16 MR. AXELRAD: We'll wait for redirect.

17 CROSS-EXAMINATION

18 BY MR. ROSOLIE:

19 Q What is the NRC now requiring you to do at the
20 Trojan Plant regarding fire protection?

21 A (Witness Frewing) They require us to have a
22 physical system, fire protection system, which is described
23 in the FSAR. You may recall that as a result of the
24 Browns Ferry fire in 1975, the NRC conducted a rather
25 extensive study and issued guidance to all licensees as to

mpb10 1 what additional conservatisms they desire. They called for
2 the submittal of a good bit of information. We have provided
3 that information to the NRC. We have gone through several
4 rounds of questions with them. And we are in a schedule to
5 implemant several additional conservatisms at Trojan.
6 The NRC has issued a Safety Evaluation Report
7 dated March 9, 1978, and concluded that we're doing the
8 proper thing on the proper schedule.
9 Q Are those additional systems considered back-
10 fitting?
11 A We're not talking about additional systems.
12 We're talking about additional barriers or administrative
13 controls or detectors, by and large. In a lay-sense, one
14 could view them as backfitting. In a regulatory sense,
15 that is from the NRC's standpoint, I don't think they con-
16 sider that it comes under 50.109. But that would really be
17 a question for them.
18 Q So you don't know, in other words?
19 A We're just doing the work.
20 (Laughter.)
21 MR. ROSOLIE: I have no more questions.
22 CHAIRMAN MILLER: Thank you.
23 The Staff -- I'm sorry.
24 BY MS. BELL:
25 Q Now you referred to several additional

mpb11

conservatisms when you were talking about barriers, vertical and horizontal barriers, and cable spreading and things like that. Is it that sort of thing?

A (Witness Frewing) I'm not familiar with all those details, but it is that sort of thing.

Q In that phrase "several additional conservatisms" do you include the alternate or dedicated shutdown system that has been proposed will be in in the summer of 1979?

A The answer is yes. But let me clarify the answer.

Q Okay.

A Our commitment to the NRC following their request is to provide for certain decouple switches in safe shutdown systems such that one can shutdown outside of the control and cable spread rooms more easily were the fire supposedly or hypothetically in those areas.

The NRC had a criteria that said for plants of our status those decouple switches should be installed during the second refueling. We committed to that.

As you recall, we are now in our first refueling. We believe that the material provided by Mr. Pollard was dated and was based on an NRC opinion that we would start up in May of '78 and shutdown for our second refueling in May of '79, and, hence, it would be installed by -- was it June of '79?

mpb12 1 Q June or July.

2 A Right.

3 Because of this control building proceeding

4 our schedule for startup has been delayed. And we likely

5 will not complete all the work by June of '79. We will

6 meet the NRC requirement which was laid on us, that is to

7 complete the work by the end of the second refueling.

8 Q Is that requirement -- you're familiar with

9 the document that is Enclosure 7 to Mr. Pollard's limited

10 appearance?

11 A Let us look at that one moment.

12 Q All right.

13 (Pause.)

14 A The answer to your question as to whether or

15 not we're familiar with it is not generally. I mean, it's

16 not addressed to us.

17 Q Instead of that, then, what document would you

18 base the information you just told me, that the timing on

19 the alternate or dedicated shutdown system is based on the

20 second refueling?

21 A I would tell you it's based on the Safety

22 Evaluation Report. But except for a couple of minutes to

23 find it, I can't tell you the page.

24 Maybe Mr. Cooke knows.

25 (Pause.)

mpb131

Yes, page 3-1 of the SER, which begins with Section 3.0, entitled Summary of Modifications and Incomplete Items says:

"The Licensee plans to make certain plant modifications to improve the fire protection program as a result of both his and the Staff's evaluation. Such proposed modifications are summarized below. These modifications will be completed prior to the return to power for cycle three operation in the Spring of 1979."

Q Okay.

And when is that dated?

A (Witness Cooke) That's dated March 9, 1978.

Q Thank you.

In your own mind do you believe that the concept of the second refueling has anything to do with at what point the fire protection should be completely installed in Trojan?

A (Witness Frewing) I'm not sure I understand the question.

Q All right. Well, we'll just drop it, then.

What sorts of things might cause a fire in a cable?

A (Witness Cooke) Some failure within the cable, material-wise, or an overload in the cable, a short, ground, something of that sort.

mpb14 1 Q Under what conditions do you think it would be
2 most likely that something like an over-- or any of those
3 things might occur?
4 A If a piece of equipment failed.
5 Q Would there be any other hypothesized situations
6 that you can think of where an overload might occur on a
7 cable?
8 A Not other than the one I just mentioned, where,
9 for example, a circuit breaker does not function correctly
10 and it does not clear the fault in the cable. As a result
11 the cable will heat up.
12 Q You can tell me if you think you can answer
13 this question, and if so, go ahead, and if not, just say so.
14 When do you think that the highest current would
15 be in a cable that was, let's say, related to the emergency
16 core cooling system?
17 A That depends on many, many factors. It depends
18 on what the cable is feeding, what the cable is running in,
19 tray or conduit, what size of the cable -- it depends on many
20 variable.
21 Q Might it be true that a cable, let's say connect-
22 ed to the emergency core cooling system, an emergency core
23 cooling system pump would be carrying its highest current
24 during -- well, in the case of an accident, when that pump
25 would be used?

mpb15 1

A Only when it's starting.

Q When it's starting. Okay.

end 14

t 15

M.BLOOM jl-1

Q Now, my last question is simply: Under the NRC regulations, is it true that you assume fire damages even if you don't believe that they would actually happen?

A That is correct.

Q And could you give me your interpretation of what single failure criteria means?

Perhaps Mr. Frewing should answer the question.

A (Witness Frewing) We are consulting on, honestly, which reference to cite to you. That term is used in regulations in various standards, and it is applied to electrical systems and fluid systems related to the safety of nuclear power plants.

Q What if we were talking about -- now, you may not know this reference right off hand, but general design criteria, 17 and 34, of Appendix A of 10 CFR, Part 50.

Would that refresh anything in your mind?

A No.

Let's say the question again.

Q Single failure criterion is mentioned in general design criteria, both 17 and 34, and in Appendix A of 10 CFR Part 50, and that is my reference right there.

A Right. In those cases, I believe the intent of our designers was to use the definition in the IEEE documents, which are used to implement those general design criteria.

jl 2

Am I right on that?

A (Witness Cooke) That's right.

Q And when considering single failure criteria, do you assume that a fire will or will not occur given any other accident that is happening at the same time, or -- I could clarify the question if you don't understand.

A Yes, go ahead clarify it.

(Laughter.)

BY MS. BELL:

Q When you consider an accident at a nuclear power plant -- and we are talking about the Trojan Plant -- do you assume that a fire will occur at the time of an accident when you are considering simple failure criteria, the single failure criteria?

end 15

16WEL
wel 1

A (Witness Frewing) I believe not. Let me read for you the definition from IEEE-279-1971, single failure criteria.

"Any single failure within the protection system shall not prevent proper protective action at the system level when required.

Note: Single failure includes such events as the shorting or open circuiting of interconnecting signal or power cables. It also includes single credible malfunctions or events that cause a number of consequential component module channel failures.

For example, the overheating of an amplifier module is a 'single failure' even though several transistor failures result. Mechanical damage to a mode switch would be a 'single failure' although several channels might become involved."

Does that help?

Q No. It doesn't help me figure out what you think about it.

I have no more questions at this time.

CHAIRMAN MILLER: Staff?

MR. GRAY: No questions.

CHAIRMAN MILLER: Redirect?

MR. AXELRAD: No redirect.

CHAIRMAN MILLER: All right, gentlemen, you're excused.

wel 2

(Witnesses excused.)

MR. AXELRAD: The Licensee will now call Mr. Withers, who has previously been sworn.

CHAIRMAN MILLER: You have been sworn, and you remain under oath, sir.

Whereupon,

BART D. WITHERS

was recalled as a witness on behalf of the Licensee, and, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION

BY MR. AXELRAD:

Q Since you have not previously appeared at this particular session, would you please state your name and address for the record?

A Bart D. Withers. My working address is Trojan Nuclear Plant.

Q And what is your position at the plant?

A I'm the plant superintendent.

MR. AXELRAD: Mr. Chairman, Mr. Withers is being called at this time to respond to the question that Dr. McCollom had with respect to the Zion incident.

As I mentioned before, we do not necessarily agree that the matters as to which he was called to testify are within the ambit of this proceeding, and we're not

waiving any rights in that respect, but we are willing to make Mr. Withers available.

I will ask Mr. Withers just a couple of questions which I think focus upon the matters that I think Dr. McCollom has in mind.

BY MR. AXELRAD:

Q Mr. Withers, are you familiar with the incident at the Zion Nuclear Plant which is referred to in the limited appearance statement of Mr. Pollard that was introduced here yesterday?

A Yes, I am. I'm familiar with that occurrence in a general sense. I have no first-hand knowledge of the events and circumstances surrounding that, only from what I've read about it.

Q From your knowledge of that event, would you explain to us whether your operating procedures are such at the Trojan Nuclear Plant which would prevent the occurrence of that type of incident at the plant?

A We took a look at that situation. The Nuclear Regulatory Commission issues what they call circulars and bulletins to alert the various nuclear power plants concerning problems or situations which occur around the country.

Some of these require a response by the licensee, and others are just for information. But in either case, the I&E inspector assigned to a particular facility always follows

up with the plant management to verify that they have reviewed that document to determine its applicability to their particular operation.

So we did take a look at our procedures as a result of the incident at Zion, and really concluded that we would not get into that particular situation.

There are no physical stops --

Q Excuse me, Mr. Withers. Before you go on, could you just describe briefly what your understanding is of what happened at Zion, before you describe why you do not think it could occur at your plant?

A The incident referred to in Mr. Pollard's limited appearance testimony identified the situation where all of the parameters which would indicate pressurizer pressure, pressurizer level system flow had been taken out of service to facilitate testing or calibration of the facility.

The plant was shut down at that particular time.

Our procedures at Trojan would only allow us to take one particular channel of any given parameter out of service at a given time, unless the plant was in Mode 5, which means cooled down to less than 200 degrees.

Now, there's one particular type of testing which requires you to have all channels in test, and that's the response time test where you need to have dummy signals into all the channels in order to do that particular kind of

testing.

Our procedures for performing that response time testing would require the plant to be in Mode 5, or cooled down to less than 200 degrees.

We also carefully monitor and coordinate activities between instrument and control technicians and plant operators so that both parties are involved and aware of what's taking place when channels of instrumentation are taken out of service.

The technician has to get the approval of the control operator. He then logs that information in the control operator log, when it's taken out and when it's put back.

We have indication in the control room that a given channel has been taken out of service for testing. When we take a certain channel of instrumentation out of service, we have to put it in the trip mode, so that the protective logic circuit would see that as a protective signal from that channel. And that is shown to the operator by the status panel.

So he's very much involved and aware of what is being done.

In the case of the Zion incident, I don't have a lot of details, but there were a number of people involved in this, and some consideration given to apparently deviating

wel 6

from their procedures. And whenever that kind of a situation arises, that is done with much deliberation and caution, and involves a number of people.

Q You mentioned that the Zion incident was brought to the attention of Licensees throughout the country through an I&E circular or bulletin. When you received that information did you check your procedures at that time?

A We felt at that time that our procedures adequately covered our situation to preclude that kind of occurrence.

Q And they continue to?

A Yes, they do.

Q You mentioned in your testimony that there are times when a channel is removed for test or maintenance purposes. Would that create a problem at Trojan if a seismic event were to take place while this channel is removed?

A No, I don't believe it would. As the previous panel testified, this equipment is all seismicly qualified, and we really put ourselves in a more conservative situation from a safety standpoint when we take a channel out of service and put the by stable in the trip condition.

Normally we have a logic where, for example, we might monitor a certain paramater with four different detectors or instruments, and then have our shutdown logic such that whenever we reach the set point of 2 or 4, we would get a shutdown signal, or whatever was supposed to come from

that.

Now, in the event that we took one of those channels out of service, we would trip the by stable, which would look to the logic, the same as if we had a shutdown signal on that.

So, really, from that point on, any one signal would give you a shutdown or a protective action.

So you're almost in a safer mode from a conservative standpoint, a less reliable mode from a standpoint of the potential for one spurious signal of some kind to shut down the plant.

Q So it's less reliable from the standpoint that the plant would not continue to operate?

A That's correct.

MR. AXELRAD: We have no further questions on the subject.

EXAMINATION BY THE BOARD

BY DR. MC COLLOM:

Q When you say trip condition, that means that one channel has a signal coming through that says the condition is such that the reactor should be shut down, is that correct?

A Yes. If we're talking about a parameter that would give you a reactor shutdown signal, then that channel that you'd taken out of service would have the same effect on the logic train as if it were sending a signal through

wel 8

greater than the set point.

Q And in your test conditions you really only have one channel out,or can you have more than one channel out if you're testing?

A The technical specifications cover that, and it varies a little bit for different channels of instrumentation.

There's a table that covers several pages in the technical specifications, and it might -- say, there's four channels monitoring some parameter, and it would allow you to operate with three. Then there's an asterisk that would say in the event you need to test one of the other three, you could take one of those others out for a very limited period.

That provision is provided for in the technical specifications, and our plant procedures normally refer back to the technical specifications for those kinds of limitations, rather than try to duplicate that within the plant procedures. We feel it's important that that be corrected, so that normally appears only in one place, which is the tech specs. And our procedures refer back to that point.

Q Then would you describe -- I'm not sure how you described it -- where you'd take more than that number of channels out to check the response in your so-called level 5 condition.

A In that particular case, the plant would be in

what I said was Mode 5, or less than 200 degrees, where the technical specifications would not require any of that instrumentation to be in service.

So you would be outside the requirements of the technical specifications. You would still be concerned, however, with what you might need in the way of instrumentation from an operational standpoint.

Whenever you are depending on a bubble in the pressurizer to maintain plant pressure, the operator would certainly feel that pressurizer pressure and prassurizer level were probably the two most important parameters that he had. And to get him to give you all of those would be a very demanding job.

Q Is it necessary for any test to have all of them?

A Only this one response time test, and I'm really not familiar with all of the details of how and why, but that does require you to have dummy signals in, say, the three you're not testing. So that those would not be giving you a trip signal. You'd have it in a range where you would not have a trip, and then you would dummy through a trip signal on the fourth, so that you knew exactly that you were timing a given signal from the sensor all the way through to the actuating action.

Q Can you do that in more than one functional channel at one time?

A No.

Q LIke if you had four redundant channels, if you wish, for one channel of instrumentation, and you have another one over here maybe with three, do you do those at the same time, or do you do this one at one time and this one at another?

A I would say we would normally be working with all of the channels at one particular parameter at once, and when we finish that then go on to the next.

There's a limitation to how much activity the plant operators can really follow at any one given time.

17WEL DR. MC COLLOM: Thank you.

CHAIRMAN MILLER: Mr. Socolofsky?

MR. SOCOLOFSKY: I have no questions.

CHAIRMAN MILLER: Mr. Rosolie?

MR. ROSOLIE: I have none.

CHAIRMAN MILLER: Miss Bell?

MS. BELL: I have none.

CHAIRMAN MILLER: Staff?

CROSS-EXAMINATION

BY MR. GRAY:

Q Mr. Withers, how often is that test done that requires all these channels to be taken off line?

A That's done on, I think, what the technical specifications refer to as a refueling frequency, which would

be annually or every eighteen months sort of a range.

Q When would that be done next?

(Laughter.)

Let me back off a little bit. You don't have to give me a date, but what kind of event?

A Pardon me?

Q I'm not looking for a date, but what kind of event would that --

A It would be done during a shutdown period, with the plant shut down for maintenance.

Q Did you say it was tied in to refueling?

A Normally those kinds of things that are on a refueling or eighteen month interval are done concurrent with the refueling sequence, because they do require considerable perbds of shutdown time. And that's really the only time when you find that kind of time available.

MR. GRAY: Staff has no further questions.

CHAIRMAN MILLER: Redirect?

MR. AXELRAD: No redirect, Mr. Chairman.

CHAIRMAN MILLER: Thank you. You're excused, Mr. Withers.

(Witness excused.)

CHAIRMAN MILLER: Any further witnesses by the Licensees?

MR. AXELRAD: NO further witnesses today, Mr.

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Chairman.

CHAIRMAN MILLER: Is Staff going to be ready to put on one?

MR. GRAY: Tomorrow we would be ready to put on all.

CHAIRMAN MILLER: Well, none today?

MR. GRAY: No, sir.

CHAIRMAN MILLER: Well, then I guess we're through for the day, aren't we? Does anybody have any matters? We would like to finish tomorrow.

How many are flying out here, Mr. [illegible]

MR. GRAY: Three, Mr. Chairman.

CHAIRMAN MILLER: Shall we start at 8:30?

MR. GRAY: Mr. Chairman, they will be getting in somewhat late. I guess I was thinking of providing the extra half hour for them to rest up, but if the Board desires to go on earlier, we could.

CHAIRMAN MILLER: No, we'll go at 9:00. This morning you said they were in the air, and now I'm -- are they still in the air?

(Laughter.)

MR. GRAY: I thought I said arrangements were being made to get them in the air. They are now in the air.

CHAIRMAN MILLER: All right. We'll make it 9:00 o'clock. Could you give us an idea -- we're not asking

you to divulge your strategy, but some scope or approximate time so that the parties can know how to adjust their own schedules?

MR. GRAY: Mr. Chairman, we are going to attempt to address each of the questions raised by the Board in the morning. I suppose it always depends on the extent of the questioning. It could take half of tomorrow, or all of tomorrow.

CHAIRMAN MILLER: Are there any other matters that anyone wishes to bring up, anything that would save time tomorrow, for example? We would like to have the Staff's evidence taken and concluded, so if there's anything that could be done now rather than tomorrow, this is your opportunity.

MR. AXELRAD: It is clear, Mr. Chairman, that the Board has no further questions of us? The only matters as to which the Licensee might testify is is, as a result of the questions addressed to the NRC Staff tomorrow there are any additional matters that you would want to bring forth. But otherwise there's nothing that we should be preparing for?

CHAIRMAN MILLER: That's correct. Tonight you sleep.

(Laughter.)

And we do appreciate counsel and witnesses working

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on short notice. We know it took a good deal of time, and we do appreciate it.

Very well. Anything further?

Mr. Rosolie?

MR. ROSOLIE: (Shaking head negatively.)

CHAIRMAN MILLER: Miss Bell?

MS. BELL: I don't think so.

CHAIRMAN MILLER: Columbia Environmental Council?

MS. SCOTT: No.

CHAIRMAN MILLER: We will recess until 9:00 in the morning.

(Whereupon, at 3:20 p.m., the hearing was recessed, to reconvene at 9:00 a.m., Thursday, 14 December 1978.)

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