TERA

UNITED STATES
NUCLEAR REGULATORY COMMISSION

In the matter of:

PORTLAND GENERAL ELECTRIC COMPANY, et al
(Trojan)

Docket No. 50-344

Place: Portland, Oregon

Date: April 2, 1980 **Pages:** 4300 - 4453

INTERNATIONAL VERBATIM REPORTERS, INC.
499 SOUTH CAPITOL STREET, S. W. SUITE 107
WASHINGTON, D. C. 20002
202 484-3550

MEM

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:)
PORTLAND GENERAL ELECTRIC CO.) Docket No. 50-344
et al.) (Control Room Proceedings)
(Trojan Nuclear Plant))

Court of Appeals Room
Pioneer Court House
Portland, Oregon

Wednesday, April 2, 1980

The above-entitled matter came on for hearing, pursuant to adjournment at 8:30 A.M.

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

DR. KENNETH A. McCOLLOM, Member
DR. HUGH C. PAXTON, Member

APPEARANCES:

REGULATORY STAFF
Joseph R. Gray, Esq.
Jay McGurren

LICENSEE
Maurice Axelrad, Esq.
Alberto Carr, Esq.

COALITION FOR SAFE POWER
Eugene Rosalie

STATE OF OREGON
Richard M. Sandvik, Esq.
Frank W. Ostrander, Jr., Esq.

CONSOLIDATED INTERVENORS
Nina Bell

PROCEEDINGS

CHAIRMAN MILLER: All right, we will resume our evidentiary hearing. I believe that Mr. Clemenson and Mr. Knight were testifying, and Dr. McCollom was asking some questions at that point, please.

DR. McCOLLOM: Were you present here when we had the walk through of the installation of the eight plates by the panel from the Licensee?

THE WITNESS: Yes.

DR. McCOLLOM: Were both of you present?

THE WITNESS:

DR. McCOLLOM: Since your testimony, since we reviewed that, could you tell me any points at which the description was presented by the Licensee's panel differed from what your conception of what the process of the installation of the plates was or whether there is any disagreement on your part in the understanding of how those plates were to be installed.

MR. CLEMENSON: I do not recall any difference in understanding as to how the plates were to be moved and installed.

DR. McCOLLOM: What aspects of the plate installation do you consider your expertise covers and that your analyses, if you wish, were involved?

MR. CLEMENSON: In regards to the handling of heavy

loads which obviously are all eight plates I feel my area of review is to determine the adequacy of the handling procedures for those eight plates.

DR. McCOLLOM: Your conclusion, then, with respect to the safety of installation of the plates is what?

MR. CLEMENSON: It is acceptable.

DR. McCOLLOM: Mr. Knight, did you have any area in this.

MR. KNIGHT: No, I have no information for that area.

DR. McCOLLOM: Which one of you would be involved, I believe it would be Mr. Clemenson, in the process of drilling through the walls with the holes? You studied dust collection, et cetera.

MR. CLEMENSON: I think we both had an interest in drilling of the holes through the walls from different points of view. My concern dealt with noise, dust, and moisture associated with the drilling operation and vibration. Mr. Knight was interested in drilling the holes from the standpoint of any electrical connections associated with the drilling operations.

MR. KNIGHT: Well, any possible effects to the equipment inside.

DR. McCOLLOM: Mr. Clemenson, as just a point of information, when they use the water cooling to drill through with a diamond bit, what kind of water, how much water is

used typically? What do you expect when you do this drilling?

MR. CLEMENSON: I don't know that I can quantify it, in those operations that I have witnessed and I can't specifically say where, it's a slurry more or less, and the intent behind it is really nothing more than to carry away the grinding particles or particles of concrete and also to keep the cutting faces of the tool cool. And it's not a vast amount of water.

DR. McCOLLOM: Another way of characterizing it, is it like having a garden hose here turned on full force or is it just dripping off the edge of the garden hose?

MR. CLEMENSON: I would say it would be closer to the latter.

DR. McCOLLOM: Do you have the feeling that the collection of water on the inside of the control room building with the container that the Licensee has identified will adequately contain that water and it will be appropriate procedures that have been established for such that that water will be caught in the container and absorbed?

MR. CLEMENSON: Yes.

CHAIRMAN MILLER: I believe that's all the questions that the Board has.

I believe the Staff did ask for an opportunity for redirect; is that correct?

MR. McGURREN: I just have one question, Mr.

Chairman.

CHAIRMAN MILLER: Very well.

MR. McGURREN: Mr. Knight, yesterday you were asked about the situation where the plant brigade would be going in the cable spreading room at the same time that a fire brigade might be going into the cable spreading room, would that present a problem?

MR. KNIGHT: No, that would not be a problem. The people with the Board could simply be directed to move out of the way and allow the fire brigade to pass. For example, a brigade in the doorway going into this area and it shouldn't be any problem at all.

MR. McGURREN: That's all have we have, Mr. Chairman.

MR. CHAIRMAN: Any recross within the scope of the redirect? We excuse you at this time. Thank you, gentlemen.

Next?

MR. GRAY: Mr. Chairman, at this time the Staff would call Mr. Charles Trammell to introduce his testimony which has been previously identified as Staff Exhibit 16.

CHAIRMAN MILLER: 16?

MR. GRAY: 16.

CHAIRMAN MILLER: Mr. Trammell has already been sworn. So you remain under oath, Mr. Trammell.

CHAIRMAN MILLER: You are Charles M Trammell, III.

CHARLES M. TRAMMELL, III

was thereupon produced as a witness in behalf of the NRC, and having been first duly sworn on oath was examined and testified as follows:

THE WITNESS: Yes, sir.

CHAIRMAN MILLER: You testified previously and you are about to testify now from questions from Mr. Gray, Staff counsel.

EXAMINATION BY MR. GRAY:

Q. Before we get to Staff Exhibit No. 16, Mr. Trammell, were you present yesterday during the cross examination of Mr. Knight and Clemenson by Ms. Bell for the Intevenors in which a matter was raised with regard to the operability of safety trains A and B during the cold shutdown period for plate 8?

A. Yes, I was.

Q. Would you please describe -- could you please describe what matter was raised in the cross examination?

A. Ms. Bell was inquiring in her cross examination about the operability of train table B during the installation of plate 8 which caused me to inquire further as to what the requirements there is in the license with regard to operability. And it's true that Trojan has redundant trains and the Staff is relying on this redundancy during the

installation of plate 8 and, in fact, realize on it at other times as well.

But in particular, in looking at technical specifications and what is actually required during the installation, during the mode that we think that the plant should be in for this installation, there are very minimal requirements in cold shutdown. And with respect to the service water component cooling and residual heat removal, and I think it's my opinion as if Liscensee's condition should be supplemented to require that during the installation of plate 8 that both trains of equipment needed for maintenance of cold shutdown be required to be operable for that limited period.

Under the license as written now, it's technically possible or it's permissible to remove a pump from service for a standard period of time exempt for maintenance. And this would prevent that from happening. I don't think it's the type of thing they would do, anyway, but nevertheless the license as written now allows it.

So in summary, my recommendation, or I would like to supplement my testimony yesterday under the license conditions to state that during the installation of plate 8 that both trains of equipment needed for continued safe shutdown be required to be operable during installation of plate 8.

Q. Is that during the cold shutdown period for the installatin of the plate?

A. During the cold shutdown period for the installation of plate 8, yes.

Q. Mr. Trammell, do you have in front of you a document entitled NRC Staff testimony in charge of Charles M Trammell, III regarding relocation of the railroad purchased and reduction in size of the equipment hatch under the proposed modifications which has been marked for identification as Staff Exhibit 16?

A. Yes, I do.

Q. Did you prepare that document?

A. Yes, I did.

Q. Is also attached to that document a copy of your professional qualifications?

A. Yes.

Q. And did you prepare that?

A. Yes.

Q. Do you have any additions or corrections to make to this exhibit?

A. No, I don't.

Q. Is Staff Exhibit 16 for identification including your statement of qualifications attached thereto true and correct?

A. Yes, it is.

Q. Are you aware of any descending opinions or minority

view with regard to what you've expressed in this testimony?

A. No.

Q. Would you briefly describe what this testimony does address?

A. It addresses the safety impact of the relocation of the railroad spur and the reduction in size of the equipment hatch in the inline wall.

MR. GRAY: Mr. Chairman, at this time, I offer this Staff Exhibit 16, identified as Staff Exhibit 16 into evidence as the exhibit for the NRC Staff.

CHAIRMAN MILLER: Is there any objection to the admissability of Staff Exhibit 16?

MR. AXELRAD: No.

CHAIRMAN MILLER: Being no objections, the Staff Exhibit 16 is admitted into evidence.

MR. GRAY: The Staff has no further questions. Mr. Trammell is available for cross examination, both on the -- obviously on the items we talked about, the suggested change of the license condition, and also on Staff Exhibit 16

CHAIRMAN MILLER: Very well, State of Oregon care to cross examine?

MR. OSTRANDER: We have no questions, Mr. Chairman.

CHAIRMAN MILLER: Thank you. Intevenors?

MS. BELL: We have no questions, Mr. Chairman.

CHAIRMAN MILLER: Licensee, Mr. Axelrad?

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

CHAIRMAN MILLER: Yes, certainly.

MR. AXELRAD: No questions, Mr. Chairman.

CHAIRMAN MILLER: Thank you. You are excused at this time.

CHAIRMAN MILLER: Dr. McCollom? I am going to put you at the end of my cross examination list.

DR. McCOLLOM: I just want to clarify a little bit about the ability and design of the railroad system and the terminology used here, which I am not familiar with, in terms of cars coming into that railroad track from the outside.

First, you talked about a bumping post? Would you describe a bumping post and say how that bumping post works when that car comes in?

THE WITNESS: Well, the bumping post is a steel framework to basically provide the dimension and shape, which is designed to provide, designed to stop a train when it reaches usually the end of a track.

DR. McCOLLOM: That's sufficient. Now, describe a derailer and where it's located and what its function is.

THE WITNESS: Yes, sir. A derailer is a piece of metal which is bolted on the track and in case -- in this case locked such that when the train approaches the derailer, it lifts the inside flange of the wheel, which makes a track for the inside flange of the wheel which normally doesn't

rest on anything, and moves the train and derails the train like moving it to the left or right.

DR. McCOLLOM: And is there a standard operating procedure as you understand it by the Licensee that these are in place except when they are moving a piece of equipment on the railroad car in to the area -- I think it's described as the security fence.

THE WITNESS: Yes, these are in place. There is procedures governing their removal and they are verified to be in place periodically. The inside one, I believe the frequency is once every hour. The outside is less frequent. but this is a matter of the installation of these are subject to surveillance.

DR. McCOLLOM: The procedure, then, from my information, it would be in place up to the time that they are ready to move the car in and then they would remove it?

THE WITNESS: Yes, sir.

DR. McCOLLOM: Thank you.

CHAIRMAN MILLER: I believe that, then, does conclude the examination at this time. Thank you, sir.

MR. GRAY: Mr. Chairman, next we would have liked to have presented Mr. Herring. He is still disabled and will not be able to testify today. I believe that based on our discussions yesterday that the option at this point is to, I guess, go to the Licensee to start their testimony.

CHAIRMAN MILLER: Yes, I think due to Mr. Herring's illness, that we will depart somewhat from our scheduled witnesses slightly out of order. We will now proceed to the Licensee testimony on structural adequacy; is that correct Mr. Axelrad?

MR. AXELRAD: Yes, Mr. Chairman, however, in view of the fact that Dr. McCollom still had questions from Mr. Knight and Mr. Clemenson and Mr. Trammell and they testified further this morning, we misjudged the period of time that would be required for that, and the witnesses for our structural panel were instructed tore here at ten o'clock this morning. We are trying to locate them. They are someplace between the motel, PGE offices and the courtroom. We may be able to gather them by 9 9:30.

CHAIRMAN MILLER: We'll send somebody out and start gathering them. In the meantime. Let me ask the State of Oregon. Would it be possible since we are moving into structural adequacy, would it be possible to put your witnesses on without inconveniencing anybody?

MR. OSTRANDER: Could we have a moment?

CHAIRMAN MILLER: Sure.

MR. OSTRANDER: Mr. Chairman?

CHAIRMAN MILLER: Yes.

MR. OSTRANDER: Is it would probably be more efficient if we could go after the Licensee. We prefer to

hear their testimony first

MR. CHAIRMAN: All right, does anybody have any witnesses? Does anybody want to make any limited appearance statements?

All right, let's recess for about 15 minutes or so. We will be in or near the judge's chambers back here. Advise us as to the availability of witnesses.

MR. AXELRAD: Mr. Chairman, let me make sure that we do this for a few minutes now, what the testimony will be and how we will go about that.

CHAIRMAN MILLER: All right.

MR. AXELRAD: We have the panel prepared to testify with respect to its prefiled testimony. We have not, because of Mr. Herring's illness, been yet made fully aware of what the remaining issues in controversy with respect to what that testimony may be. What we propose to do is put our witnesses on at this time and have them testify with respect to their prefiled testimony. And we may have to recall them subsequently in order to discuss some additional matters arising from further discussions with the Staff.

CHAIRMAN MILLER: Sure, you wouldn't be precluded. You are assisting us by advancing, slightly, the order. And we will permit you to call for any reasonable purpose subsequently as well.

MR. AXELRAD: Thank you, Mr. Chairman.

CHAIRMAN MILLER: Is there anything you need to inquire of the Staff in preparation in moving into the phase you might not have intended to go into earlier? Is there any way the Staff can be of any assistance in focusing on issues not yet approached in

MR. AXELRAD: We have some preliminary information in that regard and we are trying to develop some additional information with respect to matters that have been mentioned to us. We believe that it may be more orderly to proceed with the prefiled testimony and then perhaps take up any additional matters after Mr. Herring has recovered.

In discussions with the court reporter, the other court reporter that was here this morning, there was some indication that it might be possible to expedite the preparation of the transcript on any particular subject matter if the Staff would want to have a copy of that transcript available for Mr. Herring at his hotel room. And perhaps the Staff will want to consider whether, when they cross examine or any particular portion of our testimony, if there are portions that they want to have expedited for Mr. Herring's review. That might be one way to make sure Mr. Herring is aware of what is happening in the courtroom today.

CHAIRMAN MILLER: That might not be the way to insure expedient recovery. However, we will make sure that the witness is familiar with what is occurring in that regard.

And we will stand in recess about 15 minutes and let us know what the results are.

(RECESS)

CHAIRMAN MILLER: Let's have the record show that we are having to make an arbitrary assignment of page numbers. And the portion of the testimony or proceedings which started at 8:30 this morning April 2nd, 1980 will commence numbering with page no. 4300. We will have the record reflect certain gaps are hiatuses in previous transcript numbering, but we will wait until the transcripts for Monday the 31st and Tuesday the 1st of April are completed and we will then make some record notations as to that portion of the pagination.

All right, now, the Licensee, by Mr. Axelrad, has indicated that the original panel has been recalled for some additional matters. The panel is now seated consisting of Mr. Broehl, Mr. Anderson, Mr. White and Mr. Cook, who have previously been sworn and remain under oath. You may proceed, Mr. Axelrad.

MR. AXELRAD: Dr. White, yesterday you explained to us in detail installation of the plate number 8. It is completely lowered into location, adjacent to the R wall and rested to the top on plate R 567. Will you please describe to us what the next step will be at that time with respect to the installation of plate number 8?

DR. WHITE: The next step will be to secure the

plate, which will result in the installation of five bolts and applying a quarter inch beam at the base of plate 8 attaching it to plates 7 and 6. Now, this is adequate to hold the plate in place.

After those have been -- after the plate has been secured, then the hoisting arrangements can be released and then the timber area supports the cripts for the wood can be removed.

MR. AXELRAD: Can you describe for us the mount of the welding that will be involved, the length of it.

DR. WHITE: We will be putting in 40 inches of weld across the bottom plate, 48 in quarter inches of weld, and this will supply the resistance with the safety factor of five for the S B E as will both the bolt safety factors on those are way beyond 5.

Q. Dr. White, I would like to bring you to your attention your answer to question 124 in Licensee's Exhibit 27. In the last paragraph of that answer on page 59, the second line of that last paragraph indicates that the tack welding will be to plates 5 and 6. Do I understand your testimony to be that that tack welding will be to plates 6 and 7?

DR. WHITE: Yes.

MR. AXELRAD: So that will be reflected to reads plates 6 and 7 and not 5 and 6.

Dr. White, could you read that sentence, please?

DR. WHITE: In addition, once plate is secured and with a tack weld to plates 5 and 6.

MR. AXELRAD: No, 6 and 7

DR. WHITE: That's the way it is. It will be corrected to read plates 6 and 7.

MR. AXELRAD: And the rest of the sentence will continue as it reads?

DR. WHITE: Yes.

MR. AXELRAD: Could you repeat for us the safety factors that would be involved with respect to a 0.25g SSE and whether that considers both a north-south and east-west earthquake?

DR. WHITE: There is a safety factor for both the welds in the bolts, it is a safety factor of five or greater, considering both east-west and north-south earthquakes.

MR. AXELRAD: Mr. Broehl, since in accordance with Dr. White's testimony at the time that the welding that he has described is having 5 bolts that he has mentioned replaced, plate number 8 will be able to withstand a 0.25g earthquake, is there any reason to maintain a cold shutdown any longer for the installation of plate 8?

MR. BROEHL: No, there is not.

Q. In yesterday's testimony, the Staff indicated that it believed that the cold shutdown should continue until all of the bolts for plate number 8 are installed. Could you tell

us what that would entail in terms of effort and what period of time it will require?

MR. BROEHL: The difficulty in installing the bolts in plate 8 are principally all along the top line of bolts which are into the control room. We have committed to have only one of these holes open at a time. So all of the bolts in that top row have to be put in sequentially. And I would judge that it's probably along that row two shifts work to put those bolts in alone.

Down in the cable spreading room, there is a considerable amount of grading required to install the plates for the bolts so that this is a slow process and involving few workmen, so it is going to be somewhat lengthy. I would estimate that the normal process as we will perform the work, it would take probably four to six days to install the bolts and plates.

MR. AXELRAD: Could you tell us how many bolts are involved?

MR. BROEHL: There is a total of 44 bolts in the plate.

MR. AXELRAD: So that would be the work required for the remaining 39 bolts to be installed?

MR. BROEHL: That's correct.

MR. AXELRAD: We have no further questions of this panel.

CHAIRMAN MILLER: Cross examination, State of Oregon?

MR. OSTRANDER: Just a minute, Mr. Chairman.

Mr. Chairman, we'd like to adopt a procedure, if we could, consistent with 10 CFR Section 2.733 which provides for examination by expert witnesses, other expert witnesses.

Before we do that, I would like to ask one question and then qualify Dr. Larsen, if that would be an acceptable procedure.

CHAIRMAN MILLER: Very well.

MR. OSTRANDER: Mr. Broehl, would you state precisely how much extra time the plant would have to be under cold shutdown because of the NRC's requirement that an additional 39 bolts be tight.

MR. BROEHL: I will state it is 4 to 6 shifts that we would need to do this on around-the-clock basis. We are talking probably two days.

MR. OSTRANDER: So your testimony is two extra days?

MR. BROEHL: Yes.

MR. OSTRANDER: Thank you.

DR. LARSEN: Is Larsen.

MR. OSTRANDER: Mr. Chairman, with me is Dr. Harold Larsen, the expert that the State of Oregon has utilized throughout this proceeding who is qualified, I believe, during Phase 1 of this proceeding. The requirements of Section 2.733 for examining by an expert witness are that the

Board find that the witness is qualified, that he has read the written testimony, and that he is prepared to conduct expeditious questioning. I am not sure how the Board wants to go about making those findings. We are prepared to do whatever you require. I can certify or state that Dr. Larsen has read the testimony and is prepared for an expeditious questioning.

MR. AXELRAD: If it would assist the Board in reaching a decision, we would have no objection to the proposal by the State of Oregon

CHAIRMAN MILLER: I am going to inquire, are there any objections by any of the parties? The Licensee indicates none. Intevenors, none. Staff?

MR. GRAY: No, Mr. Chaiman.

CHAIRMAN MILLER: In accordance with 10 CFR Section 2.733 examination by experts, the Board does find that Dr. Larsen professes the necessary qualifications which are described in that section of our regulations, and, therefore, we exercise our discretion to permit Dr. Larsen to interrogate the panel in accordance with both our regulations and within the scope of the direct examination.

You may proceed.

DR. LARSEN: We need some clarification on this item on Page 59. I think, Dr. White, you are responding to it first.

In particular, it's with regard to the 5-bolt capacity.

DR. WHITE: Yes.

DR. LARSEN: Could you describe the means by which you determine the forces within these five? Is it the inertia force of plate 8?

DR. WHITE: Yes, the inertia forces in plate 8. That would be the demand on the bolts due to an east-west earthquake.

DR. LARSEN: East-west and north-south?

DR. WHITE: Well, the resistance required for the north-south earthquake will be coming from the welds in plates 7 and 6. The east-west earthquake is going to try to move the plate away from with wall R, whereas the north-south earthquake will be putting sheer forces on those, and the bolts, themselves, will keep the plate in proper alignment, but will not develop any resistance, per se, due to the north-south earthquake. The resistance for the north-south earthquake is coming from the quarter-inch weld.

DR. LARSEN: That was part of my next question. As to the molds of resistance, is there tension in the bolts and sheer in the bolts and sheer in the welds?

DR. WHITE: No.

DR. LARSEN: The plate has been satisfied as far as movement normal to the wall and parallel to the wall; is that

correct?

DR. WHITE: The resisting doesn't include sheer in the bolts. The flexure in the bolts are for east-west earthquakes. The north-south earthquakes are resisted by the bolts. They are not required for resistance in the north-south earthquake.

DR. LARSEN: Could you explain the resistance in those 5 as distributed over the area of that plate?

DR. WHITE: They are distributed over the area of the plate. There is three in the top row. This would be up in the control room. And then there will be two from below the slab at 93, down in the cable spreading room. So they are spread out.

DR. LARSEN: Then I have just one last question. Is there any liquid material present during this state, grout?

DR. WHITE: No.

DR. LARSEN: That's all I have, Mr. Chairman.

CHAIRMAN MILLER: Thank you.

MR. OSTRANDER: Thank you, Mr. Chairman.

CHAIRMAN MILLER: Intervenors.

MR. BELL: We don't any questions.

CHAIRMAN MILLER: Thank you. Staff.

MR. GRAY: Would you describe the weld that you were going to use? You indicated 48 inches. Now, is that 48 inches total, or is that 48 inches for plate 8 to plate 7,

and 48 from plate 7 to plate 6?

DR. WHITE: No, this would be a total of 48 inches that will be distributed into three areas. Those areas are on plates 7 and 6. And you can see from the location of the supporting plates for the wood 4-by-4 timbers, you can see the three zones that these welds will be placed in. So it will not be concentrated. It will be spread out. But it is 48 inches total, not 48 for 7 and 48 for 6.

MR. GRAY: Are you going to nondestructively test this weld at all to determine they are good welds?

MR. BROEHL: Considering the very large safety factor we have on the welds, we do not intend to perform nondestructive testing at this time. It will be nondestructive testing as a part of the completed weld, however.

MR. GRAY: But you wouldn't have the safety factor if you didn't have a good weld; isn't that true?

MR. BROEHL: Could you repeat your question?

MR. GRAY: You said you are not going to nondestructively test the welds because of the large safety factor, but you would not have that safety factor if you did not have a good weld there?

MR. BROEHL: I don't know that the nondestructive testing has anything to do with the safety factor. That has to do with the quality of the weld. It will certainly be

visually inspected so that we have a reasonably high degree of confidence that the weld is competent, certainly no visual cracks in it.

DR. WHITE: The allowable stresses used for the evaluation of the capacity of the weld have been normal working stress ideas rather than going to some ultimate strength.

MR. GRAY: Will the plates below plates 7 and 8, will they have been fully welded to the plates below them?

DR. WHITE: Yes, they will be fully welded and grout will be placed in behind them prior to the movement of plate 8.

MR. GRAY: And the tensioning on the bolts - I know that's the wrong word to use - but how are they going to be tightened up?

DR. WHITE: Those will be snug. I might also mention that the spacers will be placed in the plate prior to the snugging of the bolts, so that the plate is firmly attached to the wall, but there will be a wedged gap. But the bolts will be snugged rather than any post-tensioning kind of operation.

MR. GRAY: Will the bolts prevent movement of the plate in the east-west direction?

DR. WHITE: Yes, that is their main resisting mechanism, the main purpose.

By mentioning that, the passing of a single bolt based on the bearing plate requirements is in the neighborhood of 200 kips. Our plate weighs 47 kips, so just one single bolt in terms of resistance can develop a tremendous amount of capacity. We are looking at .5 Gs as the acceleration of the wall in an east-west direction. So the actual demand of the total plate is like 24 kips. So a single bolt gives us 200. So we put 5 of them in just to spread them out over the resistance of the plane of the plate so the east-west direction.

MR. CHAIRMAN: What is a kip? K I P, isn't it?

DR. WHITE: Yes, K I P, 1,000 pounds.

CHAIRMAN MILLER: Could you put it another way, though? I am only being facetious, but I did want the definition of kip on the record.

DR. WHITE: Yes.

MR. GRAY: Is there any way that the vibration of an earthquake could cause this plate to bend or move in such away as to break those welds?

DR. WHITE: If you were to size the welds on just a safety factor of 1 to 1, we would be 33 inches in order to resist that.

Now, I mean 1 to 1 based on allowable stresses. Even if that's all we put in there, you still have the additional code margin.

So we are putting in -- I'm sorry. I'm sorry. Let me back up a minute.

You need about 6 inches. The 33 inches has a safety factor defined of 1 in it over the total. So we are going beyond that and putting in 48 inches. So we are looking at a safety factor of 7 or 8. So in terms of the actual earthquake doing some damage to this, that's inconceivable. I mean all of these things have been considered

MR. GRAY: Okay, you said that the -- your analysis was based on using working stresses as opposed to element capacity?

DR. WHITE: Yes.

MR. GRAY: If you used the element strength capacity or method, would these safety factors be in mind?

DR. WHITE: Yes.

MR. GRAY: That's the end of the Staff's questions.

CHAIRMAN MILLER: Thank you. Anything further of this panel?

MR. AXELRAD: Just one further question?

CHAIRMAN MILLER: Yes.

MR. AXELRAD: Dr. White, do I gather from your testimony that you agree that nondestructive testing or welding is not necessary in order to provide the confidence that the welds will perform their purpose?

DR. WHITE: Yes.

MR. AXELRAD: Thank you.

CHAIRMAN MILLER: Dr. McCollom?

DR. McCOLLOM: Why did you choose just five bolts?

DR. WHITE: Well, if you believe in numbers from a calculation point of view, one is plenty. Now, in order to provide some stability on a plate, you ought to have one in each corner. From an engineering point of view, it's probably -- that would probably be all you really need. I think for a little added security, we said, "What the heck, let's put in five." It doesn't really take that much more time in order to put in five. It's just way beyond what a person would require based on just calculations alone. But put in five, more security, bigger security blanket is what it amounts to.

DR. McCOLLOM: Now, are these bolts in there for good when you put in five?

DR. WHITE: They will not have to be taken out, relocated or anything else.

DR. McCOLLOM: So the only other thing that will have to be done to finish the plate off in terms of full installation of the bolts would then just be to tighten these bolts?

DR. WHITE: As far as these bolts are concerned. You have to put in the others, but --

DR. McCOLLOM: This is part of the permanent process

of installing the bolts; it's not an interim thing that you are going to permit yourself to start operating which would require you to replace them or take them out or put them in some combination?

MR. BROEHL: I would like to add a little information on that. What we would intend to do with these five bolts would be to install them in a temporary manner as a part of the plate erection process. They will not have the Teflon tape on them, nor will the three-inch plate on the back side of the wall have the one-inch space on that. So in that sense, yes, they will be installed in these locations temporarily to expedite the completion of the securing of the plate. The bolts will be then placed using the Teflon tape and the spacers behind the three-inch washers in the permanent manner.

When that work is completed, we will go back to these five bolts, remove them, put the tape on the bolts, put the spacer, one-inch spacer, the grout, the washer, and reinstall the bolts in preparation for doing the grouting.

DR. McCOLLOM: All right, then your comment is this, all of the bolts will be installed before you pull out the original five bolts to make their installation complete; is that correct?

MR. BROEHL: That's correct.

DR. McCOLLOM: Okay.

CHAIRMAN MILLER: I believe that's all at this time.

MR. GRAY: Mr. Chairman, I seem to have missed one additional question, if the Board will permit me.

CHAIRMAN MILLER: All right.

MR. GRAY: You indicated there are going to be spacers behind this place. I suppose there are spaces for the grout in order to be poured down. What material are those spacers?

MR. BROEHL: Those will be steel spacers.

MR. GRAY: Have you examined whether those things might be crushed or damaged during an earthquake such that the plate would then be moving around?

DR. WHITE: In terms of examining those spacers, we haven't. But in terms of the loads that the system is going to see, there is no reason to bother. Go back to the inertia load of the plates. There is only 23 kips total, and we are going to spread that out over five spacers. And if the spacer were to fail on that, it would be so flimsy, it wouldn't provide any spacing capability. So any spacing at all in there is going to take care of it.

MR. GRAY: Thank you.

CHAIRMAN MILLER: Dr. Paxton?

DR. PAXTON: Mr. Broehl, you mentioned Teflon tape. Where is this applied?

MR. BROEHL: This is a thin-film Teflon which will

be wrapped on the surface of the mold to provide a positive bond breaker between the grout and the mold.

CHAIRMAN MILLER: Is that it? Thank you.

MR. AXELRAD: Mr. Chairman, I will ask Mr. Anderson and Dr. White to stay in their positions and they will be joined. For the next panel of Mr. Bimal Sarkar and Mr. Patrick Chang-Lo

CHAIRMAN MILLER: Mr. Sarkar, you are standing now, will you raise your right hand to take the oath, please?

SIMAL SARKAR

was thereupon produced as a witness in behalf of the Licensee, and having been first duly sworn on oath was examined and testified as follows:

CHAIRMAN MILLER: Thank you, be seated.

The other two witnesses have already been sworn and remain under oath, of course.

MR. AXELRAD: Gentlemen, dose each of you have before you a document entitled "Testimony Under Structural Adequacy of the Modified Complex" which has previously been marked as Licensee's Exhibit No. 28?

MR. SARKAR: Yes.

MR. CHANG-LO: Yes.

MR. AXELRAD: Mr. Anderson, is the statement of educational professional qualifications attached to the rear of Licensee Exhibit 28 the same statement that has previously been accepted in evidence with Licensee Exhibit 27?

MR. ANDERSON: Yes?

MR. AXELRAD: Dr. White, is your statement of educational and professional qualifications attached to Licensee proposed Exhibit 28 the same that was accepted in evidence as Licensee Exhibit No. 27?

DR. WHITE: Yes.

MR. AXELRAD: Mr. Sarkar, is a copy of your

statement of educational and professional qualifications attached to proposed Exhibit No. 28?

MR. SARKAR: Yes.

MR. AXELRAD: Do you adopt that statement as your statement of qualifications in this proceeding?

MR. AXELRAD: Yes.

MR. AXELRAD: Could you summarize for us briefly your educational background and professional experience?

MR. SARKAR: My name is Bimal Sarkar. I am engineering supervisor. I have a Bachelor of Science Degree in Civil Engineering from University of Bihar, India, a Master of Science in Engineering from University of Calcutta in India and a Master of Science in Engineering from the University of California in Berkeley. I was an lecturer in Civil Engineering at the University of Calcutta for three years.

CHAIRMAN MILLER: Calcutta?

MR. SARKAR: Calcutta, where I taught undergraduate classes in Structural Mechanics and Structural Engineering. And I was a design engineer with Ballardie, Thompson & Matthews.

CHAIRMAN MILLER: B A L L A R D I E, Thompson & Matthews are a structural engineering firm in Calcutta, India?

MR. SARKAR: That's right.

CHAIRMAN MILLER: Thank you.

MR. SARKAR: And I was involved in the design and analysis of reinforced concrete and structural steel.

MR. AXELRAD: Maybe you should bring the microphone a little bit closer to you.

MR. CHAIRMAN: Yes, I think that would help.

MR. SARKAR: Then I was an engineering specialist with the government of Libya for four years and attached to their Ministry of Planning and Ministry of Industry, where I was involved in the review of design as were done by consulting engineering firms for the design of some of the major industrial projects in the country.

Then I came to this country and joined John Blume & Associates.

CHAIRMAN MILLER: Pardon me. When did you join John Blume & Associates?

MR. SARKAR: In 1971.

CHAIRMAN MILLER: They are located in San Fransisco, are they not?

MR. SARKAR: That's correct.

CHAIRMAN MILLER: Consulting engineers?

MR. SARKAR: Yes.

CHAIRMAN MILLER: I might indicate to counsel and for the record, I think that my brother-in-law is or was an engineering member of that firm of John Blume & Associates. I have not had any discussion with him regarding this case or

any similar case, but I recognize John Blume & Associates. My brother is -- or my brother-in-law is James Keith, K E I T H. I believe that he is and was at that time a member of the firm. So I call it to the attention of the parties and counsel.

You may proceed.

MR. SARKAR: I was involved in the analysis of buildings which were subject to the 1971 Los Angeles earthquake in Los Angeles and the vicinity. And I worked there for about two years. And I joined Bechtel in 1974. And since that time, I have been involved in the design and analysis of the nuclear power plants.

My involvement in Trojan Power Plant has been since June, 1978.

MR. AXELRAD: Thank you, Mr. Sarkar. Are you a registered professional engineer?

MR. SARKAR: Thank you. I am a registered professional engineer in the State of California.

MR. AXELRAD: When I first asked you a question, I neglected to ask you for your business address. Could you provide that for us, please?

MR. SARKAR: My business address is 50 Beale Street, B E A L E, Street, San Fransisco, California.

MR. AXELRAD: Can you describe your involvement in Trojan Control Building proceedings?

MR. SARKAR: As I said, I have been involved in the Trojan Control Building since June, 1978 both in regard to the Phase 1 operation, the seismic evaluation, and also the modification of the Control Building

MR. AXELRAD: Thank you, Mr. Sarkar.

Mr. Chang-Lo, will you please provide for us your full name, working address and present position?

MR. CHANG-LO: Yes, my name is Patrick Chang-Lo. My business address is at 50 Beale Street, San Fransisco. I am employed by Bechtel Power Corporation as project engineer responsible for civil structural design and analysis of the Trojan Control Building modification.

MR. AXELRAD: Do you have before you a copy of Licensee's testimony in the structural adequacy of the modified complex, which has been marked as Licensee's proposal Exhibit 28

MR. CHANG-LO: Yes, I do.

MR. AXELRAD: Is a copy of your statement of professional educational qualifications attached to this testimony.

MR. CHANG-LO: Yes.

MR. AXELRAD: Do you adopt that statement as a statement of your qualifications in this proceeding?

MR. CHANG-LO: Yes.

MR. AXELRAD: Could you summarize briefly for us

your educational backgrond and professional experience?

MR. CHANG-LO: I have a Bachelor of Science Degree in Civil Enginering from the Virginia Military Institute and a Master of Science Degree in Civil Engineering, San Jose State College. I am registered civil engineer in California. I have been employed by Bechtel Power Corporation for 13 years and have been involved in the structural design of nuclear power plants

MR. AXELRAD: Could you describe for us your involvement in the Trojan Control Building proceeding?

MR. CHANG-LO: Yes, I have joined the project as of November of 1979 as a civil structural project engineer. I have had supervisory position and I have reviewed all of the work that has been performed up to now.

MR. AXELRAD: Thank you.

Mr. Anderson, are there any corrections or additions which you wish to make at this time in Licensee Exhibit 28, the testimony of this proceeding?

MR. ANDERSON: Yes, there are a few minor corrections. On page 14 A, the fifth line down from the top of the page, the four-mass system should be described as a five-mass system as shown in figure 1. So the sentence would read, "Figure 1 shows a simple model of a five-mass system." And the rest is the same.

On page 58, there is a typographical error in the

next-to-the-last line on the page. The question mark after the word "tension" should be deleted. And the capital where should be replaced with a lower case where.

On page 5, the title should be changed from SEE to SER. So it will read "SER open items."

CHAIRMAN MILLER: The page before that, I think I have two pages 65. Is that intentional?

MR. AXELRAD: That is correct. I believe the second page 65 should be marked 65 A.

CHAIRMAN MILLER: All right. We will have the second page 65, which consists of five lines amended to 65 A, please.

MR. ANDERSON: And the last correction is on page 86?

MR. OSTRANDER: Could you repeat that?

MR. ANDERSON: The last correction is on page 86. The date shown in the question, may 16th, 1978, should be changed to May 26th, 1978.

MR. AXELRAD: I would like to ask the other three members of the panel if they adopt those corrections that have just been identified by Mr. Anderson.

DR. WHITE: Yes.

MR. SARKAR: Yes.

MR. CHANG-LO: Yes.

MR. AXELRAD: Gentlemen, is this testimony with these corrections true and correct to the best of your

knowledge?

(Affirmative responses)

MR. AXELRAD: Do you adopt that testimony as testimony in in this proceeding?

(Affirmative responses)

MR. AXELRAD: When this testimony was prepared, were there any minority or dissenting opinions expressed?

(Respond negatively)

MR. AXELRAD: Gentlemen, do each of you have in front of you a document entitled Licensee responses to McCollom's prehearing conference questions March 11, 1980 which has previously been marked for identification as Licensee Exhibit 30?

(Responding affirmatively)

MR. AXELRAD: Are the answers to questions 1 through 12, 16, 17, 20 and 21 true and correct to the best of your knowledge?

(Responding affirmatively)

MR. AXELRAD: Does each of you adopt those answers as additional testimony of yours in this proceedings?

(Responding affirmatively)

MR. AXELRAD: Mr. Chairman, at this time I would ask that they be received in evidence in this proceeding, Licensee's Exhibit No. 28 and with respect to the document that has been previously been marked for identification as

Licensee Exhibit No. 30, namely the answers to Dr. McCollom's questions, we previously offered questions 13, 14, 15, 18 and 19, we have now had testimony sponsoring the remaining questions. I would therefore ask that Exhibit No. 30 himself be received into evidence

CHAIRMAN MILLER: Is there any objections to the receipt in evidence of Licensee's exhibits number 29 and 30?

MR. GRAY: No objections.

CHAIRMAN MILLER: There being no objections, the exhibits Licensee's number 28 and 30 in toto will be admitted into evidence.

MR. AXELRAD: Mr. Chairman, we do not have any supplementary oral testimony at this time. As I indicated earlier this morning, we may have supplementary oral testimony by this panel later. If they are still on the witness stand at that time, we may offer that evidence later. Or if they are excused temporarily, we may recall them at some subsequent time.

CHAIRMAN MILLER: Very well, you will be given leave in that regard.

MR. AXELRAD: The witnesses are now available for cross examination.

CHAIRMAN MILLER: We will proceed with cross examination. State of Oregon?

MR. OSTRANDER: May we have just one minute?

CHAIRMAN MILLER: Yes.

MR. OSTRANDER: Would it be possible to recess for 10 or 15 minutes?

CHAIRMAN MILLER: Yes.

MR. AXELRAD: Mr. Chairman, perhaps the Intervenors could go --

CHAIRMAN MILLER: Yes, but the State of Oregon would like to cogitate and confer. Could you tell me, Intervenors, about how much time you anticipate in cross examination?

MR. ROSOLIE: Mr. Chairman, I don't believe we have any cross examination. Of cores -- oh, we have about five minutes.

CHAIRMAN MILLER: Fine. And the Staff, could you give us an estinate?

This isn't binding. This is just for scheduling purposes.

MR. GRAY: I would say about a half hour.

CHAIRMAN MILLER: All right, what do you need about 10, 15 minutes.

MR. OSTRANDER: About 15 minutes.

CHAIRMAN MILLER: Take a recess.

(Recess)

CHAIRMAN MILLER: Very well, you may proceed.

MR. OSTRANDER: Mr. Chairman, we would like to use the same procedure we used last time. And we will have Dr.

Larsen conduct our questioning.

CHAIRMAN MILLER: Granted leave so that you can.

MR. OSTRANDER: I might point out it may be refer to the model that is before the Board. Dr. Larsen, understand that he is supposed to refer to the column and the wall numbers so that it is clear on the record what is being described.

CHAIRMAN MILLER: Yes, be sure to use description in words when you are using models or anything so that our record, our transcript will reflect it as well as being visually available here. I am sure you will remember to do that. You may proceed.

DR. LARSEN: My first concerns have to do with the construction, for instance, in some of the statements that have been made regarding that. If we could, refer to page 12 of, I believe we are calling this, Exhibit 27, matters other than structural adequacy of the complex. It's on page 12.

First, am I correct in assuming that these are additional improvements that are going to be incorporated into the final modification? I know these were discussed in San Fransisco at this meeting, but as they appear on page 12, are these items to be incorporated in the final modification?

MR. ANDERSON: Yes.

DR. LARSEN: If we could then, turn to page 69 of that same document. I missed the slide show on Monday, so

Maybe you are going to be repeating some of the things that you indicated there with the slides. But let me just indicate my concern in the construction sequence.

It seems that at each stage of construction you must indicate some additional or a substitute structural item to pick up anything that may be reduced in strength. And I am quite satisfied with everything that occurs up to the 65-foot level, because you have added the in-prime wall and brought it to a particular strength.

But in looking to the statements made on Monday and also on page 69 I need some clarification as to where the substitute strength is going to come above elevation 65 at the time in which some of the columns are exposed. I simply cannot see the substitute strength coming in at these different floor levels. Can someone respond in just general sequence as to how this would be done? I would particularly like to hear the substitute item, its location, and whether or not it changes in response of the conflicts at each floor level as it is done.

DR. WHITE: I am assuming that you are talking about the substitute for vertical sheer resistance?

DR. LARSEN: Yes, that is primarily the concern, yes.

DR. WHITE: Okay, as we were talking earlier, the vertical sheer resistance is the thing that is being removed from the structure during the construction sequence. And if

you consider the, the material is being removed in order to exposed column lines R 41 and R 46, for instance, refer to that as a typical situation.

DR. LARSEN: That's fine.

DR. WHITE: We have removed the vertical sheer transfer around the corner versus R 41. Now, while it's being done, the new wall directly below this elevation, the new with all is 45 to 65. Now, the concrete is at 2,000 PSI prior to removing the material at elevation 65 and 77. So, now, this is new vertical sheer transfer capability that exists that did not exist prior to the modification.

Now, the adequate sheer transfer capability that existed between elevation 45 and 65 is way beyond what has been removed from elevation 65 to 77.

DR. LARSEN: Could I interrupt for just a second? I am concerned, though. Have you added something to the inner storage behavior between 65 and 77. I realize you have strength added below 65. But is there innerstorage strength between 65 and 77, has that been strengthened at this point or is there a weakness?

DR. WHITE: Some has been removed, you can't remove move material without weakening the structure.

DR. LARSEN: That is where my concern lies. Is there anything going in as a substitute for those levels?

DR. WHITE: No. But that doesn't mean that the

structure cannot resist the S S E. Because there was margin in that with all both due to horizontal sheer and vertical sheer prior to removing this material. So some of the material wasn't moved had excess sheer transfer to start with.

DR. LARSEN: I agree with that. But I did question the statement that we haven't reduced, from reductions. Are you indicating between these floors we have lost a little or how much.

DR. WHITE: We haven't reduced the capacity structure below the resistance required for the .25 SSE.

DR. LARSEN: Could you then go on up to between 77 and 83, is the story going to be the same there.

DR. WHITE: Yes, there is adequate capacity at the various stages of construction to resist the .25 SSE, even though locally something has been removed. But from a local point of view in the structure itself, the structure has the capability of resisting the S S E.

DR. LARSEN: That's what I am getting at. At times I saw the wording no reduction had been made and you are saying now there is sufficient strength.

DR. WHITE: Yes.

DR. LARSEN: I tend to agree with you. It's just the wording I couldn't agree with all the time.

DR. WHITE: The wording does, perhaps, need explanation.

DR. LARSEN: Then could I go back to that page I just referred you to, page 12. This was done, as you know, at the San Fransisco meeting, and I simply did not have time to explore in detail. This doesn't really alter any statements you have made. There is no further reduction due to your adding these improved modifications on 12, in other words, exposing the columns to weld being to column connections, and you are also going to tie some wall better together. Has any of this reduced its existing capabilities to withstand a SSE?

DR. WHITE: The areas where the capacity is reduced temporarily would be for the construction of column line 41 Q, starting with 41 wall, bear the sequencing of construction that we talked about earlier which indicated that column line 41 Q would not be open at the same time that column lines R 41 and N 41 would be open. So the sequencing there is such that before 41 Q is opened up, there is adequate capacity added to other areas or it would be opened up by itself, essentially, 41 Q along with N prime.

DR. LARSEN: 41 Q is opened up only to elevation 65; is that correct? .

DR. WHITE: Yes. And going along wall 41, 41 Q will not be opened at the same time as 41 R and 41 N

MR. AXELRAD: Mr. Chairman. If I may interrupt for a minute.

CHAIRMAN MILLER: Yes, are you inquiring because we are beyond the scope of the present panel's testimony?

MR. AXELRAD: Yes.

CHAIRMAN MILLER: I see, very well, fine.

MR. AXELRAD: My feeling is if there are any matters that the state wants to explore with respect to the construction sequence or the way the facility is going to be improved, we would like to have those matters clarified on the record, and we will be perfectly willing to have this particular panel to define matters of that kind

CHAIRMAN MILLER: It has occurred to us in the interests, in the public interest, we have permitted cross examination on matters that are not before us on cross examination, nis as you know, counsel. It should probably be limited, had you told is, it would probably be granted. For that reason we did not interrupt. We are, however, into an area where there is present, presently before us prepared written direct testimony on the matters of the structural adequacy.

Now we want a complete record. As we say, we are not criticizing you. On the other hand, now, if we are going to get into matters other than that, which were in the first phase of the second phase, so to speak, in fairness to the witnesses and Mr. Axelrad, we should have some deliniation and we should have some indication from the State of Oregon

which has taken no position with regard to contentions, as it is not required to do, but if you are going to get into substantive areas we must have fairness. And so I suggest that you give that some thought, and you can then tell us how you wish to handle that so that all parties including licensee's, Staff and intervenors will have notice of the various intentions that you plan to go into and get on to some affirmative evidence.

Thank you, you may proceed.

MR. AXELRAD: The reason I did interrupt was that when Professor Larsen had indicated before starting his examination, that would be useful if he had some diagrams to refer to for purposes of his examination.

CHAIRMAN MILLER: Do you have some such material.

MR. AXELRAD: We have now received the copies of the slides that were used in the presentation on Monday.

CHAIRMAN MILLER: Very good. That would be helpful I think.

MR. AXELRAD: I would like to have marked a document entitled "Slides used in oral testimony by Mr. R C Anderson and Dr. William H White on March 31, 1980", consisting of slide A, and then slides numbered 1 through 12. I would like to have that document marked as exhibit, Licensee's Exhibit No. 30.

CHAIRMAN MILLER: You have a 30.

MR. AXELRAD: 31.

MR. CHAIRMAN: 31, that will be so marked for identification.

After you have had a chance to examine it, I will ask counsel and parties to indicate whether or not you have any objections to it being admitted into evidence at this time.

(EXH.-NO. 31 marked)

CHAIRMAN MILLER: My understanding is that these slides which are indicated in Licensee's Exhibit 31 consist of those slides which were visually demonstrated in our courtroom Monday, was it, Monday, March 31. And that they have now been reproduced in such fashion that they may both be made part of the record and that Professor Larsen, State of Oregon, or others may utilize them in further examination; is that correct?

MR. AXELRAD: That is correct, with one addition as Dr. White pointed out when he started his presentation, slide 1 was not, in fact, a part of the presentation, but is just included to depict the construction sequence.

CHAIRMAN MILLER: That is slide 1?

MR. AXELRAD: Yes.

CHAIRMAN MILLER: All right, slide 1, which was the second, I guess, slide that was photographed was not, itself, physically used in the presentation, but fair and accurately

portrays the information of data which was the subject of testimony?

MR. AXELRAD: That is correct.

CHAIRMAN MILLER: Is there any objection to slide 1 with that explanation appearing in this exhibit?

MR. GRAY: No objection from the Staff.

CHAIRMAN MILLER: All right, I take it there is no objection, then. So slide 1 may be included.

Now I have asked you, if you had a chance to examine these sufficiently to tell us whether or not you wish to object to the admission into evidence of Licensee's Exhibit 31 at this time?

MS. BELL: Mr. Chairman, some of the intervenors would object unless it is clarified in some way -- well, there is a problem in the back, let's see, the back of the building from the view that it's shown in these slides, that sometimes the color, the yellow or the blue, basically you can't see it because it blends in the background. And that was orally explained by Dr. White during the slide show, but it doesn't show up in these pictures.

CHAIRMAN MILLER: That is true, that does not show up in the color reproduction. It was explained by Dr. White in his testimony. Do we have any suggestions as to how to handle the problem?

MR. AXELRAD: Mr. Chairman, we thought the exhibit,

even with this slight imperfections as described in the record is useful to all parties and the Board. If there is any objection, we will be pleased to withdraw the exhibit.

CHAIRMAN MILLER: Well, it's been marked for identification, you may proceed with it on that basis, and we will consider the matter in point, if it is offered. And it is accepted. Licensee Exhibit 31 for identification may be used in your examination of the panel.

(EXH.-No. 31 received)

MR. OSTRANDER: Thank you, Mr. Chairman. I would like to comment briefly on your remarks concerning how we got into that area on this panel's presentation.

CHAIRMAN MILLER: Okay.

MR. OSTRANDER: Yesterday we tried to alert the Board and the parties to the fact that we had considered the sequencing of construction to be a structural matter. And Dr. Larsen addressed that in his structural testimony. And it's obviously one of those areas that crosses, I think, into both nonstructural and structural areas. And we had requested the Board, and I think the Licensee agreed that we could treat this issue flexibly. And that was our intention.

CHAIRMAN MILLER: What we are pointing out is that you are not now presenting affirmative evidence going into those matters as you have given, but nonetheless, we want a complete record as we are getting now, on the process of a

certain broad issue for going into this a certain amount of time into other issues.

MR. OSTRANDER: I think the advantage of this now is we make our affirmative evidence more precise.

CHAIRMAN MILLER: Fine, we have no objection.

MR. OSTRANDER: Thank you.

MR. OSTRANDER: Could I ask the panel one question concerning Exhibit 31?

Does this accurately reflect the sequence of construction that is set forth in the March 17 testimony Licensee Exhibit 27?

DR. WHITE: Yes.

MR. OSTRANDER: That's all.

DR. LARSEN: I have just a couple more things.

First of all, let me indicate that I think slide 11 indicates my concern at that point, and I think you have addressed it and answered it, in the way that I would hope that you would have cleared things up. And I think you have cleared up as far as I am concerned.

Slide 11 indicates those areas around those columns between particular floors that I was concerned with as far as the construction sequence. And I think I have only one other question, and I don't know whether there is a proper time to bring it up. It will have to do with the defined stiffness of the final system and how much the floor response spectra

will be widened. But I think probably we will wait until a later date to do this.

CHAIRMAN MILLER: Whatever is most convenient from a logical standpoint.

MR. AXELRAD: Mr. Chairman, that is part of this testimony. This would be the appropriate time to cross examine on that point.

CHAIRMAN MILLER: I would think so.

MR. OSTRANDER: It's night to be in the right place at the right time.

DR. LARSEN: I would like to refer to Exhibit 28.

DR. WHITE: Page 28?

DR. LARSEN: Exhibit 28, pages 65 and 65 A. This has to do with the response spectra that will be used in the pipe analysis, I believe.

DR. WHITE: Yes.

DR. LARSEN: There was some indication up to a couple weeks ago that further evidence would be provided as to how low the stiffness might possibly degrade. Has anything more been presented beyond what we see on these two pages? Any particular? Are you still planning to broaden the curve by a 31 percent as indicated on page 65 A?

DR. WHITE: Yes, that is, that is our plan, the curve is lowered 31 percent on the low frequency side, and then in addition to that, additional ten percent. The 31

percent here just due to the matters of stiffness associated with gross bending, creeping, shrinkage, all these kind of items, not talking about variation in material properties due to changes, not including variations in weight, these kind of things. Those items are in the additional ten percent. So 31 percent is just to talk about the departures from the frequency predicted by the original STARDYNE model.

DR. LARSEN: Do you feel at this time you have the best representation that you can hope to achieve using the STARDYNE model as far as stiffness is concerned?

DR. WHITE: I think that the representation that was used in the original STARDYNE model is a very reasonable model. The additional broadening that we have included I think more than adequately covers any, any possible departure from the idealized case that was originally analyzed.

MR. OSTRANDER: That concludes our questioning, Mr. Chairman.

CHAIRMAN MILLER: Thank you,. Intervenors?

MS. BELL: First I'd like to direct you to a letter from the Licensee to NRC dated March 17, 1980. I believe it's in Exhibit 25, but I am not sure which section. Section J in Exhibit 25.

DR. WHITE: Okay.

MS. BELL: I am referring to answer 1 An and B page 8 of 18.

DR. WHITE: Could you repeat that, please.

MS. BELL: I am referring to answer number 1 A and B, page 8 of 18.

DR. WHITE: Okay.

MS. BELL: Okay. On the second paragraph on that page, let me just read that, "It is important to note that all wall sections considered in these examples have an unreinforced core. In the actual complex, walls, especially in the Control Building, most of the wall panels of the sheer walls have reinforcing steel in the concrete core, and therefore, their sheer capacities for all the predicted modes will be increased accordingly."

Would some member of the panel please explain to me and quantify the word "Most" that appears in the second sentence of that paragraph.

DR. WHITE: Clarification on what's meant by most, most cores having reinforcing steel in them?

MS. BELL: Right.

DR. WHITE: It's calculated the number of cores below elevation 93, I think there is like 95 percent of the course have concrete in them -- I mean the cores have reinforcing steel in them. That's in the Control Building.

MS. BELL: In the Control Building, not the complex. Is this referring specifically to the Control Building? The sentence reads, "Any actual complex walls, especially in the

Control Building, most of the wall panels. But the word "most" I would assume refers to the actual complex walls.

DR. WHITE: The number 95 percent I gave you was specifically for the Control Building.

MS. BELL: And could you quantify from what the word most would mean in reference to the actual complex walls?

DR. WHITE: On that one, I haven't calculated a figure, but the walls that are being used to, primarily to resist the earthquake loads do have reinforcing steel in the core.

There are a number of walls in the Auxiliary Building that are used primarily for shielding, three to four foot thick walls, and those, in general, do not have reinforcing steel. But an actual percentage, that I don't have.

MS. BELL: Judging from your use of the word most, without being accurate, can you could you just give me in general, would it be over 50 percent?

CHAIRMAN MILLER: Most what, now? I am getting confused as to the most.

MS. BELL: Of how many of the wall panels in the complex have reinforcing steel. That is how many of the wall panels that have concrete cores have reinforcing steel in those cores?

CHAIRMAN MILLER: Now, the complex consists of more

than one building?

MS. BELL: Right.

CHAIRMAN MILLER: Now which building or buildings are you inquiring about?

MS. BELL: I am referring to the entire complex, all of the panels in the complex that they are referring to.

DR. WHITE: In one of our responses to the NRC question we prepared a table which gives those items, you can calculate it as well as I can.

MS. BELL: I am just trying to elicit, I realize that appears in section A of B of the same exhibit, I am asking whether your use of the word most refers to over 50 percent of those panels?

CHAIRMAN MILLER: Of what panels? If you are including the Control Building panel you are going to get a different percentage than if you exclude it.

MS. BELL: All the panels in the complex including the Control Building which is part of the complex.

CHAIRMAN MILLER: So then you are going to get a percentage. If you are asking for a percentage which is going to include the 95 percent in one of the three buildings, is that what you are inquiring?

MS. BELL: That's correct.

CHAIRMAN MILLER: Okay, can you approximate it or give it exactly?

DR. WHITE: Yes, for the complex, most would mean 50 percent or greater.

MS. BELL: Okay.

My second question has to do with the block rather than the core. Turning to section B of that exhibit, which are the summary tables that you were referring to, is it your understanding that all the block has steel reinforcement?

DR. WHITE: Yes.

MS. BELL: Okay, thank you. We have no further questions.

MR. CHAIRMAN: Thank you, Staff?

MR. GRAY: Starting out with PGE Exhibit 26, on Page 11, the answer to, a response to question 18, do you have that?

CHAIRMAN MILLER: What page was that?

MR. GRAY: Page 11.

CHAIRMAN MILLER: Thank you.

MR. GRAY: Response to question 18. You indicate that the originally proposed structural extension or structural extension that was being contemplated required difficult analysis and design to fully demonstrate the capability and stiffness between the old and new structures and therefore is a more difficult design for the physical connections between. Isn't there somehow an element of that, also, in the proposed modifications?

DR. WHITE: There is some of that in this particular design. However, if you look at the relative conditions of the two, I think the distinction will become apparent in the structural support system, which was perhaps one of the earlier concepts for the making the modifications. There we were unable to grab ahold of the existing complex along lines at the edges of slabs and the edges of walls. We weren't able to really grab ahold of the area in the wall in getting a good resistance from it. And this is one of the main problems in the structural support system.

However, if you look at the modifications that are currently being proposed, rather than grabbing the existing complex at the line, we are able to do it over an area, which gives us much better distribution between the existing elements and the new elements. So this is one of the differences. I am not saying that the connections now are simple but relatively speaking much simpler.

MR. GRAY: Is it easier to maintain the seismic qualification during the construction work using this present concept for proposed modification relative to what it would have been for that other sort of structural extension.

MR. ANDERSON: Well, our considerations were that if we had a problem that was in the existing building, the only way that problem could be solved was to have some kind of a structure or elements that would reach out into the building.

And if we did that, then reaching out into the building would reach out into perhaps the control room or cable spreading room into areas that we felt would have made it more difficult to do during operation, and that was one of the major considerations in going to the present concept of the modification program.

MR. GRAY: Moving on to page 13 of this exhibit, response to question 21. Let's see. You discussed the ground motion at the base of the structure. Is a major consideration in the ground motion the simultaneous combination of horizontal orthagnal components of the earthquake with the vertical.

DR. WHITE: Could you repeat that, please?

MR. GRAY: Is a major consideration, in considering the ground motion, the simultaneous combination of a horizontal orthagnal components of an earthquake along with vertical that is orthagnal,

DR. WHITE: That wasn't part of the original design criteria, and that's what we are working with, the original design criteria.

MR. GRAY: What was the original design criteria?

DR. WHITE: The original design criteria stipulated that one horizontal and one vertical component were to be considered simultaneously and the influence of these would be added absolutely.

MR. GRAY: In response to question 32 given there on pages 16 and 17, actually on page 17, you indicate the force lapse in the building transfer a certain load. In addition to the force slabs transmitting their own inertia loads of attached equipment and piping to the sheer walls and then to the base of the structure, they also transmit dead load and thermal loads, don't they, to some extent?

DR. WHITE: Yes.

MR. GRAY: Okay, in response to question 33 at page 17, you discuss there web walls and flange walls, web and flange walls in the structures. Does the STARDYNE analysis which you have used, does that rely on the web walls to resist bending in addition to sheer?

DR. WHITE: Yes.

MR. GRAY: Moving on to page 18, response to question 34. You indicate there that the force slabs in the building are very stiff in a horizontal plane. Are they equally as stiff to resist out-of-plane bending at the flange walls?

DR. WHITE: Out-of-plane bending as the flange walls?

MR. GRAY: At the flange walls.

DR. WHITE: I am not sure I understand the question. Repeat that, please.

MR. GRAY: Okay, are those force slabs as stiff to

resist the out-of-plane bending at the flange walls as they are stiff to, in their horizontal planes.

DR. WHITE: Well, the force slabs can definitely take the out-of-plane bending, to whatever loads comply. That is their main function is to resist vertical loads, which is the out-of-plane bending effect.

MR. GRAY: Moving on to page 19, response to question 38. You state there that the effect of gross overturning is to do several things, but among others, it will produce axial compression on one end and axial tension on the other end of the wall. Does the gross bending or overturning, gross bending or overturning introduce any net compression and tension in the wall?

DR. WHITE: In our assessment of the behavior of the complex due to gross bending, the walls see at most a very low level of tension. There is definitely compression build up on the compression side. But in our section of the complex, the panels, if they go into tension at all, is very, very minimal.

MR. GRAY: Can you quantify the minimal.

DR. WHITE: 5 PSI kind of thing.

MR. GRAY: Moving on to Page 21 and the response to question 40. I'm sorry. The response to question 39.

MR. GRAY: You discuss there a mechanism to develop

moment restraint. And you say a complex wall in one of these mechanisms is the beam-column connection was the beam-column connection relied on in your analysis to resist the moments in double curvature mode behavior.

DR. WHITE: No, it was not relied on.

MR. GRAY: Okay, page 23, in response to question 45, you there discuss the structural steel framing, the steel beams and columns which support the force slabs in the complex. Isn't it true that originally that steel framing was not relied on for any lateral resistance, only for vertical resistance, vertical load?

MR. ANDERSON: Well, the original steel -- originally the steel frame was certainly considered by the design team in the design of the structure. The steel frame was considered to be imbedded in the walls and certainly although it was not directly designed for lateral loads, it was considered as a member in the walls and a contributor to the building's overall capability

MR. GRAY: But it's primarily a design for taking the vertical loads.

MR. ANDERSON: Yes, because the steel frame was built prior to the walls being constructed and the steel frame had to be designed to carry the vertical load.

MR. GRAY: And today with regard to the modified complex, it is now being brought to some extent to resist

lateral load; is that true?

CHAIRMAN MILLER: Pardon me, I didn't quite catch all that?

MR. GRAY: Today, with regard to the analysis of the modified structure as proposed, that steel framing system is relied on to some extent to resist the lateral loads?

DR. WHITE: Yes.

MR. GRAY: Moving on to page 24, there is some discussion of the test program that you conducted in conjunction with the development of the proposed modifications. You indicated that one of the purposes of the test program was to assure composit behavior of the masonry walls with the concrete core. I guess this is what we call the composit walls, and that no delamination will occur at that concrete and masonry interface. Was that object of the test program specifically addressed for walls that have imbedded columns? In other words, were the imbedded columns accounted for.

DR. WHITE: We did have two test imbedded columns and there was no delamination of those specimens.

MR. GRAY: Page 25, response to question 50, I believe you indicate there that the test specimens demonstrated that the walls will withstand lateral loads of the OBE or the SSE without significant physical damage. What do you mean by significant physical damage? Give us some

description?

A. Yes, in the -- in the behavior of these test specimens up to and including the ultimate capacity of the specimens, cracks within the specimens did develop, but big pieces did not fall off, in fact, no pieces fell off.

One of the important characteristics demonstrated by the test specimens is that once the ultimate capacity had been reached, the specimen did not explode or release its load. It was a very abductal kind of behavior and was enable to maintain its load even after reaching the ultimate capacity. So this was a very important observation.

MR. GRAY: So even at failure of the wall test specimen itself, you did not have block flying out from --

DR. WHITE: Exactly, it was abducted behavior, pieces not falling off up to and including the ultimate. .

MR. GRAY: Okay, on page 26 of this exhibit, response to question 51, part B here, you indicate a sheer capacity of 300 PSI could be considered as a conservative lower bound for normal sheer failure for specimens with an aspect ratio of .5. Is that 300 PSI always the lower bound of normal sheer failure for those aspects ratios?

DR. WHITE: For an aspect ratio of .5?

MR. GRAY: .5, yes.

DR. WHITE: In the test specimens that we have been working with, all the test specimens that failed in diagonal

tension were beyond 300 PSI. Perhaps Mr. Sarkar can add some information to that based on the analytic studies that were done.

MR. GRAY: Diagonal tension, this is what you refer to as normal sheer failure.

DR. WHITE: Yes.

MR. SARKAR: Does this explain sufficiently?

MR. GRAY: That's sufficient.

Going up to page 47, the response to question 91. There you talk about the steel plates to be installed in the west wall and frictional resistance.

DR. McCOLLOM: Mr. Gray, I have an awful time. We are shielded from here, and if you could enunciate a little better, I think I could hear it.

MR. GRAY: Okay, the question was that in this response on page 47 to response to question 91, the steel plates to be installed on the west wall Control Building are discussed, and there is some discussion there about frictional resistance between the plate and the concrete wall or the concrete behind it. On that, what is the -- can you a test the adequacy of the sheer friction coefficient between the new concrete and the steel plate? In other words, will that required frictional resistance be developed?

DR. WHITE: Okay, I think in order to address the question will the frictional resistance be developed, I will

need to take a look at the overall design mechanism here.

We are using a post tension bolt system in order to provide the clamping force. And in evaluating that force, we are including the influence of bolt relaxation, creep in the wall, these kind of things to their effect on the adequate tension of the bolt. In addition to that, we have an inspection program that will insure the tension of the bolt be maintained throughout the life of the plant. That's one aspect.

Second is the coefficient of friction that we are using, plus whatever safety factor we have. So we are using a safety factor to, in conjunction with a coefficient friction of .7. And from a number of different studies, the .7 for concrete on steel is a reasonable coefficient of friction.

Now, to further enhance this coefficient of friction, we are going to roughen up the back of the plate to further insure that this coefficient of friction is, in fact, object taped.

MR. GRAY: Where is that going to be.

DR. WHITE: This would be in the vicinity of bolts. That's where the clamping force will have the primary influence, and we haven't really decided on how big a range of area that will be roughened up, but it will be an adequate area.

MR. GRAY: How about the washers on the other side

of the wall, will they be roughened up?

DR. WHITE: There is no sheer transfer at the interface of the washer. The sheer transfer takes place only at the interface of the plate 3 and the ones on that side, and the wall. The plates 1 through 3 in general.

MR. GRAY: Although that design was with a coefficient of friction of .7, do you really need that much of a coefficient of friction?

DR. WHITE: No, as I mentioned in terms of actual slippage, we are using a safety factor of 2, so that, in essence, drops it back to a coefficient of friction of point 35 which really all is needed in order to preclude slippage. In addition to that, the capacity of the bolts are sized based on seismic loads in conjunction with thermal loads. And about 40 percent of the load is coming from thermal. And this is a self-relieving kind of situation, so in terms of slip during an earthquake, the possibility is extremely remote.

MR. GRAY: You did mention the bolts. They are going to be two inches in diameter; is that correct?

DR. WHITE: Yes.

MR. GRAY: What stress level will be in those two-inch diameter bolts as opposed to the stress level that would have developed in the one and three quarter inch bolts that you were previously going to use.

DR. WHITE: I am not sure what the tension is. It would be reduced by the two cross section area. Because the actual tension in the bolts will still be the tensile force and I will have the same magnitude. It's just reduced by the ratio of the two areas.

MR. GRAY: The stress would be less. You've got a bigger area.

DR. WHITE: Oh, yes, absolutely.

MR. GRAY: Going to page 42, I am going back a bit. Page 42, this is a response to question 82.

There at the bottom of the page, you indicate that distributed microcracking developed on the wall during earthquake will force the wall to grow vertically. What is the basis for that statement?

DR. WHITE: What's the basis for the statement that the cracks will cause the wall to grow?

MR. GRAY: Yes. If it's obvious, please explain it.

DR. WHITE: Okay. You've got a panel, and whatever its original height was, if now you put some cracks in that, the wall is now as tall as it was plus the sum of the crack width, so it's going to widths, so it's going to increase.

MR. GRAY: But in a dynamic situation which you get with an earthquake where things are vibrating about, you might get some grinding away of these crack surfaces that could take away your growth; couldn't it?

DR. WHITE: These kind of things were not observed in normal flexure cracks in normal sheer walls, for instance. The kind of cracks we are talking about are cracks due to the reinforcing steel stretching and causing the cracks rather than a diagonal crack or something along those lines. So it would be the same kind of crack that would develop in a horizontal beam subjected to vertical loads. The beam deflects down, the bottom side stretches and a crack opens up. So there isn't, per se, a lot of forced grinding across this thing. The cracks are developing primarily due to the reinforcing steel stretching.

MR. GRAY: Okay, on page 54, response to question 107. There you indicate that if you assume that there is no bond between the columns in the concrete, you may need to develop some vertical slip in order to develop the required sheer friction which you need. And you indicate that you need a vertical slip of about 7 mils, 7 mils, 70 one thousandths of an inch. Is a 7 mil slip necessary for the develop of a factored or an unfactored OBE load.

DR. WHITE: That would be for an OBE loading condition as well as the SSE, being as the loads are the same for the two earthquake levels. So in terms of actually going out to the full demand structure, which is the SSE, that's what you get.

MR. GRAY: Do you know what did for that on an

unfactored -- I'm sorry-- for the factored OBE loading multiplied by the 1.4?

DR. WHITE: For an earthquake larger than the SSE. I would imagine it would be in the neighborhood of a hundredreth of an inch, in that general vicinity.

Q. So you are going from 7 mils to ten mils.

MR. GRAY: I'm sorry, you said a hundredth of an inch.

DR. WHITE: Yes, ten mils. .

MR. GRAY: Going on to page 57, in response to question 113, there you indicate that sliding does govern the capacity of some of the sheer walls in the complex. Can you indicate where sliding controls in the complex?

MR. CHANG-LO: In general, the sliding occurs, the sliding governs in areas where there is less dead load. So it would be in the higher elevation. And keep in mind what I mean by governing, it still meets the criteria that we have designed it to. In other words, it would be -- comparing, it would just be the critical or the governing between sliding, flexure and so on, but we still meet the margins.

MR. GRAY: Okay, you say in the higher elevations, the elevations in the complex where the dead load is lower, so the Control Building is higher elevations of the Auxiliary Building, also?

MR. CHANG-LO: Yes. That's correct. There may be

one or two walls in the Auxiliary Building. There may be one or two panels or walls in the -- I shouldn't say walls -- panels in the Control Building.

MR. GRAY: Do you have an estimate of the capacity-to-force ratios for those walls that are governed by sliding? I guess this would be for factor, it would be a condition?

MR. CHANG-LO: Yes, it would be more than 1.4.

MR. GRAY: For the unfactored. It would be more than 1.4?

MR. CHANG-LO: That's right.

MR. GRAY: Okay, in response to question 115, also here on page 57, you indicate that diagonal tension does not govern sheer capacity in any of the walls of the complex. Does that include a consideration of the additional factors that were set forth on the February 15 and March 17 response as to Staff questions?

DR. WHITE: In terms of the diagonal tension that's referred to in this particular equation, the question refers back to the diagonal tension capacity predicted by the diagonal tension equation in those responses that you referenced or mentioned. However, there are panels where we have limited the stress to 300 PSI which goes back to the limit imposed in PSE 1020 now, even though we are using that as a level for design, it's stretching things to infer that

that would be representative of diagonal tension failure. So we need that clarification.

MR. GRAY: On page 58, response to question 118. There you discuss the theoretical equation for double curvature. Now, the capacity-to-force ratios that are set forth in PGE 1020, which is Licensee's Exhibit 24, I believe, the capacity to force ratios set forth in that document for the OBE are based on the double curvature, sliding or single curvature.

MR. AXELRAD: Could you please repeat that question, Mr. Gray?

MR. GRAY: I'm sorry. I don't have a question, yet. I am a little bit confused here.

CHAIRMAN MILLER: We haven't got to the punch line yet.

MR. GRAY: Okay, are those capacity-to-force ratios in the PGE 1020 based on double curvature?

DR. McCOLLOM: Based on what?

MR. GRAY: Double curvature?

DR. WHITE: Yes.

MR. GRAY: Can other modes of failure, single curvature or sliding control in some instances.

DR. WHITE: Single curvature and sliding could govern in some areas. The representation of the capacity-to-force ratios for some curvatures is presented in another

response, I don't remember what number it is right now. But all that stuff is also laid out.

MR. GRAY: Okay. Offhand, I guess you don't have the Exhibit No. Of that. Is that the responses to the March 7th Staff questions?

MR. SARKAR: February 13th.

MR. GRAY: February 13th.

MR. AXELRAD: That would be item Q in Licensee Exhibit No. 25.

CHAIRMAN MILLER: Q.

MR. GRAY: Thank you. Page 59. Instead let's go to page 64.

CHAIRMAN MILLER: What page is that, Mr. Gray?

MR. GRAY: 64. And it's the response to question 127. Down near the end of that first paragraph. You say the general methodology used to determine the subsequent qualifications of equipment components, pipings, is the same that's described in the, employed for inneroperations. What you mean by general methodology. In other words, why are you using the term general? Is there something in some instances some other methodology that's being used?

MR. ANDERSON: Well, I think certainly the intent is to use the methodology described in the FASR. However, if I recall in the interim operation proceedings, we had testimony, cross examination on the methodology that was used, some of

the methodology used to calculate piping systems would be the latest approved Bechtel procedures and Bechtel topical report that would be used now that is perhaps slightly different than what was used originally. That was meant by the term generally.

MR. GRAY: Okay, also in response to this question 127, there in items 1 and 2, you indicate that all safety related equipment, components and piping in the complex will be reviewed and modifications made as necessary. I guess my question goes to the words "in the complex." Does that phrase include equipments, components, piping that may be attached to the complex but maybe aren't physically located inside the wall or inside the complex.

MR. ANDERSON: Yes, it includes any equipment or components that would be affected by the seismic response of the complex.

MR. GRAY: By the changeable response. Any effect, even though it may be outside, but somehow attached?

DR. WHITE: One good example of this would be a piping network. And the system is followed out beyond the complex to the first seismic anchor, and everything out to that seismic anchor is analyzed as though with respect to the response spectra within the complex.

MR. GRAY: Moving on to page '75. Response to question 136, near the bottom of that large paragraph, you

indicate openings in the panel significantly reduce the available capacity of the panel. Generally, how are the stiffnesses of the walls with openings affected by those openings?

DR. WHITE: Say that again, please?

MR. GRAY: How are the stiffnesses of the walls affected by the openings in the walls.

DR. WHITE: Well, the stiffness is somewhat reduced. In some areas of the complex, efforts were made to take this into account by reducing the models of the panel in that area, but that isn't necessarily affected as is the reduction of the capacity in that area. The capacity would drop quicker than the stiffness.

MR. GRAY: that's what I wanted to get at, say you do have large openings that could result in significant stiffness reductions, there was at one time accounted for?

DR. WHITE: Yes, that was not -- some of the openings were not monitored. Primarily, the situation exists in the upper elevations of the complex and in developing the overall model, those levels seemed at the time of model development to be ones where it is not particularly significant. However, down at the lower levels, the doors and this kind of thing, were modeled explicitly actually in the fine element model.

MR. GRAY: Would you say that all the openings that

would have a significant effect on the stiffness were in the model?

DR. WHITE: Yes.

MR. GRAY: How do forces from panels with these openings redistribute to panels without openings or to other panels that are stiffer?

DR. WHITE: Well, in terms of the redistribution associated with an opening, it's not so much a redistribution of, of the loads themselves. The loads are going to follow to the stiffness. Now, there is, perhaps, a minor discrepancy between the forces predicted by STARDYNE at a particular location versus what the wall is actually going to see, but the loads are going to follow what is the prediction of STARDYNE and then go someplace else. The response is going to develop and the walls when they picked up the load are going to develop relative to that. So there is going to be in some areas where we have an opening some departure from actual loads in the panel as opposed to what is actually showing up in the structure. But that doesn't mean that the loads predicted by STARDYNE will have to be redistributed mechanically or physically somehow. They wouldn't have been there in the first place.

MR. GRAY: Moving on to Page 78. This is the last part of a response to question 137. And it is dealing with the treatment of beam-column reactions.

In the analyses, the beam-column connections were essentially accounted as reinforcing steel; weren't they?

DR. WHITE: In the original STARDYNE analysis, they were considered as contributing to the reinforcing ratio for purposes of calculating stiffness, not capacity, but for the purpose of calculating stiffness.

MR. GRAY: Okay, moving to page 182, response to question 141. There in the first paragraph of the response, you indicate that uncertainties with respects to the effects of the interaction of an assembly of wall panels in a steel frame were addressed with respect to capacities by ignoring the amount of additional capacities shown by test specimens L 1 and L 2. How does ignoring that, those test specimens results L 1 and L 2 somehow account for the uncertainties that you are talking about here?

MR. SARKAR: Could you repeat that question?

MR. GRAY: Sure. Do you see the sentence I am reading? It's in the first paragraph in response to question 141, and it's actually the second sentence. It says the uncertainties with respect to the effects of the interaction of an assembly of wall panels encased in a steel frame were addressed with respect to capacities by ignoring the amount of additional capacities shown by the results of the tests of specimens L 1 and L 2. My question is, how does ignoring those results thereby address those uncertainties?

MR. SARKAR: What we meant here was that the test specimens L 1 and L 2 gave substantial amount of capacity, sheer capacity which were not factored into our capacity evaluation.

In other words, L 1 and L 2 which had embedded steel columns at the end, those steel columns were acted as positive amount of elements to resist the lateral load. However, in our actual capacity variances, those were not taken into account.

MR. GRAY: Okay, there further on in that same response, the next paragraph talked about the effect of the induced tensions. And I believe you indicated earlier that inducement tensions, if any, would be on the order of 5 PSI. Have you accounted for that induced net tension in the wall in your analyses?

DR. WHITE: As far as the stiffness characteristics of the complex are concerned, I think we have more than adequately accounted for these kinds of effects by considering the change in stiffness due to gross bending and the other items that got us to the overall 31 percent broadening of the response spectra on the low side. And I think this would more than adequately cover these kinds of influences.

MR. GRAY: Mr. Chairman, if you would wish to recess for lunch now, I do have some more questions, but I would

like to be able to assemble them. I think some other things were covered that I could cross out

CHAIRMAN MILLER: We will do that. If we didn't recess for lunch, do you think the interrogation would be shorter. You don't have to answer. We will recess for lunch. Resume at 1:30, please.

(NOON RECESS)

like to be able to assemble them. I think some other things were covered that I could cross out

CHAIRMAN MILLER: We will do that. If we didn't recess for lunch, do you think the interrogation would be shorter. You don't have to answer. We will recess for lunch. Resume at 1:30, please.

(NOON RECESS)

MR. AXELRAD: Mr. Chairman, as we indicated to the Board before, we are trying to proceed in the best way possible under the present circumstances. When the Staff had arrived here in Portland on Sunday, we had had some discussions with Mr. Herring who had indicated to us at that time when some of his remaining questions were, in fact, what we think all of his remaining questions are. We have been working the last several days to develop answers to those questions. And what we would propose to do is some time later on this afternoon, we would have written answers to those questions. We would propose that this panel continue be cross examined with respect to matters as they now stand. We will make as an additional exhibit those answers to those questions. The Staff can take those to Mr. Herring. The Board will be apprised and review that information overnight and perhaps tomorrow morning any additional cross examination on that additional information will take place. We have to rely on the transcript. And that will be a complication.

CHAIRMAN MILLER: I understand. We have to do the best we can.

Does that information resolve about the remaining unresolved issues by any chance.

MR. AXELRAD: Our understanding is that information which Mr. Herring requires in order to resolve the unresolved questions. But perhaps Mr. Gray can address that better than

we can.

CHAIRMAN MILLER: We only note that that is farther down on or agenda and undoubtedly take place two weeks from today, the unresolved issues. Although we will have reports as we go along.

What we are doing now is moving into the second area which is the adequacy of the modification plans and work.

MR. AXELRAD: Well, Mr. Chairman, these are unresolved matters with respect to structural adequacy, and they are part of the general subject that is being discussed by this panel right now.

CHAIRMAN MILLER: Does it involve any of the issues other than the structural adequacy?

MR. AXELRAD: This is not the short-term test and long-term test information that we plan to take up after structural adequacy

MR. CHAIRMAN: No, but you put on evidence with your first panel --

MR. AXELRAD: On matters --

CHAIRMAN MILLER: On matters other than structural adequacy, and we were intending to move on to that same area, then, by the Staff, which I guess we did in part, but couldn't complete it at any rate because of the illness.

Then we moved into the second major category of issues which we have called the structural adequacy, which we

are going on now. The Staff I take it will not it insofar as they can. Now, these issues relate only to structural adequacy.

MR. AXELRAD: That is correct.

CHAIRMAN MILLER: I was considering those being farther down since they remain unresolved. We also have under your designation of subject matter, then the short-term test results, the long term projected studies with rebuttal. And we thought some of that material would be taken up in the remaining three days two weeks hence, which gave you a chance to resolve further the unresolved consideration which were resolved. We don't want to take the time of witnesses getting resolved the unresolved and chasing our tail like we did in Phase 1 where we had two or three sets of material because there was material that needed to be sought and exchanged and so forth. And you are aware of that situation, which we historically wanted to prevent in Phase 2.

MR. AXELRAD: It had been our hope all the matters including the long- term and short-term tests and the rebuttal could be accomplished in this week.

CHAIRMAN MILLER: You understand our terms --

MR. AXELRAD: I understand, Mr. Chairman, as of now, depending upon Mr. Herring's health it still seems to be a feasible target.

MR. CHAIRMAN: You shoot for your target, we shoot

for ours, we want to get a complete record.

MR. GRAY: On Mr. Herring's health, we did go back with him at lunch time. Unfortunately, because of medication and so on, we were only able to talk with him about 5 minutes, and after that, it really wasn't accomplishing anything.

CHAIRMAN MILLER: I think he got smart doctors. He probably will recover sooner. I realize, myself, it is paramount. We will do what we can through Friday this week, noon Friday, and we will take continued readings.

Let's get as much as we can accomplished working around him. And then you will have an opportunity to be furnishing more information and negotiating and all the rest in this two- or three-week interval between the two aspects of the hearings.

Where are we now with the panel?

MR. GRAY: Mr. Chairman, I was continuing with cross examination.

I would like to go back to page 17 of PGE Exhibit No. 28. And the response to question 77.

In the last sentence of that response, you indicate that web walls transmit in-plane sheer forces. Do the web walls also contribute to the resistance to gross overturning?

DR. WHITE: Yes, they do.

MR. GRAY: Do you have an estimate of the percentage of resistance to gross overturning that they provide?

DR. WHITE: It would be approximately 20 to 25 percent.

MR. GRAY: 20 to 25.

MR. GRAY: Earlier today, you discussed the steel plate and how they required full tension for the steel plate would be assured and maintained through some inservice testing. At the same time, you indicated that the bolts to be used for that steel plate are two inches in diameter or will be rather than one and three quarter.

DR. WHITE: Yes.

MR. GRAY: I would like to ask why would the two inch bolts be used now rather than the one and three quarter inch bolts.

DR. WHITE: Going to the larger diameter bolt is an effort to reduce the stress to a level where stress corrosion would not be a concern. This would simplify the inservice inspection program.

MR. GRAY: What's your best estimate of the stress elements where the stress corrosion is important in the lateral force?

MR. CHANG-LO: We have some data which we brought along with us. I'd like to take a look at it before we say something.

MR. GRAY: You can provide that answer later.

MR. CHANG-LO: We have that information.

MR. GRAY: Back on page 12 A in response to question 19, where you talk about the analytical model for the complex, and you indicate that we've got to make certain assumptions in that analytical model.

Now, these assumptions have to be based on and properly reflect the physical behavior of a structure under the expected size of the load; isn't that true?

DR. WHITE: Yes.

MR. GRAY: What, what sorts of assumptions generally are you talking about here, the assumptions that have to be made in this model.

DR. WHITE: Generally, you would want to have a model give a representation of the distributions and also one that gave a good representation of the structural stiffness.

MR. GRAY: And what's the basis for the assumptions, for example on stiffness?

DR. WHITE: In most practical designs, reinforced concrete structures, the model is of the stiffness -- the stiffness of the model is obtained from the initial module us of the concrete in the uncracked state. And this is the traditional accepted procedure for calculating the stiffness of a model.

For the approach that we've taken using the fine element model, which is a refinement far beyond what normally is done in reinforced concrete design, we have tried to

account for the influence of sheer stress on the stiffness of the walls. In this, we have made an attempt to incorporate these kinds of refinements into the definition of the stiffness into the fine element model which is already one step beyond what is normally done for reinforced concrete structure.

MR. GRAY: Which your testimony program provided you with some data on stiffness and variation in stiffness.

DR. WHITE: Yes.

MR. GRAY: Page 15 in response to question number 28, you indicate that dampening can reduce the inertia loads and that dampening increases with increasing stress level in the structure.

DR. WHITE: Yes.

MR. GRAY: While that's generally true, you can't really quantify this change in dampening very well; isn't that correct?

DR. WHITE: That's true, we don't have any experimental data on this specific structure that could be used.

MR. GRAY: Now, the additional structural improvements, I believe they have been referred to, such as welding on the beam-column connections in certain locations, they will add to the decided resistance capability of the complex, is that not true?

DR. WHITE: True.

MR. GRAY: Have those improvements, of that additional capacity, even though it may be local, have they been factored into the capacity determinations or the capacity-to-force ratio roles that you have presented?

DR. WHITE: Okay, the capacities have been factored into the response to Dr. McCollom's question number 6. And I think that perhaps the first place where these new items have shown up in terms of overall capacity, they are not reflected in the diagram shown in PGE 1020, for instance.

MR. GRAY: They would be reflected, though, in what has been, what is PGE Exhibit 30, this is response to Dr. McCollom's questions, and you have a number of figures?

DR. WHITE: Yes, yes.

MR. GRAY: Now, we've got exhibit --

DR. WHITE: Let me make one addition to that.

The increased capacity due to tying the horizontal reinforcing steel at elevation 45, those are included. But the influence of the beam-column connections on the column line N 46, those were not included?

MR. AXELROD: Dr. White, were those included, in which answers?

DR. WHITE: The beam-column connection -- this is included in the response to Dr. McCollom's question number 6.

MR. GRAY: Do you have in front of you PGE Exhibit

25 part U? This is the March 17 responses to Staff questions of March 7.

DR. WHITE: Okay.

MR. GRAY: You have indicated in those responses that based on the equations of diagonal tension, the element sheer value can be less than 300 P S I for aspect ratios of .73; is that correct?

DR. WHITE: Yes.

MR. GRAY: Now, the 300 PSI limit was used in PGE 1020, which is Licensee Exhibit 24. So can you verify that you are using values less than 300 PSI where those values are calculated and appropriate in your analysis?

DR. WHITE: If diagonal tension controlled and it were less than 300 PSI we would use it. Now practically, that has not occurred because when we have an aspect ratio of .73 or higher, the diagonal at the, the controlling, controlling mode. But if it were, we would have used the value less than 300 PSI.

MR. GRAY: In that same document, I believe that document did not address, part U, did not address the double block walls as applicable to composit walls; is that true?

MR. SARKAR: Would you please repeat the question once more, Mr. Gray?

MR. GRAY: The factors considered in this response to Staff questions did not address double block walls in the

complex. They were considered for the composit walls; is that true?

MR. SARKAR: Yes, that's true.

MR. GRAY: And what is the reason for that?

MR. SARKAR: Well, this was, the response was generated for the purpose of illustration of the matter of calculations of the passages of the complex walls by application of the appropriate modes of behavior. And by and large, of course, we are concerned with the composit walls. But in case of the double block walls, the same approach would be taken in the applications of the other modes for the evaluation of the double block walls.

MR. GRAY: How would that effect the double block wall capacity if you applied those same considerations to those?

MR. SARKAR: Are you referring to the diagram behavior or the particular mode behavior or in general?

MR. GRAY: In general.

MR. SARKAR: In general the bending modes for the double curvature and for the single curvature the method of calculations would be the same. For the sliding the method would be the same. For the diagonal tension as is in PGE 1020 or perhaps in one of the NRC Staff responses that we are limiting ourselves to 150 PSI for the diagonal tension.

MR. GRAY: Would any of the capacities, sheer

capacities for the double block walls fall below that 150 PSI.

MR. SARKAR: Should that fall below 150 PSI, the actual value would be taken.

MR. GRAY: But that has not actually been calculated for double block walls, that same approach; is that correct?

MR. SARKAR: In terms of the diagonal sheer, again?

MR. GRAY: In terms of all three that you mentioned.

MR. SARKAR: As I say, the capacity evaluation for the various modes of behavior apply both to the double block walls and the composit walls. The only difference is that the composit walls we are restricting ourselves to the diagonal tension mode of behavior to 300 PSI where as in double block walls, that particular is 300 PSI.

MR. GRAY: Or less, if calculate.

MR. SARKAR: Of course, that is the ultimate.

MR. GRAY: Moving on to PGE Exhibit 30, which is Licensee's responses to Dr. McCollom's prehearing questions.

On Page 2 of 3 at the response to questions 1, 2 and 3, in the next-to-the-last paragraph, you state that the applicable load combinations of the S S A must be satisfied to show that the margins are restored. Isn't it true that the load combinations are not everything. The corresponding acceptance criteria are also important in determining whether the margins have been restored. In other words, you concentrate here on the load combinations, but you've also

got acceptance criteria which you compare to in determining whether the margins are restored.

DR. WHITE: Well, that's true that the two go hand in glove. I guess I don't understand your question.

MR. GRAY: I am just trying to -- the indication here is that to determine whether the commission's order of May 26, 1978 satisfied it's necessary to ascertain whether the modified complex would satisfy the applicable load combinations in the FSAR. That seems to concentrate on load combinations alone.

DR. WHITE: Okay, in order to satisfy the other aspects of the 40,000 PSI steel and those kinds of things, is that what you are referring to?

MR. GRAY: Yes, in other words there is more to it. It's also what is acceptable to order the acceptance criteria.

DR. WHITE: This is referring to or attempting to refer to on the load side of the whole operation, what are we considering and trying to clarify that.

MR. GRAY: Fine. In response to question 6 on pages, on Page 1 of 4, the last paragraph on that page, you refer to the capacities shown in certain figures for walls R, N, 41, 46 and 55. Were those capacities divided by the load factor of 1.4?

DR. WHITE: Yes, they have been divided by 1.4 and the appropriate capacity reduction factors have been included.

MR. GRAY: On Page 2 of 4 in response to question 6, the top of the page there, you refer to the capacities that have been modified 41, 46 and 55 walls for the single curvature mode of behavior. How were those single curvature capacities determined?

DR. WHITE: It's the same approach that was described in our response to NRC question of February 13 in the same, same procedure all the way through. I don't know if you want to go through all that or if that's adequate.

MR. GRAY: What capacity reduction factors were used in that that?

DR. WHITE: For the vertical sheer on the side of the members there, the sheer resistance is coming from sheer friction, so they were using the .8 5. The moment across the bottom of the free bodied diagram, this is a flexure related resistance, so they were using .9.

MR. GRAY: Was there capacity reduction factor used for the beam-column connection?

DR. WHITE: No.

MR. GRAY: And why was that?

DR. WHITE: The capacity reduction factors as we interpret them are applicable to portions of resistance associated with concrete. And here we are taking the capacity from a steel kind of connection and therefore the capacity reduction factors from A C I are really applicable.

MR. GRAY: Even though that beam-column connection has been considered as additional reinforcing steel?

DR. WHITE: That perhaps may be your interpretation of it, but not ours. The beam-column connection was for purposes of stiffness calculations for convenience of the evaluation considered as part of reinforcing steel, just as a matter of convenience. But in terms of the actual mechanism of development, it's a steel type of behavior not necessarily concrete.

MR. GRAY: Okay, in response to question 6, again, Page 2 of 4, the last sentence at the top paragraph, you indicate that the sliding of the diagonal tension loads of behavior don't govern the capacities for modified walls 41, 46 and 55. Are the sliding and diagonal tension capacities that you are referring to there, those given in PGE Exhibit 25 item D, that is the March 17 response to the set of questions. In response to Staff questions. Response to Staff question 1 A.

DR. WHITE: I didn't understand the question.

MR. GRAY: Let me go back over this again.

You state in the last sentence there that the sliding and diagonal tension modes of behavior do not govern the capacities of any of these modified walls.

DR. WHITE: Right.

MR. GRAY: Are those capacities in sliding diagonal

tension capacities that you are referring to there, are they the capacities that were calculated and provided in PGE Exhibit 25 item U in response to Staff question 1 A?

DR. WHITE: Let me repeat the question to make sure I am giving you the right answer. The sliding diagonal tension referred to here in the last sentence of that paragraph, these are the behavior mechanisms that are reported in question 1. Is this what the question was?

MR. GRAY: Right, that's the question.

DR. WHITE: The sliding diagonal tension referred to here is the same as the sliding diagonal tension here.

MR. GRAY: Fine. And does that have the appropriate capacity reduction factors?

DR. WHITE: Yes, yes. The figures in exhibit U as has been stated you recall, yes, the capacity reduction factors are not included in these figures. These were just for purposes of illustration. When we get around to calculating the actual capacity of the walls, then the appropriate reduction factors were included.

MR. GRAY: Okay, in the second paragraph on this same page of Exhibit 30, you, you state in the second paragraph on Page 2 of 4 of the response to question 6, that the flexural capacities were calculated by conservatively neglecting the bond between the imbedded steel columns and the concrete?

DR. WHITE: Yes.

MR. GRAY: Isn't it true that that bond may not be very reliable, that it may well not exist?

DR. WHITE: It is undetermined the quality of the bond. This is why we have conservatively neglected it. Our neglecting of the bond does not indicate on our behalf that we expect the bond to be zero. We do not expect that to be the case at all. We expect some bond to be there. But not being able to quantify it, we have conservatively neglected it. But that should not be construed to indicate us believing that there is no bond. We believe there is.

MR. GRAY: So if there is a bond there by neglecting it obviously it's conservative. If it's not there, then neglecting it is just what should be done.

Even if that bond does exist, that should have no effect on the double curvature behavior; isn't that true?

DR. WHITE: If the bond does exist between these panels, then they would not function as individual panels. They would function now as a segment of wall 93 feet long or depending on the wall we are looking at. So the presence of bond or no bond is important. I say if the bond is there, then it doesn't behave as individual panels between beams, one great big long panel.

MR. GRAY: On Page 3 of 4, the next page, you indicate that the growth of the wall panel due to this

microcracking or small cracking will compensate for the effect of creep and shrinkage.

DR. WHITE: Yes.

MR. GRAY: How much creep and shrinkage will it compensate for? Compensate for, you assume 140 microinches per inch of creeping and shrinkage?

A. We are looking at the influence of this microcracking to provide a vertical growth strain in the neighborhood of 240 microinches.

Q. On the last two sentences of that paragraph, you state that the total load of the wall will not, in effect, change and the effect on capacity will not be significant. Do you see where I am referring to?

MR. AXELRAD: What page are you on, Mr. Gray?

MR. GRAY: This is the same page, 3 of 4, top of question 6, the large paragraph, last two sentences.

MR. AXELRAD: Thank you.

MR. GRAY: In making that statement, have you considered what the combined effects of gross bending and dead load reduction could be concurrently?

DR. WHITE: Well, the combined effects are addressed in response to question 1 B that are March 17. So that is backed up for the previous statement.

MR. GRAY: Have you verified that the load capacity for redistribution of the loads are viable? In other words

that the loads can redistribute the way they need to.

DR. WHITE: Yes, we have looked at the load redistribution that would be associated with the influence of gross bending and this kind of thing.

Now, if you take a look at the panels being attached to one another by the floor diaphragm, this is the mechanism that is used for actual load redistribution within the system. If a panel should be -- actually, you can't put the load in the panel, and the panel says that its capacity has been exceeded, and then the load goes someplace, that isn't really what happens. The load will not have gone to that panel in the first place. So by virtue of the load never being there, the idea of redistribution is somewhat the figment of an analytical imagination. The actual building doesn't respond that way. In actuality, the floor diaphragm will route this load to whoever has the stiff he's members. It isn't the load started out in one member, that capacity exceeded and then the load went someplace else because it was never there to start with.

However, if you get down in a microscope to look at this thing, if you are not careful to arrive at that beginning point and then try to see how a load is going to try to depart from that identification. But when you step back and actually look at the response of the building, it really doesn't quite behave that way. .

MR. GRAY: Will substantial cracking occur in the wall panels under these conditions we are talking about?

DR. WHITE: I wouldn't call it substantial. Let's try to put some, some bounds on that. If you take a look at the behavior of the test specimens, for instance, in their approaching ultimate load, the kinds of cracks that develop where -- I think what most people would call a hairline crack, something in the ten mil category, a fairly small crack. And in terms of actual cracking as referring to developing in these walls, this is primarily what it's going to be. The panels are essentially flexure controlled so the cracks will be flexure cracks rather than large diagonal cracks.

MR. GRAY: In the figures attached to your figure -- specifically figure 63 and 64 and 65, the single curvature capacity is not shown on the figure; is that correct?

DR. WHITE: What was that again?

MR. GRAY: The single curvature capacities?

DR. WHITE: Correct.

MR. GRAY: Do you have any idea where that single curvature capacity would fall on each of these figures?

MR. SARKAR: Yes, as discussed yesterday which we talked about earlier, there is a substantial amount of difference. So for a matter of clarity, we did not show the single curvature capacities in those figures.

MR. GRAY: You say they are not substantially

different from what?

MR. SARKAR: From the double curvature capacities. There is some slight difference. But as I say, this is a large amount of difference in order to make any substantial change.

MR. GRAY: Okay, on response to question 11, Page 2 of 2.

DR. WHITE: Still on Exhibit 30?

MR. GRAY: Yes, Exhibit 30, the third paragraph, I guess, again, the same question, if, the probability of the beam and the columns and the concrete, if that bond exists it provides you with some additional capacity here; is that correct?

DR. WHITE: Correct.

MR. GRAY: Which you have neglected in any event.

DR. WHITE: That's true.

MR. GRAY: In response to question 12 in Exhibit 30, Page 1 of 2, the first paragraph in the answer, in the last sentence, you state that the Trojan FSAR went beyond the minimal requirements of the UBC. And the simplified equation in the UBC by specifying response spectra method of that analysis. You are not claiming that this is a conservatism, or are you indicating that that's a conservatism.

DR. WHITE: No, I think it was just a simple statement of what the situation is and a word of caution of

trying to apply UBC allowables with a set of loading conditions that is inconsistent with the kind of load that UBC was talking about. In developing a particular code, their loads, their allowables are normally developed hand in glove. And if you pick one set of allowables in someone else's loading conditions, you run the risk of coming up with an incompatible, although maybe conservative, at least an incompatible set of conditions.

MR. GRAY: We have no further questions at this time.

CHAIRMAN MILLER: Okay, Dr. McCollom?

DR. McCOLLOM: In the questions that I gave at the prehearing conference I was concerned about the criteria about which we should judge whether we have met the requirements of the FSAR. Both you and the Staff have responded to this. You did it in your Licensee Exhibit No. 28 and the Staff did it in the Staff Exhibit No. 17. Have you had a chance to review the Staff's writing on this?

MR. SARKAR: The answer is yes, Dr. McCollom, we went through the Staff's yesterday.

DR. McCOLLOM: All right, are you the one that is knowledgeable, then, about whether, what you have suggested is the criteria and what they have suggested is the criteria are compatible or does one go outside the bounds of the other one in certain areas, and if so, how.

MR. SARKAR: That is a question, Dr. McCollom, I

have to refresh my memory a little bit and go through the Staff's testimony and give it a glance to see where we stand.

DR. McCOLLOM: I think that would be useful, and if that's all right, I would suggest that you do that carefully and then we can address that problem.

MR. AXELRAD: Dr. McCollom, are you referring to the Staff's answer to your, the Staff's answer to question 21 or referring to pages 19 and 20 of the Staff's testimony of March 24, 1980?

DR. McCOLLOM: That is part of it. I believe, also, there is some part of it in question 23.

CHAIRMAN MILLER: Page 35.

MR. AXELRAD: Appearing on Page 22 of the Staff's testimony, their question 23 and answer 23?

DR. McCOLLOM: Also, so is -- the answer to that is yes, Mr. Axelrad, but also, I believe question 22 starting on Page 21 is related to that. And the answer to it.

MR. AXELRAD: So we are referring to the Staff's testimony appearing beginning on page 19 on March 24

CHAIRMAN MILLER: Right, and subsequent, most, if not all, the balance of page 19, I think, Mr. Axelrad.

DR. McCOLLOM: I believe it goes through page 25, if I have gotten my pages right now.

MR. AXELRAD: No, I believe it would stop at page 23. Appearing on page 24 is a question with respect to analytical --

DR. McCOLLOM: I agree, so it would be from page 19 to page 23 inclusive.

MR. AXELRAD: Yes, right.

CHAIRMAN MILLER: Do we understand the panel has not examined that testimony or not? I didn't get the answer.

DR. WHITE: We have.

MR. CHAIRMAN: You have.

MR. AXELRAD: The panel has reviewed that testimony together with a lot of other testimony and a lot of other materials. We just wanted to be sure they were addressing the right question. It might be useful if we took a short recess at this point.

MR. CHAIRMAN: If we take a short recess, the panel as I understand has read the testimony of the Staff, is familiar with it, the short recess will enable the Staff to focus so we can proceed. Recess.

(Recess)

DR. WHITE: We believe that we are in the basic agreement with NRC Staff in terms of the objective of the storing required margin. It's primarily my meeting the FSAR criteria, this is prepared in the discussions of the Staff section FSAR section 3678 but since the NRC is still in the process of reviewing, we are not sure we are in total agreement. But from what we think so far, we think we are.

DR. McCOLLOM: One of the places where the Staff

questioned was that you were taking advantage of other structural capacities such as the steel frame primarily being used to carry the weight rather than being relied on to resist lateral loads. Now, is that consistent with or inconsistent with anything with respect to the FSAR criteria for seismic capabilities?

DR. WHITE: The FSAR indicates that the steel frame was designed to carry the vertical load and the concrete masonry walls were designed to resist the lateral sheer. It does not say that the steel frame was designed to carry only the vertical load. It says it was designed to carry the vertical load.

As Mr. Anderson indicated this morning, the original designers obviously recognized the steel frame being there and was able to take some value for it. It was not quantified in the original design, however.

DR. McCOLLOM: In terms of the use of the STARDYNE finite element model, in your words, how does the criteria in the FSAR permit the use of that model?

DR. WHITE: In my understanding of the requirements in the FSAR, it makes no mention as to the limitations that one must use in developing analytic model. At the time that the original analysis was done, the finite element analysis that we are currently using was not available on production basis. It was strictly a research tool if used at all. As a

consequence, the best tool available at that time was the stick model which you recall from Phase 1 what the stick model refers to, viewed from today's standards, that was a relatively crude model. However, at that time that was as good as could be done.

DR. McCOLLOM: See, now, I appreciate that, and I appreciate the ability of the STARDYNE model. But all I am trying to do at this point is to determine that we haven't violated the FSAR or if we have that we justify that. And I think what you are trying to do is justify it. But I wonder if it cannot be included or is not included under whatever cover the FSAR would have permitted.

DR. WHITE: Well, the FSAR would certainly not exclude the use of STARDYNE. It doesn't require that it be used.

DR. McCOLLOM: STARDYNE or a finite element model as compared to a beam stick model.

DR. WHITE: Right. I might point out that in the original design, you have certain knowledge of loads, and knowledge of loads that existed at the time of the original design is not as good as we currently know it. And because of that, this is a different, different kind of situation. We feel we have a much better appreciation for the behavior of the structure than the original design was able to develop. And because of that, it gives us certainly more comfort.

DR. McCOLLOM: On page 47 of your testimony, Licensee Exhibit No. 28, there are two questions, 89 and 90 that respond to the criteria being used for the new reinforced concrete walls capacity and the capacity of the steel plates.

DR. WHITE: Yes.

DR. McCOLLOM: Are those both consistent within the requirements of the FSAR?

DR. WHITE: These would supersede the requirements of the FSAR. They refer to the code at that time.

DR. McCOLLOM: Do you recall that there is any reason why codes cannot supersede as far as the FSAR requirements are concerned? Just like, for instance, a STARDYNE analysis permitted where as the beam stick model was permitted first?

DR. WHITE: They certainly can supersede.

DR. McCOLLOM: In your opinion, does it change the ability or margin of the seismic capability of the structure?

DR. WHITE: In the development of codes, a following code is not necessarily more conservative than previous code. As -- if you look back over history, sometimes they learn something that causes them to go more conservative or less conservative. So a new code in itself does not necessarily indicate an increase in margin. In many cases that is the situation, but not in all cases. I think that it would

certainly be the design that would develop based on the latest code would certainly reflect the latest thinking. So from that point of view, whatever margin you have as a result of using that code would be considered by the engineering community certainly an adequate margin.

DR. McCOLLOM: And possibly even a better or justified one with more accuracy.

DR. WHITE: Yes.

DR. McCOLLOM: I guess I would be remiss if I didn't commend whoever wrote the section for an excellent editorial analysis. Is that yours, Mr. White?

DR. WHITE: No, I have to certainly give credit to Mr. Sarkar. I think he did an excellent job in developing this overall testimony.

DR. McCOLLOM: I would like to turn to page 56.

DR. WHITE: I might also indicate that the questions were developed along with Mr. Johnson as well.

DR. McCOLLOM: In your question number 110 and the answer, you suggest that using single curvature capacities result in calculated capacities that still satisfied the OBE and SSE demand with appropriate capacities. What do you mean by appropriate capacities? Did I get the wrong one? Excuse me, it's question 111, the next one. Question 111 with the answer there. Appropriate margins. My question is, what is the appropriate margin?

DR. WHITE: Your reference is made to satisfy the criteria within the FSAR. And the modifications are developed with the idea of meeting the requirements of the fact of OBE loading combination within the FSAR.

DR. McCOLLOM: I think the only other question I have is with respect to Licensee Exhibit No. 30, the answers to the questions from the prehearing conference. And it is with respect to question 6, again.

I accept the fact that the walls that you selected to make these comparisons were the ones that were most effected. And certainly, it was very helpful to me, I am happy to say, because I know it was extra work, to put them on these figures as they are. But is there some way that you could either using the model or just descriptively tell us why it is that these were the ones that were most effected by the changes that were made in the modification?

DR. WHITE: Well, the force capacity representation that is on these diagrams, the reason these particular walls were selected is, first off, these were the walls upon which modification were made. Modifications were physically made to in terms of the east-west walls, walls 41, 46 and 55. So as a result, whatever capacity these walls had prior to modification, their capacities now are further enhanced.

The other two walls that are mentioned are the east and west walls of the Control Building walls, R and N. And

again, these walls had substantial modifications made to them with the filling of the train bay, adding essentially an additional 30 to 40 percent of sheer area on these two walls at the lowest elevation to where the elevation of the sheer is the highest. Now in addition to the complex, the walls were not modified because the capacity was at their current condition, the loads within those elements, those walls which were not modified changed somewhat, but there was not a major redistribution of the walls as a result of modifying the wall within the Control Building complex, the Control Building.

So the walls that were not shown in these diagrams, the capacities were not changed at all. The loads only varied slightly and in virtually all instances there was some reduction in the loads because now the walls that had been modified have the capability of accepting greater load than they were before. So the other walls now are loaded less. So the walls that are shown, that are shown that way because these are where -- this is the place where the new capacity has been added. The other walls as mentioned earlier, capacities were unchanged, loads went down slightly, not a big shift.

DR. McCOLLOM: I assume from that statement that if the facility had been left as it were, unmodified, and if there were a seismic event to occur that were large enough to cause failures of any walls, that the walls that you have

modeled here would be the ones that would be expected to fail first?

DR. WHITE: If these walls were to --

DR. McCOLLOM: I am saying I know that it isn't feasible and that it isn't in the specification, but if there were a seismic event sufficiently large to cause failure, would those be the ones that would be failing first? Not necessarily?

DR. WHITE: Not necessarily. There are some fairly small walls, we refer to them in Phase 1 as minor walls. There are some of those walls that would reach their capacity prior to some of the major elements. Now, whether or not for that local wall, you would consider that wall as having failed or not, this, I think, depends on one's definition of failure. In terms of functionality of the overall complex, the complex certainly has not degraded its capacity from a functional point of view. So from that point of view, there is no failure in terms of an individual wall exceeding its local capacity, zeroing in on that one wall, maybe you would conclude that it had yielded or failed or something, but certainly not the complex.

If one of these major walls were to exceed its capacity, however, now we are talking about, at least from our predictions of earthquake, far beyond the SSE. But if that were to occur, now we are getting into structural damage

where it's more difficult to predict the functional capabilities of the complex. Probably still do just fine, but it's more difficult to track from an analytical point of view.

But as far as saying the probability of the wall doing just fine, is that the earthquake in San Fransisco, '06, there are a number of structures where construction technique was in some respects similar to what we are using here. They had a steel frame with unreinforced brick infilled panels and the building came through fine in terms of not collapsing in this kind of thing. Now, we certainly would not expect the same kind of behavior in this particular building. But just as an example of what can be done with virtually no seismic design whatsoever yet be able to survive an extreme earthquake condition. So for this reason, I feel very confident in saying that even though there may be some sorts of damage for a SSE beyond the level that we are looking at from a functional point of view, not a real big problem.

CHAIRMAN MILLER: Very good. That completes my questions.

CHAIRMAN MILLER: Thank you. Is there anything further of this panel?

MR. AXELRAD: If we could have just a few minutes to determine whether or not we have any redirect, Mr. Chairman.

CHAIRMAN MILLER: Yes.

MR. AXELRAD: A ten minute recess?

CHAIRMAN MILLER: Let me inquire first, and you will get your ten minute recess. Anybody else have any questions? Intervenors?

Very well.

MR. AXELRAD: If we have no redirect, or just a few minutes of redirect, we then plan to put on Professors Holley and Bressler

CHAIRMAN MILLER: All right, are we ready to resume?

MR. AXELRAD: Yes, we are, Mr. Chairman

CHAIRMAN MILLER: I assume these gentlemen men are the next witnesses?

MR. AXELRAD: Yes, they are, Mr. Chairman.

MYLE J. HOLLEY and BORIS BRESLER

was thereupon produced as a witness in behalf of the Licensee, and having been first duly sworn on oath was examined and testified as follows:

MR. AXELRAD: Before proceeding with the testimony of these witnesses, Mr. Chairman, we have previously had marked as an exhibit in this proceeding a document entitled review of proposed design modifications for Trojan Control Building, March 13, 1980 by Myle J Holley, jr. and Boris Bresler. We previously marked that Exhibit 29. If we could make that Exhibit 29 A and we have handed up to the parties, to the members of the Board and the reporter two additional documents, one entitled professional qualifications of Myle J Holley, jr. which I would ask to be marked for identification as 29 B, consisting of two pages, and a 1-page document, at the head of which is name, Boris Bresler, which I would ask be marked for identification as exhibits 29 C

CHAIRMAN MILLER: They may be so marked.

(EXH.-NO. 29 A, B and C marked)

MR. AXELRAD: Professor Holley, would you please state for the record your name, address, and present position

DR. HOLLEY: My name is Myle J Holley, jr. My business address is box 88, M I T branch, post office, Cambridge, Massachusetts.

And your third question was what?

MR. AXELRAD: Your present position.

THE WITNESS: I am a consulting structural engineers. I hold the title of professor ameritus in civil engineering of M I T.

MR. AXELRAD: You have before you a copy of the two-page document entitled Professional qualifications of Kyle J Holley, jr. which has been marked for identification as Licensee Exhibit 29 B.

DR. HOLLEY: Yes, I do.

MR. AXELRAD: Do you adopt that statement as your statement of qualifications in this proceeding?

DR. HOLLEY: I think there may be one small error.

MR. AXELRAD: Would you bring that to our attention, please?

DR. HOLLEY: In the second sentence, the document says I joined the M I T faculty in 1946. My recollection is I became an instructor in 1946 and actually joined the faculty in 1947. Other than that, I think the document is all right.

MR. AXELRAD: Thank you. Do you adopt that statement as your statement of qualifications in this proceeding as corrected?

DR. HOLLEY: Yes.

MR. AXELRAD: Could you sum vice for us briefly your

educational background and experience?

DR. HOLLEY: I have a bachelors degree and masters degree from M I T in civil engineering. I received the bachelor's degree in 1939 and then remained at the institute for 2 years as a teaching assistant. I was away from the institute until 1946 during which time I was working for the S Morgan Smith Company in York, Pennsylvania, primarily as a stress analyst in the heavy machinery field.

In 1946, I returned to M I T, went into the studies which I had interrupted, as noted, received my masters degree in '47 and joined the faculty in '47 in the structures division of the department of civil engineering. I remained an active faculty member until 1974 and for a large. For a significant portion of those years, I was head of the structures division of the department of civil engineering.

I have been involved in, in engineering essentially since 1941. Starting sometime in the early 50s, I combined my consulting engineering efforts with Professors Biggs (phonetic) and Hanson (phonetic) and over that 20 some odd years, I have been involved in a large number of engineering projects. I would say that my efforts have been primarily either in assisting in the design of complex structures or in the appraisal of structures which evidence some difficulty.

The experience has included, as indicated in the written document, a considerable amount of time in the

nuclear power field.

MR. AXELRAD: Professor Holley, you testified in the interim operation phase of this proceeding; did you not?

DR. HOLLEY: Yes, I did.

MR. AXELRAD: And since that time, you have continued to be involved in the review of the proposed modification program?

DR. HOLLEY: Yes, sir.

MR. AXELRAD: Do you have before you a copy of the document entitled review of proposed design and modification for Trojan Control Building March 13, 1980 which has previously been marked for identification as Licensee Exhibit 25 A?

DR. HOLLEY: I do.

MR. AXELRAD: Are there any corrections or addition you would make to that document?

DR. HOLLEY: There are not.

MR. AXELRAD: Is this testimony true and accurate to the best of your knowledge?

DR. HOLLEY: To the best of my knowledge, it is.

MR. AXELRAD: Do you adopt that in this proceeding?

DR. HOLLEY: I do.

MR. AXELRAD: Mr. Bresler, would you state your address and name for this proceeding?

DR. BRESLER: My name is Boris Bresler, my address

is Watergate Tower, Suite 755, 1900 Powell Street, Emeryville, California.

I am at the present time one of the principals in the firm of Wiss, Janney, Elstner and Associates, and manager of their California office.

I have been retired from the University of California at Berkeley for the last two years where I had taught for a period of 32 years. I received my bachelor of science in civil engineering degree from the University of California in 1941 and for several years following was working as a design engineer in the ship building industry and then the aircraft industry.

At the end of the war, I returned to California Institute of Technology in Pasadena where I received my master of science degree and an article in engineering. And shortly thereafter joined the faculty at the University of California at Berkeley.

During the years at the University of California, in addition to teaching and research, I have continued to engage in consulting to a more limited extent while I was engaged in the University. The focus of my research has been primarily structures in distress or structures where a potential hazard was involved and to a large measure the source of the hazard was of seismic nature. This involved a variety of structures, steel, and reinforced concrete alike.

My area of specialization was, at least for the last 20 years, was in reinforced concrete. I have been active in a number of professional committees both in the American Concrete Institute and the American Society of Civil Engineers, committees which produce documents leading to developing of total criteria.

I think that might be a sufficient resume'

MR. AXELRAD: Thank you, Professor Bresler, are your qualifications summarized on the 1, page document that has previously been marked for identification as Licensee Exhibit 29 C?

DR. BRESLER: Correct.

MR. AXELRAD: Do you have any corrections or additions to make to that 1-page document?

DR. BRESLER: I have not.

MR. AXELRAD: Do you adopt that statement as a statement of your qualifications in this proceeding?

DR. BRESLER: I do.

MR. AXELRAD: You have previously testified in this proceeding at the interim operation phase?

DR. BRESLER: Yes, I have.

MR. AXELRAD: Since that time have you continued to review the design and proposed modification of this facility?

DR. BRESLER: Yes, I have.

MR. AXELRAD: Do you have before you a document

entitled review of proposed design and modification of proposed Trojan building, as was marked Licensee Exhibit 29 A

DR. BRESLER: I have.

MR. AXELRAD: Do you have any corrections or additions to make to that document?

DR. BRESLER: No, I do not.

DR. BRESLER: That is document true to the best of your knowledge?

DR. BRESLER: It is to the best of my knowledge.

MR. AXELRAD: And do you adopt that testimony as testimony in this proceeding?

DR. BRESLER: I do.

MR. AXELRAD: Professor Holley or Professor Bresler, could you summarize for us the review that you have performed which led to the preparation of this report in this proceeding and also summarize for us the conclusions that you have reached?

DR. BRESLER: If it's agreeable with you, I will try to summarize this testimony briefly. And I am sure professor Holley would want to add further remarks when I complete my brief summary.

As I have already responded following the hearings, previous hearings, we have been participating in developing design modifications. These involve frequent conferences, the Bechtel Staff, PGE Staff, and in addition conferences

between professor Holley and myself in addition to these. Also I did at this time to estimate precisely the amount of time we have spent on this, but I would guess something in the order of perhaps 30 days a year or something of that sort, at least of that order. I have not checked the figures precisely, but something of that sort. So this would represent an effort, for me, at least, of about a month and a half over a period of a year and a half.

In the course of this appraisal, we have followed closely the development of various analysis, the development of criteria, but which results of the analysis were evaluated. We have developed closely test results which led to the development of these criteria and examined all the documents that resulted or reported results of analysis and evaluation.

We have in our testimony discussed the objectives of structural modifications. And, of course, the principle objective is essentially mandated objective to satisfy the specified OBE criteria, essentially under the same conditions as the original design specified in these conditions.

There has been some discussion of the OBE criteria. They are not, perhaps, easy to state directly, and as has been discussed previously, there may be different interpretations by engineering, qualified engineering professionals as to their precise meaning.

It is our opinion here, it is our view here that OBE

represents maximum event that a facility -- maximum seismic event a facility will be subjected to without any way disrupting functional capability. And that's all it gives.

When one introduces factor, one introduces only for the purpose of comparison of the response and the OBE conditions with so much higher capacity and to show that there is a reserve margin of performance but a so-called factor OBE event is not an event that describes specified OBE. If I have misstated or misrepresented anything, I know professor Holley will correct me.

The next item, perhaps, in our testimony goes to the matter that because of the complex nature of the buildings in this complex, and I mean the type of construction which utilizes a steel frame, in many cases a thick concrete core, faced by masonry exterior and interior, a very difficult sandwich to digest, that the existing codes, in fact, do not deal with such structures. The existing codes are usually developed either for reinforced concrete structures or prestressed concrete structures or steel structures. But when the structure involves the various materials in one composit, one gets into problems of interpretation of codes that are just intractible and inapplicable.

Therefore, it became necessary in this program to verify criteria by which the analytical results could be judged. The criteria could be developed from theoretical

consideration, from our knowledge of materials and from our knowledge of composit behavior of these materials. But our confidence in criteria so developed would probably not be sufficient and would require verification by SSE program and the principle purpose verification by a testing program. And the principle purpose of the testing program was to verify such criteria.

Further more, in this particular experimental program, there were a number of parameters characterizing the specific Control Building, not just in general dealing with composit structures, the amount of reinforcement, the thickness of concrete core. The specimen as nearly as possible designed to model some of the parameters that represented this particular building. The effect of cyclic loading was another aspect that had to be verified by a testing program.

The principle test results of this program were 1, to identify modes of failure. And three modes of failure were identified, flexural failure, sheer failure which are quite common to all types of construction and sliding mode of failure that is frequently observed in masonry construction but might not be observed in other type of construction.

In the composit structures, it was quite interesting that when the full composit wall masonry concrete and steel frame acted together, the sliding mode generally was not a

critical mode. This was verification that was very important for us in developing and applying the various criteria.

Very useful data was obtained from the cyclic loads on the specimens and results of this permitted us to gain a much better insight both into the effect of such cyclic loading stiffness, effects of such cyclic loading on possible reduction in capacity, and effects of such cyclic loading on the utility or ability of the test specimens to deform.

While this was, as any test program, it's a somewhat limited test program. And I don't recall exactly now, but the order, the number of specimens on the order of 25 or something like that. We did and we were able to verify the criteria with substantial confidence in these criteria.

The rest of our testimony deals with achievement of the OBE design criteria. And this is addressed primarily both to the applicability of linear elastic analysis, the use of STARDYNE, the interpretation of these results, that is how well known existing nonlinearities and linearities could effect the results of a linear analysis or how a linear analysis could be interpreted to engage the performance of such a structure, a more accurate performance, which would be nonlinear.

And skipping finally towards our summary and conclusion, we have concluded that the finite element program provides good results for prediction of response in the

elastic range for the particular case for the prescribed ground motion, the force resultants are predicted reliably. That nonlinearities which cause differences between the actual distribution of forces in the building, differences between the analysis and the actual forces can be evaluated and interpreted and finally applying the criteria for determining the capacities, capacities both for resistance of force, and capacities to the form when compared with the results of the analysis with due interpretation of nonlinearities indicates to us that the objectives of restoring the original conservatism for OBE criteria objectives have been achieved.

I know you want to say something.

DR. HOLLEY: I want to say that was excellent.

I think I would simply like to emphasize one or two points which Mr. Bresler made.

First of all, in an early section, in the section where we talk about objectives, he mentioned to you our interpretation of this factor 1.4, and I think that may be of some importance because in the course of reading the voluminous amount of information that has been generated on the effort of this sort, I think it's easy to get confused. And we view the 1.4 factor, if you will, as having absolutely nothing to do with an earthquake beyond OBE, which in this particular case means beyond SSE because of the factor they

are essentially identical magnitude and load. But that rather the 1.4 says that you are going to try to design in such away that when you have forces develop by 1 OBE, the demand on major resisting elements in the case of the Trojan building, this would be major sheer walls particularly, doesn't exceed 1 over 1.4 times their individual capacities. As I think we discussed in our earlier meeting with the Board on another occasion, this is for the purpose of having some confidence as to the performance of the 1 OBE.

In making calculations or in writing text about this process, engineers sometimes use a shorthand, particularly if you are dealing with linear situations, you may sometimes say I am comparing 1.4 OBE with capacity which, of course, numerically is the same as saying I am comparing OBE with 1 over 1.4 times capacity. But it is an important point, I think, which we would like to note.

Then getting to in terms of some of the things you attempt to write in here about analysis, it was important to us to think about nonlinearities, and you gentlemen are probably more aware than we of the considerable discussion in questions from the Staff and responses from the Licensee on nonlinearities of various sorts, so there are a number of things about nonlinearities that seem to us important to consider. We were, because this is a dynamic situation, namely in response to an earthquake. We were forced to be in

a position where for the particular response spectra that was specified and the particular characteristics of this structure, the inertia loadings on the structure for a piece of equipment per wall per square foot, however you want to put it, are extremely insensitive to the nonlinearities, which is fortuitous, it means we know the loading we are talking about quite well.

Now, there remains the question about nonlinearities which may effect the distribution of the resisting forces throughout the structure given that you know the loading itself quite well.

And here in our testimony we discussed some aspects of that. But I guess the bottom line is that the important point is that the structure has ductility which is very important in terms of situations where there may be departures in distribution of forces throughout a structure from those which are obtained from a linear elastic analysis.

And here then carrying the chain back just one step, it will be apparent to you why the results of the test program were of particular importance to us. It may well be that if it was not the most important one of the most important factors in indicating first a basis for some capacity predictions based on extreme assumptions. But perhaps to me more important, based on the need for ductility. I think that's all.

MR. AXELRAD: Thank you.

Professor Bresler and Professor Holley, your testimony is dated March 13, 1980. Since that time have you had an opportunity to review the documents which have been subsequently generated? Let me ask specifically, the testimony on structural adequacy that was submitted by the Licensee dated March 17, 1980? The testimony on structural adequacy dated March 17, 1980 that was submitted by the NRC Staff, the testimony of Mr. Herring?

DR. BRESLER: Yes.

DR. HOLLEY: Yes.

MR. AXELRAD: The information that was submitted by the Licensee to the NRC Staff on March 17, 1980?

DR. BRESLER: I have.

DR. HOLLEY: Yes.

DR. BRESLER: You have in mind the details of the walls on the reinforcing steel.

MR. AXELRAD: March 17, 1980 was the response to the March 7 questions that were discussed in San Fransisco.

DR. BRESLER: I remember.

MR. AXELRAD: March 20, 1980 was information pertaining to the reinforcing steel in the sheer wall panels.

DR. BRESLER: Yes.

MR. AXELRAD: Does any of that information or testimony cause you to modify or change the conclusions that

you have reached in your testimony.

DR. HOLLEY: No.

DR. BRESLER: No.

MR. AXELRAD: Mr. Chairman, at this time I would like to offer into evidence Licensee Exhibits 29 A, 29 B and 29 C

CHAIRMAN MILLER: Are there any objections to Exhibits 29 A, B and C?

No objections, the Licensee Exhibits 29 A, B and C are admit in evidence.

(EXH. NOS. 29 A, B, and C received)

MR. AXELRAD: One last question, Professor Bresler and Professor Holley, were you here in the courtroom during the cross examination of the Bechtel panel witnesses that began with Professor Larsen's this morning?

DR. HOLLEY: Yes,

DR. BRESLER: Yes.

MR. AXELRAD: At this time they are available for cross examination.

CHAIRMAN MILLER: State of Oregon?

MR. OSTRANDER: We have no questions, Mr. Chairman

CHAIRMAN MILLER: Intervenors.

MR. ROSOLIE: We have no questions, Mr. Chairman.

CHAIRMAN MILLER: Staff?

MR. GRAY: Just two minor questions. On page 16 of

your report, or your review of the design modifications, you indicate that your review and your evaluation is limited to some extent; is that correct?

DR. BRESLER: Yes.

MR. GRAY: And that limitation is set out in that Section 5.1 of this document.

DR. BRESLER: Yes.

MR. GRAY: Therein, you indicate that special adequacy problems relate to the equipment and the special attachments to the masonry walls have not been addressed. What special problems are you referring to there?

DR. BRESLER: Perhaps I should attempt to clarify that. I don't know if Mr. Holley may have. It has not been addressed by us.

MR. GRAY: Yes.

DR. BRESLER: We have participated in some of the discussion of problems associated with the adequacy of the attachments of equipment, the piping. We are aware of some of the measures that have been taken of some of the field work and investigations that are carried on. But that was not the main focus of our review. And we thought we would make that clear that this was not the main focus of our review and this is the only limitation, I would say, that related to this item that I have.

DR. HOLLEY: I would say quite simply that we didn't

take those as items to which we should direct a lot of thought and come back and write something. We had our mind on other things. But as Professor Bresler said, we were involved in some discussions where these things were talked about.

MR. GRAY: I guess what I am getting at is your report here does not consider those and other things.

DR. HOLLEY: That's true.

MR. GRAY: We have no further questions.

CHAIRMAN MILLER: Thank you.

CHAIRMAN MILLER: Dr. McCollom?

DR. McCOLLOM: This morning we discussed a little bit, and this afternoon as well, about how you go about assuring yourself that you've met the criteria that you need to meet on the modification of a building that was built under different kinds of criteria at a different time. And there are several thoughts that I thought you might address in this.

One is, I think, particularly Professor Bresler, been involved with the development of codes, and I would ask in this respect, the kind of procedure that is carried out to test the capacities of these different kinds of walls was the normal kind of activity that would have been conducted to develop new codes as you move along. Would you address that, Professor Bresler?

DR. BRESLER: I will try, if Mr. Holley will help me later.

In developing code criteria for various types of structures, the criteria themselves represent a simplified model or simplified equation giving some kind of a lower bound to possible behavior in a structure. Structural behavior is, I suppose there is all kinds of physical natural processes. It is a very complex process, and therefore, it is not possible in the quantitative code criteria to define all possible details of that behavior so that criteria that are developed sometimes simplify the process and make sure that these criteria are conservative.

Specifically, I think in the contest of evaluating this existing building, and as a consequence of the test results which are very important in our development of these criteria, three major modes of failure were observed. We could have predicted that such modes of failure would be observed. But the level or the magnitude of force, the magnitude of deflection, the effect of cyclic loading on these responses on the characteristics of such wall panels would be more difficult to predict from the other considerations.

Some of the panels in the test program represented panels with free-edge boundaries which would fail, essentially, in what we call double flexure. I am sure you

have come across this term in testimony, the certain reverse curvature S-shaped type mode of failure.

Others had columns imbedded preventing sliding, and some specimens were tested, only with loading at the top without restraint at the top so it failed only in the single flexure mode. So various modes of flexure and other modes of failure were investigated in the test program.

The resulting equations that were developed with a fuller understanding of behavior of the specimen and of behavior of similar walls in the building I think have reflected at least the same conservatism as we normally would expect to find in code equations which are also often based on a combination of theoretical and experimental results.

DR. McCOLLOM: Do you think, then, that this testing program was typical of what you might academically project for a situation similar to this in terms of finding out what should be used and verifying our theoretical considerations?

DR. BRESLER: Yes, I would.

DR. McCOLLOM: Professor Holley, would you like to add anything to that?

DR. HOLLEY: I might differ slightly on the very last response. I guess that we were doing a research program on this kind of wall for general use.

DR. BRESLER: For general use, okay.

DR. HOLLEY: You might envision some circumstances

in which it was used quite differently in this complex which might lead to additional tests. But for the use in this complex and for the specific kind of wall we are dealing with, I think it was an unusually extensive program.

DR. McCOLLOM: You were able to do this because of the nature of the walls that you were going to deal with.

DR. HOLLEY: Yes. It may also be worth noting, Dr. McCollom, although perhaps this has already been mentioned, the kinds of conservative capacity expressions which Professor Bresler said could come out of a program of this sort when applied to the actual complex in essence reflect a judgment on the part of the engineers that we would look at the complex in its most extreme position, I don't mean geometric position. Obviously in any real earthquake condition, you will not destroy all the bond along all the vertical edges. And so the engineers I think quite properly said what happens if. What if you quite narrowly destroyed the bond and had something with free edges, what now?

So I think on the one hand, the expressions that came out of the program were sound. On the other hand I think they would conservatively apply. But I must always go back that to me the most important thing was the code

DR. McCOLLOM: Now to address the problem that I think the Board has, looking at the criteria that we are supposed to meet specified in an F S A R that was written and

a building that was built several years ago and then taking the current building and saying we have brought it back up to the same criteria as was originally expected, what is your, what's your thoughts on what we need to say, what we need to do to say that we have met that?

DR. HOLLEY: We need to say it was excellent.

DR. McCOLLOM: Well put.

DR. HOLLEY: To be more serious, that's not an easy question for you, I am sure. One factor which has not been mentioned, however, and which one might overlook, I suppose, in comparing X years ago and today. If my memory doesn't misserve me, I think the inertia forces that we use that came out of the original terminations and so forth were substantially lower than what we have come up with. I stand to be corrected on that, but to the extent that is so, I think it's a relevant factor and one that might easily be overlooked. And I speak now about inertia loading per se. Am I correct or not?

DR. BRESLER: Yes, that's a critical element, particularly the distribution of the forces altered by more precise analysis bringing out their realistic response.

DR. HOLLEY: I am not sure whether I can be helpful. If I think I can, I will answer.

DR. McCOLLOM: Let's see, I believe it might be helpful if you would again take this more or less as an

academic question.

Let me recap. I believe that during your testimony during the interim operation Phase 1, we asked, well, how would you fix this building up? And as I recall, one of you said, well, you could put plates on the wall?

DR. HOLLEY: Put what?

DR. McCOLLOM: Plates on the wall. And, of course, that's what they have ended up doing. This is a method of correction. Does this fit logically and appropriately to what you think a good correction process for increasing the capability of this building to seismic capability?

DR. HOLLEY: I think that is more readily addressed. I confess I didn't recall that we had mentioned plates.

DR. McCOLLOM: I think maybe Professor Bresler, I think maybe we will put him on the carpet.

DR. BRESLER: Unfortunately, I don't recall either.

DR. HOLLEY: As to whether the concept is in our judgment a good one, I think Professor Bresler and I both fully agree that it is. You have had a number of choices in fixing the structure, none of which was pleasant, starting with just building a completely new Control Building, which would be horrendous to other kinds of things which might be done such as the but the rest structure, which would interfere with operation itself, which is a much more important consideration than dollars or time per se. And I

rather feel that the concept that the engineers have arri ed at is attractive because it doesn't change radically the nature of the response. It doesn't, you know, if I build a new structure and try to hook it on to this when I may get into a different natural frequency and things are quite thoroughly changed, so the effort was rather to keep things qualitatively and certainly somewhat quantitatively in similar characteristics, but to beef up the strength, and that appeals to me. I am not able to say what plates where, but I think this is a very rational approach.

DR. BRESLER: I would like to add a few comments it's also a little difficult to -- whenever you deal with an existing structure, retrofitting an existing structure, it's a very difficult problem. First of all, it could be done in a variety of different ways. Second, it is sometimes difficult to identify precisely the performance of the sequence of events under given seismic conditions. If you want me to put it more bluntly, what may be the weakest link in the chain. And it isn't always easy to identify that.

I think partly because of a much more careful analysis of the structure, there were several things. For one thing, putting another abutting structure was really not a very effective, practically effective way of doing it.

The second thing was the walls in which large openings existed where the railroad was passing through, that

in areas of those walls, some deficiency in capacity existed.

Similarly, there may have been some difficulties in the areas above where some openings existed in the original structure where the steel plate finally was adopted as a means of strengthening that area.

Some other areas without much interference was the operation of the plant if you knew walls were added to increase the resistance in the direction.

As I see it, altogether apart from criteria, from analysis, and from comparison of margins, capacity over the demand, I think that the areas in the building which normally one would expect to be sensitive to cracking and yielding and in the event of an earthquake, those areas have been substantially strengthened. And in that sense, I think this is a building that not only meets but probably exceeds the requirement of restoring original conservatism.

I may have gotten myself out on a limb, in which case, of course, Holley would stop, if I know, generally, generally.

DR. HOLLEY: The only other thought that we should perhaps add in terms of the rational of the fix is that Professor Bresler's plate idea is a very good idea. We did establish it was your idea.

DR. BRESLER: I am not taking credit for it.

DR. HOLLEY: In other words, had is a perfectly

feasible way to strengthen those particular walls. And we judge the method of attachment thereto to be reasonable and to have been proper. If I missed something, I can't think of it.

DR. McCOLLOM: I would like to ask a question about a feeling that I have. And not being either a civil or structural engineer, you can bring upon my electrical background, if you wish. But from what I have understood, the beam stick method of design is -- and the STARDYNE method -- to get these forces, I ask the question, would the beam stick method be less sensitive in showing the weakness of the passage of the railroad in the walls missing down at that lowest level than the STARDYNE method would have been able to?

DR. HOLLEY: Yes, if you will let me change slightly one thing you said, yes.

DR. McCOLLOM: All right.

DR. HOLLEY: I don't think the method of analysis be it beam stick model or STARDYNE would tell you anything about the weakness. It would tell you something about the demand, and you would then by trying to carry that demand say, ah-han, I am not strong enough here, but neither of these analytical tools tells you anything about the capacity. They do tell you something about how much you are trying to put through various parts of the structure.

In this regard, it may be necessary to separate

things a little bit once more. The stick model, as I recall, was primarily for dynamic analysis. In other words, it didn't give you directly forces in any wall. It gave you resultants, let us say, at several levels through the structure, and then some sort of simplified, certainly not a fine element type analysis, was used to distribute these among the walls. That was not expected to be as good as STARDYNE in terms of telling you where the forces are going. I would much prefer to have the STARDYNE results available. But I hasten to say that excellent design was done and can be done today using the original approach.

DR. McCOLLOM: Have you reviewed those six diagrams that is part of Licensee Exhibit No. 30 that shows before and after forces and capacities in answer to my question number 6?

When corrections were made in the walls, and these, of course, as was testified, were the walls that had modifications made to them for the proposed change, I see both redistribution, I'd say, of the forces in some way, and also a change in the capacity. Sometimes the force goes up, sometimes the force goes down at a given level, and the capacity, of course, always appears to have gone up, which it seems logical, any way.

Are these curves something that gives you real comfort about the results of this modification, as you have looked at these and analyzed to see what's the resultant

modification is as produced by these assumptions made by the Licensee? Do you have any comment?

DR. HOLLEY: You go ahead. So help me, I am color blind.

DR. McCOLLOM: I share that, Dr. Holley, I am color blind, too.

DR. HOLLEY: Shall we talk about them the way you and I see them?

DR. BRESLER: Let me make some remarks. Our problem was that we saw these diagrams but they were not in color before. I think certainly these diagrams demonstrate substantially reserved capacity for storage sheers for the modified system. I would say these are not the only diagrams that give us confidence in the general modification. These diagrams alone, without knowing something about walls that make up each individual story and the responses in those walls and the capability of those walls and the capability of those walls to act together, these diagrams alone would provide only limited comfort to us. Yes, this is very important. Storage sheers have the required reserved capacity. But I think this is only part of the evidence that we have looked at.

DR. HOLLEY: That's correct. This is part of the picture, Dr. McCollom. I don't think it's the whole picture.

DR. BRESLER: Did you figure out what the red stands

for?

DR. HOLLEY: It's red and brown.

CHAIRMAN MILLER: Dr. Paxton, do you have any questions?

DR. PAXTON: I believe that the answer to my question has been implied, but I would like to make sure.

Apart from academic interest, are you gentlemen satisfied with the scope of the test program that you have reviewed?

DR. HOLLEY: I am, but I think Professor Bresler's comment would be more meaningful in this regard. He has been involved in similar kinds of research of it.

DR. BRESLER: I am trying to think the question through, if you will allow me just a few minutes. And one thing that I have a little problem with is you say apart from academic interest am I satisfied with the test program. I would put it differently. I would say I am satisfied with the test program exclusively apart from the academic interest. If, indeed, I approach this with academic interest, I might be, say, well, it's a very interesting thing that we have tested 25 specimens, let's test 25 more, because that's what academically we would like to do.

DR. PAXTON: I know there is no limit to the academic end of it. That's the reason I tried to exclude it.

DR. BRESLER: I think like any test program, I

suppose, when one completes the test program, one can think of one or two or three other things they might like to do, either to satisfy their curiosity or to provide additional information on this data or another, I don't know. I feel this particular situation is enough information to say that the design criteria that were developed for verification of this modification design were adequate. If I use my academic interests, I can't easily imagine what more could have been done.

DR. PAXTON: Thank you.

CHAIRMAN MILLER: Let me inquire first. Is the Staff or anyone else going to have any more questions of Professors Holley and Bresler?

MR. GRAY: No, Mr. Chairman. Mr. Chairman, maybe just one question.

MR. GRAY: There has been some substantial comment on the test program in this vein with regard to the test program. That was a program on an individual panel representing walls, whereas a complex itself is an assemblage of panels. Do you believe that does provide good results to be applied to an assemblage of panels?

DR. HOLLEY: Now I can say what I was about to add to your last.

DR. HOLLEY: If one had chosen in the test program to model let's say complete framing in panels, panel or

panels, I have a feeling that you would have had a hard time ever finishing, because now you really would be saying I am trying to make the test assemblage look as much as possible like the real structure. And I assure you, I can think of a great many variables. And if you are going to have at least two specimens for each, I am not -- I think they we might have had a very great problem in making sure that enough testing had been done, or at least in satisfying the people.

I think the engineers were wise in deliberately deciding not to do that, to say we will test masonry composit walls, per se, and learn something about their properties relatively free of the framing. And then in making use of it in the complex, we will assume the worst conditions in terms of the interaction of the panels in the framing. So I think in terms of getting something that could be used in a test program of reasonable length, it was better to idealize and say I will try to find out what the panel is like under pretty awful conditions, because I am quite sure the panel would be happier to have had a column on each side in each test. So I think in a sense it was a wise choice and it doesn't disturb me that we did go into a program. The Licensee didn't go into a program of more nearly matching the actual installation, because the next question would be shall we put the force slabs in, too, and very soon it would be easiest to test the complex.

DR. McCOLLOM: I think those are very good comments. Does that answer your question, Mr. Gray?

MR. GRAY: Well, not exactly. What I really want to know, I understand that, of course, you cannot model the whole complex, and that even in modeling multiple panels, it may be very difficult, and that therefore, the results of your test may not be useable, but the real question is, in monitoring and testing a single panel, can those results then be appropriately and conservatively applied to walls that are not single panels, they are multiple panels and have they been.

THE WITNESS: Sure, so the question now is not should they have looked at multiple panels in the test, but rather can one appropriately use the results of single panel tests and evaluate the structure, which is a different question but part of the same thing.

And I think the answer is yes. But it has to be done in a rather simplified conservative manner. In other words, I am saying that where you are uncertain of a particular interaction of the boundary, let us say, between a real panel and a real column, you have to be conservative in what you assume to be there and its effect on the panel. Is that correct, Dr. Bresler?

DR. BRESLER: Yes, I would say the same thing. Maybe, again, at the risk of repeating myself a little bit,

emphasize the real purpose of the test was to assist in developing criteria and verifying criteria and not really trying to apply the results directly to the panels in the building. If the maximum stress at failure, and some of the test specimens were 400 to 430 pounds per square inch, that would not necessarily give me any comfort if we took 430 pounds per square inch and applied this to all of the wall panels or to even some of the wall panels and perhaps the prudent thing would be to limit it to 300 pounds per square inch. If we verified certain type of sliding and how the level of the force at which sliding was initiated and the magnitude of the level of force could be verified in sliding of the panels, then this could be promptly applied to those panels in the building which would be most likely to fail in a sliding mode and not in a flexural mode. So I would say the tests were extremely useful and quite adequate for purposes of verifying the criteria that were developed.

DR. McCOLLOM: Let me follow that up just one more step now.

I accept the fact that you say that we verified certain theoretical model and the numbers that we could put into it. Now, then, have you, Professors Holley and Bresler, evaluated the way they have been used now and tell us what you conclude the results are, then? That is, have they done the right -- they utilized this information in a conservative

and correct way to prepare a modification that will meet the criteria that we have to meet.

DR. HOLLEY: Have they gone from the test program to the reality in a sensible way?

DR. McCOLLOM: That's correct.

DR. HOLLEY: And I think my answer would have to be yes.

DR. McCOLLOM: Professor Bresler.

DR. BRESLER: Yes, I would concur with that. Of course, I do want to -- the application of the criteria to every and each panel was discussed in our meetings in a general way. We did not sort of do the bookkeeping and verify every number. But I think all these criteria were applied properly and correctly to the walls, each story. Just as, for example, one of the things that is associated with initiation of sliding, there might be a local crack, local yielding which would occur, which as a matter of fact, to an observer who is not accustomed to look at buildings under any load whatsoever, it would not look to him like anything is going on. It takes an experienced observer to say yes indeed this crack is here because of flexure or this 15 thousandths of an inch displacement is an initiation of sliding. These are the kind of things that we observe. And I think that based on the performance of the specimen and the criteria in the way they were applied in interpreting or in

verifying which, I think this was done correctly.

DR. McCOLLOM: I guess the last thing in order to complete this story, we should know just how you were, how you evaluated the tests. Did you actually observe them? Did you evaluate the results? Did you extrapolate those or did you observe the calculations that extrapolated those into this theoretical model? What kind of relationship have you had to those tests.

DR. BRESLER: I don't know whether I was less fortunate or more fortunate than Dr. Holley was, but the test was conducted about 30 or 40 miles from my office and therefore, I had occasion to visit testing of about, maybe, on, 20 percent of specimens. So I have on many occasions observed this during the tests and find a failu . I have gone through reduction of all test results and participated in discussion of the development of these criteria, and I notice that another independent consultant, having done that, showed pretty good correlation something on the order of the average of 6 percent was predicted failure capacities in test results. So I have looked at a lot of data reduction in the way this was compared with the resultant criteria.

CHAIRMAN MILLER: Any further questions?

Did you have anything further Mr. Axelrad.

MR. AXELRAD: No, Mr. Chairman, I was going to say that perhaps at this point, we would just excuse professors

Bresler and Holley, perhaps only temporarily. They have, as indicated by the testimony, of course, reviewed the current version of the Staff testimony as well as the S E R. We have not asked them to address each and every one of the so-called unresolved items, because we don't know at this point whether they are unresolved. If there is something further that might be useful in evaluating after the Staff provides its testimony perhaps we will ask them to come back again

CHAIRMAN MILLER: Very well, we would appreciate that. We would excuse at this time Professors Bresler and Holley, but if you could be available, if necessary, some additional information which may be forthcoming which you will be advised by Mr. Axelrad, we will appreciate it.

DR. BRESLER: There is any indication as to when?

MR. AXELRAD: No.

CHAIRMAN MILLER: The Staff's witness is ill, we will try to get the information to you as soon as possible. We try not to impose on your time, also, and we will try to make it not an imposition upon you.

CHAIRMAN MILLER: Thank you very much.

DR. BRESLER: Thank you very much.

DR. HOLLEY: Thank you.

CHAIRMAN MILLER: Is there anything further at this time that counsel wishes to go into?

MR. AXELRAD: Yes, we have the answers to the

questions that we identified earlier. And if we could just have those marked as Licensee's Exhibit 32 at this point.

CHAIRMAN MILLER: Licensee 32 will be so marked for identification.

(EXH.-NO. 32 marked).

MR. AXELRAD: It's a document entitled Licensee's April 2, 1980 answers to 6 questions of March 30, 1980. Exhibit 32, and it consists of the answers to 6 questions.

As I indicated the Bechtel panel would be available to testify on these questions perhaps tomorrow morning or perhaps after the Staff's witness tomorrow.

I believe the only testimony further than that is the testimony of Mr. Larsen.

CHAIRMAN MILLER: Yes, what is the situation as to the State of Oregon and Professor Larsen.

MR. OSTRANDER: We will go right now, we could go on right now, if that's the Board's wish

CHAIRMAN MILLER: Well, what is your pleasure. We don't want to chop up your testimony. We started to impose upon people to a certain extent today because of the change of order. I just ask you as counsel for the State of Oregon, would you prefer to start at this time or would you prefer to start in the morning?

MR. AXELRAD: Mr. Chairman, perhaps we could ascertain how much cross examination would be involved before

we know whether professor Larsen would be on the stand for a lengthy period or not?

CHAIRMAN MILLER: I have had certain indications from various people that there is a certain amount of we are I necessary at the end if a long day. We did start at 8:30. We prefer to have every one fresh. We are all right, we are not having to work hard. But a lot of you are. We believe the record, I am speaking for myself, not only every one else, unless someone wishes to go forward to accommodate someone, we will do that. But short very of that, we think a night's rest and I know those seats are hard back there, so I think we will stand in recess until 8:30 in the morning.

MR. GRAY: Mr. Chairman, could I just ask one thing with regard to the Licensee exhibit, I believe it was 31 for identification, which you have the slides on the work sequence. Was any of it resolved, the status of it.

MR. AXELRAD: We have offered it in evidence, but it has not yet than been ruled on.

CHAIRMAN MILLER: It has been marked for identification. There was an objection to some portion of it. There was therefore no offer or ruling upon it.

MR. AXELRAD: I would offer that in evidence at this time, Mr. Chairman

CHAIRMAN MILLER: All right, there has been an offer into evidence. What Exhibit No. Is that?

MR. AXELRAD: 31.

CHAIRMAN MILLER: 31, which are the reproductions of the slides. There is an objection? I think Ms. Bell you had an objection before, as I recall?

MS. BELL: Yes, we do.

CHAIRMAN MILLER: What was the nature of that? It didn't show the yellow or something.

MS. BELL: I believe it is on the east side of the model in the slides that some of the steel plates don't appear because the color is lost against the background.

CHAIRMAN MILLER: You know, some of our experts here are color blind.

MS. BELL: That really makes it difficult.

CHAIRMAN MILLER: I am not sure how necessary it is to have the color any way. Is it possible you can state your objection in which it could be cured. In other words, you are prepared to identify the areas that you say should be in yellow and not in yellow, and say we should be able to look at it and tell what's what?

MS. BELL: I think it would be helpful in the Licensee somehow could add that in a sheet of paper that identified where those pieces of concrete were because looking at it, I can only guess as to whether or not something is vaguely blue and yellow in the background.

MR. AXELRAD: Mr. Chairman, the record describes

very adequately what the building in the modification program is going to be. It's described in detail, in testimony. There was cross examination on the subject, extensive discussion. We don't like to appear uncooperative, but these were prepared with a certain amount of difficulty and expense, it's called reproduction, and we don't feel it would be necessary to require us to go under any more difficulty to cure the problem and which the record clearly reflects it.

MS. BELL: Mr. Chairman, my only concern is that the document doesn't stand alone in being accurate.

CHAIRMAN MILLER: It doesn't stand alone. What do you mean?

MS. BELL: What I mean is as a document without the testimony or the transcript, it is not accurate because you can't figure out what its saying.

CHAIRMAN MILLER: Well isn't that true of the entire document. Standing alone it wouldn't tell me much of anything. It could be a child's toy. I don't think standing alone completes could be appropriate.

DR. McCOLLOM: Where is the 55 column modifications, which slide is it on? Which one should being colored that we can't see? That's what I am looking for.

CHAIRMAN MILLER: That's the color blind leading the color blind.

MR. AXELRAD: No, the 55 color modification would

not require the slide presentation. It is not shown on the slides.

CHAIRMAN MILLER: Not shown.

MR. AXELRAD: This is the construction sequence involving the steel plate. Not the structural improvements.

DR. McCOLLOM: Which one of the slides do you object to, Ms. Bell?

MS. BELL: I guess anyone of those that has, shows a color above the elevation 65 on the east wall. It would seem that that could be recommended by the Licensee quite easily.

MR. GRAY: Mr. Chairman, one possibility simply would be to have these collected and hand drawn in here. I know that's difficult, but if that --

MR. AXELRAD: Mr. Chairman, if I may just explain, these are not intended, slides, to show the complete modification. It would tend to only show a certain sequence of the structural installation underneath the detail of the slides themselves are this pictorial would show what was meant to be shown by the slide indicating which walls would be done in which sequence. This representation is certainly clear for the purpose both of what it shows and for which it was used. Of course, the slide presentation. Anyone else can go to any number of other portions of the record to see what the facility would look like when completed. This is not the purpose of these slides and that's not the way it was

shown.

CHAIRMAN MILLER: Well, it's the Board's understanding that the slides used in the oral testimony of Mr. Anderson and Dr. White are reflected in that testimony, were intended for a limited purpose, namely showing essentially the sequence of the work under way. It is further the Board's understanding that Licensee's Exhibit 31 is also for the limited purpose of showing the sequence. It will be admitted for that purpose. If it's going to be used for anything else, it's going to have to be used in connection with testimony on some other matters because it does not purport standing alone to depict anything else. And the Board doesn't consider that for its purposes it will be so used. It is sequenced. For that purpose, it's a limited function. Anything beyond that you won't be able to use it for that purpose anyway. You can going to have to refer to the transcript and to the testimony. It will be received for the limited purpose described.

CHAIRMAN MILLER: All right we stand in recess until 8:30 in the morning.

(EVENING RECESS at 4:30 PM)