NUCLEAR REGULATORY COMMISSION

ORIGINAL

In the Matter of:

SPENT FUEL ROD MODIFICATION	)	
	)	DOCKET NOS. 50-237 SP
(Channel Bowing at Dresden	)	50-249 SP
Spent Fuel Pool)	)	

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the matter of:	
SPENT FUEL ROD MODIFICATION	Docket Nos. 50-237 SP 50-249 SP
(Channel Bowing at Dresden Spent Fuel Pool)	

O'Hare Hilton Hotel
Montgolfier Room
O'Hare Intl. Airport
Chicago, Illinois
April 20, 1981

Hearing in the above-entitled matter commenced at 1:00 P. M., pursuant to notice, before:

MR. JOHN WOLF, Chairman of the Atomic Safety & Licensing Board Panel.

MS. LINDA LITTLE,
Member,

MR. FORREST J. REMICK,
Member.

APPEARANCES:

MR. RICHARD J. GODDARD,
NRC Staff Counsel;

MR. PAUL W. O'CONNOR,
NRC Project Manager;

MR. HORACE K. SHAW,

NRC Senior Mechanical Engineer;

MR. DAVID STAHL,

MR. PHILIP STEPTOE, and

MR. ROB FITZGIBBONS,

appeared on behalf of Applicant Commonwealth Edison Company;

MS. SUSAN SEKULER,
Illinois Department of Nuclear Safety;

MS. MARY JO MURRAY,
Assistant Attorney General; and

MR. RICHARD HUBBARD,
Technical Consultant, State of Illinois;

appeared on behalf of Intervenor State of Illinois.

C O N T E N T S

JUDGE WOLF: Good afternoon, ladies and gentlemen.

We are meeting here today in the matter of the Commonwealth Edison Company's application to modify its spent fuel pool at Dresden Station Units 2 and 3.

The matter that will be taken up this morning is the fuel channel bowing and the issue that has been raised around that question.

The Applicant has submitted written testimony regarding fuel channel bowing and the staff has responded.

To begin with, I would like to introduce the administrative judges who are making up this panel.

On my left is Dr. Linda Little, an environmentalist, and on my right is Dr. Forrest Remick, an engineer and physicist.

The clerk for the Board this morning is Mr. Paul Hamilton.

At this time I would like to ask counsel to state their appearance for the record, beginning with Mr. Goddard.

MR. GODDARD: I am the attorney for the NRC staff, Mr. Richard J. Goddard.

With me at counsel table on my right are Mr. Horace K. Shaw, the NRC staff's witness on the subject of fuel assembly channel bowing.

With me on my left is Mr. Paul W. O'Connor, the NRC staff's project manager for the re-racking of Dresden Station's Units 2 and 3.

MR. STAHL: Good morning, Judge Wolf. My name is David Stahl. I represent the Applicant, Commonwealth Edison Company.

With me at the table -- counsel table -- are Mr. Phillip P. Steptoe and Mr. Rob Fitzgibbons.

There are, also, a number of personnel employed by or consulting for Commonwealth Edison Company in this matter in the hearing room; and we will be calling most of them as witnesses this afternoon.

JUDGE WOLF: Thank you.

MS. MURRAY: Good afternoon, Judge Wolf. My name is Maryjo Murray. I am counsel for the State of Illinois, the Intervenor in this proceeding.

On my right is Richard Hubbard, the consultant for the State of Illinois, and on my left is Susan Sekular, also an attorney for the State of Illinois.

JUDGE WOLF: Thank you.

Are there any preliminary matters that we should take up at this time?

Mr. Goddard, do you have something?

MR. GODDARD: No, no preliminary matters.

However, I was advised by each of the administrative

judges today that they had not received their copies of the staff's testimony on this issue by mail.

Inquiry has revealed to me that both the attorneys for Applicant and for Intervenor did receive their copies.

I would like to know if there is anyone who at this time needs a copy of that testimony. I would be happy to provide one, if so.

(No response.)

MR. GODDARD: Apparently, there is not.

The staff has nothing further at this time.

JUDGE WOLF: I would like you to discuss for a moment the question of your answer to Board Question No. 2, if you would, please.

MR. GODDARD: As we indicated in the last conference call between the Board and all parties in this proceeding, the staff would move with all deliberate haste to provide the requested affidavits on this subject to the Atomic Safety and Licensing Board. Those affidavits were not ready as of the time I left my office this last Friday, the 17th of April. They will be provided to all parties and the Board as soon as they are available. I expect that to be within the coming week.

JUDGE WOLF: Thank you.

I believe the question was raised as to whether or not -- well, as to whether, if there were questions about

any of the affidavits to be submitted in response to Board Question 2, would we need another meeting; and if we do need another meeting, if the Board has further questions, I would like to announce that that meeting will be in Washington. At that time if the Board has questions, we will announce it sufficiently in advance to give you time to prepare for it.

MR. GODDARD: Thank you.

JUDGE WOLF: Mr. Stahl, do you want to proceed?

MR. STAHL: We are ready to proceed, Judge Wolf.

Well, there is one preliminary matter that, perhaps, we could take up at this point.

JUDGE WOLF: Yes.

MR. STAHL: Earlier today, Applicant provided to the staff and to the State of Illinois a General Electric document, which is entitled, "Design Study Summary. Subject, lower end plug friction coefficient test."

This is a document that General Electric advises us that they consider to contain propriatary information.

We have provided it to the other parties in this case on the understanding that this document will be subject to the protective order that has already been entered by the Board in this case; and I believe we have the agreement of both the staff and the State of Illinois that the document will be so treated as a propriatary document subject to the

protective order.

JUDGE WOLF: Very well. You will announce to the Board when you are about to use that material, so we can take the necessary steps to protect it?

MR. STAHL: Yes. We do not intend to make any use of this document in our presentation today, but we have been advised by the State of Illinois that at least one other document may be used by the State.

That document also contains propriatary information; and we will so advise the Board of the use -- of the advance use -- of any such document, so appropriate steps can be taken to continue the protection of the information in those documents.

JUDGE WOLF: Thank you.

MR. STAHL: With that out of the way, the Applicant is prepared to proceed today. We have filed prepared testimony of Messrs. O'Boyle, Mefford, Gilcrest and Ragan on the fuel bowing question -- the channel bowing question.

We have also provided an affidavit of Mr. Wong, and we will be presenting Revision No. 5 to the licensing report today, and that will be accomplished through Mr. Gilcrest.

I think that it would make more sense from our point of view -- and if the Board agrees -- we will proceed with

the testimony of Dr. O'Boyle; and we can call him to the stand for cross examination.

JUDGE WOLF: Very well; but before you do that, let's ask, Ms. Murray, if you have any preliminary matters.

MS. MURRAY: The only preliminary matter I had wanted to bring up was that as to propriatary documents, and that has been taken care of by Mr. Stahl.

JUDGE WOLF: Very well.

Mr. Stahl, you may proceed.

MR. STAHL: We will then ask Dr. Dennis O'Boyle to take the witness stand.

JUDGE WOLF: Mr. O'Boyle, will you raise your right hand, please? I want to swear you.

Will you stand up, please?

(The witness was thereupon duly sworn.)

JUDGE WOLF: Very well. You may be seated.

MR. STAHL: May we proceed?

JUDGE WOLF: Yes, you may.

MR. STAHL: Thank you.

DENNIS O'BOYLE

called as a witness by the Applicant, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. STAHL:

Q Dr. O'Boyle, would you please state your full name for the record?

A Dennis R. O'Boyle.

Q By whom are you employed, Dr. O'Boyle?

A Commonwealth Edison Company.

Q In what capacity are you employed?

A I am the Fuel Technology Engineer in the Nuclear Fuel Services Department.

Q Dr. O'Boyle, do you have before you a document entitled, "Testimony on dimensional changes of BWR fuel channels as a result of irradiation and on non-GE fuel bundles and channels?"

A Yes, I do.

Q Dr. O'Boyle, was this testimony prepared by you or under your supervision and control?

A Yes, it was.

Q And is the testimony contained in this document true and correct to the best of your knowledge and belief?

A Yes, yes, it is.

Q Do you have any changes that you would like to make in this prepared testimony at this time?

A No.

MR. STAHL: At this point, Presiding Judge Wolf, we would request that the prepared direct testimony of Dennis O'Boyle previously identified be incorporated into

the record as though it had been read.

JUDGE WOLF: Are there any objections?

Mr. Goddard?

MR. GODDARD: None from the staff, sir.

JUDGE WOLF: Ms. Murray?

MS. MURRAY: None from Intervenor.

JUDGE WOLF: Without objection, the testimony described by Mr. Stahl, which has been prepared by Dr. O'Boyle, will be received in the record as if read.

MR. STAHL: Thank you. Before we render Dr. O'Boyle for cross examination, there are a couple of other questions that I think we ought to ask about a deposition that was taken of Dr. O'Boyle last week.

BY MR. STAHL:

Q Dr. O'Boyle, do you have the transcript of the deposition of Dennis O'Boyle that was taken in this matter on April 15, 1981, in front of you?

A Yes, I do.

Q And have you reviewed that transcript since it was prepared?

A Yes, I have.

Q Are there any corrections that you would care to make in that transcript at this time?

A Yes, there are.

Q Will you please identify the page and the correction for the record, please?

A On Page 90, the last question, third line, the word "least," should be "test."

JUDGE WOLF: Pardon me just a minute. I am trying to locate that.

Have we been served with that?

MR. STAHL: I am not sure, Presiding Judge Wolf, if you have been served with that or not, or if the State has filed that deposition with the Board.

This was a deposition taken at the request of the State of Illinois. I am just not certain if they have filed that with the Commission.

JUDGE WOLF: Do you have it?

JUDGE REMICK: No.

JUDGE WOLF: We don't seem to have it.

MS. MURRAY: We have just received the original. It has not been filed with the Board yet.

JUDGE WOLF: Do you intend to file it, Ms. Murray?

MS. MURRAY: Yes. However, signature was not waived; and we don't have signature on it, I believe.

MR. STAHL: That is correct. We are making the corrections now. With these corrections, Dr. O'Boyle will be able to sign the deposition; and at that point I assume the State will then be filing it with the Commission?

MS. MURRAY: That is correct.

JUDGE WOLF: Very well.

MR. STAHL: There are only two or three short corrections that need to be made.

JUDGE WOLF: Fine. You may proceed now, Dr. O'Boyle.

A (Continuing.) The second correction is on Page 109, about the middle of the page. The answer given was, "It should have no thickening, no effect on the bowing."

That answer should read, "It should have no effect on the bowing."

The third correction is on Page 123, the fifth line, there are two words given, "space or." That should read, "spacer."

Those are all of the corrections.

MR. STAHL: Thank you, Dr. O'Boyle.

At this time, we have nothing further of Dr. O'Boyle by way of direct examination, and tender Dr. O'Boyle for cross examination.

JUDGE WOLF: Ms. Murray, do you wish to cross examine Dr. O'Boyle?

MS. MURRAY: Yes, Judge Wolf.

Thank you.

CROSS EXAMINATION

BY MS. MURRAY:

Q Dr. O'Boyle, on Page 3 of your testimony, the first full paragraph, about the middle of the paragraph, you state that the fuel channel is about 13-and-one-half-feet long and that it has a square cross-section of 5.278 inches inside diameter and .08 inch wall thickness.

Does this mean that the total outside dimension is 5.358 inches -- pardon me -- 5.438 inches?

A To that dimension must be added tolerances, but the 5.438 is the basic outside dimension.

Q And what tolerances should be added?
A The manufacturing tolerances of 16 mils. A maximum outside dimension of 5.454.
Q Now, what is the cross-section, including the spacer button and the manufacturing tolerances?
A The spacer button dimension is .306. Adding that to 5.454, I get 5.760.
Q Dr. O'Boyle, if you will refer to Figure 4 in your testimony, I believe the spacer button is .309; is that correct?
A Yes. The dimension given is .309. I am three mils short. We can add three mils onto that. I was using .306. It should be .309.
Q Dr. O'Boyle, would you repeat for the record the total outside diameter at the spacer button, including fabrication tolerances?
A It would be, with that three mils added, 5.763.
Q Has anyone ever taken actual measurements of fuel channels before irradiation?
A Yes, they have.
Q Do they fall within these maximum limits that you have just given?
A These limits are based on the GE drawings, and the channels that we have under irradiation were provided by GE in about 1970; and I am not aware of any measurements that were made

when those channels were first provided.

I am aware of channels that are provided today, and the channels that we received this year were measured extensively.

Q By whom?

A These channels were measured by Car-Tech.

Q GE channels were measured by Car-Tech?

A No. The channels that were provided this year were purchased from Car-Tech and they were measured by Car-Tech.

Q Referring back to the GE channels, you do not know then whether or not the GE channels actually fall within the fabrication tolerances; is that correct?

MR. STAHL: I will object to that question, unless we have a specification of which GE channels Ms. Murray is questioning the witness on at this time.

MS. MURRAY: The witness has stated that in 1970 Commonwealth Edison purchased the channels from GE, and the measurements which he is referring to are based on GE drawings.

BY MS. MURRAY:

Q With reference to all GE channels which Commonwealth Edison has purchased for use in the Dresden 2 and 3 reactors, has anyone ever taken actual measurements of those channels?

A I don't have any knowledge whether or not GE has measured those channels.

Those channels were delivered, though, seven years before I joined Edison; and I would certainly assume that during manufacturing dimensions were recorded.

Q But you have no actual knowledge of what those dimensions are; is that correct?

A I am not aware that they have been -- that they have been measured and I haven't seen any measurements from ten years ago.

Q So you don't know whether they fall within these tolerance ranges which you have given us; is that correct?

A I have no reason to suspect that they don't.

Q But you do not know for sure; is that correct?

JUDGE WOLF: Just answer the question. You can say yes or no.

A No, I don't know based on first-hand information.

BY MS. MURRAY:

Q Referring to your testimony on Page 2 -- actually, that's beginning at the bottom of the first page, where you state, "Normal operational pressure gradients and neutron flux gradients cause the dimensions of the channel to change slightly from the original as-fabricated dimensions."

Would you please quantify the word "slightly"?

A By "slightly," I meant from the original as-fabricated dimensions in the terms of the flux gradient over the 13-and-a-half foot length of the channel, the bow -- the

maximum bow -- being .42 inches. I would consider that to be within the range of slightly in an overall length of 13-and-a-half feet.

The bulge on the order of 60 mils in an overall dimension of 5.454, I consider that to be slightly.

I meant to imply in that statement that the basic geometry of the channel is maintained.

Q Is it not correct in a straight fuel channel storage position that there is a minimum clearance of .346 inches total or .173 inches on each side? That is as referred to on Page 2 of Mr. Gilcrest's testimony.

THE WITNESS: Could you repeat that?

JUDGE WOLF: Would you repeat it, please?

(The question was thereupon read by the Reporter.)

MS. MURRAY: Excuse me. That should read .346 inches.

MR. STAHL: Excuse me, Dr. O'Boyle. Do you have a copy of Dr. Gilcrest's testimony in front of you?

THE WITNESS: No, I don't.

His original?

MR. STEPTOE: Down at the bottom.

MR. FITZGERALD: It's Page 2 at the bottom.

THE WITNESS: Yes.

MR. STAHL: Perhaps, we could have the question

read back.

JUDGE WOLF: Do you need it read again?

A I believe the dimension I see on Page 2 is 0.73, and I have noted a dimension of 0.70.

BY MS. MURRAY:

Q Dr. O'Boyle, are we referring to the same Page 2, Mr. Gilcrest's testimony, the last two lines?

A Yes.

Q The minimum clearance between the spent fuel channel and the wall of the storage position is determined to be .346 inches total or .173 inches on each side?

A Yes. I thought you said .170 and I read .173.

Q Thank you. Now, the fuel will be centered in the storage position; is that correct?

A The lower tie plate will be centered in the bottom of the storage position. The rest of the bundle is free to move from side to side.

Q So the minimum clearance for the bow will be the .173 inches; is that not correct?

A No. It would be larger than that.

Q How much larger?

A Since the bundle can move to the left and the right at the top, that gives you additional distance over which it can move.

If the bundle were centered, then the clearance of

.170 would apply.

Q .173?

A .173.

Q Now, given this clearance of .173, would you still be willing to refer to the change as slight in terms of the maximum bow that has been measured of .420?

A My testimony says, "Slightly from the original as-fabricated dimension"; and, yes, I would stay with slight in that.

Q Slight in terms of the 13-and-a-half feet, correct, slight in terms of the amount of clearance?

A The testimony doesn't say that.

Q Would you be willing to say that?

A In terms of the clearance, no, it certainly would not be slight.

Q Thank you. Going back to a statement you just made -- and I can't quote you exactly -- but it referred to the ability of the bowed assembly to move back in the storage position so there was more clearance than .173 inches?

A Yes.

Q Isn't it correct that independent of the bow problem, there will be interference between the lead-in clip and the spacer button?

A When you say, "there will be" --

Q Could be?

A There could be if the maximum dimensions of the channel were put in the minimum storage position hold; there could be interference.

Q Independent of the bowing bulge; is that correct?

A That is correct.

Q Dr. O'Boyle, when did you first learn about fuel channel bowing?

A When did I personally?

Q That's correct.

A The first measurements of bow that I am aware of, that I became aware of, were made by GPU in 1977; and that's the first time, to my recollection, that I became aware of bow.

Q What did GPU measure?

A The bow of irradiated channels.

Q Whose channels were they?

A GPU channels.

Q Where were these measurements taken?

A I believe it was Oyster Creek.

Q Is that a BWR?

A Yes.

Q Was it GE fuel?

A I am not sure whose fuel it was.

Q Do you know if they were Car-Tech channels that were measured?

That is C-a-r-T-e-c-h.

A Your question again?
Q Do you know if they were Car-Tech channels that were measured by GPU at Oyster Creek in 1977?
A I am quite certain they were not.
Q Do you know how many channels were measured?
A About 25.
Q Do you know what the maximum bow measured was?
A To the best of my recollection, 230 mils.
Q Was that bow plus bulge or just bow?
A I am not certain.
Q Is it possible to measure bow independent of bulge?
A Yes.
Q In the channels which you have referred to as being measured, I think the best description is on Page 9 of your testimony.

Were these measurements of bow plus bulge?

A The discussion on Page 9 in which I give dimensions, these are as stated in the testimony, bow plus bulge deformation.
Q Do you know from the measurements what percentage of this bow plus bulge is bow?
A That can be determined easily for each individual channel. We get out a reading of bulge and we get independently a reading of bow.
Q Do you know what your largest measurement -- independent measurement -- of bow was?

A Bow only?
Q That's correct.
A It would be very close to 0.360 inches.
Q Isn't it correct that bulge has been measured up to 110 mils?
A I am not certain. I don't believe we have seen any bulges that large in the channels that we have measured.

MS. MURRAY: I would like to have this marked as Intervenor's Document No. 1, for identification only.

(The document was thereupon marked Intervenor's Exhibit No. 1 for identification as of April 20, 1981.)

BY MS. MURRAY:
Q Dr. O'Boyle, this is a document that has --

MR. STAHL: Excuse me. Presiding Judge Wolf, I would like to have the opportunity to at least examine this document before the witness sees it.

JUDGE WOLF: Yes. Since you don't have copies, would you show it to the parties, please? Even though you don't introduce it, you should prepare copies for the other parties.

MR. GODDARD: Thank you.

MR. STAHL: I would just like the record to reflect my objection to asking the witness a question about

this isolated document, since the document, on its face, appears to be part of a larger document.

In the upper right-hand corner there is a notation that it is Page 5; and it is possible, taken out of context, that this document may be misleading.

JUDGE WOLF: Ms. Murray, where did you obtain this document?

MS. MURRAY: We obtained this document from Commonwealth Edison. It's document No. 1788. We most likely have the first five pages.

If Commonwealth Edison would like to review their own document --

JUDGE WOLF: But it's something you obtained on discovery from Commonwealth Edison?

MS. MURRAY: That is correct.

MR. STAHL: Judge Wolf, I am not questioning the authenticity of the document.

All I am saying is there may have well been information in the other four pages of this document which would be very helpful to Dr. O'Boyle to also examine while he is answering questions about this page. Perhaps we can see if Dr. O'Boyle needs that assist, and maybe the problem won't arise.

MS. MURRAY: We will see if he recognizes the document.

BY MS. MURRAY:

Q Dr. O'Boyle, I am handing you Intervenor's Exhibit No. 1 for identification. It was obtained through discovery from Commonwealth Edison.

Do you recognize that document?

A Yes, I do.

Q Do you recognize the handwriting in that document?

A Yes, I do.

Q Whose handwriting is it?

A It looks like Ed Armstrong's handwriting.

Q Who is Ed Armstrong?

A He is a Commonwealth Edison employee working in Nuclear Fuel Services.

Q Are you his supervisor?

A No, I am not.

Q In what way do you know Mr. Armstrong?

A We have a working relationship in Nuclear Fuel Services, but he doesn't work for me. He is in a different group.

Q And you don't work for him?

A That is correct.

Q Thank you. Now, Dr. O'Boyle, I will repeat my question. I will rephrase it.

Has there ever been a measurement of bulge of 110 mils?

A No, there has not, that I am aware of.

This document does not reflect measurements.

Q What does it reflect, in your opinion?

A It reflects estimates of possible bow and bulge. It does not represent measurements.

You will note that the 110 mils applies to Dresden 2; and as of the date of this document, there were no measurements at all made on any Dresden channels.

Q Who made the estimates, do you know?

A These estimates are in a document, and I am quite certain this is Ed Armstrong's writing, and I am also fairly certain that he discussed these estimates with me to get my idea of what they might be.

You might also note from this document for Dresden 2 that the total bow plus bulge estimated is 400 mils, which is less than the amount that was measured.

Q Isn't it correct, though, Dr. O'Boyle, that the estimate for Quad Cities 1 and 2 is 350 mils; and, in fact, there was a fuel channel from Quad Cities that was measured at 420 mils bow plus bulge?

A Yes, that is true. Again, consider the date of the document. We did not have a complete set of measurements from Quad Cities at the time this document was written.

Q In your opinion, is it possible that bulge could go as high as 110 mils?

A In the D-2 channels, which are unique due to their time of

manufacture, I would expect that it is possible to get bulge greater than 60 mils.

Q How high would you expect the bulge to go?

A I would believe the 110 mils is not unreasonable. I would prefer to make the measurements at this point rather than estimate it.

Q You stated, I believe, that 110 would not be unreasonable; is that what you said?

Could we have what he said read back, please?

(The answer was thereupon read by the Reporter.)

BY MS. MURRAY:

Q When you are stating that you think that 110 mils is not unreasonable, is that the highest estimate that you would make for bulge?

MR. STAHL: I object. That is not an estimate that the witness made.

MS. MURRAY: He just stated 110 mils was not unreasonable and he said it's not a measurement.

MR. STAHL: My objection is that the witness did not testify that he would estimate that the bulge could approach 110 mils.

He responded to a question, "Would you consider that unreasonable?" He said no, he would not consider that unreasonable; but it is not the witness's estimate.

That is the basis for my objection.

JUDGE WOLF: We will sustain that. If you wish to make an estimate, you may; or you may reframe your question.

MS. MURRAY: Thank you, Judge Wolf.

BY MS. MURRAY:

Q When you state 110 mils is not unreasonable -- strike that.

What would be your estimate of maximum bulge in the Dresden 2 channels?

MR. STAHL: I object, Judge Wolf. This has been asked and answered.

The witness stated that it's possible to get bulge in excess of 60 mils. He said that beyond that he was not willing to estimate; he would prefer to measure.

I believe he has already responded to the question.

JUDGE WOLF: Well, if you have reservations about making an estimate, you may state that; but let's move on and get the answer.

A I do have reservations about making an estimate.

I would expect that it could exceed 60 mils.

BY MS. MURRAY:

Q Then, Dr. O'Boyle, you stated that the maximum bow that was measured would be around 360 mils?

A Yes.

Q Is it possible then with the Dresden 2 fuel, because of its unique characteristic which you referred to, the bulge plus bow could be greater than 420 mils?

A I believe that's unlikely, based on the fact that the D-2 fuel channels will not be used as extensively as the Quad Cities channels.

We have decided to retire those channels, and they will not be put back in to achieve the same high exposures as the Quad Cities channels.

Q Why will they be retired before they receive that same high exposure?

A They are unique, in that they have a higher corrosion rate than the Quad Cities channels; and we prefer not to have channels in that have this higher corrosion rate.

Q What corrodes?

A The zircaloy 4.

Q I am sorry. The zircaloy?

A 4.

Q That is the zircaloy in the channel?

A Yes.

Q Was that taken into consideration in determining the -- strike that.

How many cycles of irradiation are the Dresden 2 fuel channels going to be going through?

A I don't understand your question. An average, a minimum, a

maximum?

Q You stated that they won't be used as extensively as the channels at Quad Cities.

A Yes.

Q What is the average number of cycles of irradiation that they will be put through?

A The average number is three or four cycles.

Q Maximum?

A I would have to examine the records of 800 or so channels to answer that. For all practical purposes, I think four is a maximum. There might be a few that went further. I can't -- I am almost certain there aren't any that have gone beyond four cycles.

Since we are not re-using them, there no longer is any possibility that they go beyond four.

Q How many cycles of irradiation did the fuel that was measured for bowing at Quad Cities go through, on average?

A Do you mean fuel or channels?

Q Fuel channels.

A There were some channels in that group that went five cycles; and, in fact, the maximum bow channel was one that was in for five cycles.

Q Is it correct that bowing increases with each cycle of irradiation if the channel is in the same location in the core?

A No, not necessarily.
Q Why?
A Bow is the function, primarily, of the fluence in a fast neutron flux gradient; and bow will continue if the channels are left in the peripheral region of the core, but should not continue if left in the mid-section of the core.
Q Did the channel that had bowed 420 mils at Quad Cities go through five cycles in the periphery of the core?
A No. It went through four cycles in the periphery of the core, which is unusual.
Q Is it possible that one of the Dresden 2 fuel channels could go through a maximum of four cycles in the periphery of the core?
A It is nearly impossible; under no normal circumstance would that happen.
Q Let's go back to the history of fuel channel bowing. You stated the first measurements were taken by GPU along about 1977.

When were the next measurements taken, do you know, in the United States?

A I believe GPU took two sets of measurements, so the next set would be later GPU, followed by Northern States Power.
Q When was the second set of GPU measurements taken?
A I can't give you a date. Some time after 1977.
Q Do you know when the Northern States Power measurements

were taken at Monticello?

A The measurements that I referred to in my deposition were taken in 1979. I cannot testify with certainty that they might not have started in late 1978, but the bulk of the ones that I looked at and analyzed were made in 1979.

Those were the first set of data on channel bow that, in my opinion, could be analyzed with respect to the rack interference problem.

Q When were the racks, the high-density racks for the Dresden 2 and 3 pools, designed?

A That is Mr. Gilcrest's area, but I believe it was 1977.

Q Do you know when the manufacturers of the tubes and racks were hired to construct these tubes and racks?

A In reply to your previous question, the first licensing report is dated December 30, 1977. So I believe 1977 is correct.

MS. MURRAY: Could I have my second question read back, please?

(The question was thereupon read by the Reporter.)

A That is not in my area, and I don't know when they were hired.

BY MS. MURRAY:

Q They were, in all probability, hired after the racks were designed; is that correct?

A Who are you asking about being hired?
Q I am asking about Brooks and Perkins and Leckenby.
A I have no idea when they were hired.
Q Referring to your first full paragraph at the top of Page 7 in the second sentence, "The recommendations relating to the location history of fuel channels in the reactor core," your second sentence reads, "The purpose of these recommendations was to eliminate the potential of interference between the channels and the reactor control blades."

Is there a potential for interference with the reactor control blades and bowed fuel channels?
A Yes, there is.
Q Is it known how much bow would impede a control rod from inserting?
A That is a reactor design question, and I can't give you a number.
Q Is it likely that you knew about the existence of fuel channel bowing before the racks -- high-density racks -- for Dresden 2 and 3 were designed?

MR. STAHL: I object to the question insofar as the question is whether it is likely.

Either the witness knows or does not know. Other than that, it calls for speculation.

JUDGE WOLF: I will sustain that. Eliminate the

word "likely."

BY MS. MURRAY:

Q Dr. O'Boyle, you stated that GPU made measurements of fuel channel bowing in 1977 and that's when you became aware of it, and that the racks were designed as of December 30, 1977.

Did you know about fuel channel bowing before the racks were designed?

A We are talking about the same time period in 1977, and I wasn't aware of the racks being designed until 1979. So which came first, I have no idea.

I knew about bow long before I knew about the high-density racks.

Q Then no one ever asked you what size the racks or the rack storage positions would have to be to accommodate the fuel assemblies?

A No one asked me that. I didn't have any discussions about that until until 1980.

MS. MURRAY: I would like to have this marked as Intervenor's Exhibit No. 2, for identification only.

(The document was thereupon marked Intervenor's Exhibit No. 2 for identification as of April 20, 1981.)

JUDGE WOLF: Off the record for a minute, please.

(There followed a discussion outside the record.)

(Intervenor's Exhibits Nos. 1 and 2 for identification were thereupon re-marked as Intervenor's Exhibits Nos. 14 and 15 for identification as of April 20, 1981.)

JUDGE WOLF: Back on the record.

BY MS. MURRAY:

Q Dr. O'Boyle, I am handing you what has been marked as Intervenor's Exhibit No. 15 for identification.

Would you look at it and tell me if you have ever seen that document before?

A Yes, I have.

Q When did you first see that document?

A About a week ago.

Q Keep it for a moment.

In what context did you first see this document; why?

A That was given to me by Mr. Steptoe following the deposition of Mr. Mefford of GE.

Q So up until a week ago you didn't know that GE had any fuel storage requirements for bowed fuel; is that correct?

A Up until -- no. Up until a week ago I was not aware of the existence of this document.

Q Did you know that GE had fuel storage requirements for bowed fuel channels?

A I wasn't aware of any written recommendations. I had never seen anything from GE, but that is not my area.

The whole area of rack design is out of my area, and I wouldn't have any occasion to see any documents on storage rack design or recommendations.

Q Dr. O'Boyle, what other dimensional changes take place in fuel channel assemblies besides bow and bulge?

A Twist and growth.

Q Would you explain twist, please?

A Twist is the radial re-orientation of the top of the channel with respect to the bottom with reference to a center line of the channel.

Q And how does that affect insertion of the fuel channel assembly into a high-density storage position?

A I would expect it to have almost no effect, unless the twist were very large.

Q What do you mean by "very large"?

A Perhaps 200 mils.

Q What is the largest amount of twist that has been measured, to your knowledge?

A To my knowledge, about 30 mils or so. That's the basis for my saying it has no effect.

Q Where did that figure come from, 30 mils?

A From measurements that were made on Quad Cities channels.

Q Wasn't there a measurement at Quad Cities of 62 mils of

twist?

A Not that I recall, but even 62 mils would have no effect on insertion.

Q Did Mr. Armstrong ever talk to you about twist measurements that were made at Quad Cities?

A Yes.

Q What did he tell you, do you recall?

A We discussed what effect, if any, twist might have on insertion; and I asked him to look at that geometrically and to consider the effect of twist when added to the maximum bow plus bulge, to see if there would be any effect on the distortion toward the storage racks.

He did that analysis, and our conclusion was that there is no significant effect of the maximum twist when you have the large bows.

Q Why?

A Because twist doesn't at all move the side of the channel closer to the side of the storage rack. If you imagine the side bowed out -- pardon me, bulged out -- and you rotate it, it doesn't move closer to the wall.

Q Does twist interfere with the way the lower tie plate is seated in the rack?

A No.

Q Does it interfere with the way the fuel channel sets at the lead-in clip?

A With respect to what?
Q If there is twist, how does the lower tie plate sit in the rack?
A The bottom -- the lower end plug is conical in design, so as it is put down, it can assume any orientation.
Q In your conversations with Mr. Armstrong about twist, did you ever discuss measurements of twist?
A Yes.
Q Did you ever see any documentation on the measurements?
A I have seen measurements of twist. If that's documentation, yes, I have seen twist measurements.
Q What is the highest value you have seen?
A The highest value I recall is on the order of 30 mils.
Q Is this information on Quad Cities 1980 tests?
A Yes.

MS. MURRAY: I would like this marked as Intervenor's Exhibit No. 16 for identification.

(The document was thereupon marked Intervenor's Exhibit No. 16 for identification as of April 20, 1981.)

BY MS. MURRAY:
Q Dr. O'Boyle --

MR. STAHL: Excuse me, Ms. Murray. We have not seen the exhibit. May we, please?

MS. MURRAY: I assume you had, since it was your exhibit.

MR. STAHL: If we had received notice that you were going to use this, we would have had it available.

BY MS. MURRAY:

Q Dr. O'Boyle, I am handing you what has been marked as Intervenor's Exhibit No. 16 for identification.

Will you look at it and tell me if you have ever seen this document before?

A I don't remember ever having read this document. It looks, again, like Ed Armstrong's writing.

Q And this document refers to the 1980 Quad Cities measurements of twist?

A I would have to read it to --

Q Take the time.

A After reading this document, to the best of my knowledge, this is the first time I have read this document.

(Indicating.)

This looks like it's from some working papers from Mr. Armstrong's file that were never circulated or never put out in a memo or never reviewed internally; and I find this isn't dated. I have no idea where this is from.

Q Did Mr. Armstrong do the measurements of twist at Quad Cities in 1980?

A No.

Q Who did?
A They were done under the direction of the Nuclear Engineering Staff at Quad Cities.
Q Who is the head of the Nuclear Engineering Staff?
A At that time Brian Strub, with no "e".
Q What relation to these measurements did Mr. Armstrong have?
A Mr. Armstrong works in Nuclear Fuel Services, and some of these measurements were provided to him by the Nuclear Engineering Staff at Quad Cities, but he did not direct those measurements.
Q So before today you did not know that the largest value of twist could be up to 62 mils?
A I --

MR. STAHL: I object to that. There is no foundation in the record that, in fact, that is the case.

JUDGE WOLF: Well, I think the witness can answer. He either knows or does not know the answer.

A My best recollection of twist was plus or minus 30 mils; and I have just reviewed the deposition -- the first deposition -- and I note I used the same figure in there, plus or minus 30 mils; and I, obviously, didn't see Mr. Armstrong's memo in which he came across one that was larger.

His memo does state, though, that that's very unlikely and he does state in there that most of the twist

is a couple dozen mils; and that is my recollection. I agree with that observation.

BY MS. MURRAY:

Q If there was twist up to plus or minus 60 mils, would that affect your testimony as to interference from twist?

A No.

Q Referring to your testimony at the bottom of Page 6 and top of Page 7, you talk about the recommendations which GE issued, first limiting the exposure of BWR fuel channels to 33,000 megawatt days per standard ton, and your second recommendation in 1979 relating to the location and history of the fuel channels in the reactor cores.

No. 1, do you know why GE issued the recommendation which limited the exposure of the BWR fuel channels to 33 megawatt days per standard ton?

A I believe that was based on the potential for interference between bowed channels and reactor control blades, and that potential was evaluated based on calculations or expectations of channel deformation in cores as opposed to measurements.

Q Do you know why GE made the further recommendations on the location history of the fuel channels in 1979, measurements which you referred to on Page 7?

A Yes.

Q What is the reason?

A These recommendations were made so as to minimize the possibility for the buildup of bow during successive cycles of irradiating channels in peripheral core locations.

Q You state beginning in Line 5 on Page 7 that after reviewing the early channel deformation data obtained by other utilities, that you concluded that the GE recommendations limiting channel exposure were unnecessarily conservative.

Does Commonwealth Edison follow the recommendations limiting the exposure of BWR fuel channels to 33 megawatt days per standard ton?

A In the channels that have been measured we do not follow that recommendation.

Q Are you following the GE recommendations that were made in 1979 relating to the location history of the fuel channels?

A That recommendation is one of the recommendations that is used in the review of the core loading patterns.

Q And how long have you been doing this?

A I believe since 1980.

Q So since 1980 you have been using the recommendations on the location of fuel channels in the core when you review your core loadings; is that a good way to state it, or can you state it better for me?

A That's fine.

Q Why didn't you start using these recommendations in 1979?

A They might have come out in December. I don't know what month they were issued.

Q How do you follow the 1979 recommendations; what do you do?

A Which 1979 recommendations?

Q The one at the top of Page 7 that we have been talking about.

A When we review a core loading plan, we look at the location of the bundles in the core. That, again, is somewhat outside of my area. That's more in the nuclear engineering area of core reload, and I can't tell you what we all do when we review core loading, but one of the things that we do do is look at the channels.

Q And if the channels are deformed, what do you do? How do you look at the channels?

A We would look at their history and determine how many cycles they had been irradiated in peripheral positions.

Q And?

A And if that number was unacceptable, we could either move the bundle to a different core location or have that channel removed and replaced with another channel or we could discard that channel and put a new channel on that bundle. So we would have many options.

Q Who did you purchase your channel measuring system from?

A We purchased that from General Electric Company.

Q You state that this was the first commercial system built

by General Electric.

Were there other systems available before --

A There was --

Q -- 1979?

A I am sorry.

Q Go ahead.

A There was one other system on the market at about the same time.

Q Whose system was that?

A That was a system offered by Car-Tech.

Q So by 1979 Car-Tech was offering a channel measuring system?

I am using your date of October, 1979, the first full paragraph at the bottom of Page 7.

A That's when the specification was written, not when it was purchased.

Q It was purchased in April of 1980; correct?

A Yes. At that time there were two.

Q Were there two in October of 1979, two channel measuring systems available -- I am sorry. Strike that.

How long has the Car-Tech channel measuring system been available?

A I believe since 1979.

MS. MURRAY: These are a series of documents that you provided to us.

I would like to have this marked as Intervenor's Exhibit No. 16.

JUDGE WOLF: Off the record.

(There followed a discussion outside the record.)

(The document was thereupon marked Intervenor's Exhibit No. 16 for identification as of April 20, 1981.)

JUDGE WOLF: All right. We may go back on the record.

BY MS. MURRAY:

Q Dr. O'Boyle, would you please refer to the document -- the series of documents which I have just handed you and tell me: Is that your handwriting?

A Yes, it is.

Q On all five documents?

A Yes.

Q The documents, for the record, are numbered 1941, 1868, 1869, 1872, and 1891.

A Yes.

MS. MURRAY: At this time I would like to offer this exhibit into evidence.

Do you have any objections?

MR. STAHL: May I review the document for a

moment?

THE WITNESS: I note from this document --

MR. STAHL: Excuse me. I am not sure if there is a question pending. I have been asked by Ms. Murray whether I have any objections to this document going into evidence.

I am not sure --

MS. MURRAY: There are no questions pending.

MR. STAHL: There are no questions pending, okay.

Well, it is apparent that Dr. O'Boyle has prepared all of these documents. I have no objection to their admission into evidence.

I would only note, however, for the record, that what has been marked as one exhibit appears to be three separate documents prepared on three separate dates.

Subject to that statement, I have no objection to their admissibility into evidence.

THE WITNESS: I note --

MR. STAHL: There is no question pending.

BY MS. MURRAY:

Q Dr. O'Boyle, these are a series of several different documents in your handwriting and I just have a few questions on each of them.

If you will refer first to document No. 1872, which is the fourth page.

Is it correct to state that, referring to the center of the page, your estimate of the number of fuel channels that would stick, a rough estimate, would be 11 percent?

A That page that you referred to are some notes that I made, and I would characterize that page as a back-of-the-envelope calculation, on which there were no data.

This estimate, essentially, came right out of my head and is -- I certainly would not stand by the estimate as given there. This is just scratching that was done based on no measured data.

Q However, at the top of the page it does state in your handwriting, "Estimate of sticking channels based on bow data of 12/5/80, and dimensional analysis, N. F. S., Ed A." I assume that is Ed Armstrong, "Ed A., 12/22/80."

Would you still say your estimate of 11 percent was based on no data at all?

A I am reviewing the estimate.

This estimate is based on the measured bow data, but the figures that I picked out of the air are the interference figures that are based on the rack dimensions, and I didn't have any available measurements.

So part of this calculation is based on not the bow data but the other part is based on figures right out of the air. So this number has no relevance.

Q What do you mean right out of the air?
A It means I looked at the range of possible dimensions on the drawing and then picked some intermediate position.
Q What drawing are you referring to?
A The drawings of the rack, the storage rack.
Q Whose drawings?
A These were dimensions that were provided to me by Ed Armstrong, and I believe he obtained those from the Dresden drawings, but I have no assurance that he was using the latest drawings or relevant drawings.

This is not our job, to analyze the high-density storage rack dimensions, and I have no assurance what we have is --

Q At this point what would be your calculation?

MR. STAHL: Excuse me, excuse me. I don't believe the witness has finished his answer.

MS. MURRAY: I am sorry.

A (Continuing.) I have no assurance that the drawings he had were the drawings that were used in fabricating the rack.

BY MS. MURRAY:

Q At this point what would your estimate be of the number of channels that would stick?
A I couldn't make that estimate without having available and analyzed the range of dimensions on the rack.
Q Not all of the racks are constructed, are they?

A I am not sure.

Q If the figures that were provided to you by Ed Armstrong were correct figures, then your estimate would have a scientific, rational basis, would it not?

MR. STAHL: I object to the form of the question. I am not sure what is implicit in the, "scientific, rational basis," the questioner is asking.

JUDGE WOLF: Do you understand the question, Mr. Witness?

THE WITNESS: Could we have the question restated? I have lost the track.

JUDGE WOLF: Will you restate the question, please?

MS. MURRAY: Yes.

BY MS. MURRAY:

Q If the figures provided to you by Mr. Armstrong were, indeed, actual rack measurements, then your figure of 11 percent would be accurate; is that correct?

A My figure, again, is an estimate; and it would remain an estimate and be more valid than it is right now; and I would characterize it as a rough estimate.

Q Okay. Referring to the last page, Document No. 1891, this is dated November 17, 1980. I believe that was two days before our hearing started last November.

Can you read Paragraph 1-A for me?

A Into the record?
Q Into the record, please. I can't understand your handwriting.
A "If corrosion is observed resulting in tube size change, measure all channels and discard those with bow plus bulge greater than some value, say 200 mils."
Q Is that still a possible plan of Commonwealth Edison?
A It certainly is something we could do. I wouldn't characterize it as a Commonwealth Edison plan. It's based on corrosion being observed, and I don't expect any, but we certainly could discharge and discard channels with bow plus bulge greater than some value

JUDGE LITTLE: Ms. Murray, before you get much further, I would like to know what the first word is here. (Indicating.)

MS. MURRAY: That was my next question.

BY MS. MURRAY:
Q What is the first word in that paragraph above the letter A?
A "Recommendations."
Q Are you still recommending under Subparagraph B that a select number of tubes be tested with a mandrel?
A That recommendation -- the first part of that recommendation is if the corrosion test program shows signs of boral corrosion; and if that were so, I would recommend

that we test some of the tubes with a mandrel, yes.

Q Okay. Thank you.

On document No. 1941, the top page, on the left-hand side, it looks like you have written, "Call Ron."

Could you read into the record what the paragraph immediately to the right of that says, beginning with the letters, "C. H"?

A Yes. "Check with Ron Ragan on what the station would agree to with respect to post-installation mandrel testing."

Q And did you do that?

A I don't believe I discussed that with Mr. Ragan.

I also believe that this was written before we actually made measurements on the racks, so this may no longer be relevant.

Q In what way would it no longer be relevant?

A Well, if we make the measurements prior to installation, it wouldn't be relevant to make them again post-installation. I would rather have the measurements pre-installation.

Q But if you made the measurements pre-installation, that doesn't take into account any subsequent corrosion, does it?

A I don't see any reference to corrosion there.

Q Could you answer my question?

A The pre-installation measurements would not consider any corrosion in them.

Q Thank you. Referring to the third page, 1869 is the document number, under, I believe, it's a small c., Subparagraph 2, could you read to me what is in Subparagraph 2, just the first sentence?

A "These are being replaced with new channels that are fabricated to minimize bow."

Q Will all the channels that are now being used in the Dresden 2 and 3 reactors be replaced with Car-Tech channels?

THE WITNESS: Could you repeat the question?

(The question was thereupon read by the Reporter.)

A There are two major suppliers of channels; and we can purchase them and we might purchase them from either supplier, either GE or Car-Tech.

BY MS. MURRAY:

Q Your plan now is to purchase channels from Car-Tech; is that correct?

A Right now we have a contract with Car-Tech to provide channels; and that contract expires, I believe, in 1982.

Beyond that we might purchase them from either vendor.

Q How many channels will you be purchasing from Car-Tech?

A The exact number hasn't been determined. It depends on what our needs are. Those needs are usually established

about four to five months before the outage, and so I can't answer that --

Q Why are you --

A -- precisely.

Q I am sorry. Why are you switching to the Car-Tech channels?

A They were cheaper.

Q Looking at your testimony on Page 9, you state in Paragraph 2 that a total of 1,736 channel sides were measured.

How many channels does this break down into?

A The total number of channels measured was 875.

Q So on these 875 channels, on some of them you measured more than one side; is that correct?

A That is correct.

Q Now, the bow only occurs on one side of the channel; is that correct?

A No. The bow can occur in any of the four principal directions.

Q That is correct; but when it does bow, it only bows in one particular direction; is that correct?

A No. It might occur --

Q Only one side bows; is that correct?

A No.

Q Then describe for me what it bows like, what the bow is like?

A The usual bow is more heavily in one dimension; but if the channel is oriented in the periphery at about 45 degrees to the axis of the core, then the bow would be in the X-Y direction as opposed to either the X direction or the Y direction; and we have seen channels with X-Y bow.

Q Have you ever seen channels with S-shaped bow?

A That's highly dependent on how flat the S is. We have never seen channels with a S-shaped bow where one of the loops of the S is greater than 100 mils.

Essentially, the answer to your question is no; but I don't want to rule out some slight loop going below zero that might be 20 mils or so.

Q Okay. Going back to the measurement of the channel sides and the bow along the X-Y access when it's at a 45-degree angle to the core or however you described that, when you measure that type of bow, do you attribute the bow to two different channel sides or one particular side or how do you include that type of bow in your measurements and calculations here?

A If we measured two sides of the channel, those two sides would be included in the total of 1,736 of the sides measured; and in the data that I cite in that paragraph, the bow measured on both of those sides would be included in the number cited.

Q But if the bow is along a 45-degree angle, which side do

you attribute the bow to?

A We measure the bow on both sides, on the X side and the Y side; and we record both of those.

Q So that means that both the sides bow together?

A The channel bows in the X direction and in the Y direction. We record both of those.

The net result of X bow and Y bow is X-dash-Y bow.

Q Okay. Now, do you measure channel sides that aren't bowed; that is, if side X is bowed, then do you measure the side opposite of X?

A In the measurements that were done, the majority of these we measured the side X and the side at 90 degrees to X.

We have done a limited number of measurements where we measure all four sides, and what we find and what we expect is that the side opposite of X bows the same as side X.

Similarly, if side Y bows, the other side follows right along and bows just as much as Y. Let's call it Y prime bows as much as Y and X prime bows as much as X.

Q So if you had channel side X bowed in X direction, then you would measure the side at 90 degrees to X and find no bow; is that correct?

A No.

JUDGE REMICK: Dr. O'Boyle, when you say no, you mean no or not necessarily?

THE WITNESS: If you measure X, X prime would bow the same amount as X; but measuring X says nothing about the bow in side Y. The bow in X is unrelated to the bow in Y.

JUDGE REMICK: Maybe I misunderstood Ms. Murray's question; but I thought her question was if you measure X and you find a bow, that if you then measured Y, you would find no bow or you would --

MS. MURRAY: That was my question.

JUDGE REMICK: Your answer was no.

THE WITNESS: That is what I heard her question to be.

My answer is if you measure X and you find bow, that says nothing about what you might find in Y. Y might bow, it might not.

They are, generally, independent.

JUDGE REMICK: That is why I thought, perhaps, "not necessarily," would be more correct than "no." I wasn't sure what your answer of a flat no meant.

THE WITNESS: Yes.

JUDGE REMICK: You may or may not have bowing in the Y if you find bowing in the X; is that correct?

THE WITNESS: That is right.

JUDGE REMICK: That is dependent on core location from what orientation?

THE WITNESS: That is right.

JUDGE REMICK: Excuse me.

MS. MURRAY: Thank you, Dr. Remick.

BY MS. MURRAY:

Q Dr. O'Boyle, would it be correct to say that not all of the 1,736 channel sides which you measured were bowed?

A If one defines the minimum of bow as 30 mils, 20 mils, yes, there were many channels that had bow less than 20 or 30 mils; and I would consider that no bow.

Q I am not talking about channels. I am talking about channel sides.

You measured more than one side per channel, and those sides were not necessarily all bowed; is that correct?

A That's correct.

Q Okay. Your second sentence, "Approximately 86 percent of the channel sides had a total deformation, bow plus bulge, of less than .150 inches.

What is the minimum bow that you measured?

A A minimum bow is zero bow.

Q That you measured?

A Zero bow.

MS. MURRAY: Judge Wolf, at this time we have been going for about two hours.

Would you mind taking about a ten-minute break?

JUDGE WOLF: Do you have much more with this witness?

MS. MURRAY: I do have probably about another hour's worth, but some of it will be on the propriatary document.

JUDGE WOLF: We will take a ten-minute break at this time.

MS. MURRAY: Thank you.

(Whereupon a recess was had, after which the taking of the hearing was resumed as follows:)

JUDGE WOLF: Are you ready, Mr. Reporter?

THE REPORTER: Yes, sir.

JUDGE WOLF: Ms. Murray, are you ready?

MS. MURRAY: Yes; yes, I am, Judge Wolf.

JUDGE WOLF: Dr. O'Boyle, are you prepared?

THE WITNESS: Yes.

BY MS. MURRAY:

Q Dr. O'Boyle, one last question on your testimony on Page 9. Were all these measurements made on GE channels?

A Yes.

Q Do all the measurements referred to in your testimony refer to GE channels?

A Yes, they do.

Q Okay. Where will the -- strike that. Are bow and bulge coincident at their maximum?

A No, they are not.

Q Where does the maximum bow occur?

A Maximum bow occurs in about the bottom one third of the channel.

Q Where does --

A In the range of four to six feet from the lower end.

Q Where does the maximum bulge occur?

A Maximum bulge occurs within about one foot of the lower end and it decreases moving toward the top.

Q Why does it occur so close to the lower end?
A Because bulge is driven by the pressure differential across the channel and it's a maximum at the bottom and decreases.
Q Thank you.

Are fuel pins ever stored in the racks?

A Do you mean outside of the fuel assembly?
Q Yes.
A We have, I know, at Zion some fuel pins in storage as individual pins.

I don't know the exact geometry of their storage condition.

Q Do you have any now or will you have any at either the Dresden 2 or Dresden 3 pools?
A I'm not sure.

I believe Mr. Ragan could answer that.

Q On Page 10 of your testimony, you refer to changes, which include heat treatment and fabrication processes.

Could you describe the heat treatment and fabrication processes which you are referring to?

A The description of the details of the fabrication process are highly proprietary to the manufacturer and you might ask that of Mr. Mefford.

I am aware of heat treating processes that GE has introduced to increase the corrosion resistance, and I believe it has the effect of increasing the stability.

The details of those processes I don't have.

Q Do you know by how much bow would be reduced due to these heat treatment and fabrication processes?

A There are no measurements that I can cite, because channels, to the best of my knowledge, have not been irradiated, after these improved processes, to the same exposure that the channels have been irradiated -- the channels about which we are discussing.

Q So you don't actually know if these channels that have been subjected to the new heat treatment and fabrication processes actually will be bowed less after they have been irradiated for the same number of cycles; is that correct?

A I don't know the amount by which they will be bowed less because -- but based on their metallurgical structure and effects of metallurgical structure on growth, I expect them to be bowed less.

Q What is the cost of one fuel rack; do you know?

A No.

MR. STAHL: Excuse me, Judge Wolf. May I ask that the question and answer be read back?

JUDGE WOLF: Yes, you may.

Would you read that question and answer back, please.

(The question and the answer were thereupon read by the Reporter.)

BY MS. MURRAY:

Q I, of course, was referring to the new high- density racks which will be put into the Dresden pools.

I assume that was what your answer referred to?

A Yes.

Q On Page 5 of Mr. Ragan's testimony, the last line of his testimony states, "Edison feels that such periodic mandrel testing is not necessary."

Was that your decision?

A No; but it's one that I agree with.

MS. MURRAY: At this time, Judge Wolf, I would like to discuss some figures in the document which have been labeled proprietary by Commonwealth Edison.

It will be my last series of questions to Dr. O'Boyle, and we should -- I would request that we go in camera.

MR. STAHL: We would join in that request pursuant to our commitment to maintain a proprietary nature of these documents and --

JUDGE WOLF: Mr. Goddard, do you have any --

MR. GODDARD: The staff will join in the request, also.

JUDGE WOLF: Those who are not counsel in this proceeding will be requested to withdraw while this session goes in camera to discuss proprietary information. As soon as that discussion has been concluded, the clerk will

announce it in the hall and you may return.

MR. STAHL: Judge Wolf, there is one additional request that we would make, which we believe is required by the protective order, and that is this portion of the transcript pertaining to the proprietary document be transcribed separately from the main portion.

JUDGE WOLF: Yes, I'm sure the reporter knows that.

That's correct, is it not?

THE REPORTER: Yes, sir.

Would one of you gentlemen open the door so that anyone who is out there who wants to come in may do so.

We're back on the record now.

RECROSS EXAMINATION (Continued)

BY MS. MURRAY:

Q Dr. O'Boyle, if a channel were so badly bowed -- this is all theoretical -- that it would not fit in a storage position, would the channel then be removed from the bundle and the bundle stored in that position without the channel?

A Yes, that certainly is a possibility.

Q What would be done with the fuel channel?

A That is in Mr. Ragan's area.

I would just store it some place in the pool other than in a rack position, but that's his area of expertise.

Q Has Commonwealth Edison come up with any plans, should this occur, where channels don't fit into storage positions?

THE WITNESS: Could you repeat the question?

(The question was thereupon read by the Reporter.)

A I'm not aware of any plans.

Again, that's Mr. Ragan's area and he might know of some that I'm unaware of.

BY MS. MURRAY:

Q Is Commonwealth Edison considering a program by which they would prolong the life of the fuel assemblies in the

reactor?

A Fuel assemblies or channels?

Q The fuel channel assembly. Like there's a fuel channel, the fuel bundle. Together that's the fuel channel assembly.

A We have several programs for extended burnup.

Q In extended burnup, how many cycles of irradiation would a fuel channel assembly be put through?

A The most significant programs for extended burnup are in Zion, where they are no channels.

I assume you are referring to Dresden or Quad Cities?

Q I would be referring to Dresden, yes.

A Right now, we have one assembly that is in the Quad Cities for an extended irradiation period.

(Indicating.)

Q What is that period?

A It is a fifth cycle.

Q Do you plan to institute that program of high burnup fuel at Dresden 2 and 3 reactors?

A No, we have no -- no plans for that right now.

Q Do you anticipate that you might at some time in the life of the channels?

A I would certainly see that as a possibility. There's a general trend toward higher burn up and fuels.

Q If you did go into a program of using higher burnup fuels

at the Dresden 2 and 3 reactors, putting the fuel channel assemblies through four, five, six, however many cycles of irradiation that would account for, would that not be directly at odds with reducing fuel channel bowing?

A No, it wouldn't. It would be advisable, I think, to measure the channels that are on the extended burnup fuel and only use those channels that are below some minimum bow plus bulge, or what might be more prudent is simply to remove the channel.

Since this high burnup assembly or this high burnup bundle would be of no great value, we might simply remove the channel and replace it with a new channel.

Q Where would you store this removed channel?

A In the storage rack in some other position.

MS. MURRAY: I don't believe I have any more questions for Dr. O'Boyle.

JUDGE WOLF: Thank you.

Do you have any questions, Mr. Goddard?

MR. GODDARD: The staff has no questions for Dr. O'Boyle.

JUDGE WOLF: Do you have any redirect, Mr. Stahl?

MR. STAHL: Yes, we have very little redirect.

REDIRECT EXAMINATION

BY MR. STAHL:

Q Dr. O'Boyle, very early in Ms. Murray's questioning of you,

she referred you to Page 3 of your prepared testimony and specifically the figure relating to the outside diameter of the GE channel; and I believe you testified that, taking into account the spacer button and the manufacturing tolerances, that the figure for the outside diameter should be 5.763 inches.

Do you recall that testimony today?

A Yes, I do.

Q Now, can you tell us, Dr. O'Boyle, whether that figure of 5.763 inches, for the outside diameter of the GE channels, affects in any way the validity of the statement contained in Mr. Gilcrest's testimony concerning the minimum clearance of .173 inches between the rack and the channel?

A No, it does not. The 5.763 dimension includes the spacer button, and Mr. Gilcrest's testimony is based on the OD of the channel body itself and the clearance of the -- the clearance between the channel and the rack in the portion of the rack that exhibits the maximum bow; that is, the midsection.

Q Where is the spacer button located with respect to the midsection of the channel?

A It's located on the top of the channel.

Q Dr. O'Boyle, you state, on Page 10 of your prepared testimony, that the largest bow plus bulge measured to date -- I'm sorry. It's Page 9 of your testimony -- the largest

bow plus bulge measured to date has been 420 mils.

Do you see that?

A Yes.

Q Do you anticipate, Dr. O'Boyle, that any channels now in Dresden 2 or 3 or any channels that will be inserted in Dresden 2 or 3 will show bow plus bulge to the extent of the 420 mils or larger?

A No, I do not. The 420 mil max bow plus bulge was, I believe, in the upper end of the statistical tail and their -- that point seemed to stand alone in the distribution of data.

We have also, as I mention in the testimony on Page 10 and 11, instituted measurements that will cull out and eliminate channels with large bow, so that they will not be used in subsequent cycles.

We also are following the GE recommendations with regard to location, and that also will reduce the maximum amount of bow that should occur at any time in the future; so I believe that the 420 mils is, in fact, a maximum that we will see.

Q You also testified, in response to one of Ms. Murray's questions, that Edison does not follow the GE recommendation referred to at the bottom of Page 6 and at the top of Page 7 of your prepared testimony relating to the exposure of BWR fuel channels to 33,000 megawatt days

per standard ton; is that correct?

A Yes, that is.

Q Can you explain for the Board why it is that Edison does not follow that recommendation?

A Yes. As I mentioned earlier, that recommendation is based on calculations of expected deformation, and we follow the intent of that recommendation in that we actually measure the deformations, and the limit that we use is the deformation limit of the channel rather than an exposure limit, the actual measurements of deformation being far more important.

(Indicating.)

Q Dr. O'Boyle, do you have a copy of Exhibit 17 in front of you, Intervenor's Exhibit 17?

These are your handwritten notes.

A Yes, I do.

JUDGE WOLF: The record -- pardon me. The record should show, in connection with the identification of that exhibit, that it's for identification. It's not been received in evidence.

MR. STAHL: Thank you.

BY MR. STAHL:

Q Would you please turn to the page marked at the lower right hand as 1872 of that exhibit. I believe it's the fourth page of the exhibit.

A Uh-huh.
Q Ms. Murray asked you earlier this afternoon about quote "rough estimate" unquote of 11 percent of channels that might stick.

When you prepared this document on or about December 22nd of 1980, did you, in fact, anticipate that 11 percent of the channels would stick in the racks at Dresden?
A No, I did not.

That term sticking I was using very loosely. By that the estimate is the percentage of channels that might have any degree of interference, any degree being larger than zero mils, so sticking is an inappropriate term to use there. Interference would be more appropriate.
Q So is my understanding correct, Dr. O'Boyle, that, with respect to this page of the exhibit, not only is the 11 percent figure a figure that you would no longer stand behind but also the reference to sticking is also one that you did not mean as sticking per se?
A That is correct.
Q Dr. O'Boyle, I'd like to go back to the outer diameter or the outer dimension of the GE channels for a minute; and there was some discussion earlier about a convexity allowance?
A Uh-huh.
Q If you would assume a convexity allowance for the GE

channels, in addition to the 5.763 outer diameter that we've already talked about, 5.454 -- strike that -- a convexity allowance in addition to the 5.454 that we've already discussed in connection with the GE channels, is it your -- what is your opinion as to the implications, if any, that that would have in connection with the possibility of interference between the channel and the high density racks?

A That would add on an additional 25 mils toward the channel rack, so there would be a slightly higher percentage of interference, if that were the case.

Q Would that slightly higher possibility of interference lead you to change any of the conclusions stated in your testimony?

A Not at all.

MR. STAHL: Thank you. We have no further redirect of Dr. O'Boyle.

JUDGE WOLF: Do you have any questions, Ms. Murray?

MS. MURRAY: No, I do not, Judge Wolf.

However, I was amiss. I believed that I had introduced the Exhibit 17 into evidence and perhaps I forgot to. I offered it into evidence with no objections from Applicant.

MR. STAHL: True, I did not object to the

document at the time, but I must say, in light of Dr. O'Boyle's testimony both on direct and in cross examination, redirect, as to the significance of this document, particularly Page 4 of this document, I would have to reconsider my earlier position.

I think this document has no relevance to this proceeding at all. Dr. O'Boyle has testified that, certainly with respect to Page 4, these were preliminary calculations that he is no longer willing to stand behind and they were based on some assumptions that turned out not to be the case.

For that reason, I believe it has no probative value and I think should not be part of the record in this case.

JUDGE WOLF: Mr. Goddard, do you have any questions?

MR. GODDARD: I just have a question or two for Dr. O'Boyle based upon the cross examination by Mr. Stahl.

JUDGE WOLF: Well, let's clear up this matter of the offer that's before us now of this exhibit by the Intervenor; namely, Intervenor's Exhibit 17 for identification.

MR. GODDARD: It is the staff's position that that document would be relevant, but as stated by Mr. Stahl, its weight has been greatly diminished by the live testimony of this witness.

The staff would not join in the objection nor support its admission in this proceeding as well.

JUDGE WOLF: Well, the Exhibit 17 offered by the Intervenor will be received into the record and the weight to be given it will be determined by what the record shows.

Now, Mr. Goddard, would you go ahead with your questions.

RECROSS EXAMINATION

BY MR. GODDARD:

Q Dr. O'Boyle, returning to your rough estimate on Page 4 of this document, at the time that that estimate was made and based on assumptions, were you assuming the fact that I now believe to be the case; namely, that the lead-in clips would be removed from the racks or ground down where appropriate?

A No. That estimate has no relevance to whether or not the lead-in clips are removed or not.

MR. GODDARD: Thank you. No further questions.

MS. MURRAY: I have two more short questions.

RECROSS EXAMINATION (Continued)

BY MS. MURRAY:

Q Referring to what Mr. Stahl was speaking of, the figure of .173 in Mr. Gilcrest's testimony, Page 2, given the addition of the manufacturing tolerances which you referred to early in your testimony, is Mr. Gilcrest's figure of

.173 inches correct?

A I believe, as indicated on Page 2, that that .173 is based on the outer dimensions of the GE channel, and one would have to reduce that by the amount of the difference -- or half of the amount of the difference; that is, by about 25 mils.

Q Reduce what about 25 mils?

A The -- the .173.

Q And the 25 mils which you are referring to is the convexity allowance which you spoke of earlier as being 25 mils; is that correct?

A Yes. The convexity allowance, I believe, is exactly 20 mils.

Q And what's pertinent -- where is the difference between 20 and 25 mils? What tolerances are you referring to?

A The letter that --

MR. STAHL: Excuse me. I think we may be at a point where we're about to discuss some more proprietary information.

Is that -- are you referring to the letter?

THE WITNESS: Yes.

MR. STAHL: I think, if we go on any further with this line of questioning, we will have to, once again, ask --

JUDGE WOLF: Wait a minute.

JUDGE REMICK: I don't think that was a question.

MS. MURRAY: I'm not referring to any proprietary information.

MR. STAHL: Okay.

JUDGE WOLF: So don't you respond in that light.

THE WITNESS: Okay. Could we have the question again.

JUDGE WOLF: You are not using any proprietary data.

THE WITNESS: Okay.

BY MS. MURRAY:

Q Let's start over, Dr. O'Boyle.

I believe that early on in cross examination you added manufacturing tolerances of 16 mils to your figures; is that correct?

A Yes.

Q Does Mr. Gilcrest's figure of .173 reflect that 16 mils or do you know?

A It doesn't reflect 6 of those mils. It might reflect 10 of the 16 mils. Again, I'm not sure.

That question might go to the GE witness.

Q Or to Mr. Gilcrest himself.

Do you know if Mr. Gilcrest's figure of .173 includes an allowance for any convexity?

A That's the same question you just asked, and the answer is we would have to go to the source.

MS. MURRAY: I have no further questions.

JUDGE WOLF: Since there are no further questions, do you have any questions?

JUDGE REMICK: I have one question.

BOARD EXAMINATION

BY JUDGE REMICK:

Q Dr. O'Boyle, on Page 2 of your testimony, the footnote at the bottom, you indicate that the difference between the BWR/3 type and BWR/6 type reactors are not significant for the purposes of this testimony; but could you recite what some of those differences are?

I believe you were referring to fuel assemblies?

A Yes. The BWR/6 channels are thicker; and in referring to my Figure 1, the slight difference in thickness just wouldn't show up in that figure. That is, one could hardly distinguish the difference between an 80 mil channel and a 120 mil channel in looking at that figure.

Q But the dimension -- in what figure? I'm sorry.

A Figure 1.

Q Oh, Figure 1. I'm sorry.

Figure 4 is the actual dimensions for Dresden 2 and 3 units, though; is that correct?

A Yes, it is.

Q Are there any other differences you were alluding to there between BWR/3's and 6's?

A No.

Q On top of Page 3, you refer to a fuel bundle shown in Figure 2 contains 64 rods in an 8x8 array.

Are all 64 rods fuel rods?

A No. There are 2 water rods.

Q All right.

A And that's indicated in Figure 2, the position of those water rods in the array.

Q What's the difference between the one marked water rod and spacer positioning water rod in Figure 2 that you just referred to?

A The spacer positioning water rod is a water rod, but it has tabs welded to the outer diameter at seven locations and these tabs lock the spacers, the grid spacers, into position.

Q I see. Thank you.

You indicated that the outside dimension -- maximum outside dimension of the GE fuel channels was 5.454 plus 16 mils; is that correct. That would be the max?

A No, no. The 5.454 includes the 16 mils.

Q I see. All right.

So the 5.454 is the maximum?

A Yes.

Q What is the min permitted?

A I don't -- I'd have to go back to the GE drawing to see if

a min is indicated.

Just looking at the tolerances on wall thickness and the standard manufacturing tolerance, it would be at least 22 mils less.

Q 22 mils less than what?

A 5.454.

Q So you are saying, then, that the dimension -- the outside dimension -- would be 5.438 plus 16, minus 6; is that how I would interpret that?

A I -- I'm taking 22 mils away from 5.454 and I get 5.432.

Q All right. Oh, the nominal dimension was 5.438; am I correct? Is that the nominal dimension?

A Yes, I believe that's the nominal.

We add to that the 16 to account for the maximum wall thickness, rather than being the nominal 80. It can go up to 83; and so that adds 6 mils because wall and manufacturing tolerance is another 10 mils.

Q So I interpret what you are saying -- and correct me if I'm wrong -- 5.438 nominal plus 16 mils, and I interpret, from what you said earlier, that there's a minus 6 mils, to the best of your knowledge, tolerance?

A The 22 -- the 22 mils that I mentioned before I believe should be 16 less. I added the 3 mils plus 3 mils, the 6 mils, and added it twice here.

Q So am I correct that you now are saying that there is a

tolerance of plus 16 mils minus zero mills?

A The minus side of the tolerance, again I'd have to go to the drawing.

I just haven't given that any effort to look at --

Q All right.

A -- what the minimum might be.

Q All right. That was an effort to clarify the record. I don't think I succeeded

(Laughter.)

BY JUDGE REMICK:

Q On Page 5, you refer to channel side-wall bulging in the second paragraph.

Is that bulge a permanent bulge?

A Yes, the bulge I referred to is permanent. In addition to that, there is an elastic deformation that occurs that's relaxed when you pull the channel out and do the measuring.

Q All right. But the one you are referring to is a permanent?

A Plastic deformation, yes.

Q You indicated that the bottom of the fuel assembly in the storage rack is centered by a cone-shaped nozzle and hole, I believe, but that the top was free.

Am I correct, however, that in Mr. Gilcrest's determination of .173 mils, he assumed that the top acted as if it was restrained so that you had a clearance of only

.173?

A He assumed it was centered in the top.

Q Centered, yes.

A And that's different than restrained.

I think his basic assumption, it's centered.

Q All right. So is that a conservative assumption?

A Yes, it is.

Q And in actuality, you would have greater clearance than that?

A Yes. If that -- if it leans slightly, you would have greater clearance.

Q You referred to channels being measured at Oyster Creek in 1977.

Were those GE fuel channels?

A Yes, they were.

Q Do you have any idea of the force that would be required to restore a bulge in contrast to a force to restore a bow? Would they be the same, less or greater?

A I would expect it to be considerably greater.

Q To restore a bulge?

A Yes.

Q You also indicated, in response to a question from Ms. Murray, that -- you said something to the effect that under no normal circumstance would fuel channels -- would a fuel

channel remain in a peripheral location in Dresden 2 or 3?

A Uh-huh.

Q Would you explain why that statement is true?

A Because the fuel is normally repositioned within the core from cycle to cycle to obtain the maximum energy output; and one might initially put the assembly in the periphery to flatten the core power and then move the fuel in during the later cycles so the fuel is moved around from cycle to cycle.

(Indicating.)

Q Well, when you say, "Under no circumstance," is there a procedure that prevents you from allowing it in a peripheral location if somebody determined that it should be there?

A I'm not aware of any procedure that would prevent you from leaving it in one position from cycle to cycle, other than the neutron economy being less.

Q Didn't you also state that it might be Quad Cities -- I presume it was -- that at least one of the fuel assemblies was left in that peripheral location for four cycles?

A Yes, there was one; and that was part of an experiment and that was done intentionally, very intentionally.

(Indicating.)

Q Well, interpreting when you mean by under no normal circumstances, it is just that as a result of fuel being

shuffled, that you would not expect it to occur?

A That's right.

Q You were also talking about twist.

How do you define twist of 30 mils?

A The channel measurement is made using sets of LVDT's, lineal variable differential transformers, and they move along a plane that is defined by their relationship with the channel measuring system, so that sets up an absolute plane.

The twist is measured by comparing the output from the LVDT's. If we assume that there are three along a side and call them A, B and C, the difference is computed between the A and C LVDT's at all locations that are measured, and these measurements are made at about one-foot intervals, so along the entire thirteen-and-a-half foot length these measurements are made, and one looks at the difference in LVDT position between the A and the C LVDT at all of these locations and looks at the maximum difference.

(Indicating.)

Q All right. I'm not sure that helps me, though.

Let's take a channel in a rack --

A Uh-huh.

Q -- where one would apparently normally expect 173 mil clearance.

A Uh-huh.

Q Would I normally require a twist of 173 mils before I'd have interference? Does it go roughly one for one?

A Yes; assuming there were no, you know, bow, you would have to have about 173 mils of twist, yes.

(Indicating.)

Q Of twist to --

A Yes.

Q -- to begin to have interference?

A Yes.

Q All right. Now, you also said that there was a twist of plus and minus 30 mils.

What does a minus twist mean? In the opposite direction?

A Opposite direction, yes.

The data are plotted out as plus or minus around a zero plane.

(Indicating.)

Q Clockwise or counterclockwise?

A Yes.

Q Are you familiar with Dr. Draley's testimony, which was presented earlier as part of this proceeding, on corrosion?

A Yes, I am.

Q If I recall, Dr. Draley spoke about a worst-case situation which, if the boron carbide were to form a hydrated oxide -- if all of the boron carbide, I think, were to form a

hydrated oxide, and he made some estimates of how much swelling might occur in the side of the storage tube, was that possibility in any way factored into -- do you know, in Mr. Gilcrest's clearance of .173 that he calculated?

A I believe there was no tolerance taken into account for swelling. That is, an assumption was zero based on Draley's testimony, indicating that that swelling is highly unlikely.

Q Do you remember what his estimate of maximum amount of swelling would be under those assumed circumstances?

A Yes, I have his testimony here; and my corrected version of that on Page 7 indicates that the maximum swelling would be 180 mils.

Q And, if I recall, he testified at the earlier part of the hearing that it was reasonable to assume that swelling would be in one direction -- inward -- in the storage tube?

A Yes, I believe -- I believe he did.

Q I think that was because it was a difference in thickness of the stainless steel on the inside?

A (Indicating.)

Q If one did have a swelling of the 180 mils, would that add a potential 180 mils further interference?

A Yes, that would.

Q And I assume that the force calculations would be something Mr. Gilcrest will testify to, then; is that correct?

A The force testimony?
Q The force -- excuse me. The force necessary to overcome that interference is the appropriate question for Mr. Gilcrest rather than you?
A I would believe so.
Q You also indicated earlier that -- you were talking about amount of bow and you indicated that 20 mils or 30 mils, something like that, was expected, and you will not consider that significant.

The as-received new channels -- what tolerance is permitted for bow in an as-received unirradiated channel?
A The current specification, I believe, is plus 20 minus 70 mils, where the minus 70 is away from the control blade.
Q So you are saying if you detected bowing of 20 mils, you would not know whether that was initially in the -- in the channel or whether it was due to irradiation?
A That is correct.
Q All right.
A I would say -- I would expand that and say that if we detected bowing of 70 mils, we wouldn't know whether that was as-manufactured tolerance or irradiation-induced bow.
Q Because -- is that because when you make the measurements on the irradiated channels you don't distinguish plus or minus in the same way you did just on the as-received, unirradiated?

A No. That's because the initial channel as-received could have had 70 mils of bow, and if we measure 70 mils, it could have been the as-fabricated channel.

In fact, the channels that we have measured, the -- I'm quite sure there was no specification on the bow, whether it be toward or away from the blade, again recalling these were fabricated over 10 years ago, and I believe the tolerance at that time was plus or minus 70 mils, so the 70 mils could have been in either direction, so we can't distinguish.

Q All right. So when you just testified that the tolerance was plus 20 minus 70, what were you referring to?

A I believe that's the current specification on channels manufactured more recently than 1970 or 1969.

Q All right. I think in the record today we have references to cycles and then we have also reference to megawatt days per standard ton.

Is there any rule of thumb one can utilize in converting from one to the other in the record today?

A Yes. A rule of thumb would be 4 cycles corresponds to about 30 megawatt days per standard ton.

Q All right. In response to a question from Ms. Murray, you -- I think she asked the question -- that is, you removed a channel presumably because it was bowed beyond certain limits. She asked what you would do with it and I think

you indicated that, although that was in Mr. Ragan's area, that you thought they would put it in a rack, a storage rack; am I correct?

A No. My answer was put it alongside of the rack.

Q Alongside. I see.

So you would not insert it?

A I thought the question was if you can't insert it into position, what would you do with it? I assumed by that the question meant insert it in any position.

If the question means if you put it -- a channel assembly into a specific hole and it didn't go in, I think what you do is just move it to the hole next door, and the probability is greater that it would go in there.

(Indicating.)

Q But I thought that you were -- or at least the question that was asked you was recited, if you removed the channel -- I think twice she asked you -- what would you do with the channel that you removed and what was your answer?

Perhaps I misunderstood your answer. Talking about just the removed channel now, not the assembly.

A The basis for that removed channel that I understood was that it would not fit into any storage rack position and that's the basis on which I answered, and my answer was that that is in Mr. Ragan's area, but I would assume you would just take that channel and put it in one of the

spaces outside -- in the pool but in one of the spaces outside of the storage positions.

JUDGE REMICK: Thank you.

That's all the questions.

JUDGE WOLF: Do you have any questions?

MS. LITTLE: No.

MR. STAHL: Excuse me, Judge Wolf. We do have one question that came up in connection with Dr. Remick's examination of Dr. O'Boyle.

REDIRECT EXAMINATION (Continued)

BY MR. STAHL:

Q Dr. O'Boyle, can you please refer to your prepared direct testimony, Page 2, Footnote No. 1, please.

There's a statement in there concerning the similarities between BWR/3 and BWR/6.

Is there any difference in length between the channels in BWR/3 reactors and BWR/6?

A Yes, there is. The BWR/6 channels are longer.

Q How much longer?

A I believe they are four inches longer.

Q Four inches.

MR. STAHL: Thank you. We have no further questions.

JUDGE WOLF: Very well.

MS. MURRAY: Judge, I have two very short

questions.

JUDGE WOLF: Yes.

RECROSS EXAMINATION (Continued)

BY MS. MURRAY:

Q Dr. O'Boyle, do you use BWR/6 fuel assemblies in the BWR/3 reactors?

A No, we do not.

Q Okay. And last, but not least, if you had 60 mils of twist, how much bow plus bulge would you need for interference in --

A With what?

Q -- with respect to the .173 which Mr. Gilcrest refers to in his testimony?

A The analysis that we -- that I asked Mr. Armstrong to do, to the best of my recollection, was to assume a twist of 50 mils for a channel that had the maximum bow plus bulge and I asked him to look at what that would do as far as movement toward the rack, and the ratio of movement toward the rack to twist was a factor of about 10 to 1, so the 50 mils of twist resulted in 10 mils.

I haven't done the specific analysis you've asked, but I would expect that the 62 mils would move it perhaps slightly more than 6 mils toward the rack; again 10 to 1 ratio.

Q Yes. You said a 10 to 1 ratio and 50 mils of twist moved

it 10 mils?

A No; 5 mils.

Q And the maximum bulge to bow you considered there was 420 mils?

A Yes, I believe it was.

MS. MURRAY: Okay. I have no further questions.

JUDGE WOLF: You may be excused, Dr. O'Boyle.

(Witness excused.)

MR. STEPTOE: Mr. Chairman, at this time, of course, we are prepared to put on any witness at the convenience of the Board. However, Dr. Wong does have a plane to catch and I don't think his testimony is very long.

I was wondering if it would be convenient to place him -- go out of order and place Dr. Wong on for the limited purpose of talking about the criticality -- the supplemental criticality analysis which was done with respect to the proposed Exxon fuel?

JUDGE WOLF: You may do that. Call him to the stand.

MR. STEPTOE: Well, the witness has already been sworn.

JUDGE WOLF: You were sworn previously and you are still under oath for this proceeding.

KIN W. WONG

called as a witness by the Applicant, having been previously duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. STEPTOE:

Q Dr. Wong, would you please state your full name for the record?

A My full name is Kin, K-i-n, W. Wong, W-o-n-g.

Q By whom are you employed and in what capacity?

A I'm employed by Quadrex Corporation as nuclear engineer in the reactor engineering department.

Q Are you familiar with an affidavit of Kin W. Wong, which is dated the 21st day of January, 1981?

A Yeah. I wrote that affidavit.

Q Okay. Is it true and correct to the best of your knowledge and belief?

A Yes.

Q Do you have any changes that you would like to make?

A No.

Q You accept responsibility for it?

A Yes.

MR. STEPTOE: Chief Judge Wolf, at this time we move for the introduction of the affidavit of Kin W. Wong into evidence.

We hope that it will be received into evidence as if read.

JUDGE WOLF: Does everyone have a copy of the offered -- material that's being offered?

Mr. Goddard, do you have any objections?

MR. GODDARD: No objections from the staff.

JUDGE WOLF: Ms. Murray?

MS. MURRAY: No objections.

JUDGE WOLF: What exhibit will this be?

MR. STEPTOE: Well, we could introduce this as Commonwealth Edison Exhibit No. 3, if that's appropriate.

JUDGE WOLF: Without objection, the affidavit of Kin W. Wong and the attachment thereto will be received in the record.

(The document referred to follows:)

MR. STEPTOE: Thank you Chief Judge Wolf.

We have no further questions by way of direct and we tender the witness for cross examination with respect to this affidavit.

JUDGE WOLF: Ms. Murray, are you prepared to cross-examine this witness?

MS. MURRAY: Yes, Judge Wolf, I am. We have very few questions for Mr. Wong.

JUDGE WOLF: Two?

MS. MURRAY: A few.

CROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Wong, what affect does the bowing of the fuel channel have on K effective?

A We have not done a criticality analysis specifically for the bowing of a channel, but we have done analysis on the movement of the fuel in the storage tubes, which -- which is -- which appears in the licensing report, Page 3-16, that's Condition 2; and I think we can use that to estimate the effect of the fuel bowing on the K effective values; and based on those values, in my judgment, the criticality effect will be negligible.

Q Okay. What size fuel channel did you use when doing your criticality analysis? What was the outer dimension of the fuel channel?

A The dimension of the fuel channel appears in Figure 3.3-1 and the zircaloy channel is identified as Region 3, so it will be 6.56082 plus .14224 plus .2030 multiplied by 2. That will be the outside dimension of the channel.

MR. STEPTOE: Objection for the record, Chief Judge Wolf. We tendered this witness for cross examination with respect to an affidavit concerning Exxon fuel and we brought him back here because we were requested by Intervenor to do so. This cross examination is clearly beyond the scope of what the witness was tendered for.

JUDGE WOLF: Ms. Murray?

MS. MURRAY: Yes, Judge Wolf, I do believe that Commonwealth Edison will be using Car-Tech channels with the Exxon fuel, and it is my question that what effect would a larger channel have on the K effective.

JUDGE WOLF: Mr. Steptoe?

MR. STEPTOE: Because this is -- the NRC staff should speak to this, but the Exxon fuel has not yet been approved for use in the Dresden reactor, and certainly one of the things that will have to be done before it's approved is a criticality analysis to be done.

We, perhaps, out of an excess of caution, knowing that it was something that the Board expressed some interest in at the November hearings, offered this affidavit to keep the Board informed of our purchase of

Exxon fuel, but it seems to me that we're really going beyond what we need to to accomplish for licensing the proposed spent fuel rods.

JUDGE WOLF: Well, Ms. Murray, I think you ought to strive to keep it as close to the affidavit as you can. We'll give you some leeway, if you feel it's needed, but we do want to move on; and if you will pose the next question or restate the one that has been objected to.

MS. MURRAY: Thank you, Judge Wolf.

BY MS. MURRAY:

Q Paragraph 3 on the first full page of your affidavit says that the NRC staff interpretation of the acceptance criteria is that it is not necessary to include both Condition 4 and Condition 5 at the same time.

Do you know why this is so?

A Well, I -- I talked to the NRC staff and asked for the interpretation or how should -- for analysis, how should Condition 4 and Condition 5 be combined and their reply is we only need to consider one accident situation at a time; and if we look at the -- those two conditions, Condition 4 is when extra fuel assembly -- one extra fuel assembly at the side of the rack and Condition 5 is all racks in contact with each other; and it's very unlikely that those two conditions can happen at the same time.

Q In your opinion, is it necessary to consider both Condition

4 and Condition 5 in this criticality analysis?

A No.

Q Was this criticality analysis done considering the size of the Car-Tech channels or the GE channels?

A I don't know what's the size of Car-Tech channel.

It was based on the dimensions we had before.

Q Which are the GE channels?

A Yeah.

Q Does size of channel make a difference in the value of K effective?

A In my judgment, it will be negligible.

Q If you look at your figure, on the first page, of .94957, that is 43 ten-thousandths away from being .95.

Is that, in your opinion, a negligible amount?

A Yes.

Q So is it possible, then, increasing the size of the channel could increase it to .95?

A Possible.

MS. MURRAY: I don't have any further questions.

JUDGE WOLF: Thank you.

Mr. Goddard, do you care to cross-examine this witness?

MR. GODDARD: Before -- I don't know, sir.

Before doing so, I'd like a short recess of 5 to 10 minutes.

JUDGE WOLF: 10 minutes.

MR. GODDARD: Thank you, sir.

(Whereupon a recess was had, after which the hearing was resumed as follows:)

JUDGE WOLF: Mr. Goddard, are you ready?

MR. GODDARD: Yes, sir.

The staff has no questions for Dr. Wong.

We would point out that the NRC staff will, independently of this proceeding, be performing a criticality analysis for Exxon fuel in these racks before the use of such were approved.

JUDGE WOLF: What is the last statement you made?

MR. GODDARD: Before the utilization of the Exxon fuel in these units was approved.

JUDGE WOLF: Well, now, in that connection, are there public hearings?

MR. GODDARD: The decision of the applicant to use Exxon fuel will be noticed.

MR. STEPTOE: Chief Judge Wolf, I am not sure whether the staff has made a determination as to whether the use of Exxon fuel represents a significant hazards consideration. Either way, it's going -- it will require license amendments which would be noticed up, but I simply don't know whether it will be prenoticed at this time.

Adding another layer of the confusion is the decision in the Sholly case, so --

MS. LITTLE: Sholly.

JUDGE WOLF: I don't understand your use of the word "prenoticed."

MR. STEPTOE: Prenoticed?

JUDGE WOLF: Yes.

MR. STEPTOE: My understanding of the regulations is that a license amendment which is considered by the staff to involve a significant hazards consideration is noticed up 30 days in advance of the issuance of that notice so the people have plenty of time to intervene.

JUDGE WOLF: Right.

MR. STEPTOE: License amendments which are regarded as presenting no significant hazards have traditionally been post-noticed, which means that the NRC staff issues the license and then -- and then notices it up in the Federal Register and there is a right to a hearing at that time. However, the hearing does not stay the effectiveness of the license amendment.

The United States Court of Appeals for the District of Columbia in the case of Steven Sholly versus United States Nuclear Regulatory Commission has thrown these traditional rules into question. That case is pending on cert before the Supreme Court.

I think, to summarize, there clearly will be a right to a hearing with respect to the use of Exxon fuel in the Dresden reactor.

The question which I am not able to answer at this time is whether that hearing will be prior to the use of Exxon fuel.

JUDGE WOLF: Are there any further questions -- pardon me. Do you have any questions?

JUDGE REMICK: Yes.

JUDGE WOLF: Any further questions?

MS. MURRAY: I have none.

JUDGE WOLF: Doctor Remwick has some questions.

BOARD EXAMINATION

BY JUDGE REMICK:

Q Dr. Wong, I guess it's on Page 1 of your testimony, the first page, the first major paragraph where you give values of K effective.

Are those calculations conducted with the channels in place or just the fuel bundles?

A It's conducted with the channels in place.

Q All right. If I refer to the enclosure that you included with your testimony -- it's the long enclosure, and I guess the page number is missing, but I guess it would be page -- oh, I'm not sure. It's -- I guess it's III-1 -- III-1 under the major heading III, "Nuclear and Thermal-Hydraulic

Considerations."

Do you find it?

A Yeah.

Q The paragraph that's numbered 1.1a says that the racks shall be designed to contain the most reactive fuel authorized to be stored in the facility without any control rods or any noncontained burnable poison and the fuel shall be assumed to be at the most reactive point in its life.

Do your calculations comply with that, the calculations on K effective that I just referred to?

A Our calculation used the fresh fuel --

Q Is that --

A -- and -- and it assumes no control rod and no noncontained burnable poison.

Q I'm sorry. What?

A No noncontained burnable poison.

Q Does it assume gadolinia present?

A No, it doesn't.

Q No gadolinia?

A Right.

Q Is that the most reactive condition for the fuel, then --

A Well --

Q -- or most reactive point in its life is what the -- perhaps I should refer to?

A If you have gadolinium, it will be less reactive.

Q When; at the beginning of life?
A Yeah; but we didn't have gadolinia.
Q Well, the question I'm asking -- it says you should perform these calculations at the most reactive point in its life and you indicated that you assumed it with new fuel at the beginning of life?
A Uh-huh, yeah.
Q Is that the most reactive point in the life of that fuel?
A Yeah.
Q All right. Is that the case if there is -- if you do assume gadolinia is the most reactive point?
A Then it is not --
Q Right.
A -- because the gadolinium will be burned and will be more reactive.
Q You actually get an increase --
A Right.
Q -- with burnup; am I correct?
A That's correct.
Q But you used no gadolinium?
A That's correct.
Q I believe you indicated -- did you personally have a conversation with the member of NRC staff about the interpretation of acceptance criteria?
A Yes.

Q And to whom did you speak?
A I speak to a Mr. Walter Brooks at the NRC.
Q I'm sorry?
A Mr. Walter Brooks.
Q And what is his position; do you know?
A I -- I don't know.
Q All right. Now, I notice in your testimony you talk about Condition 4 and Condition 5, but in answering a question from Ms. Murray, you said that the reason that apparently Mr. Brooks told you you didn't have to consider Condition 4 and Condition 5 is something about accidents?
A That's correct.
Q And yet you called these conditions.

In the licensing report, they're referred to as conditions, not accidents, and that causes me a little bit of confusion. In fact, I might say a little bit more than a little bit of confusion.

Because if I refer you to -- once again, to the enclosure -- and the numbers are missing again -- I think it's -- it must be III-3. Do you have that?
A Yeah.
Q The paragraph that's 1.5, "Acceptance Criteria for Criticality," says, "The neutron multiplication factor in spent fuel pools shall be less than or equal to 0.95 including all uncertainties, under all conditions."

A The Condition 4 and Condition 5 actually should be called accidents rather than conditions. It's fuel dropping in -- into fuel pool and that's -- that actually should be an accident situation.

Q I wish you would elaborate a little bit on that, because I was confused as to why you selected to have a fuel assembly at the side when the -- they do in here somewhere define the accidents and they talk about a fuel assembly dropping on top?

A Because when we did the analysis, the dropping by the side is the most severe case than dropping at the top of the sampling, so that's why we -- we used it as an accident situation.

Q So a fuel assembly at the side of the racks is considered a postulated accident?

A That's correct.

Q And that is -- that is what you have called Condition No. 4; am I correct?

A Yeah.

Q How about Condition 5, then?

A I think that's a situation where all the fuel racks all slide together; and I think, according to NRC interpretation, that's postulated accident situation, too.

Q I somehow got the impression that that was a case where it -- just through fabrication and installation of racks, that

they were put in that condition.

A No. That's when something happens which cause all the fuel racks to slide together.

(Indicating.)

Q Is that described in the licensing report anywhere?

A Well, it's not described very clearly. It just says all racks in contact with each other.

Q And your testimony is that the only way that they could be in contact with one each is under some kind of an accident?

A That's correct.

Q What kind of an accident would cause them to do that?

A Maybe -- right now, the only thing I can think of will be maybe a seismic event.

Q Now, to lead to my confusion, on Page 3-14 of the licensing report you indicated that the dropping of a fuel assembly along the side of the fuel racks was, in my words, a postulated accident, and I selected those words out of the enclosure, but here under Paragraph 3.3.4 in the licensing report on Page 3-14, there's a definition of abnormal storage and handling. It doesn't call it an accident.

A Yes. This analysis was done before the issue of the -- the NRC guidance, so it's -- it doesn't -- it doesn't follow the terminology used in the NRC guidelines --

Q All right. Then it's your --

A -- but if you look at the NRC guidance, they have abnormal

storage and then postulated accidents --

Q Yes.

A -- and then postulated accidents.

Actually, we look at the content. Refers to our abnormal condition of dropping of a fuel assembly.

Q I'm sorry. I couldn't understand. What were the last few words?

A Well, if you look at the NRC guidance, you have abnormal storage.

Q Could you refer me specifically to a page?

A It's 3-2 page.

Q All right.

A Have abnormal storage and then postulated accidents and the --

Q Excuse me. On 3-2?

A 3-1.

Q 3-1?

A 1.1 is abnormal storage --

Q Yes.

A -- and then postulated accidents.

Q Yes.

A And that postulated accidents actually corresponds to our abormal conditions.

Q Now, if you look in just what you referred to under postulated accidents, the second paragraph you are talking about accidents, but you say realistic initial conditions,

so when I saw in your testimony Condition 4 and Condition 5, I thought you were talking about quote conditions end quote following the staff guidance here and that they were not postulated accidents, they were conditions.

But am I correct in understanding that in your testimony what you are calling Condition 4 and Condition 5 you are now saying are postulated accidents?

A That's correct.

Q And it's the staff's position that you need only one simultaneous accident --

A That's correct.

Q -- to meet the -- and still meet the criteria of .95 or less?

A Right.

Q May we refer to Page 3-16 of the licensing report, please.

Do you have that page?

A Yes.

Q There are a list of conditions there, 1 through 5.

How many of those would you call postulated accidents now according to the staff definition in contrast to conditions as you have them indicated in the licensing report?

A It will be 4 and 5.

Q Just 4 and 5?

A That's right.

JUDGE REMICK: Thank you. That's all the questions.

JUDGE WOLF: Okay, very well. Do you have any questions?

MS. MURRAY: One, yes.

RECROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Wong, I misunderstood what your Condition 4 stood for, the fuel assembly at the side of the racks.

Now, in his testimony, Dr. O'Boyle referred to the possibility of badly bowed fuel channels being stored in the pool at the side of the racks.

What affect would this have on K effective?

A Well, if you have one -- one fuel channel at the side of the rack in the whole pool, the effect will be very small.

(Indicating.)

Q Could you quantify very small for me?

A I -- I haven't done the analysis.

(Indicating.)

Q So you don't know what affect on K effective fuel channels stored at the side of the pool would have; is that correct?

A Your situation will be one fuel assembly outside?

Q No, not a fuel assembly.

Dr. O'Boyle stated essentially that if a fuel channel became so badly bowed that it could not be inserted into a

storage position, they might put it at the side of the racks.

Now, would that increase K effective if the position was subsequently filled up by another fuel channel assembly?

A If you add another fuel by the side of the rack, yeah.

Q Okay. Did your calculations assume a fuel pin and a fuel assembly stored in the same position?

A I don't understand your question.

Q Well, Dr. O'Boyle stated that at Zion there was an instance of a fuel pin being stored in the storage position, and this might be a possibility in the Dresden 2 and 3 pools.

Would that increase K effective?

A We -- we assume that the -- that all the fuels are in position -- all the fuel assembly are in the rack in our analysis.

(Indicating.)

Q No additional pin in a storage position?

A It's already filled.

Q What about an accident condition; a pin plus a fuel assembly in the same storage position? Did you consider it?

A You are talking about two fuel assembly in one storage location?

Q I believe the fuel pin and an assembly are two different

things.

A Well, you are talking about one fuel pin?

Q Uh-huh.

A No, we haven't considered that.

Q Would it increase K effective if you did consider it?

A If you have one fuel pin drop into one storage location, yes, it will.

MS. MURRAY: I have no further questions.

MR. STEPTOE: May I conduct some redirect, Chief Judge Wolf?

JUDGE WOLF: Well, I think that Mr. Goddard would --

MR. GODDARD: No, we have no questions based upon this cross examination.

JUDGE WOLF: Yes, you may.

REDIRECT EXAMINATION

BY MR. STEPTOE:

Q I believe in response -- excuse me.

In response to Ms. Murray, I believe you stated that the use of Car-Tech channels with Exxon fuel, any difference in the channel involved in that combination might possible increase K effective greater than .95.

Do you recall saying that?

A Yes.

Q Have you done that analysis?

A No.

Q Do you know whether the NRC staff, in their analysis of Exxon fuel, will consider the criticality effect of storing fuel assemblies in the Dresden spent fuel pools, including proposed Dresden racks, assuming those have been approved by the licensing board?

A Can you repeat the question?

Q Do you know whether the NRC staff routinely considers criticality considerations affecting spent fuel pool when it is asked to authorize the use of new fuel such as Exxon fuel?

A I understand the additional criticality analysis will have to be performed at that time.

Q And if that additional criticality analysis does not meet the NRC's criteria contained in your Attachment C, the Branch technical position, do you know what the result will be?

A The result will be it will not be approved.

Q The what will not be approved? I couldn't hear you.

A The -- the -- the installation of new fuel will not be approved.

MS. LITTLE: Just a moment, Mr. Wong. We're all trying to hear you, not just Mr. Steptoe.

BY MR. STEPTOE:

Q Turning to Attachment C again, to the section that you and Dr. Remick were talking about concerning postulated

accidents, it's III, Section 1.2.

Do you have that in front of you?

A Yes.

Q Beginning with the last word on the bottom of that page, Page III-1, continuing on to the rest of the paragraph, there is a sentence beginning, "The postulated accidents shall include," is there not?

A Yes.

Q Referring to the No. 1 in parentheses, one of those postulated accidents is dropping of a fuel element on top of the racks and any other achievable abnormal location of a fuel assembly in the pool; is that not correct?

A That's correct.

Q Is your Condition 4 an achievable abnormal location of a fuel assembly in the pool?

A Yes.

Q Going back to the No. 3 in parentheses, it states that a postulated accident should include the effect of tornado or earthquake on the deformation and relative position of the fuel racks, now, does it not?

A Yes.

Q Does that language correspond to Condition 5 in your analysis?

A Yes.

Q Do you have an opinion, therefore, whether Conditions 4 and

5 are accidents within the meaning of this Branch technical position?

A Yes, I think they are accidents.

Q Now, you were asked by Ms. Murray what would be the effect on criticality -- K effective of storing the channel at the side of the rack.

Do you recall that question?

A Yes.

Q And I believe your answer was that you had not analyzed that; is that correct?

A That's correct.

Q Putting aside the need for mathmatical exactness, which I understand, if you learned that a channel, without a fuel assembly inside -- simply a channel were stored in the Dresden pool following installation of these proposed racks, would you have concern for the safety of anybody at the plant?

A Oh, when answering the question, my understanding was there was fuel in the channel.

Q Okay.

A If there is no fuel in the channel, then there won't be an effect on the criticality.

Q If there is fuel in the channel, does that correspond to Condition 4?

A Yes.

Q And you have analyzed that, have you not?
A Yes
Q If there is simply an empty channel stored at the periphery of the pool outside the racks, do you have an opinion concerning whether the value of K effective would be less than or greater than .95?
A It would be less than .95.
Q Now, you were also asked about the possibility of storing a single pin plus a fuel assembly in a single storage location.

Do you recall that question?

A Yes.
Q Do you have an opinion -- putting aside, again, the mathematical exactness which you have to live by, would you have an opinion as to the danger of storing a single pin along with a fuel assembly in a storage location in the proposed Dresden racks?
A Can you repeat your question?
Q If you learned that a storage position in the Dresden -- proposed Dresden racks contained not only a fuel assembly similar to those that you have analyzed, but, in addition, a single pin, do you have an opinion whether K effective equal to 1.0 would be exceeded in the pool?
A My opinion will be it will not be exceeded.
Q Why is that?

A Because the reactivity-worth of the single fuel pin is very small compared with the whole rack --

Q If you learned --

A -- and .95 is very far away from 1.0, and it's impossible for one single fuel pin to have a reactivity-worth of .05.

Q If you learned that a single pin was stored in a storage location -- just a single pin without a fuel assembly -- do you have an opinion as to what that would do to K effective compared with the analysis which you've done in that affidavit?

A That will reduce the K effective.

Q Why is that?

A Because you have only one single fuel pin compared with fuel assembly, which consists of 7x7 or 8x8 fuel pins.

Q Is the reactivity-worth of a single pin greater or less than that of a fuel assembly?

A It will be less than a fuel assembly.

Q In conclusion, Dr. Wong, do you have an opinion concerning the safety of the proposed racks using Exxon fuel?

A My judgment will be it will be safe.

Q Do the calculations which you have described in this testimony support or detract from that judgment?

A It all supports the judgment.

Q They what?

A It all supports the judgment.

Q One further question.

If you took either Condition 4 or Condition 5 in your testimony and you replaced either one of those conditions with the accident which Ms. Murray has suggested -- that is, a single pin stored along with a fuel assembly in a storage location -- would that increase or decrease the value of K effective shown in your affidavit?

A In my judgment, it will decrease the K effective.

Q Why is that?

Well, let us me ask this: Do some accidents have greater reactivity-worth than others?

A Yes.

Q Does the accident described by Ms. Murray, a fuel assembly and a single pin in a storage location, have greater or less reactivity-worth than the accidents which are -- which you refer to as Condition 4 and Condition 5?

A I think that accident situation of having one fuel pin drop into a fuel assembly will have less reactivity-worth compared with Condition 4 and Condition 5 mentioned in the affidavit.

Q Than either one of them?

A Yes.

MR. STEPTOE: I have no further questions.

JUDGE WOLF: Anyone have any further questions? Do you, Ms. Murray?

MS. MURRAY: No.

JUDGE WOLF: You may be excused. Thank you, Dr. Wong.

(Witness excused.)

MR. STEPTOE: Chief Judge Wolf, our next witness is Mr. Mefford of General Electric.

May we call him now?

JUDGE WOLF: Let's call him now, but I think that in order to provide for a supper hour, that we'll break in, well, 15 minutes and adjourn for an hour and 15 minutes, but at least we can take care of the preliminaries.

MR. STEPTOE: Certainly. May we ask that Mr. Mefford be sworn.

JUDGE WOLF: Yes. Will you raise your right hand, please.

(The witness was thereupon duly sworn.)

JUDGE WOLF: You may be seated.

CARL R. MEFFORD

called as a witness by the Applicant, having been first duly sworn, was examined and testified as folllows:

DIRECT EXAMINATION

BY MR. STEPTOE:

Q Mr. Mefford, would you please state your full name for the record?

A Yes. My name is Carl R. Mefford.
Q By whom are you employed and in what capacity?
A I'm employed by the General Electric Company. I'm principal engineer in the fuel mechanical design area.
Q Mr. Mefford, you are going to have to speak up considerably so that everyone can hear you.

Mr. Mefford, are you familiar with the affidavit dated January 29, 1981, which has been filed on your behalf in this proceeding?

A Yes, I am.
Q Do you have any changes or corrections that you would like to make at this time?
A No, I do not.
Q Is this affidavit true and correct to the best of your knowledge and belief?
A Yes, it is.
Q Do you accept responsibility for it?
A Yes, I do.

MR. STEPTOE: Chief Judge Wolf, at this time we request that the affidavit of Carl R. Mefford be incorporated into the record as if read.

JUDGE WOLF: Are there any objections?

MR. GODDARD: None from the staff, sir.

JUDGE WOLF: Any objections?

MS. MURRAY: None from the Intervenor.

JUDGE WOLF: Without objection, the affidavit of Carl R. Mefford will be bound in the record as if read.

(The document referred to follows:)

MR. STEPTOE: I have nothing further by way of direct, Chief Judge Wolf, and I tender this witness to cross examination with respect to the subject matter of his testimony.

JUDGE WOLF: Would you begin the cross examination, Ms. Murray.

MS. MURRAY: I certainly will.

CROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Mefford, you have a bachelor of science degree in electrical engineering; is that correct?

A That is correct.

Q And you have taken what is called the A Course from General Electric; is that correct?

A That is correct.

Q Can you please describe just what the A Course is?

A The A Course is an advanced technical course that General Electric provides for engineering graduate students -- I'm sorry. Not graduate students, but -- but their new engineers.

Q How long does the A Course take?

A One year.

Q And there's also a B and C Course, aren't there?

A Yes, this is.

Q You did not take either the B or C Course; is that correct?

A No, I did not.

Q Is there any particular reason why you didn't take either one of these courses?

A No.

Q What do the B and C Courses cover?

A The B and C Courses cover the same thing, just to a larger extent.

Q You say that your unit, the fuel assembly design unit, is responsible for mechanical design of fuel bundles, channels and channel fasteners.

What exactly do you mean by mechanical design?

A Basically, we do the stress analysis for the fuel, set the dimensions.

Q Do you decide on what type of material will be used?

A In conjunction with materials engineering.

Q Do you work with any other departments in mechanical design of the fuel?

A Well, yes. We work with -- with all other kinds of organizations.

In General Electric, a department is a very large organization. It's -- you know, it's hundreds of people; and so I interface probably only with -- well, with maybe two or three departments, but that could be, you know, a dozen different organizations.

(Indicating.)

Q So when you say you set the dimensions, you design the size

of the fuel channel and bundle?

A Yes, in conjunction with, say, the input from nuclear engineering and the input from the thermal-hydraulics people.

Q And --

A These dimensions are jointly arrived at.

Q That is, your unit, in conjunction with these other units, are responsible for the design of the fuel channels that are now bowing in the Dresden 2 and 3 reactors; is that correct?

A That's correct.

Q Is your unit also responsible for designing the -- designing fuel channels that would bow less?

A We are responsible for designing channels at this very time, yes.

Q As I understand it, there are no heat treatment and fabrication processes that you are using so that the fuel channels will bow less; is that correct?

A To my knowledge, at this time I cannot specifically state that if a channel was located on the core periphery under the same differential fluence, that the current channels would bow less.

Q Is there any way to design the fuel channels, either in their dimensions or their structure or their materials, that would cause them to bow less?

A If you had a channel made from a material that the axial growth was not dependent upon the fluence at which the channel seized, then it would not bow.

Q To your knowledge, is there such a material?

A Not that is suitable for use in a reactor.

Q When did you first learn about fuel channel assembly bowing?

A I would estimate that I first heard of channel bowing about 1977.

Q And subsequent to your learning about the fuel channel bowing, did this influence the way you designed your fuel channels or bundles?

A No.

Q Reading your testimony on the first page, under "Introduction," you state, "As described in the testimony of Mr. Gilcrest, there is potential for interference between spent fuel assemblies and the racks for the combination of worst case fabrication tolerances and worst case channel bowing."

It is correct that there is the possibility or the potential for interference in worst case channel bowing alone without taking into account worst case fabrication tolerances; is that correct?

A That I cannot say.

When I'm talking about worst case tolerances here,

I'm talking about rack tolerances as well as bundle tolerances.

Q What I'm asking is: Without taking worst case rack tolerances into consideration, there could still be interference with worst case channel bowing; is that correct?

MR. STEPTOE: Chief Judge Wolf, I'm going to object at this point. This is beyond the scope of this witness' testimony. He's here to talk about the loads that will occur, and as clearly stated in this sentence, he's just taking the interferences as given by Mr. Gilcrest in Mr. Gilcrest's testimony.

Counsel for Intervenor is asking about bowing, which is not in his testimony, and now counsel for Intervenor is asking about interferences, which is the subject of Mr. Gilcrest's testimony.

It seem to me that it's beyond the scope of what he's up here to testify on.

JUDGE WOLF: Do you want to respond to that, Ms. Murray?

MS. MURRAY: As far as worst case fabrication tolerances in the rack, I guess I should address the question to Mr. Mefford as to when he received this information from Mr. Gilcrest, but as for fuel channel assembly bowing, Mr. Mefford has indicated that he is

responsible for the design construction of the fuel bundles, channels and channel fasteners and as such should know about fuel channel assembly bowing.

JUDGE WOLF: Well, ask him about it.

BY MS. MURRAY:

Q All right. Why is General Electric concerned with the problem of fuel channel assembly bowing?

A You mean in regards to questions other than insertion of fuel bundles into storage racks?

Q That's correct.

A Well, the other implications of channel bowing is that if it is sufficiently large, it could create an interference condition with the control rods.

Q Have you ever known that to happen?

A There is one reported incidence at a reactor. I cannot -- I don't recall which reactor it was, but a channel was left in the core periphery for an extended period of time. It was then shuffled into a new position and there was high control rod drive friction noted. That channel was moved, a new channel was put in its location and the friction -- and the high friction went away.

JUDGE WOLF: Ms. Murray, can you come a point that would be convenient to stop at?

I think we ought to take steps to have a recess for dinner.

MS. MURRAY: Chief Judge Wolf, I could mark off a question right here and we can take a recess now.

JUDGE WOLF: Fine, okay. I thought --

MR. STEPTOE: Chief Judge Wolf, I was going to ask about the time we reconvene and how long we would like -- you would like to go tonight.

I have some witnesses that I might send home if it's unlikely that we're going to get to them.

JUDGE WOLF: Well, the notice said that we'd go from 7:00 to 9:00, but I was hoping we could go to 10:00 if that would finish it. I don't know that it would; but could we discuss that further after dinner?

MR. STEPTOE: Certainly.

JUDGE WOLF: Let's take an hour-and-a-quarter and come back at -- it will be 7:00 o'clock; is that correct?

JUDGE REMICK: Yes.

JUDGE WOLF: How many witnesses do you have?

MR. STEPTOE: We have, in addition to Mr. Mefford, Mr. Gilcrest and Mr. Ragan; and I think the only person who knows how long this is going to go, and she may not know, is counsel for Intervenor.

JUDGE WOLF: Well, whatever it takes, it takes. Let's do that, then.

MS. MURRAY: Judge, in addition, I believe Horace Shaw has to testify yet.

MR. STEPTOE: Yes, that's true.

JUDGE WOLF: I wanted to mention, so that we think about it a little bit before you go to dinner, that the staff indicated, as you know, at the beginning of this session, that it would be some time during the course of this week or perhaps even the early part of next week before they can get the affidavit in in response to the Board Question 2.

I wondered if we could expect that, within 2 weeks after the receipt of the answer, that both the Intervenor and the Applicant could get affidavits in in response. Then if it's necessary for the Board to ask any questions, as I stated earlier, we'll have a short meeting in Washington to clear it up, but I hope after we get -- we'll keep the record open until we get the affidavits and we'll then close it.

Because you have done advance work on your findings of fact and conclusions of law, we might set a short period of time on that and finally move this case to a conclusion.

We'll adjourn, then, until 7:00.

(Whereupon a recess was had,
after which the hearing
was resumed as follows:)

JUDGE WOLF: Ms. Murray, are you ready to proceed?

MS. MURRAY: Yes, I am, Judge Wolf.

JUDGE WOLF: Are you ready, Mr. Witness?

THE WITNESS: Yes, I am.

JUDGE WOLF: Mr. Reporter?

MR. SONNTAG: Yes, sir.

BY MS. MURRAY:

Q Just before we broke, Mr. Mefford, I believe we were talking about the interference between bowed channel assemblies and the reactor blades.

Do you know how much a fuel channel would have to be bowed before it interfered with a reactor blade?

A No, I do not know the precise number.

Q Can you give us your opinion on a rough estimate?

MR. GODDARD: Objection. Judge Wolf, the --

JUDGE WOLF: What is the basis for the objection?

MR. GODDARD: The basis for the objection is that the interference with the reactor blades is not a part of the spent fuel pool modification hearing that we are engaged in here today.

If I may, Judge Wolf, poor performance is not an issue in this proceeding.

JUDGE WOLF: Objection sustained, Ms. Murray.

MS. MURRAY: Judge Wolf?

JUDGE WOLF: Yes.

MS. MURRAY: To the extent that a fuel assembly would bow to the point that it interfered with the reactor blade, perhaps at that point it would be taken out of the reactor.

I was curious as to the amount of bow that then would be the maximum and then put into the spent fuel pool, if that would be a criteria that they would use in determining when to take a bowed assembly out of the reactor.

JUDGE WOLF: Why don't you ask it that way, what the criteria is?

MS. MURRAY: Thank you.

BY MS. MURRAY:

Q Mr. Mefford, do you know what the criteria would be for a bowed fuel assembly before it would be taken out of a reactor?

A No, I do not.

Q Then there are no design criteria which your unit --

A I would say that the criteria for removing a channel, when you know you would have to remove it, is when you start seeing an increase in control rod drive friction.

Q Do you know what that amount of bow is?

A That might start occurring at, maybe, approximately, a quarter of an inch of bow.

Q Which would be approximately 250 mils?

A Yes.

Q Thank you. What recommendations has General Electric made to the users of its products, specifically Commonwealth Edison and the Dresden 2 and 3 reactors, to alleviate the problem of fuel assembly channel bowing?

A I am not an expert in that area.

Q You designed the fuel channels and the fuel bundles but you don't make any recommendations as to how to alleviate bow?

A There are other organizations within the General Electric Company that follow the performance of the components and provide inputs to the utilities as to how they should be operated.

Q Do you have knowledge of those recommendations?

A I am familiar with a SIL, which was prepared and provided to the customers. A SIL is a Service Information Letter.

Q Would you please describe that specific Service Information Letter that was sent to the customers?

A I do not have a copy of that document with me; but it provided -- well, in essence, it was the recommendations that Mr. O'Boyle was referring to, that were provided in 1979.

MS. MURRAY: Could I have this marked as Intervenor's Exhibit No. 18 for identification, please.

(The document was thereupon marked Intervenor's Exhibit No.

18 for identification as of April 20, 1981.)

BY MS. MURRAY:

Q Mr. Mefford, I am going to hand you what has been marked Exhibit No. 18 for the Intervenor for identification.

Is this the Service Information Letter which you were referring to a few minutes ago?

A Yes, it is.

Q Have you seen this document before?

A Yes, I have.

Q Where did this document originate from?

A As indicated on Page 3 of this document, Mr. K. E. Watkins was the primary originator of the document.

Q Are these Service Information Letters prepared in the normal course of business of General Electric?

A Yes.

MS. MURRAY: I would like at this time to offer Intervenor's Exhibit No. 18 into evidence.

JUDGE WOLF: Mr. Steptoe.

MR. STEPTOE: Chief Judge, we have no objection to the introduction of this into evidence. It was referred to in Dr. O'Boyle's testimony.

However, we must say that it's not clear to us what the relevance or what the purpose is for introducing this document.

We do strongly believe, along with the staff, that the subject here today is interference in the racks and the storage pools, and it's not reactor operation; but --

MR. GODDARD: The staff --

JUDGE WOLF: Pardon me.

MR. STEPTOE: But subject to that, we have no objection at this point.

JUDGE WOLF: Mr. Goddard.

MR. GODDARD: The staff has a further objection to all portions of this document which are handwritten, as there is no indication as to the source of those handwritten comments which are indicated thereon.

JUDGE WOLF: Well, as to that, it can be taken subject to the condition that the handwritten material on it would not be considered part of the exhibit.

Ms. Murray, tell me the purpose for which you are making this offer, please.

MS. MURRAY: Mr. Mefford is a GE employee. He does design the fuel channels and the fuel bundles, and I would be trying to make the point that he would have something to say on how those fuel channels and bundles should be used and to what extent.

I am just about to start entering my questions on the loads and the stresses on those fuel assemblies.

JUDGE WOLF: But I don't see the relevance of

this document in that regard. He was presented in that capacity; but --

MS. MURRAY: Well, it first shows that there are recommendations for the use of the GE channels and bundles; and it also shows the time period in which GE --

JUDGE WOLF: I know; but he, I take it, did not make these recommendations and is not the sponsor of this document.

I have difficulty seeing --

MR. STEPTOE: Chief Judge, may I say that this would relate to Dr. O'Boyle's testimony, since he referred to it; but this witness is talking about stresses and loads and not about fuel channel bowing.

Furthermore, I don't think this document contradicts anything that Dr. O'Boyle said. So I really don't understand what it adds.

JUDGE WOLF: Well, in order to move along, for what it's worth, subject to the condition that none of the writing on it shall be considered part of it, we will accept it as your exhibit.

BY MS. MURRAY:

Q Mr. Mefford, referring to your testimony on Page 3, are all your calculations as to component loadings based on information which you received from Mr. Gilcrest?

A I would say yes, that my evaluations of the impact of

insertion of GE fuel and removal of these rods was based upon Mr. Gilcrest's inputs.

Q Has GE ever done any measurements similar to Mr. Gilcrest's?

A No, we have not.

Q Now --

A To my knowledge, to my knowledge.

Q Excuse me.

A GE is a very large company.

Q Now, in the event that Mr. Gilcrest's testimony should be changed due to various factors that he might not have taken into account, would your calculations then be changed?

For instance, if the amount of interference which he calculated was increased, would your measurements be changed?

A The margins which I have indicated here might change; but the --

Q What do you mean by margins?

A The capability --

MR. STEPTOE: Objection, your Honor. I think the witness ought to be allowed to answer the question.

JUDGE WOLF: Do you have more to state, Mr. Mefford?

THE WITNESS: Yes, I do. For example, in each of these different loadings that I addressed here, we

indicated the factor at which the design loads are greater than the identified loads. That factor would change as the applied loads change.

BY MS. MURRAY:

Q If the bundle was stored without the channel, what would support the weight of the bundle in the storage position?

A The lower tie plate.

Q So the lower tie plate is attached --

A The lower tie plate of the fuel bundle.

Q What forces will the tie rods be subjected to during withdrawal of the fuel channel in worst case channel bowing?

A Essentially, the only loads in the tie rods will be the loads required to lift the weight of the assembly or the weight of the fuel bundle, approximately 600 pounds.

Q Can they withstand that amount of force?

A Yes, they can, readily.

Q Are you ever involved with the storage of the channels and bundles that your unit designs?

A No, I am not.

Q Are you aware of any GE design requirements for storage of bowed fuel channels?

A I am familiar with a document which was prepared by GE for distribution to utilities providing guidelines for design of fuel storage racks.

Q And what are those guidelines?
A I can't recite them right now. It's -- there were some recommendations in regards to the size of the opening, how the fuel bundle was to be supported, et cetera.
Q If you saw that document, would it refresh your recollection?

MR. STEPTOE: Objection, Chief Judge. I don't think the witness has stated -- he stated that it's not his responsibility to design or to issue such documents.

So I object to counsel's characterization of the problem as being refreshing his recollection.

JUDGE WOLF: Sustained. Next question, please.

BY MS. MURRAY:
Q Is it your opinion that the improvements that GE has instituted in the fabrication processes and heat-treatment areas might change the bow slightly, but since the bow is primarily due to the location of the channel on the core periphery, the new processes are not going to solve the problem?

MR. STEPTOE: Objection, your Honor. I don't know what counsel is doing here; but, first of all, the question has been asked and answered.

Second of all, she is, apparently, reading something into the record; and I don't know what she is reading; and if it's part of a document that she is trying to get into

evidence, there are more proper ways of approaching that.

Third, we don't know what problems she is referring to.

MS. MURRAY: Judge Wolf, if Mr. Mefford had answered that specific question, I was not aware that he had answered it.

Secondly, I am not reading from any particular document, only from a list of questions that I prepared; and that came from his deposition, which was taken, roughly, ten days ago.

JUDGE WOLF: Can you answer the question, Mr. Mefford?

THE WITNESS: Could you repeat the question, please?

JUDGE WOLF: Would you do that, please, Mr. Reporter?

(The question was thereupon read by the Reporter.)

A The new processes will not make channel bowing go away in the peripheral fuel bundle locations. It may be that it could improve the situation, but I cannot quantify the magnitude of the improvement.

BY MS. MURRAY:

Q Referring to your testimony on Page 3, under upper tie plate lifting bail, is the figure of 2,040 pounds something

you calculated or something that you achieved from doing a test?

A Our design specs for the fuel are that all components shall be capable of withstanding a load equivalent to the weight of the bundle, plus two G's.

The 2,040 pounds is that. That's the weight of the assembly -- three times the weight of the assembly.

The capability of the tie plate has been addressed relative to that design limit or design guide.

Q Referring to your testimony on the channel corner gusset, at the bottom of Page 3 you state, "General Electric has performed a test wherein the load-carrying capability of the channel corner gusset was measured."

Was that one single test that you performed?

A Yes, it was.

Q So that's the basis -- that one test is the basis -- for your conclusion; is that correct?

A That is the -- that most readily demonstrates the capability of the channel gusset to withstand this kind of load.

Q Did you do any tests on the channel fastener bolt to determine what kind of load they would withstand?

A The channel fastener bolts are tested to the limits which are specified in my testimony by the supplier, and then they are also periodically checked by the General Electric

receiving inspection people.

Q Okay. Your conclusion states that the possible interferences described in Mr. Gilcrest's testimony do not present any safety problem with respect to fuel assemblies provided by or supplied by GE.

What do you mean by the term, "Safety problem?"

A I would consider a safety problem -- the only thing I can think of is if you should perforate the fuel cladding.

Q So if the upper tie plate lifting bail should fail, you wouldn't consider that a safety problem?

A If the upper tie plate lifting bail fails while the bundle was sitting in the storage rack, no, I would not.

Q You wouldn't consider failure of the channel corner gusset a safety problem?

A No. That will release no radioactivity.

Q Or a failure of the channel fastener bolts a safety problem?

A Again, no.

Q Then if you don't consider failure of any of these three components, the upper tie plate, the channel corner gusset or the channel fastener bolt, a safety problem, why did you consider them in your testimony?

A I considered the loads which were provided by Mr. Gilcrest that would be applied to the fuel bundles.

Q Would you say, in your opinion, it is -- strike that.

Is it better, in your opinion, to design racks that would accommodate both fuel assemblies or to have the high-density racks wherein you have to consider the loads that will be applied to the assemblies in putting them in and out?

A My opinion?

My opinion is that the best thing for the country is the high-density fuel storage racks.

Q Even though they cannot accommodate bowed fuel assemblies without interference?

A The fuel will not be harmed by the amount of interference which has been defined.

Q Then it's okay, in your opinion, to have to resort to extra force to insert or withdraw the bowed fuel assemblies in case of worst case interference?

A The loads which have been defined, there is no problem with. We are not talking about failure. You asked a theoretical question about, you know, is there a safety problem with the bail failing, the gussets failing, the bolt failing?

I indicated there was no safety problem with those components failing.

I am not saying that they are failing. I am saying they will not fail.

Q Do you know why the grapple limit switch is set at 1,100

pounds, as described in Mr. Ragan's testimony?

A I do not for a fact; but it's my opinion that that --

JUDGE WOLF: Well, unless he knows, I don't think it helps the record.

MS. MURRAY: I don't believe I have any further questions, Mr. Mefford.

JUDGE WOLF: Mr. Goddard, do you have any questions?

MR. GODDARD: The staff has no questions for this witness.

JUDGE WOLF: Does the Applicant have any further questions?

MR. STEPTOE: Yes, I have a few questions.

REDIRECT EXAMINATION

BY MR. STEPTOE:

Q Mr. Mefford, do you consider yourself an expert in metallurgy?

A No, I do not.

Q Do you consider yourself an expert on fuel channel bowing?

A I do not.

Q Do you agree or disagree with Dr. O'Boyle's statement about the likelihood of heat-treatment and fabrication processes decreasing future bow?

A I cannot agree or disagree, because I do not know. I do not know for a fact that this new processing will change

the radiation growth properties of the material.

Q On Page 3 of your testimony with respect to the upper tie plate lifting bail --

A Yes.

Q -- you were asked about the design load of 2,040 pounds?

A Yes.

Q If a load of 2,041 pounds is put on the upper tie plate lifting bail, will the bail fail?

A It will not.

Q Do you have any general idea -- I am sorry.

Do you have an opinion as to the ultimate strength of the upper tie plate lifting bail, whether it is -- well, strike that last comment.

A Yes, I do. Approximately, oh, eight to ten years ago there was a test run on an upper tie plate lifting bail for 7-by-7 fuel assembly, which is very, very similar to 8-by-8 fuel assemblies that are now our current design.

That lifting bail failed at, as I recall, 18,500 pounds. I did not use that as a basis for my testimony, because the test was not well-documented, but I have the tie plate sitting in my office.

(Laughter.)

MR. STEPTOE: We have nothing further of this witness, Chief Judge.

JUDGE WOLF: Yes, Ms. Sekular?

MS. SEKULAR: May I ask one question of the witness for clarification?

JUDGE WOLF: Yes.

RECROSS EXAMINATION

BY MS. SEKULAR:

Q Toward the end of your testimony on Cross Examination, Mr. Mefford, you stated that it was your opinion -- I don't know if I have this as an exact quote -- but it was your opinion that it would be better for the country to have racks of the sort that are going into the Dresden pool as designed as opposed to having redesigned racks.

Was it your assumption in stating that opinion that that redesigned rack would not allow for compaction?

A Yes, it was my assumption that a redesigned rack would not allow for compact storage of the fuel.

Q May I ask you another question then, which is:

If you had the alternative of using the racks as designed today or another compacted rack which allowed enough space for the fuel to fit in without jamming, which would you prefer?

A I would choose to answer that question by stating that I do not think that there are any problems with the racks as designed.

Q Would you, therefore, prefer not to have a newly designed rack that would allow for no jamming?

MR. STEPTOE: Objection to counsel's use of the word jamming in this context. Certainly, there is no support in the record for it.

MS. SEKULAR: It came from the testimony that --

JUDGE WOLF: Excuse me. Would you read the question back to me, please?

(The question was thereupon read by the Reporter.)

MS. SEKULAR: I will rephrase that to say that would assure no interference.

JUDGE WOLF: The question assumes a fact that is not proved in the record here.

MS. SEKULAR: I believe that in the testimony that was submitted, that there was. Mr. Gilcrest indicated that there could be some interference, two interferences.

JUDGE WOLF: Mr. who?

MS. MURRAY: Gilcrest.

MS. SEKULAR: Mr. Gilcrest in his written testimony.

JUDGE WOLF: We haven't heard from him, yet.

MR. STEPTOE: Chief Judge Wolf, two things.

JUDGE WOLF: Yes.

MR. STEPTOE: First of all, I think his testimony is talking about worst case possible interference, that is the possibility of interference.

Second, I have another objection to this whole series of questions, which is that Mr. Mefford and General Electric Company are not the people who have the responsibility for making the decisions as to whether these racks should be redesigned or not.

It seems to me that, perhaps, a representative of Commonwealth Edison Company, such as Mr. Ragan, would be the appropriate person to ask that question of.

It's clearly outside the scope of this witness's testimony.

JUDGE WOLF: I would suggest that we reserve until Mr. Ragan gets on and then lay a foundation for asking him that question and you can explore that area with him to the advantage of the record.

MS. SEKULAR: Mr. Chairman, I would be glad to do so. I was wondering, however, if Mr. Ragan is not able to answer the question, if we might re-call the witness for the purposes of having the question answered at that time.

JUDGE WOLF: Well, if you could qualify him to do it, you could re-call him; but the reason I am not accepting the question now is that I don't think that he is the person who is qualified.

MS. SEKULAR: Thank you.

JUDGE WOLF: So let's see what you can develop from Mr. Ragan in that area.

MS. SEKULAR: Thank you.

MR. STEPTOE: Excuse me, Chief Judge.

We have a problem with that, in that Mr. Mefford is going back to California tomorrow; and we won't be able to release him if we leave it in that ambiguous state, I think.

JUDGE WOLF: Well, we are going to have Mr. Ragan right now, aren't we, as a witness?

MR. STEPTOE: Well, we were planning on putting up Mr. Gilcrest. We can put up Mr. Ragan, I suppose.

MS. SEKULAR: Judge, would it be possible to have him answer the question as an offer of proof and then have the Board decide at a later date whether or not they were going to accept his testimony?

JUDGE WOLF: Off the record.

(There followed a discussion outside the record.)

JUDGE WOLF: Back on the record now.

MS. SEKULAR: I don't have any other questions of the witness at this time, Judge.

JUDGE WOLF: All right. Thank you.

Are there any further questions of this witness at this time?

MR. STEPTOE: No.

JUDGE WOLF: Dr. Remick.

BY JUDGE REMICK:

Q Mr. Mefford, in response to a question from Mr. Steptoe, you partially clarified a question I had on the upper tie plate lifting bail; but I am not completely clear yet.

You earlier said in response, I think, to a question from Ms. Murray that the design criteria for that upper tie plate lifting bail was the weight of the assembly plus two G?

A That's right.

Q Then you equated that to three times the weight. There is something I am missing in your answer there.

What is the significance of the weight plus two G?

A Well, it's basically three times the weight, three G's.

Q All right. But why did you answer weight plus two G?

A No reason, except that I have seen it expressed in that way to laymen, to help explain what we are talking about, not that I am putting you in the layman category.

(Laughter.)

JUDGE REMICK: I might prefer that I am a layman.

(Laughter.)

BY JUDGE REMICK:

Q All right. The lifting bail, how is it attached to the upper tie plate; is it welded or threaded?

A It's integral with the upper tie plate as a casting.

JUDGE REMICK: As a casting. All right. Thank

you.

Those are all the questions I have.

JUDGE WOLF: There are no further questions?

MS. MURRAY: No.

JUDGE WOLF: You may be excused for now, Mr. Mefford.

(Witness Excused.)

JUDGE WOLF: Next witness.

MR. STEPTOE: Yes. Chief Judge, our next witness is Mr. Ron Ragan.

JUDGE WOLF: Mr. Ragan, you have been sworn before and we will consider you are still under oath and accept your testimony on that basis.

MR. STEPTOE: Chief Judge, I believe Mr. Ragan is still under oath.

JUDGE WOLF: Yes. We just went through that.

MR. STEPTOE: I am sorry. I didn't hear that. I am sorry.

RONALD M. RAGAN

recalled as a witness by the Applicant, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION (Continued.)

BY MR. STEPTOE:

Q Mr. Ragan, will you state your name, spelling it for the

record?

A Ronald M. Ragan, R-a-g-a-n.

Q By whom are you employed; and in what capacity?

A Commonwealth Edison Company, at Dresden Station. I am Assistant Superintendent for Operations.

Q Are you familiar with the supplemental testimony of Ronald M. Ragan which has been filed in this matter?

A Yes, I am.

Q Do you have any changes that you would like to make at this time?

A I have one. On Page 1 at the bottom, the last sentence, and the top of Page 2, the sentence that begins with, "With the cable slack an electrical interlock limits the additional weight of the grapple resting on top of the fuel assembly to about 50 pounds," that statement is incorrect and I would like to delete it.

The next sentence I would like to remove, "If this interlock were to fail," and start the sentence at, "The added weight of the telescoping cans on the fuel assembly would be approximately 500 pounds when the assembly is seated."

And then the third sentence I would like to remove completely.

Q Can you, please, explain the reason for this change?

A We were under the wrong assumption of the operation of the

grapple at the time this was written; and after consulting with General Electric and some of our engineering people, we found out that when the grapple telescope seats and assembly, all the weight on the grapple cans is put onto the assembly until 50 pounds is sensed and then the interlock takes effect so that no more weight is put on it in a downward direction.

Q Could you explain what you mean by, "50 pounds is sensed"?

A (No response.)

Q Is 50 pounds a maximum or minimum?

A 50 pounds is a minimum.

Q What senses that 50 pounds?

A It's a load selsyn on the telescope. There is a cable that holds onto the assembly through the telescoping cans and that is hooked to a load selsyn which senses the 50 pounds.

Q Do you have any other changes that you would like to make in this testimony?

A No.

Q Subject to those changes, is it true and correct to the best of your knowledge and belief?

A Yes, it is.

Q Do you accept responsibility for it?

A Yes, I do.

MR. STEPTOE: At this time, Chief Judge Wolf, we request that the supplemental testimony of Ronald M. Ragan

be accepted into the record as if read.

JUDGE WOLF: Is there any objection, Ms. Murray?

MS. MURRAY: I would like to voir dire the witness first.

JUDGE WOLF: You may do that.

MS. MURRAY: Thank you, Judge Wolf.

VOIR DIRE EXAMINATION

BY MS. MURRAY:

Q Mr. Ragan, you state that you have a Bachelor of Science in Mechanical Engineering.

Do you have any other advanced degrees?

A No, I don't.

Q Have you taken any courses in metallurgy?

A Only in my undergraduate work.

Q What courses were those?

A Strength of materials and one metallurgy course.

Q Have you taken any advanced courses in mathematics?

A Only undergraduate mathematics courses up through -- well, differential equations; and I believe that's all.

Q Have you done any metallurgical experimentation?

A No, I haven't.

Q Have you done any analyses of stress?

A Only in lab courses in school, yes.

Q In your strength of materials courses?

A Strength of materials courses.

Q When was that; when did you take that course?
A 1964, 1965.
Q What level in college was it, first year, second year?
A I had two, two strength of materials courses in the third year of school.
Q Have you done any experimentation with corrosion?
A No, I haven't.
Q Have you computated amounts of corrosion?
A No, I haven't.
Q Have you studied corrosion in stainless steel or zircaloy?
A By what do you mean? Could you explain, study of corrosion effects?
Q Have you done any experimentation with corrosion in stainless steel?
A No, I haven't.
Q Zircaloy?
A No, I haven't.
Q Have you reviewed the literature in corrosion of stainless steel and zircaloy?
A I have read many documents on corrosion of stainless steels, yes.
Q Whose documents were those?
A They were various. I can't think of any in particular.
Q What are your current job responsibilities?
A I oversee operations of Dresden Nuclear Power Station's

Units 1, 2 and 3, and along with that the fuel handling activities associated with those units.

Q On Page 5 of your testimony, did you personally make the decision to delete the mandrel test?

A It was part -- it was the station's responsibility, I felt, to make that decision. Based on evidence that was produced by testimony of Dr. Draley and previous people ahead of me and, also, because of the samples that we would be putting into the pools that can measure corrosion effects and would give us a head start on determining whether or not corrosion would be a problem in the racks.

Q But did you personally make that decision?

A For the station?

Q Yes.

A Yes.

Q Did you consult with Dr. Draley about that decision?

A No; but I discussed this with our people in NFS, in engineering.

Q Do they have any experience in corrosion?

A I can't answer that.

Q Mr. Ragan, did you alone write the testimony on mandrel testing of unfilled storage locations?

A Do you mean -- could you rephrase that question, please?

Q Did anybody help you write the testimony on mandrel testing?

A Yes.
Q Who was that?
A Scott Pedigo, who works on the station's technical staff.
Q What was his input?
A A lot of the data that was supplied on the testing of the locations of the racks, the input from the different departments, such as NFS and Station Nuclear Engineering, was supplied to Scott, and he input the data into the testimony.

MS. MURRAY: Judge Wolf, at this time I would move to strike the testimony of Ron Ragan, starting on Page 4, Paragraph D, "Mandrel testing of unfilled storage locations."

JUDGE WOLF: Very well. Do you want to respond to that, now, Mr. Steptoe?

MR. STEPTOE: Chief Judge Wolf, I don't think she has explained the grounds on which she is moving to strike; and I would be interested in knowing what they are.

JUDGE WOLF: Mr. Goddard, do you have anything you wish to add?

MR. GODDARD: I would join in Mr. Steptoe's observations with regard to this motion.

JUDGE WOLF: Do you want to expand on the reasons for striking Paragraph D on Page 4?

MS. MURRAY: First of all, Mr. Ragan has had no

courses in metallurgy, he has no experience with testing for corrosion, with computation of corrosion. This was all expert testimony submitted by Dr. Draley at the hearings in November, so he has no personal expertise to say whether or not this mandrel testing should or should not be done for corrosion.

Secondly, he has stated that the input was received from somebody else, and so the analysis of whether or not it should be done was not his personally.

MR. STEPTOE: Chief Judge, if I may respond, with respect to the first point about Mr. Ragan's expertise in metallurgy, this is not offered as expert testimony. It's simply -- there is no statement on Pages 4 and 5 with respect to metallurgy or corrosion that does not simply describe what the testimony of Dr. Draley is and acknowledge what that already establishes.

With respect to what this is, is a statement of personal knowledge as to the reasons why Commonwealth Edison made a decision not to accept a particular recommendation. It is not the -- it does not purport to be the -- expert opinion concerning a corrosion problem.

Second, with respect to the preparation of the testimony, I am not aware that it is grounds for objection that Mr. Ragan received help from one of his co-workers with respect to the collection of data.

Certainly, Mr. Ragan has sworn that this is true and correct and he has accepted full responsibility for it.

There is simply nothing in the voir dire which establishes that he has signed a blank check here for another person's work. Therefore, I do not believe that the counsel for Intervenor has made a valid motion to strike here.

JUDGE WOLF: Well, in the manner that counsel for Applicant has qualified the testimony, it will be received in the record as the supplemental testimony of Ronald M. Ragan as if read.

MR. STEPTOE: I have nothing further by way of direct examination.

I tender the witness for Cross Examination, Chief Judge.

JUDGE WOLF: Do you wish to begin the cross, Ms. Murray?

MS. MURRAY: Yes.

CROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Ragan, on the first page of your testimony, under, "Design of the fuel grapple," you state that there is no way to try and force a partially inserted assembly down?

A That is correct.

Q If severe fuel channel assembly channel bowing should occur

to the point where the fuel channel is inserted or attempted to be inserted into a storage position which would not accept it, what plans does Commonwealth Edison have to deal with that situation?

A Under the worst case fuel rack dimensions and fuel channel bowing, we feel that there is no problem lifting the assembly back out of the location.

The interference is not great enough that it would present a problem with a normal grapple operation, just pulling the assembly back out of the can.

Q Then what would you do with it once you pulled it back out?

A We may do one of two things. Based on its position within the rack, we may try another location, assuming that a tube is larger than the adjacent space locations; or, secondly, we may dechannel the assembly and store the element without a channel or the bundle without a channel.

Q Where would the assembly be dechanneled?

A In the dechanneling machine on the wall of the pool.

Q Would this dechanneling result in additional exposure to workers of radiation?

A Not significantly. The dose rates in the area of the pool range between 2 to 5 millirem per hour. The dose rates at this channeling machine are probably 4 to 5 millirem per hour, so there is not that much difference between the dose rates between working on the pool and beside the pool.

Q But because workers would have to take extra time to dechannel these assemblies, wouldn't it result in additional exposure?

A Looking at it that way, yes.

Q Referring to the change in your testimony on Page 2, where you state -- I believe this is the way your testimony should read now, "The added weight of the telescoping cans on the fuel assembly would be approximately 500 pounds when the assembly is seated."

Now, should the assembly have to be removed, would this 500 pounds have to be taken into account in the amount the grapple can lift?

A That 500 pounds is already taken into account in the load that the grapple has to lift.

Q Okay. In Mr. Mefford's testimony, on Page 3, under "Component loadings," he states that the combination of fuel assembly component weights in worst case interference could result in the following maximum loads being applied to spent fuel during insertion and removal from the subject upper tie plate lifting bail, 1,190 pounds.

Now, isn't the maximum lift that the grapple can exert 1,100 pounds?

A Yes, it is.

Q What would happen if the maximum force needed to withdraw a fuel assembly from the storage position was greater than

1,100 pounds?

A I believe that -- I calculated that number, using numbers supplied in Mr. Gilcrest's testimony and also Mr. Mefford's testimony; and the 680 pounds that they use is for an assembly's dry weight, which is out of the water.

I believe the number for an assembly in the water is 600 pounds weight. So when you add the 600 pounds, plus the drag forces, you come up about 1,110 pounds.

The grapple motor hoist is rated at 2,000 pounds. The electrical interlock was set down to 1,100 pounds during original operation to account for lifting the cans, the telescoping cans, along with the assembly.

That interlock could be bypassed and taken up to 1,800 pounds, the original set point; but that is a set point that has to be changed by electricians and is not a bypass type of operation by a fuel handler.

Q Looking at your Attachment 1, which is a representation of measurements on the racks, what do these figures refer to?

A These are the internal dimensions of the lead-in clips on each storage location within that rack. It is the smallest diameter found in those, the smallest dimension found in both the X and Y positions within those storage locations in the racks.

Q How do you know that is the smallest dimension?

A When we had our mechanics take the dimensions in the rack,

they used a vernier caliper and just ran the calipers along the walls until they come up with what they felt was the smallest dimension.

Q Along the walls of each storage position?

A At the location of the lead-in clips.

Q At the location of the lead-in clips, does this mean that they didn't measure the internal dimension halfway down the storage position?

A That's correct.

Q So it's possible that there could be a smaller dimension in the storage position but you wouldn't be aware of it at this point; is that correct?

A No. The reason we didn't take the dimensions any further down than the lead-in clips is because, one, we could not reach that far down; and, two, the lead-in clips have the smallest dimension of the total rack.

Q I am not familiar with the exact physical set-up, but how can you be sure at the lead-in clips is the smallest dimension if you haven't measured further down in the storage position?

A We were just -- we had just taken drawing dimensions as the possibility of the smallest dimension being in that location.

We had no belief that there could be a smaller dimension further down in the can.

Q Would there ever be a situation where you would exert force to insert a fuel channel assembly into a rack?

A No. There is no way to do that with the equipment that we have for moving fuel.

Q Under Paragraph 7, on Page 3, how can you visually determine if an assembly has fully inserted?

A Inserted into the cans, is that the question?

Q This is your statement, the second sentence of Paragraph 7.

A When this was written we had meant that the cans had a considerable extension outside of the can -- the assembly, excuse me, had a considerable extension outside the cans.

The tie plate, the upper tie plate, and the spring clip would rest inside -- entirely inside -- the cans; and that is easily visualized by the fuel handlers. Anything outside of that can be readily seen and noticed by the fuel handlers.

Q So you are saying that once the upper tie plate lifting bail is at the top of the rack, you know it's fully inserted?

A You have a -- yes. You have visually -- you can visually see that the assembly is inserted into the cans.

Q Referring to the following two sentences in that Paragraph 7, at this time you have no procedure for what Commonwealth Edison would do should a fuel assembly be partially inserted; is that correct?

A We have no approved procedure. Those procedures are in our review process now. They have been changed and are in a review process to put an action statement, a precautionary statement, in there for fuel handlers, what would happen if an assembly became partially lowered into a fuel element can.

Q Will you have any way of telling before insertion into the racks how badly a fuel channel assembly is bowed?

A No.

Q So you won't know whether you are inserting one of the 420 mils bowed assemblies or one of the 100 mils bowed assemblies; is that correct?

A That's correct.

Q Is there any way to determine prior to insertion the size of the storage position you will be inserting the fuel channel assembly into?

A We will have dimensions of all the racks and all the tubes that will be installed into the pools and we will have an idea of those; but installing one assembly into any of those positions, I don't think we are going to follow it that closely.

Q You won't pick and choose the positions that you are going to insert assemblies into then; is that correct?

A That is correct.

Q On Page 8 of Dr. Draley's testimony, which was submitted

last November into evidence, he states, "I have recommended that a periodic mandrel test of unfilled storage tubes be carried out to guard against this unlikely event"; and I believe the event he is referring to is the swelling of boral due to corrosion.

Now, you did not consult with him before determining that this mandrel test was unnecessary; is that correct?

A I have not personally, no.

Q Has anybody at Commonwealth Edison?

A Our Engineering Department -- I believe our Engineering Department and our Nuclear Fuel Service Department have talked to Dr. Draley, yes.

Q But you don't know for sure?

A I know that for sure.

Q Who told you?

A In my discussions with Dr. O'Boyle.

Q Did you specifically talk about mandrel testing with Dr. O'Boyle?

A At different times, yes, I have.

Q Did Dr. O'Boyle recommend that the mandrel testing be abandoned?

A We have talked about the mandrel testing and feel that we have enough data and will install coupons within the pools that are specifically to determine boral corrosion; and we feel with that program there will not be a need to test the

rack positions or do mandrel testing on the positions.

Q Mr. Ragan, as I recall, that coupon program is such that ten years from now, I believe, you go during a five-year period without even withdrawing the coupon; is that correct?

A I believe that's correct, yes.

Q So do you not believe that it would be more prudent to do a mandrel test prior to insertion of a fuel channel assembly into a storage position rather than rely on a five-year periodic coupon withdrawal?

A I don't have Dr. Draley's testimony here; but, as I remember, he feels that the boral corrosion for the lifetime, the 40 years of the rack designs, will not be a problem.

Q Couldn't a mandrel test also tell you if a fuel storage position would accommodate a bowed fuel assembly?

A Not necessarily.

Q Could it if designed properly?

A If designed properly, I am sure it would.

Q Was the basis for abandonment of the mandrel test only factored on the corrosion element or did you also take the bowing problem into account?

A When I made that decision, I felt that bowing was not a problem and corrosion was not a problem based on Dr. Draley's studies; that in the event that we would see, and

in a sense, see it coming before there was actually a problem.

Q When did you make this decision?

A Since the last hearings. I can't give you a specific date.

MS. MURRAY: Judge Wolf, I would like to take a two-minute break in order to determine the last question we had with Mr. Mefford and how this witness could best be prepared to answer it, just so we can get both questions out of the way.

JUDGE WOLF: You may do that.

MS. MURRAY: Thank you.

(Whereupon a recess was had, after which the hearing was resumed as follows:)

JUDGE WOLF: May we come to order, please? Ms. Murray, are you prepared to go on now?

MS. MURRAY: Yes, Judge Wolf.

BY MS. MURRAY:

Q Mr. Ragan, have you ever talked to Carl Mefford about preferred designs of racks?

A No, I have not.

Q Have you ever talked to Mr. Mefford about how to handle fuel that -- fuel channel assemblies -- that become stuck or interfere with the walls of the storage positions?

A No, I have not.

Q Have you ever had any conversations with Mr. Mefford?
A No.
Q With your knowledge of fuel channel assembly bowing problems and the physical handling problems associated with it, in your opinion, as Superintendent of Operations, would you prefer to have high-density storage racks designed to accommodate bowed fuel with no possibility of having the fuel partially insert or impede during withdrawal?

MR. STEPTOE: Objection to the form of the question, Chief Judge. First, the use of "problems, " Mr. Ragan's knowledge of problems. I think his testimony is to the contrary, that he doesn't see any problems.

Second of all --

JUDGE WOLF: Rephrase the question, Ms. Murray.

MR. STEPTOE: Perhaps I should add, Chief Judge, at this point, we also have an objection to the relevance of expressing a preference for a hypothetical situation.

We have got a real question here before the Board, not the question that Intervenor seeks to raise. We are not starting from scratch.

JUDGE WOLF: I think that point is well taken. Let's see how Ms. Murray can reframe the question.

BY MS. MURRAY:
Q Mr. Ragan, do you not indicate in your testimony with the fuel channel assembly bowing and minimum tolerance storage

positions that there is a possibility for interference?
A Under worst case conditions, there is a possibility of interference, yes.
Q And you have considered the situation where there would be a partially inserted assembly; is that not correct?
A Under worst case conditions; beyond that it is possible from happening, I suppose, yes, we have analyzed what we would do to respond to those situations.
Q And you have, also, had to analyze the maximum lift that the grapple can exert and the possibility that it might not -- it might go over the 1,100 pounds that the force of the grapple can exert; is that not correct?
A We have analyzed the grapple operation in our procedures, yes; but that would be something we would do normally during most types of safety-related work, to make sure that all the alternatives are weighed before we get into the operation.
Q Well, you had to specifically consider this because of the phemonenon of fuel channel assembly bowing; is that not correct?
A The possibility, I suppose, exists; that we want to have all the avenues covered before we get into the operation.
Q Well, with this knowledge you have of fuel channel assembly bowing and the possibility of interference, in your opinion, would it be better to have a high-density rack

that was designed so that there would be no possibility of interference?

MR. STEPTOE: Chief Judge, I have the same objection concerning the relevance of this question.

JUDGE WOLF: I will sustain that, Ms. Murray.

MS. MURRAY: The racks in this situation have been designed and they are designed as such that they may not be able to accommodate bowed fuel channel assemblies.

It would seem relevant that the Superintendent of Operations, who has to deal with the insertion and withdrawal of the bowed fuel channel assemblies in these specific high-density racks should be able to offer an opinion as to whether high-density racks should be able to accommodate this bowed fuel.

MR. STEPTOE: Chief Judge, it seems to me that the only relevant question here is whether the proposal before the Board, which are these racks which have been designed, offer a reasonable degree of assurance that the public health and safety will be protected.

It is always possible to envision different ways in different rack designs, different approaches, that could have been used; but under the Atomic Energy Act, the question is very simple. Are the ones that are before you safe?

It's not at all clear to Applicant how answering a

hypothetical question about other designs, which are not before you, whether there would be improvement or not, advances the issue that you have to decide.

JUDGE WOLF: The same ruling, Ms. Murray.

BY MS. MURRAY:

Q Mr. Ragan, how do you expect to handle lead-in clip interference?

A I am sorry. What was --

Q In the -- where the enter dimensions of the rack lead-in clip fall below minimum tolerance, I believe there is a possibility that the lead-in clips will interfere at the spacer button.

How do you expect to handle that problem?

A Again, I don't feel there is a problem, because the weight of the assembly and the interference there is not beyond what the fuel assembly grapple is capable of handling without problems.

Q Mr. Ragan, how much does it cost to do one mandrel test?

A In money probably not very much, but in exposure to personnel, I feel it's unwarranted because of the additional exposure.

Q However, you stated earlier that if you have to remove a fuel channel from an assembly, that there will be additional exposure to workers; and in which situation would there be more exposure?

A In the mandrel testing, because the possibility there is we would spend more hours and more manpower above the pool than we would working off the side of the pool on one assembly removing the channel.

Q How much additional exposure to workers would there be should an assembly be only partially inserted?

A That would vary on the situation where the assembly was at the time. That would be hard to cover all aspects, I would think, on that.

Q Would it be more than mandrel testing?

A Possibly.

MS. MURRAY: I have no further questions.

JUDGE WOLF: Thank you. Mr. Goddard, do you have any questions.

MR. GODDARD: Yes, I do, Judge Wolf.

CROSS EXAMINATION

BY MR. GODDARD:

Q Mr. Ragan, does Commonwealth Edison possess a channel measuring system at Dresden Station?

A Yes, it does.

Q What is the function of such a system?

A The system is used to measure channel deflexion by means of -- for bowing, primarily.

Q Would you describe how and where the measurement of such irradiated channels takes place?

A That measurement is taking place right now at the site of the fuel storage.

Q Is it done in the pool?

A The measurement itself is done in the pool and the equipment reads out to a location at the side of the pool.

Q What is the purpose of measuring the channels for deformation?

A To insure that bowing hasn't exceeded limits which our Fuel Department has established.

Q Are those limits related to core performance or to storage of bowed assemblies?

A Those dimensions are related to, as in previous hearings, channel bowing and their interference with fuel racks and then, as Mr. Mefford stated, with the interference with control blades within the core.

Q Can you quantify the increased occupational exposures resulting from measuring such channels in the pool as opposed to merely attempting to place them in their desired storage locations?

A I am not completely familiar with the channel measuring program, although I know that it takes additional manpower and time and resulting exposures.

I believe the channel measuring program that was in progress at Dresden was completed over a matter of two weeks, with two men, at exposure of about 5 MR per hour;

and I haven't accumulated that dose.

MR. GODDARD: The staff has no further questions for this witness.

JUDGE WOLF: Is there any redirect?

MR. STEPTOE: Yes, Chief Judge Wolf.

REDIRECT EXAMINATION

BY MR. STEPTOE:

Q I think in response to a question from Ms. Murray, you stated the procedures have not yet been written with respect to what to do if an assembly should became stuck in the proposed racks.

Do you recall that?

A I believe I said that the final approved procedures are not out yet.

Q Okay.

A They have been written.

Q But you have no approved procedures yet; is that correct?

A That is correct.

Q Will those approved procedures be written by the time spent fuel rods are placed in the pool?

A Yes, they will be.

Q I believe, also, in response to a question from Ms. Murray, you talked about the possibility of using a properly designed mandrel to test storage locations?

A Yes.

Q Okay. Can you describe, briefly, what you mean by a properly designed mandrel?

A A properly designed mandrel, in my mind, would have to be a mandrel designed like a fuel channel, with the dimensions of a fuel channel, with a maximum bow in one direction that would have to be installed not once but four times within each storage location to insure that it would fit all the dimensions of the storage location.

Q Do you mean installed or inserted?

A Inserted. I am sorry.

Q Is that when you are making the mandrel test that you insert it four times into each storage location; is that what you are saying?

A That is correct.

Q And how many storage locations would have to be test -- would you have to test to be absolutely sure that there was no problem with respect to clearance of that mandrel?

A I am not absolutely sure what you are looking for. To be absolutely sure that you would have no interference, you would have to install the mandrel in all the locations you plan on using.

Q Would that be a reasonable testing program or would you test less than every single one?

A You could probably test less than every one; but to be absolutely sure, I suppose, you would have to test every

one.

Q Do you have an opinion about the amount of occupational exposure which would be associated with such a program, assuming that you did it every year before refueling?

A I feel that it would probably take three men a week to complete that testing.

Q Is that for one pool or two pools?

A That would be for one pool. And, again, exposures in the neighborhood of 3 to 5 millirem per hour.

JUDGE LITTLE: May I interject here?

Are you talking about a 40-hour week?

THE WITNESS: A 40-hour week.

JUDGE LITTLE: They are exposed for 40 hours at 5 millirem per hour?

THE WITNESS: That is right.

BY MR. STEPTOE:

Q Do you have an opinion that such exposure would be low as reasonably achievable?

A No, because I feel that the testing is not required.

Q No, you don't have an opinion, or no, you don't feel it is reasonable?

A No, I don't feel it's low as reasonably achievable.

MR. STEPTOE: I have nothing further, Chief Judge.

JUDGE WOLF: Ms. Murray?

MS. MURRAY: Just one question.

RECROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Ragan, you were answering a question of Mr. Goddard's dealing with measuring channels for deformation at the pool.

How much additional exposure to workers does this involve?

A The channel measuring?

Q Yes.

A Channel measuring, as it is being completed at Dresden, involves putting a fuel assembly into a rack at the side of the pool; and then from that point all the testing is done remotely.

So the exposures to people would be primarily the involvement of picking the assembly out of the storage location, moving across the storage pool and putting it into the rack and then back again.

The actual measurements are done far enough from the pool that there are some increased dose rates in that area but they are very low.

MS. MURRAY: I have no further questions.

JUDGE WOLF: Thank you. Are there any more questions of this witness?

Dr. Remick?

BOARD EXAMINATION

BY JUDGE REMICK:

Q Mr. Ragan, I am not sure I understand the change in your testimony. Could you explain in your own words the 50 pounds and the 500 pounds? I am not sure I understand what these are.

A The fuel assembly is lifted by the means of a telescoping grapple. Inside this grapple is a cable that physically hauls the assembly up in the air, and then the telescoping cans are lifted along with the assembly. That cable goes up to a reel that is monitored by a load cell on the hoist.

When --

Q Excuse me. What is the purpose of this telescoping grapple?

A It's primarily to insure that there is no sway, it's rigidity of the telescoping piece as it goes down into the storage location to pick up an assembly or lower one into the core.

All the telescoping sections do is give rigidity to fuel movement.

An actual cable supports the assembly and then the cans as the weight of the cans is lifted off up in the air.

The upper limit on lifting the assembly in the cans is set at 1,100 pounds.

That insures that if an assembly is pulled out of the

reactor, for instance, that there is no chance of getting it caught and then causing damage to not only the assembly but the grapple lifting motor as it's pulled up.

Q Let me ask you a question at this point.

The telescoping grapple is 500 pounds and it's sitting on top of the assembly?

A When the assembly is put down into storage location, the added weight of the cans is put on top of the assembly, until a 50-pound selsyn is actuated; and then there is an interlock that prevents the cable weight from going down any further.

Q 50 pounds. Is that 50 pounds on the cable?

A It's 50 pounds on the cable, yes.

Q So the purpose of that is so that your cable doesn't go completely slack; is that it?

A That is correct.

Q But there is still 500 pounds on the assembly?

A From the weight of the telescoping cans.

Q Plus the weight of the assembly?

A That is correct.

Q Now, when you go to withdrawal, the telescoping section is still sitting on the element when you go to withdrawal?

A And, eventually -- yes, that is correct. And then, eventually, the cable starts picking up the weight of those, not only the assembly, but the cans.

Q All right. It seems to me if the assembly weighs 600 pounds in the water and the telescoping cans weigh 500, there is 1,100 right there without any drag.

How are you ever going to pull anything out that has any drag?

A The limit is set so that it is very close, I agree, to the weight of the cans, plus the weight of the assembly; and interference between the upper core grid and the vessel would --

Q Or the spent fuel pool?

A -- or in the spent fuel pool would cause tripping of that.

That limit is, actually -- I am confusing, I think, the whole issue here.

That limit is actually 600 pounds above that 1,100 pound weight, if you can follow me. There is an actual 600 pound clearance between the 1,100 pound interlock, the weight of the channel -- the weight of the assembly, plus the weight of the telescoping cans to trip that 1,100 pound limit.

The weight of the telescoping cans is really not included in the 1,100 pounds that the set point is set at. It's over and above that set point.

Q Okay. So you could then with an 1,100 pound set point pick a 600 pound assembly, plus 500 pounds of drag; is that another way of stating what you just said?

A Yes, that is correct. The original set point on that was at 1,800 pounds when the grapple was new, because if we included the weight of the telescoping cans on top of that 1,800 pounds, the total there would be 2,300 pounds, which is over the lifting capability of the motor hoist, the 2,000 pound hoist.

So we arbitrarily set it to 1,100 pounds to give us a 500 pound spread between the actual can weight and the assembly weights, to give us an 1,100 pound interlock.

Q Now, let me see if I can restate this.

You can lift a 600 pound assembly, accommodate 500 pounds of drag and the 500 pound telescoping cans. That is what, 1,600 pounds?

A That is correct.

Q Am I correct you said the maximum capacity of the hoist is 1,800?

A The original set point was at 1,800, but the hoist can lift 2,000 pounds. The motor is rated at 2,000 pounds.

Q So you could possibly set that up another 400 pounds --

A That is correct.

Q -- to accommodate another 400 pounds of drag which occurred --

A That is correct.

Q -- without exceeding the hoist motor capacity?

A That is correct.

Q So, also, if you are inserting an assembly and, let's

assume, that was bowed and you are putting it into a can, the maximum force that you could put on it would be 500 pounds of the telescoping cans, plus the 600 pounds of the assembly; that is the only force you could apply to insert?

A That is correct.

Q Is there any reason to believe that if you inserted an element that had interference with that 1,100 pounds or is there any reason to suspect that it would take or to expect that it would take more than 1,100 pounds to withdraw it?

A Not by the calculations and the drag limits that came out of previous testimony, no.

420 mils, the worst case assembly bow, plus the worst case rack dimensions, that, I think in Mr. Mefford's testimony, adds up to 1,100 -- slightly over 1,100 pounds.

So I don't feel there is a problem of lifting it out with the grapple at all.

Q I am not thinking so much of a problem as the question: Is there any reason to expect it would take more force to pull it out than it took to insert it?

A No, I can't see where there would be any.

Q In response to a question from Mr. Goddard, you were talking about -- I think it was Mr. Goddard, excuse me -- about dechanneling fuel.

Do you normally dechannel fresh spent fuel, fresh discharged fuel?

A Yes, we do. The assemblies that are pulled out of the core cycle that are depleted that do not go back in, we will remove their channels, between 100 to 200 channels, and put them on new fuel and use them over again in future cycles.

Q During that refueling cycle or after the fuel that you have removed has cooled some time?

A During the next refueling cycle.

Q The next refueling cycle?

A Yes. We take them off. As soon as the core is unloaded, we remove, put the depleted fuel in it's rack. Before the new fuel goes back into the core, it will have a new channel installed on it.

Q The point I am trying to get at is: If you take a fuel assembly out of the reactor core, how long is it normally before you would dechannel it, if you were going to dechannel it?

Would you do it immediately during that refueling cycle or would you do it some time between then and the next refueling cycle?

A Normally, it would be immediately during that refueling outage. We do not keep -- normally would not keep -- excess channels laying around. We would take those, the assemblies that were not going to be used, remove the channels and put them on the new fuel before it goes back into the vessel.

Q During that same outage?
A During that same outage.
Q I was curious about the different trade-offs that you might have considered in coming to the decision, that, I think, you indicated was your decision, to not require mandrel testing; and you mentioned occupational exposure.

Are there other major considerations in determining whether to accept, I think, a recommendation from Dr. Draley to Commonwealth Edison to consider mandrel testing and your decision to not accept that recommendation? What kind of considerations go into that, trade-off considerations? Is the most important one, the occupational exposure?

A That is a primary one. In addition to that, the manpower time. Scheduling time before or during a refueling outage would be a problem.

It's a factor, but it's minor, would be the additional cost by doing that kind of operation.

The set-up time and the interference with other operations that have to be done immediately ahead of the refueling outage is a big impact.

Q Are those the major considerations then?
A That's primarily what I had in my mind, yes.
Q You also indicated that to do an adequate mandrel testing job you would have to insert a mandrel, I think, four times

into one tube.

Why would it be four versus two times? It seems like you would have an X-Y direction. Why would you do it twice in the X? I would assume you would rotate it 180 degrees from your answer, but why would you do it four times versus two times?

A Well, when I said that I had in mind that a mandrel would be rotated -- excuse me -- would have one offset position, but you could have four different -- well, no. You would have a possibility of four different dimensions inside -- that's not correct.

I feel that the statement I made was probably in error, come to think of it, as I think about it now.

Each storage location could possibly be accomplished with two positions.

Q Do the top of the tubes, if you have the -- what are the clips called?

A Lead-in clips.

Q Lead-in clips, would those be on all four faces or would there be one in the X direction or one in the Y?

A They are in all four positions.

Q So am I correct then that two times would be sufficient rather than four times?

A That is correct, yes.

Q You also said, I believe, that your estimate would be that

it would take three men a week to complete the mandrel testing.

Now, what did you assume about the number of tubes that you would test there? Would you have to test all empty tubes or just sufficient enough for that defueling that you were about to do on that particular outage?

A For one thing, I assumed we would do each location four times so it would actually be now half of that number.

Q All right.

A I assumed that we would test all the core positions where we would plan to put spent fuel in --

Q Core positions or spent fuel positions?

A We would -- spent fuel storage locations that we would be putting spent fuel from the core in during that cycle, which would be in the neighborhood of 200 to 250 locations.

Q So in that estimate, other than the four times versus the two times, you were only thinking about measuring a sufficient number to handle the fuel coming out of the core?

A That is correct.

Q And when Mr. Goddard asked you about your fuel channel measuring apparatus, I assume you make those measurements with the fuel bundle in the channel or after it has been dechanneled?

A At Dresden we completed those with the element in the

channel.

I am not familiar with how that was accomplished at Quad Cities, though.

Q Do you have this apparatus in both Dresden 2 and 3 pools?

A No. It is only -- in fact, it is the same test fixture that was used at Quad Cities and was transported to Dresden; and we only have it right now in the Dresden Unit 2 pool.

Q What if you wanted to measure something in Dresden 3?

A It would have to be relocated over to Unit 3 pond.

Q And that is possible?

A Yes.

Q Do you have a dechanneling machine in both pools or just one pool?

A We have them in both pools.

JUDGE REMICK: Thank you.

JUDGE WOLF: Do you have anything you want to ask?

JUDGE LITTLE: No.

JUDGE WOLF: Are there any further questions of the witness?

MS. MURRAY: I just have one question.

RECROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Ragan, if you were withdrawing the fuel from the

storage position and due to the load exerted on the grapple, the grapple failed and the fuel channel assembly fell across the top of the racks, do you have any procedures which you would institute to correct that situation?

A We have procedures that would cover the evacuation of personnel in the event of a high radiation condition on the refueling floor and in the possibility that that fuel assembly would become critical with another one.

We don't have at this time procedures to cover assemblies falling across fuel racks or across -- any condition like that, no.

Q So you would have to just let it lay there until you figured out what to do with it?

A Well, until we analyzed the conditions. We would have to know the conditions before we could analyze what to do with an assembly, the radiological conditions.

Q Do you have more than one grapple at the pool?

A We have one grapple for each unit.

Q So if this grapple failed or broke during withdrawal of an assembly and the assembly dropped, you would have to replace the grapple before you can pick it up?

A On this, with the grapple telescoping section, yes, you would have to repair that before you could lift it up.

In addition to the grapple, there are two auxiliary

hoists, one 1,000-ton hoist on each of the grapples that could be used in cases to lift an assembly up.

MS. MURRAY: I have no further questions.

MR. GODDARD: The staff has one question.

JUDGE WOLF: Yes, Mr. Goddard.

RECROSS EXAMINATION

BY MR. GODDARD:

Q Mr. Ragan, with regard to your discussion of mandrel testing and Judge Remick's inquiries as to whether it would take two or four tests of each location, the channels are not symmetrical by virtue of the location of the channel spacer buttons; am I correct?

A That's correct.

Q Would it not, in fact, take four tests of each location by mandrel rather than two? If you wanted it -- I suppose if you tested the entire rack position, it would require four.

When I was contemplating the bow, I was only assuming that the bow would occur, as Mr. O'Boyle had stated, in the bottom section, four to six feet above the bottom of the assembly; and that would require only two tests per location.

Q I would concede that the bow will only occur in the general location described by Dr. O'Boyle.

By virtue of the interference posed by the channel spacer buttons at the top of the racks, would it not thus

require four positionings.

A Yes, it would.

MR. GODDARD: Thank you. I have no further questions.

JUDGE WOLF: Do you have any Redirect Examination?

MR. STEPTOE: No, Chief Judge.

RECROSS EXAMINATION (Continued.)

BY MS. MURRAY:

Q Mr. Ragan, couldn't you possibly put two buttons on a mandrel, in order to reduce it again to the two-position test?

A Then there would still be the possibility of putting the buttons in each one of -- all four positions.

I suppose in order to test the lead-in clips, you would have to do four tests; and to do the bowing, I feel you would have to do two tests down through the middle of the rack.

Q Isn't it, in fact, a plan of Commonwealth Edison's to grind down the lead-in clips so there will be no possibility of interference with the spacer button?

A That is a plan, to grind down those lead-in clips, yes, as I understand it; but you will still have the chance of the channel buttons' contact with those lead-in clips.

Q Well, you still could construct a mandrel with four channel

buttons or two channel buttons, couldn't you?

A Yes.

Q Spacer buttons?

A Yes.

MS. MURRAY: I have no further questions.

JUDGE WOLF: If there are no further questions, you may be excused.

(Witness excused.)

MR. STEPTOE: Chief Judge Wolf, our next witness will be Mr. Gilcrest. He will be our last witness.

May I ask now whether we can tell Mr. Mefford that he can catch his plane in the morning or should we recall him at the convenience of the Board?

JUDGE WOLF: Well, let's wait until we adjourn and we will give him the answer then.

MR. STEPTOE: Then I would like to call Mr. Gilcrest to the stand, please.

MS. MURRAY: Judge Wolf, before we do, I will give you a rough estimate that I am going to cross examine Mr. Gilcrest for one-and-a-half to two hours, just in advance.

If we do the full cross examination of Mr. Gilcrest, it would probably be about 11:00 o'clock before we finish.

JUDGE WOLF: Well, we only have this room tomorrow morning until 11:00 o'clock, so I think that we

ought to go for a while and we can finish up in the morning, if need be.

MS. MURRAY: I just wanted to give you --

JUDGE WOLF: I might encourage you to look over your questions.

MS. MURRAY: I will do them as fast as I can.

JUDGE WOLF: Off the record.

(Whereupon a recess was had, after which the hearing was was resumed as follows:)

JUDGE WOLF: May we come to order, please?

Mr. Steptoe.

MR. STEPTOE: Yes, Chief Judge Wolf.

JAMES D. GILCREST

called as a witness by the Applicant, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. STEPTOE:

Q Mr. Gilcrest, would you please state your name for the record?

A James D. Gilcrest, G-i-l-c-r-e-s-t.

Q It's good that you spell it, because I know it's been misspelled.

By whom are you employed and in what capacity?

A I am employed by Nuclear Services Corporation. I am the manager of mechanical engineering and I am also the project manager for the Dresden spent fuel rack design.

Q Are you familiar with the testimony of James D. Gilcrest which has been filed in this matter?

A Yes, I am.

Q Did you write it?

A Yes, I did.

Q Is it true and correct, to the best of your knowledge and beleif?

A Yes, it is.

There is one correction I would like to make to it.

Q Would you please make that correction?

A When I originally wrote the testimony, I wrote it on the basis that it would be possible to have an interference between the lead-in clips and the spacer buttons on the channels.

Since that time, Commonwealth Edison has made the decision to check each storage location with a plug gauge with a dimension of 5.768 inches, which is the maximum dimension across the spacer button.

Every position in each rack will be checked with this plug gauge; and in any case where there is an interference, the lead-in clip will be ground down sufficiently so that the interference is eliminated.

By doing this all references in my testimony to an interference at the lead-in clip will be deleted.

Q Subject to that correction, do you have any other corrections to make?

A No, I don't.

Q Okay. Is this testimony true and correct to the best of your knowledge and belief as corrected?

A Yes, it is.

MR. STEPTOE: Chief Judge, we tender the testimony of James D. Gilcrest and ask that it be received into evidence as if read.

JUDGE WOLF: Ms. Murray, do you have any objection to the offer?

MS. MURRAY: Absolutely no objection.

JUDGE WOLF: The staff?

MR. GODDARD: No objection from the staff, Judge Wolf.

JUDGE WOLF: Without objection the testimony of James D. Gilcrest related to fuel channel bowing, dated January 16, 1981, will be received and bound in the record as if read.

MR. STEPTOE: Thank you, Chief Judge. I might say that we will tender Mr. Gilcrest now for cross examination with respect to this testimony.

There is one other matter which we seek to accomplish through Mr. Gilcrest, which is his sponsoring of the licensing report Revision 5, which was submitted to you some months ago, with an accompanying affidavit; but we for continuity purposes felt it best to address the fuel channel bowing now.

So we do tender Mr. Gilcrest for cross examination on his fuel channel bowing testimony.

JUDGE WOLF: That is as modified orally by Mr. Gilcrest a few minutes ago?

MR. STEPTOE: Yes, sir.

JUDGE WOLF: Ms. Murray.

MS. MURRAY: Thank you, Chief Judge.

CROSS EXAMINATION

BY MS. MURRAY:

Q Mr. Gilcrest, does the 5.768 inches include --

A It includes a -- well, as stated on the General Electric drawing as a maximum dimension from one side of the channel to the opposite side, to the outside of the spacer button.

Q Does it include the fabrication tolerances which Dr. O'Boyle referred to in his testimony today?

A Since it is stated on the General Electric drawing as a

maximum dimension, I believe it does.

Q When would the lead-in clips be ground down?

A The specific date hasn't been set yet, but they will be ground down before the fuel racks are installed in the fuel pool.

Q Do you know for sure if the lead-in clips are going to be ground down?

A In any case where an interference exists, yes, they will be.

I don't know that it will be necessary to grind any down, no.

Q Was this interference due to construction of the racks below minimum tolerance?

A No, it's not. As explained in my testimony, it is possible to have a dimension across the lead-in clips of 5.740 inches. The difference between that dimension and the 5.768 is the basis for the 28 thousandths interference that I assumed in my testimony.

Q Do you know what the dimension of the fuel channel is exclusive of the spacer button?

A Do you mean the maximum dimension including the fabrication tolerances?

Q That is correct.

A I believe it's 5.454 inches.

Q Do you know what the smallest internal dimension that has

been measured so far in the fuel racks is?

A Do you mean the smallest dimension across the lead-in clips?

Q No. Have you measured any dimensions other than across the lead-in clips?

A You mean other dimensions within the storage cell?

Q Within the storage position.

A No.

Q Will those measurements ever be done?

A There is no plan to do those measurements now. Based on the design of the fuel racks, the minimum dimension in that location will be across the lead-in clips.

Q The clearance inside an individual storage tube is .496 inches; is that correct?

A Yes, it is.

Q That would mean a clearance of .248 on each side of a straight channel that was inserted into that position?

A Correct.

Q We are talking about a GE channel; is that correct?

A That is correct.

Q Now, when you wrote your testimony, did you take into consideration the galvanic corrosion of the boral which Dr. Draley spoke of in his testimony?

A I took into consideration the fact that Dr. Draley stated in his testimony that any such corrosion was extremely

unlikely; and, therefore, I did not include any corrosion in my calculations of the clearance, no.

Q If through some unpostulated mechanism that type of corrosion could occur, how much would the swelling of the boral reduce the size of the tube storage position?

A Well, I believe Dr. Draley's testimony says that the maximum swelling would be .180 inches --

Q That would be --

A -- assuming that all of the boral corroded; and if you took into consideration some more reasonable amount, say 10 percent of that, the effect on the clearance between the fuel assembly and the cell wall is minimal.

Q Mr. Gilcrest, when did you first learn about fuel channel assembly bowing?

A By bowing you mean bowing as opposed to bulging?

Q That is correct.

A It would have been shortly before the last hearing, approximately October of 1980.

Q That's the first time you learned that a fuel channel could bow?

A That is the first time that I had learned that there was any evidence of bowing in fuel channels in the reactors.

It may not have been October. It could have been a month or so before that.

Q Mr. Gilcrest, I took your -- you took a deposition with me;

is that correct?

A That's correct.

Q And it was on April 9th, is that correct, of 1981?

A I believe it was about April 9th. I don't remember the exact date.

Q Do you remember where that deposition was?

A Yes. It was in my office.

Q Okay. In that deposition I asked you a question, reading, "When did you learn about the phenomenon about fuel channel assembly bowing?"

Do you remember me asking you that question?

A Yes.

Q Do you remember what your answer was?

A I believe we discussed that question several times during the testimony. My first answer to that was that I learned of it probably about eight years ago.

I later clarified that when I stated that I was talking about fuel channel bowing considering what we have often been doing in this area, which is lumping bowing and bulging together.

What I had actually learned of approximately eight years ago was the problem of fuel channel bulging. The problem of fuel channel bowing as opposed to bulging I learned of only recently.

Q Mr. Gilcrest, I am going to hand you what has already been

marked as Intervenor's Exhibit, I believe, No. 13, for identification.

Would you take a look at that document, please?

(Indicating.)

JUDGE WOLF: Is this it, 13, for identification?

MS. MURRAY: Yes.

BY MS. MURRAY:

Q Mr. Gilcrest, have you seen that document before?

A Yes, I have.

Q When did you first see that document, Mr. Gilcrest?

A Shortly after it was issued. I believe it was the end of 1978.

Q And did you learn from that document that fuel channel assemblies could bow?

A It has mention of fuel channel bow in there, yes.

Q Does it not also indicate fuel channel bow independent of bulge?

A I believe it does. If I could have -- I would like to have a copy to refer to, if I could.

JUDGE WOLF: Ms. Murray, what is the relevance of determining when this witness learned of bowing or bulging or both? How does it move the case along here?

MS. MURRAY: I would like to show that this witness knew of bow and of bulge before the racks were designed and before the racks were constructed and --

JUDGE WOLF: And if he did?

MS. MURRAY: Then he didn't take the phenomenon into account when the racks were designed?

JUDGE WOLF: Was he in charge of the design?

MS. MURRAY: I believe he is.

JUDGE WOLF: Were you in charge of the design, Mr. Witness?

THE WITNESS: At the time the design was done, no, I was not. I did a review of the design some time in 1978. The design was completed in 1977.

BY MS. MURRAY:

Q Was your review in 1978 prior to the construction of the racks?

A Yes, it was.

Q Were you --

JUDGE WOLF: Well, Ms. Murray, assuming that to be the fact, and that he didn't take it into consideration, what is the point in regard to the problem here that we have?

MS. MURRAY: The point is that he knew about fuel channel assembly bowing, he knew about the possibility of interference in high-density racks and he didn't take it into consideration before the racks were constructed and should have.

MR. STEPTOE: Chief Judge, it seems to me that

your concern is appropriate here.

The issue before us is not a negligence action between Commonwealth Edison and the designer of the rack or anything like that. The only issue is whether the rack as it stands today provides reasonable assurance of the public health and safety.

Assuming that Intervenor could prove what she is trying to prove, I don't see the relevance.

JUDGE WOLF: Well, you may go along. I wanted you to understand that I was having difficulty as to the relevance and materiality of these questions.

MS. MURRAY: Thank you.

BY MS. MURRAY:

Q Mr. Gilcrest, referring to your measurements at the bottom of Page 2 in a straight fuel channel, does the .173 inches on each side of the storage channel take into account the fabrication tolerances which Dr. O'Boyle referred to in his testimony today?

A I did not hear all of Dr. O'Boyle's testimony, since some of it was proprietary, so I can only state that for the portion that I did hear, yes, it does take that into account.

Q What is the amount of fabrication tolerance which the .173 takes into account?

MR. STEPTOE: Objection, Chief Judge. I think we

should try and make it clear, fabrication tolerance in what? Are we talking about actual fabrication tolerances in the rack or fabrication tolerances in the channels or fuel assemblies?

MS. MURRAY: I am referring to the fabrication tolerances in the fuel channel assemblies.

JUDGE WOLF: Very well. Proceed then.

A It takes into account a -- well, I can't find exactly what I had here; but to the best of my recollection, it took into account the nominal inside dimension of the fuel channel, the tolerance on that inside dimension, the wall thickness of the channel and the tolerance on the wall thickness of the channel.

BY MS. MURRAY:

Q Thank you. Did it take into account any convexity tolerances?

A What it took into account is shown on a General Electric drawing as the maximum dimension across the fuel channel of 5.454 maximum dimension.

I don't know exactly what General Electric took into account in coming up with that number.

Q In your opinion, is it possible that even though the racks are vented, small pockets of hydrogen bubbles or blisters could form, have hydrogen gas that cannot escape through the vents?

A Do you mean is it possible or is it likely?
Q Possible.
A Yes, it's possible.
Q Did you take that into consideration in your figures?
A No, I didn't, because I considered it highly unlikely.
Q Do you review all of the deviation disposition requests?
A Yes, I do.
Q Have you heard of boral which is fabricated and has small creases in it?
A Yes, I have.
Q Did you take that into consideration in your calculations?
A Those creases occur only at the very end of the channel, which is a location that is not in the area of the bowing; and, therefore, it has no effect on the interference that we are talking about.
Q Even if it did occur at the -- which end of the channel are you speaking of?
A It occurs at the end of the channel from which the boral is inserted during the assembly of the tube.
Q Top or bottom?
A I am not sure if that is the top or the bottom.
Q Okay. Assuming, theoretically, that it was at the top, isn't it possible that that crease could cause interference during withdrawal or insertion?
A No, because the crease, the reduction in the opening due to

the crease, still results in a larger dimension than exists across the lead-in clips.

Q Do you know how large these creases are that we are talking about?

A The height of them?

Q Yes.

A I believe they were in the range of 40 to 60 thousandths high.

JUDGE LITTLE: Of an inch?

THE WITNESS: Pardon me?

JUDGE LITTLE: 40 to 60 thousandths of a what?

THE WITNESS: Of an inch. I am sorry.

MS. MURRAY: I would like to have this marked Intervenor's Exhibit No. 19 for identification, please.

(The document was thereupon marked Intervenor's Exhibit No. 19 for identification as of April 20, 1981.)

BY MS. MURRAY:

Q Mr. Gilcrest, I am handing you what has been marked as Intervenor's Exhibit No. 19 for identification.

Have you seen this document before?

(Indicating.)

A Yes, I have.

Q Did you write this document?

A Yes, I did.
Q You are familiar with the contents of it?
A Yes, I am.
Q I am referring to the second page of the document, the handwriting signed, "B. B. P."

Who is B. B. P.?

A I don't know.
Q Have you ever seen that handwriting before?
A It doesn't look familiar to me, no.
Q The question in that handwriting states -- and I would like to ask you the same question -- can putting a bowed bundle in one cell deform the next cell?
A Putting a bowed bundle in one cell, if you assume that the bow is large enough to exert pressure on the cell wall, will result in a certain amount of deflection of that wall, since any load imposed on the wall would deflect the wall; and in that sense it will very slightly deform the adjacent storage space.
Q What do you mean by, "very slightly"?
A Well, it depends on how much bow, how much interference you have.

With the bow that I have used in my testimony, which results in a quarter-inch interference, I haven't calculated the number, but I would guess that the deflection would be somewhere in the range of possibly five

thousanths of an inch.

Q 5 mils?

A 5 mils.

Q But you haven't actually measured that; is that correct?

A No, I haven't.

Q Mr. Gilcrest, referring to your calculations on Page 7, the maximum load which you calculated applied to the bail would be a maximum of 1,190 pounds on withdrawal.

Have you considered how much weight the bail can take upon insertion?

A I believe I stated in my testimony that, based on all the analyses that we have done, the fuel assembly will insert by its own weight.

Q What about the weight of 500 pounds of the fuel grapple on top of the assembly, would that affect the upper tie plate lifting bail at all?

A I am afraid I am not the person to answer that question.

Q Aren't you the one that did the analysis of the stresses on the upper tie plate lifting bail?

A No, I am not. That is General Electric's area.

Q Mr. Gilcrest, you have just done an analysis on Page 7 of the total force applied to the bail?

A Correct.

Q Couldn't you also calculate the total force applied to the bail in insertion?

A Well, now you are asking two different questions. You are asking me if I have calculated the forces or if I have calculated the stresses.

I have calculated the forces but I have not calculated the stresses.

Q Could you explain to me what the difference between the two is?

A The force is merely the external load applied to the upper tie plate.

The stress in the tie plate depends on the dimensions of the members that you are looking at, on the configuration of the members; and, basically, when General Electric has designed the upper tie plate, they have looked at the stresses in the piece based on external loads applied to that piece.

If I could make a clarification, perhaps?

Q Yes.

A What we have done here is that I have calculated the loads resulting from the removal of a bowed fuel assembly.

Mr. Mefford in his testimony has compared those loads with the loads used in the design of the upper tie plate.

Since the loads that I have calculated for removing the fuel assembly are lower than the design loads for the piece, we have come to the conclusion that the piece is satisfactory, the upper tie plate is satisfactory.

Q Looking at your Figure 1 at the end of your testimony, if you centered the fuel channel in the bottom of the storage position in worst case channel bowing, the channel will bow out, touch the wall of the storage position and then bow back and touch the lead-in clip; is that correct?

A That's correct.

Q So even though you grind down the lead-in clips, it is possible in worst case channel bowing that there will still be a different type of interference at the lead-in clip; is that correct?

A There won't be an interference. There will be a contact.

Q A contact. What is the difference between interference and contact?

A Well, any time two things are touching with any amount of a force exerted, there is a contact.

For an interference, it means that the space through which something is trying to pass is smaller than that object.

In other words, if the lead-in clip dimension is smaller than the channel dimension, you have an interference.

Q Do you know what spalling is?

A Vaguely.

Q Can you give me your description of spalling?

A Spalling is a, basically, removal of material from a

surface of some object by abrasion.

Q Are you aware that there are spalled channels in one of the Dresden storage pools at this point?

A No.

Q Did you take any spalling into consideration in your measurements?

A I haven't made any measurements of fuel channels.

Q I didn't mean dimensional measurements. I meant measurements of force to extract the fuel channel assembly.

A Those are not measurements, either.

Well, I made measurements of the force at the lead-in clip. The forces that are presented in this testimony for the bowing are not measurements. They are calculations.

Spalling on channel surface has not been taken into account in those calculations or measurements.

Q Is it possible, if you did take spalling into account in a bowed fuel channel assembly, that your figures would be increased?

MR. STEPTOE: Objection, Chief Judge.

At this point there is absolutely no foundation in the record that there is any spalling in the Dresden spent fuel channels, and I think it's inappropriate to pursue this line of inquiry.

JUDGE WOLF: May I hear the last question, please?

(The question was thereupon read by the Reporter.)

JUDGE WOLF: Do you know the answer to that question? You prefaced your remarks earlier by saying that you knew only about this phenomena in a vague sort of way.

THE WITNESS: I don't think I can really give an accurate answer to that question.

JUDGE WOLF: Very well. Let's move on then.

BY MS. MURRAY:

Q If interference were increased to 500 mils due to some unpostulated combination of various factors, would the fuel assembly fully insert under its own power?

A Yes, it would.

Q How much does a 7-by-7 fuel assembly weigh?

A Approximately 680 pounds dry, 600 pounds submerged.

Q Then it weighs the same as an 8-by-8?

A It's close to the same weight, yes.

Q How much interference would there have to be before a fuel assembly would not insert under its own weight?

A Excuse me. Your previous question, did you ask me if -- did you say half an inch of interference or half an inch of bow?

Q I said interference and I should have said bow.

A Why don't you ask me what you want me to answer again.

MS. MURRAY: Let me restate the question.

BY MS. MURRAY:

Q If the fuel channel bowing increased to half an inch due to whatever factors, would the fuel assembly insert under its own weight?

A With a half an inch of bowing, yes.

Q How much would a fuel channel assembly have to bow before it wouldn't insert under its own weight?

A Approximately .65 inches.

Q And when we are talking about bow, I assume we both mean bow plus bulge; is that correct?

A That is correct.

JUDGE REMICK: Excuse me. I assume that you are are assuming no interference with lead-in clips in that reply?

THE WITNESS: That is correct.

MR. STAHL: Excuse me, Judge Wolf. I would like to have a clarification as to what kind of clearance is being assumed in that question as well, if it's the minimum clearance or something else?

JUDGE WOLF: In relation to your answer, what were you assuming as regards to that?

THE WITNESS: I am assuming in that case that we have the minimum fuel rack dimensions and the maximum fuel channel dimensions. In other words, that we have the minimum clearance that we have calculated.

If either the fuel channel dimensions are less than maximum or the fuel storage position -- fuel storage dimensions are greater than the minimum, then the amount of bowing would increase.

JUDGE WOLF: Next question, Ms. Murray, please.

MS. MURRAY: Judge Wolf, I don't believe I have any further questions.

JUDGE WOLF: Any questions from you, Mr. Goddard?

MR. GODDARD: If I may have a moment.

In view of the hour, I will like to discuss possible questions for Mr. Gilcrest with other NRC staff witnesses and would prefer that we resume tomorrow morning.

I believe you indicated that we would go for about an hour. There is no way that we are going to complete tonight, since in view of the earlier estimate by Ms. Murray, the staff's final witness, Mr. Shaw, has departed for the evening.

JUDGE WOLF: We expect to put him on first thing in the morning; right?

MR. GODDARD: Yes.

JUDGE WOLF: Very well.

MR. GODDARD: If I do have any questions for Mr. Gilcrest, they will not be lengthy.

JUDGE WOLF: We will let you reserve then until the morning with this witness.

MR. GODDARD: Thank you, Judge Wolf.

JUDGE WOLF: And we have come to the end of the period that we had indicated that we would sit tonight.

Dr. Remick has a request to make. Why don't you make that now?

JUDGE REMICK: Mr. Steptoe, it's in relation to the corrections of Mr. Gilcrest's testimony. He indicated reference to interference with the lead-in clips no longer applies.

I find that a little easier to say than to actually do, and I wonder if by tomorrow morning you could indicate how that would change the actual numbers here. I think otherwise the record is going to be very confused.

MR. STEPTOE: Sure, we will do that.

JUDGE WOLF: Do you have anything you want to add?

JUDGE LITTLE: No.

JUDGE WOLF: Well, I think that what we have to decide on is a time for starting in the morning, first.

I feel it's terribly important that we get through the witnesses on this question at this sitting. We still have open, as previously mentioned before, the answers to Board Question 2, which we expect will be finished in a couple of questions, three at the outside, perhaps.

Should we begin at 8:30 in the morning? Is that too

early or too late?

MS. MURRAY: It's not, certainly, too late.

MR. STEPTOE: That sounds fine to the Applicant.

JUDGE WOLF: How about you, Mr. Goddard, 8:30?

MR. GODDARD: 8:30 would be fine, sir.

JUDGE WOLF: In that case then, we will adjourn until 8:30 in the morning.

(Whereupon the hearing of the above-entitled matter was recessed to the hour of 8:30 o'clock A. M., April 21, 1981.)

This is to certify that the attached proceedings before the

Nuclear Regulatory Commission

in the matter of: Spent Fuel Rod Modification - Channel Bowing at Dresden Spent Fuel Pool - Commonwealth Edison, Chicago, Ill.

Date of Proceeding: 4/20/81

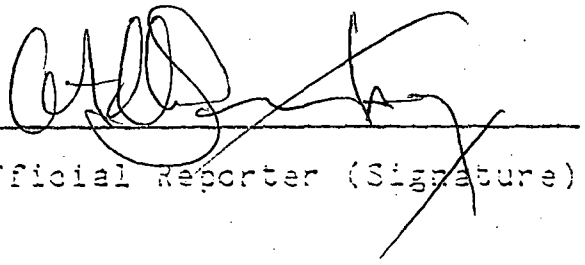
Docket Number: 50-237; 50-249 SP

Place of Proceeding: O'Hare Hilton, Chicago, Ill.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

G. Allen Sonntag

Official Reporter (Typed)



Official Reporter (Signature)