NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

DUKE POWER COMPANY

(Oconee/McGuire)

Docket No. 70-2623

Place - Bethesda, Maryland

Date - Wednesday, 12 September 1979 **Pages** 4274 - 4482

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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THE DUKE POWER COMPANY	Docket No. 70-2623
(Oconee/McGuire)	

Commission Hearing Room,
Fifth Floor, East-West Towers,
4350 East-West Highway,
Bethesda, Maryland.
Wednesday, 12 September 1979.

Hearing in the above-entitled matter was resumed, pursuant to adjournment, at 9:00 a.m.,

BEFORE:

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

DR. CADET H. HAND, Member.

EMMETH A. LUEBKE, Member.

APPEARANCES:

On behalf of the Applicant:

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On behalf of Intervenor Natural Resources Defense Council:

ANTHONY Z. ROISMAN, Esq.,
917 15th Street, N.W.,
Washington, D.C.

On behalf of Intervenor Carolina Environmental Study Group:

JESSE RILEY,
Charlotte, North Carolina

On behalf of the Regulatory Staff:

EDWARD J. KETCHEN, Esq. and RICHARD K.HOEFLING,Esq.,
Office of Executive Legal Director,
U.S. Nuclear Regulatory Commission,
Washington, D.C. 20555

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P R O C E E D I N G S

CHAIRMAN MILLER: We'll convene the evidentiary hearing, please. Is everybody present and accounted for?

MR. KETCHEN: Mr. Chairman, I think we're ready.

CHAIRMAN MILLER: The panel has resumed its place.

Whereupon,

VINCENT T.H. LEUNG,

RICHARD J. KIESSEL,

AND

BRETT SPITALNY

were recalled as witnesses on behalf of the Regulatory Staff, and, having been previously duly sworn, testified further as follows.

CHAIRMAN MILLER: Mr. Riley, the Board hopes you'll be able to conclude with reasonable expedition this cask drop matter. It's a matter the Board will consider, but on the other hand, we don't want to spend an inordinate amount of time on it. Perhaps if you could conclude the whole matter in an hour or so, it would be helpful.

MR. RILEY: Yes, sir.

MR. KETCHEN: Mr. Chairman, I just discussed this with Mr. Riley. Yesterday I think we were having trouble visualizing, at least I was, was the cross-examiner and the witnesses were talking about when they were over there talking, pointing at documents, making markings on documents, so forth

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and so on. I don't think the record reflects that clearly in my view.

CHAIRMAN MILLER: Well, would you care to supplement the record then in order to have it disclose accurately those matters that took place and not accurately reported by the usual method of question and answer?

MR. KETCHEN: Yes, I have a suggestion I was going to make. Over the break, we made some sepia copies of the diagrams which could be drawn on. What I was proposing to do was to get a viewgraph up here, so that when marks are made on an exhibit, that they be recorded, everybody could see it on the viewgraph, the Board could look at it, I could look at it, everybody could point to it and we could have the questions and answers asked. Then at the end of the cross-examination, we could simply Xerox the viewgraph and put it into the record, so visually the Board could see it, the Recorder could have it.

I have the sepias. The only problem that we didn't get taken care of in the time we had was a viewgraph, It would probably take about 10 or 15 minutes for someone to go downstairs and get one. I understand there is one in this building we could drag up here.

In the interim, I think we could continue and fill in the time. It wouldn't require a break, but we could fill in the time with Mr. Spitalny reporting on the questions

asked by Dr. Luebke. He has an interim report on those questions about what we've tried to do. That's the suggestion I have.

CHAIRMAN MILLER: Well we want to proceed and proceed expeditiously. We appreciate the efforts the Staff has made, but I'm not sure we're going to be getting into this sketch that extensively, I would hope not, but we'll see.

MR. RILEY: I thought the matter was pretty much completed yesterday.

CHAIRMAN MILLER: I did, too.

MR. RILEY: But if there are uncertainties in the minds of some members, why I have no objection.

CHAIRMAN MILLER: I take it the viewgraph is for further use of the drawing or marks that would be put upon it, is that right, Mr. Ketchen?

MR. KETCHEN: That's correct.

CHAIRMAN MILLER: And it would not do anything about the past?

MR. KETCHEN: No. That's correct, we're not doing anything about the past. If we continued with the line of questioning, it would be helpful. I have some redirect question myself in which I would like to point to the viewgraph and make some marks on it.

CHAIRMAN MILLER: Well if it's for your benefit, you can be sending for it. In the meantime, I'm encouraging

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Mr. Riley to proceed and proceed expeditiously -- I think you have pretty well covered the matter contained in the drawing anyway.

You may go ahead.

CROSS-EXAMINATION (Continued)

BY MR. RILEY:

Q Mr. Spitalny, one of the things you were going to look up overnight was the matter about when the cask drop question first entered the FSAR. Are you able to tell us now, and if so, will you please?

A (Witness Spitalny) There was a cask drop analysis performed in the FSAR. It did not evaluate the drop of the cask into the spent fuel pool, nor the consequences associated with the cask drop.

Q What was the thrust of it?

A The thrust of the document addresses the fuel handling system and the methods that the cask is manipulated in and about the spent fuel pool area.

The reason for not including such an event is that it has been concluded that that type of accident would not occur and was precluded from happening and therefore was not delved into.

Q What was the concern, then, of the -- This is the first version of the FSAR that we are referring to now?

A No, I guess I should be careful here. Again, I'm

not sure exactly, it was the first version of the FSAR.

Q Well this may have been an amendment to the FSAR?

A That's correct.

Q But you do not know the number of the amendment?

A Not offhand, no.

Q Would it be burdensome to provide that for the record after a recess? Amendments are usually indicated by number.

A They are. My problem is immediate access to the FSAR. My particular copy is in Silver Spring. I know there is a copy in the Phillips Building in Bethesda. It would have to be done over the phone and make sure somebody could find exactly what we're talking about. I would just hesitate to be able to supply that information.

MR. RILEY: Mr. Chairman, in the interest of moving along, could we ask the Applicant to stipulate as to when the cask drop matter was first raised in the FSAR? I think it might expedite things.

CHAIRMAN MILLER: Yes, we'll ask counsel, Mr. Ketchen, about obtaining the information from his witnesses to supply that information of record to the Board and the parties.

Can you do that, Mr. Ketchen?

MR. KETCHEN: Very well, sir.

CHAIRMAN MILLER: Fine, that'll take care of it.

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MR. RILEY: All right.

BY MR. RILEY:

Q Do you know how the specific cases under consideration, both in the FSAR and what Mr. Kiessel referred to yesterday as the interrogation, were determined? In other words, there are three cases there that were inquired into. Who propounded the three cases?

And if you would like to refer to another member of your panel, that's fine, Mr. Spitalny.

A (Witness Spitalny) Okay.

(The witness panel conferring.)

MR. RILEY: Mr. Chairman, while the panel is conferring, was the hour you referred to my hour of cross-examination or did it go farther than that?

CHAIRMAN MILLER: Well, you know, it could be less than an hour of cross-examination.

In other words, we would like to conclude the matter, but we want to give you a fair opportunity.

MR. RILEY: I understand the Applicant has a witness, too, on this matter.

CHAIRMAN MILLER: I was referring to your portion of it.

MR. RILEY: Thank you.

WITNESS SPITALNY: Mr. Riley, I believe it's a little bit difficult to respond precisely.. There are a

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number of different facets that enter into the picture.

If we go back in time, I believe that the initial submittal to the Staff from the Applicant was just a discussion saying that the cask drop accident would not occur. And I don't know at that time....

MR. RILEY: Would the record note that the panel is reconferring.

(The witness panel conferring.)

WITNESS SPITALNY: It's a confusing thing as to when the three cases were known to the Staff.

We do have a copy of part of the FSAR. One particular page shows Revision 10, another page shows Revision 6. I do not have the respective dates of those revisions.

It does look -- it is at least evident from Revision Number 6, there is a diagram of the case number three that we are presently discussing. So it seems as of at least that time that particular case had been considered.

Prior to the cask drop analysis and the allegations that were made by the member of the Applicant back some time ago, there were some considerations of the cask drop, there were questions asked by the Staff to the Applicant. The Applicant responded that we have evaluated a number of conditions. And then subsequently we got into a closer look during the information that transpired after the allegations

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were made, we focused on three cask drop situations.

So really, in responding to you, I'm not really exactly sure when they came about. We are aware of the three and they have come about during the time since Revision 6.

BY MR. RILEY:

Q Would it be correct to conclude that no member of the panel is able to say who propounded the several cases?

(The witness panel conferring.)

A (Witness Spitalny) Yes, that's true.

Q All right.

Does the panel --

A Excuse me. Mr. Kiessel is saying that we should at least say that the Staff did not propound the three cases, and it was probably proposed at least by the Applicant.

Q Thank you, that was going to be my next question, Mr. Spitalny.

Mr. Kiessel, turning to you, will you tell us your calculational procedure with respect to what we've been referring to as case three, the tipping cask?

A (Witness Kiessel) As I indicated earlier, I did no calculations with respect to case three because there was an insufficiency of information to permit me to evaluate how much energy would be dissipated in the crushing of either the cask or deformation of the concrete structures.

Q Well let me ask you this: did you determine where

the center of gravity of the cask was with respect to the base in any of your calculational work?

A For cases one and two, yes.

Q The center of gravity is the same for case three?

A In the initial position, yes, sir.

Q Is the center of gravity at all affected by the position?

A Its relationship to the base is, yes, sir.

Q That's not the question, Mr. Kiessel. Is the center of gravity of a physical object, a mass, affected at all by its orientation?

A No, sir, it is not.

Q That's what I wanted to know.

A In your calculational procedure, did you --

MR. KETCHEN: Objection, Mr. Chairman.

MR. RILEY: I will respond.

BY MR. RILEY:

Q In contemplating your calculation of case three, which you did not carry out, would your mode of calculation have been one in which you calculated the potential energy of the cask with respect to some referenced state, converted that to some amount of kinetic energy related to the cask gyration, and produced the term for energy robbed from the potential energy by say a cask crushing or impact limit or

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crushing or something like that.

MR. KETCHEN: Objection, Mr. Chairman. Relevancy.

CHAIRMAN MILLER: What is the relevancy?

MR. RILEY: The relevancy is to establish the mode of calculation that the Staff's witness would have used if he had had other items of information.

And the point in question is to see how it will relate to CESG's method of calculation, are they the same or are they different.

(The Board conferring.)

CHAIRMAN MILLER: The question seems rather hypothetical in nature to us, which isn't necessarily a vice in cross-examination provided it otherwise be within the parameters, testing methodology, conclusions and the like. But it also seems to be more nearly akin to certain testimony you intend to present.

Therefore, economy would seem to indicate that the Staff has done what they've done or haven't done what they haven't done, which you may delineate briefly and lead on it. And if you're going to go into it any further, it should be done affirmatively by you in your own testimony. On that basis, we will sustain the objection.

MR. RILEY: All right. My only -- if there were doubts in the minds of the Board as to the weight to give my testimony and we can demonstrate that the Staff used the

same analytical approach, it would certainly increase the weight of my testimony. That was the thrust of trying to get this in the record.

CHAIRMAN MILLER: Well it would seem to me the quick and easy way to do it, if you can frame a question in a short compass, indicating the method you used and asking whether or not they have or could have used similar methodology, we would permit it to that limited extent. But we don't want to get into long series of questions about what they did or didn't do when it's really getting into matters that you propose.

Why don't you ask one direct question and see whether they're able to.

MR. RILEY: Right.

BY MR. RILEY:

Q Mr. Kiessel, have you read my testimony in this area?

A. (Witness Kiessel) Yes, sir, I have.

Q Do you find the methodology acceptable?

CHAIRMAN MILLER: That's just methodology, it's not conclusions or it's not the testimony as such, because we do not permit witnesses to comment upon the testimony of other witnesses. So the question is a limited one.

Do you understand that, it is simply as to the validility or acceptability in that sense of the methodology

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employed?

MR. MC GARRY: Mr. Chairman, perhaps a point of clarification I don't think has been established, whether or not the witness is aware of the methodology -- he's aware of the testimony but not the methodology.

CHAIRMAN MILLER: Well that's implicit in the question. He's read the testimony. If he doesn't discern therefrom any methodology, the answer is short and simple, isn't it?

MR. MC GARRY: I would think so.

CHAIRMAN MILLER: Okay.

Proceed. Do you understand the question, Mr. Kiessel?

(Pause.)

WITNESS KIESSEL: Is it my turn?

MR. RILEY: Yes, sir, Mr. Kiessel.

WITNESS KIESSEL: There was no procedure per se that I could follow, i.e., formulas contained in your testimony.

If I am to read between the lines and therefore apply my formulas and assume that those were the ones that you used and carried it one step further, you indicate where certain percentages of the energy must be consumed. This obviously would not lead to a conclusion as to whether or not the cask would fall in. And in place of that, doing

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analysis as to exactly how much energy was dissipated, there would be essentially the same procedure that I would have followed, yes, sir.

MR. RILEY: Thank you.

BY MR. RILEY:

Q Would you agree, then, that the critical question with respect to whether or not the cask will fall into the fuel pool is whether the center of gravity in the cask gyration reaches or passes the plane of the fuel pool wall?

MR. KETCHEN: Objection, Mr. Chairman, it's beyond the scope of this direct testimony.

CHAIRMAN MILLER: WEll it may or may not be beyond the scope, however, if his expertise is applied to this -- Can you answer the question, Mr. Kiessel, are you able to answer the question?

WITNESS KIESSEL: Yes, sir, I am.

CHAIRMAN MILLER: You may answer.

WITNESS KIESSEL: Yes. The cask will fall in, assuming that the cask starts in a particular position.

BY MR. RILEY:

Q The only question was if the center of gravity coincides with or starts to lie over the fuel pool the cask will drop in the fuel pool, and your answer I gather is yes.

CHAIRMAN MILLER: His answer is whatever his answer was, Mr. Riley.

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MR. RILEY: Well his answer made some qualifications.

CHAIRMAN MILLER: Very well, his answer contains the qualifications then.

You may proceed.

MR. RILEY: My problem is, Mr. Chairman, I thought that the qualifications obscured the matter rather than clarified it.

BY MR. RILEY:

Q I'll ask another question, Mr. Kiessel, and that is that if the cask in its gyration has the center of gravity enter the plane of the fuel pool wall, will not the critical question be then the amount of kinetic energy still available to continue the gyration -- Strike that. I'll do it again.

In the cask drop incident, the cask is now in a horizontal position. The neutron shield tank is assumed to be crushed, so the effective radius of the cask is about 15 inches. Is not the critical question at this point the amount of kinetic energy still available for further gyration and whether or not it is sufficient to bring the center of gravity to the plane of the fuel pool wall?

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A (Witness Kiessel) Yes.

Q Mr. Spitalny, I would now like to take up a matter that we didn't get a chance to complete yesterday, and which

you were going to look at overnight, and that had to do with the two aspects that Dr. Luebke also was quite concerned with, namely criticality and release. Would you like to give us your information in that area now?

A (Witness Spitalny) Yes. I can tell you what we have done since we recessed yesterday afternoon.

We have gone back to other areas of the Staff to find out what types of evaluations have been performed. We have found that a cask drop into a spent fuel pool has been considered, and we do have an example of that particular case.

When it is evaluated, it is usually done in two separate evaluations: one being structural damage and what would happen to the integrity of the spent fuel pool, the other one being an evaluation determining radiological consequences.

We have an evaluation that has been performed for the Oconee spent fuel pool, which involved the dropping of a spent fuel cask into the spent fuel pool. That analysis has been performed initially by the Applicant, it has been considered by the Staff and evaluated by the Staff. It was contained in a Safety Evaluation Report which was dated September 10, 1976.

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I do have the Safety Evaluation Report available. The results that are reflected in the evaluation are that

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the possibility of 76 fuel assemblies may be encountered or affected by the cask drop. An evaluation was done relative to the radiological release, and it was determined that they would be within 10 CFR Part 100.

In addition to having these available, we are presently talking with members in the Environmental Evaluation Branch who are the members that have performed the evaluation in not only the Oconee case but in some others and have posed a number of questions to them, one being could it be done for McGuire.

The answer was yes, it could be. The time that would be involved would be considerable, however. By definition of considerable would involve some information from the Applicant which we would normally give them 30 days to respond. And at that time, the Staff might take 30 days to evaluate and make their own assessment.

Another question was has an evaluation for McGuire been done? They have indicated it has not been done to their knowledge.

We have also asked if they could address this particular situation and possibly provide a witness to testify in that area. Apparently that particular question now is being raised to upper management and we haven't gotten an answer back just yet if they will be available and, again, if somebody so desires their presence.

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I think basically that's where we are right now. We can supply more information. We have access to some more information, and we do have the Oconee SER's available.

Q You state that in the Oconee SER of 1976 that the releases fell within the 10 CFR Part 100 limits. Do you have the estimated exposure values in terms of rems, and do you know the assumptions made in terms of the age of the fuel?

A There is a table which does provide, I believe, the information you're asking for. It does discuss the power level at which the plant had operated for this fuel, the operating time, the peaking factor, decay times, the number of assemblies damaged, and it does have -- this is entitled, "Initial Inventories at Time of Shutdown." And I believe it provides it in curies, which I believe is probably what you're looking for.

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Q Aren't curies routinely converted to doses for the set of assumptions that seems appropriate?

My question is, Is it not a routine operation for the NRC staff to convert curies released to dosage?

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A Yes, there is something on that order.

There is a chart that shows at the exclusion area boundary there will be a dose to the tyroid of 150 rems and a whole body dose of less than 1 rem.

The table also shows for the low population zone there would be a dose to the thyroid of 27 rem and a whole body dose of less than 1 rem.

Q Could you more completely identify that document for the record, please? And the specific table, of course.

A The document I have in the entirety is a document dated September 10th, 1976. It is a letter from A. Schwencer, Chief of Operating Reactors Branch No. 1, Division of Operating Reactors, addressed to Duke Power Company, Mr. William O. Parker.

The letter briefly states that the Commission has issued the inclosed Amendment No. 32 to License No. DPR-38, also Amendment No. 32 to License No. DPR-47, and Amendment No. 29 to License No. DPR-55 for the Oconee Nuclear Station.

Attached to this letter are copies of the Safety Evaluation and the Environmental Impact Appraisal. In the Safety Evaluation is the inclosure of this table I was just

referring to.

Excuse me; let me correct that. It's actually attached to the Environmental Impact Appraisal, and it's Table 1.

MR. RILEY: Mr. Chairman, may we introduce this as Intervenor's Exhibit No. 31?

(Whereupon the document referred to was marked for identification as CESG Exhibit No. 31.)

CHAIRMAN MILLER: It has been marked for identification. Is there any objection to its admissibility?

MR. KETCHEN: The Staff has no objection. It's a question of copies, though, I think, for the Reporter. We only have the one copy with us. We can provide at the end of the day or at some break the additional copies.

CHAIRMAN MILLER: All right.

The document then-- What was the number?

MR. RILEY: No. 31, sir.

CHAIRMAN MILLER: It will be admitted into evidence, and the requisite copies may be supplied for the Reporter and the record.

(Whereupon the document referred to, heretofore marked for identification as CESG Exhibit No. 31, was received in evidence.)

BY MR. RILEY:

Q Was this a proceeding exclusively between applicant and staff, or was there an intervenor involved?

A (Witness Spitalny) I don't know, to the best of my knowledge. There has been a Federal Register notice issued on it. I do not know if it was contested.

MR. RILEY: Could we ask Mr. McGarry to stipulate for Duke that there was no intervenor?

CHAIRMAN MILLER: If Mr. McGarry is able to.

MR. MC GARRY: We're not aware of an intervenor, so at this point in time we would so stipulate.

CHAIRMAN MILLER: Very well.

BY MR. RILEY:

Q Now, have you had an opportunity to address the criticality question which was also raised in this area?

A (Witness Spitalny) Yes, we did address it. I have not found an evaluation that has been performed.

I do have--

Q That will do. Thank you.

MR. KETCHEN: Go ahead. Complete your answer.

WITNESS SPITALNY: We contacted the Transportation Branch in NMSS, and they are capable of providing that information.

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We did uncover an evaluation of a sequence of events which I considered worst case sequences in the WASH-1400

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document. I guess I'm not quite sure if that did address criticality.

The real answer to your question is, I did bring it up, we did not uncover something readily available but we do have the capability of performing an evaluation.

MR. RILEY: Thank you.

BY MR. RILEY:

Q Is one of the basic operating premises of the staff a conservative approach to such problems as radioactivity released and criticality events?

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A (Witness Spitalny) If I understand your question, is it the position of the staff to evaluate that?

Q Yes. -- No. Is it the basic posture of the staff one of being conservative with respect to protecting the public from criticality events and radioactive releases which would be of a magnitude to endanger the public health and safety?

A Yes, it is.

Q I will ask each member of the panel separately, then:

Is it true that one critical factor in carrying out the administrative control procedure the applicant has proposed in regard to Case 3 is the performance of the operator?

I'd like to start with you, Mr. Kiessel.

A (Witness Kiessel) From what I've seen here, yes.

Q All right.

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Now are you familiar with a bridge crane, Mr. Kiessel, such as would be used for moving the cask?

A I am familiar with what is called a bridge crane. I'm not familiar with the specific type that would be used for McGuire.

Q You cannot tell us where the operator would be positioned during operation?

A That's correct.

Q All right.

In your view, is it conservative to rely on an operator in an event which may involve criticality or significant release?

MR. KETCHEN: Objection, Mr. Chairman. Based on the hypothetical I think it is inappropriate. There is nothing in this record yet that would demonstrate that that could occur in this case. I don't know if Mr. Riley is ever going to link that up or not. But I think it's an inappropriate hypothetical.

CHAIRMAN MILLER: Mr. Riley?

MR. RILEY: Mr. Chairman, the staff has, in effect, inadvertently, I will admit, got the valve closed with respect to us finding out about whether criticality can occur or not.

We've already shown with the SER for Oconee that a substantial 150 curie release can occur with, well, fairly substantial dosage consequences.

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I think the question is related directly.

(The Board conferring)

CHAIRMAN MILLER: The objection is overruled. We do expect the criticality question to be addressed by the parties of record. This is cross-examination. We cannot require everything to be done at the same time with the same procedure. But we deem it to be relevant, and you may inquire.

WITNESS KIESSEL: With respect to the degree of conservatism associated with either criticality or radiation released, since I am not familiar with the procedures used by the staff in evaluating either of these I cannot address the degree of conservatism that would be associated.

Also I would like to point out that in response to your previous question concerning the location of the operator of the crane, although I do not have that information I have since been informed that Mr. Spitalny does have it, should you care to ask him.

MR. RILEY: Thank you, Mr. Kieseel.

BY MR. RILEY:

Q Mr. Leung, I will ask you a very similar question, and that is: Are you familiar with the detail of the bridge crane where the operator is?

A (Witness Leung) No.

Q All right.

The next question is: Is the posture of the NRC

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one of conservatism in this context?

A I would like to have you define in what context.

Q The context is that of criticality events or radioactive substance releases which would be significant with respect to the health and safety of the public.

A Yes.

Q What is your position, Mr. Leung, with respect to hypothetically having an operator as one of the essential elements in this sequence, Case 3?

A Mr. Riley, we evaluate the procedures, but we do not evaluate performance of the operator. And it is up to our I&E people to enforce that.

Q Thank you.

Mr. Spitalny, would you inform us about the bridge crane?

A (Witness Spitalny) Yes, I will.

The bridge crane is an overhead crane as I hope we have explained yesterday, in yesterday's session. The operator, however, will be walking on the floor. And there is a cable which drops from the bridge crane. The operator holds in his hand a control box and pushes a button to start the forward motion or reverse motion.

Q Or, if I may interject, the raising or lowering of the burden?

A That's correct. He does have the controls in his

hand. He is walking on the floor.

Q For four kinds of movement: longitudinal, lateral, up and down?

A Yes.

Q Do you recall the conservatism question I've asked?

A Yes, I do.

Q And what is your answer to it?

A The answer is that the staff does evaluate such events when they believe it to be necessary, when it is warranted. The conservatism which comes into this hypothetical situation that you have painted for us comes in a different fashion, in that to enable this particular event you have outlined to take place a number of critical events must occur. You have discussed the heart attack of the operator, at which time if he was to fall from the controls....

I guess I would have to ask Duke, if he releases the button does it stop?

The answer is yes, it does; which means basically it works like a deadman switch. If he was to have a heart attack and fall away from it, the crane would stop moving.

Not only would we have to have that one occurrence, something happening to the operator, we would also have to have at that exact time the cask being in the proper location for your sequence to take place. Not only would those two events how have to happen, but the cable or hook would have to fail,

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meaning there would be three events that would have to take place to enable that scenario to happen. And our margin of conservatism comes in in that aspect, precluding the cask accident from happening.

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Q In other words, you're relying on the probability being sufficiently low?

A The probability of three simultaneous events are sufficiently low.

Q All right.

That was a heart attack scenario. Are there other conceivable scenarios which might result in damage?

A Yes, there is. And the one that would eliminate the heart attack and the location possibly would be an intentional or sabotage related event. And we do have regulations which speak to internal sabotage. The operator will not be the only individual in the spent fuel pool area, which would mean not only would the operator have to have it in his head that he would like to perform this action, but he would have to convince, or at least have a team consisting of the members that are in the spent fuel pool area being aware of what he was doing.

Even if they were aware of what he was doing, he could conceivably get the cask into the proper location. I am not sure just yet how he would get the cask cable to fail, the crane cable to fail or the hook to fail. So we still have a double failure mode being -- you have to have all of the people on one side and you have to have the failure of a mechanism.

And even if all these events do take place, we're

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also not sure that the cask would even go into the pool anyway. It may end up at rest on the wall.

Q Are you assuming in the scenario you just described that the event would be slow paced, that there would have to be confederates to the operator?

A I guess I'm not quite sure of your definition of "slow paced". It wouldn't be an instantaneous operation.

Q That's agreed.

A I would need a greater definition of "slow paced".

Q Well, which would permit response time to others present once they had perceived that things were not going according to the administrative control.

A My feeling is that a response time would be available.

Q Mr. Spitalny, if the question lies out your problems I know you will say so, but do you know it to be true that with respect to reactor operation that there are many automated built-in safeguards, such as an emergency core cooling system?

A I am aware of it.

Q Would we be able to conclude that in this set of events that are potentially able to cause hazard to the public health and safety that considerable reliance is placed on automated devices as opposed to operators?

MR. MC GARRY: Mr. Chairman, I'm going to object to

mpb3

the analogy.

It seems to me that we're now,without setting any foundation, drawing analogy between the ECCS and this cask drop accident. And I think we have gone far beyond the scope of this subject area when we start talking about ECCS and operator error questions. I think we should limit ourselves strictly to the cask drop scenario.

MR. RILEY: Mr. Chairman, what we're concerned about is the guarding against a criticality event which at the present time is hypothetical. And we have established that the posture of the Commission is one of conservatism with respect to these matters.

What I'm seeking to demonstrate is the conservatism is implemented by automated devices with regard to the reactor, and that there is no physical system here which would react without requiring human perception and action. And this is the distinction between the two cases, that in one we rely on automated devices very heavily, the other we do not happen to have a physical barrier and we do have an operator.

(The Board conferring.) 1002 247

CHAIRMAN MILLER: Since the criticality question is one that's going to have to be resolved from a full record and is not resolved at this point. At any rate, the Board would not prejudge by attempting resolution. The matter is

mpb4

one which could affect the seriousness with which these matters should be analyzed and considered.

In that event, the Board deems it permissible for Mr. Riley to proceed within reasonable limitations upon this now.

BY MR. RILEY:

Q Do you recall the question, Mr. Spitalny?

A (Witness Spitalny) I would like you to rephrase it, if you would.

Q Yes.

Considering the fact that in regard to reactor safety that automated devices are very largely relied on to carry out the Commission's conservative approach to problems of public health and safety, do you feel that there is a comparable degree of conservatism in the matter of the cask drop if we hypothesize that a criticality event may occur?

A May I....

Q I'd much rather you answered this one, Mr. Spitalny.

MR. KETCHEN: Mr. Chairman, may I also instruct the witness -- I want to make sure that it's not beyond the scope of his expertise and make sure the witness knows that if he can't answer it, he's not required to if he feels that way.

CHAIRMAN MILLER: Well, the witness may be so

mpb5

instructed, but the witness is being proffered and is being received as an expert. And as an expert he is being given the opportunity to express opinions on many subjects.

Now if you're going to start backing up on his qualifications, you're probably going to have a problem on motions to strike, then, portions of his testimony.

I would say that the demonstrated expertise so far with reference to the use of the term "conservatism" and the like should well be within the bounds of a proffered expert witness. If you're going to erode his qualifications you're going to get into serious problems as to an equivalent erosion of his opinion testimony.

MR. KETCHEN: Well, they're all experts. I'm just saying they rely on each other, and he needs --

CHAIRMAN MILLER: On questions of criticality, on questions of conservatism, with that being hypothesized, it would appear to the Board that Mr. Spitalny is well qualified to give his own opinion. Don't ask him to go beyond. And the basis of it may be brought to light either by yourself or the examiner.

This is why we're in his area of expertise, as we understand it.

You may answer, Mr. Spitalny.

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WITNESS SPITALNY: The response that I was going to give is that with regard to the guidelines that have been

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offered by the Commission relative to the design of the fuel handling system, I do not have any jurisdiction over or have not had any input to, and those guidelines have been determined to be satisfactory to the Staff to assure a conservative position for fuel handling systems.

The system which is at McGuire complies with the guidelines that have been recommended for the particular types of cranes involved and the movements involved. And I believe that by providing the type of mechanisms that have been shown to be there, there is a degree of conservatism.

BY MR. RILEY:

Q To your knowledge, Mr. Spitalny, has a cask at this moment in time yet dropped into a fuel pool and come in contact with racks containing assemblies?

A (Witness Spitalny) Not to my knowledge.

MR. RILEY: That will be all, gentlemen. Thank you.

CHAIRMAN MILLER: Thank you.

Any further questions? Mr. McGarry?

MR. MC GARRY: I have no further questions. Just a point of clarification.

Was that CESG Exhibit 31?

MR. RILEY: Yes.

MR. MC GARRY: I only have CESG number 11. Did you just pick 31 out of the air?

mpb7

MR. RILEY: Mr. McGarry, I was using the Marshall System.

(Laughter.)

CHAIRMAN MILLER: All right.

At the end of the hearing we will indicate where there are gaps, maybe for purposes of expediency rather than any non-sequential numbering. But we understand that the number is selected high enough that it will not have a conflict with any precedent exhibit numbers.

Is that right, Mr. Riley?

MR. RILEY: Yes.

Mr. Chairman, I simply wish instruction at this point. We would like to also introduce as exhibits several of the papers I showed the panel yesterday. When will be the time for that?

CHAIRMAN MILLER: Which documents were those?

MR. RILEY: These were portions of the FSAR dealing with the weir gate release, et cetera.

CHAIRMAN MILLER: Well, you may offer them now if they are documents whose authenticity is not subject to question, Similarly that have been or would be otherwise offered.

You may offer them; we'll rule upon them.

MR. RILEY: All right.

CHAIRMAN MILLER: Well, first of all, are there

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any further questions of the panel?

Mr. McGarry has indicated he has none.

Mr. Roisman is not here and has indicated he's not particularly interested from his client's point of view in this aspect of the testimony.

Mr. Ketchen.

MR. KETCHEN: Mr. Chairman, I have a few questions.

CHAIRMAN MILLER: Right. Go ahead.

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REDIRECT EXAMINATION

BY MR. KETCHEN:

Q Mr. Kiessel -- Or anybody, I'm not going to limit my question, I'm asking the questions of the panel. I would like anyone on the panel who can to give me the answer to the question of what is the speed in some relative terms of movement of this cask along the path set forth in Staff Exhibit Number 33.

A (Witness Kiessel) 50 feet per minute.

Q And can you give me some subjective relationship of what 50 feet per minute means, or comparative subjective -- in other words, how fast is 50 feet per minute?

CHAIRMAN MILLER: Well how long do you estimate this courtroom to be?

(Pause.)

CHAIRMAN MILLER: I think an estimate would be sufficient.

(Laughter.)

WITNESS KIESSEL: We're talking of something probably in the neighborhood of 3/4ths of a mile per hour, in that ballpark, 50 feet per minute would be something less than one foot per second, 88 feet per second is equivalent to 60 miles per hour. So therefore we're talking of something in the neighborhood of much less -- something less than one mile per hour, probably in the neighborhood of 1/2 to 3/4ths

mr gb2

of a mile per hour.

It might also be pointed out that an average person can walk at the rate of three to four miles per hour, so it's well within the walking speed of an individual.

BY MR. KETCHEN:

Q In that figure, is that a maximum -- or what are the bounds on that figure of 50 feet per second.

A (Witness Kiessel) In the cask drop analysis, or cask drop description that was submitted by the Applicant that was indicated as the maximum speed of travel of the cask.

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MR. KETCHEN: Mr. Chairman, at this time, I would like to have a document that the Staff's going to offer marked as Staff Exhibit Number 34, and I will have the witness describe the document.

CHAIRMAN MILLER: It may be marked.

(Whereupon, the document previously described as Staff Exhibit 34, was marked for identification.)

MR. KETCHEN: And I have three copies for the Reporter and sufficient copies for the parties.

CHAIRMAN MILLER: Very well.

(Distributing documents.)

BY MR. KETCHEN:

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Q Mr. Kiessel, I would like to ask you to describe --

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or first of all, to lead you a little bit, did you prepare this document at my direction?

A (Witness Kiessel) Yes, sir, I did.

Q And would you describe what you did at my direction -- First of all, before you do that, would you describe just generally the nature of the document?

A Yes, sir. This is a sketch that shows a portion of the administrative control that would be used for the travel of the cask. It only shows the lower route that is shown on Enclosure 1 to the Staff submittal that described it.

In the area where the upper path had been shown, I've shown a couple of positions conceivably of where a cask might be located. One, which I've identified as Position Number 1 is where the cask is located di ectly over the corner. And in what I call Position Number 2, the cask is shown centered over the edge of the cask pit away from either of the corners.

Q So would you just in a little bit more specifics describe the differences between Staff Exhibit 34 and Staff Exhibit 33?

A Staff Exhibit 34, this latest one, was constructed to try and show the direction of fall that a cask would make or would have were it to be released at various points along the edge of the pool -- or excuse me, the edge of the cask

agb4

pit and as such only contains -- for clarity purposes, only contains half of the Applicant's proposed administrative paths.

Q Okay.

Now you have -- okay. Would you describe, then, the purpose of the dotted circle marked Number 1 at the top of the cask, describe the scenario for us of what that dotted circle means and what the dashed arrow means with respect to the administrative controls.

A Yes, sir.

As I said before, Cask Number 1 is centered over the corner of the pit. The arrow indicates the direction in which the cask would tip if it were -- if it was allowed to fall freely. It shows that it receives a component of motion from both the back wall and also from the side of the pit. This is what we were trying to point out in this particular sketch, that in this position the cask does not fall directly toward the fuel pool but rather falls at an angle away from the direct line toward the fuel pool.

Q All right.

Do you have before you a copy of Staff Exhibit Number 33?

A Yes, sir.

Q And do you have Exhibit 1 that was attached to Staff Exhibit 33?

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A Yes, sir.

Q Okay.

I'd like you to direct your attention to the top circle on the left-hand side of Staff Exhibit Number 33, Exhibit 1, which shows the circle of the cask in relation to the visual barrier. Have you got that?

A Yes, sir.

Q I would like to direct your attention back to Staff Exhibit Number 34, to the circle, the dashed circle which is labeled Number 1. And I direct your attention to that circle in relation to the visual barrier, and I would like you to explain to me why there is a difference or an overlap of the circle in one case to the visual barrier and not in the other.

A That's an inadvertent overlap. I'm afraid that in re-creating the drawing, I drew the handrail a little bit too long.

Q So well would you like to correct the drawing orally at this time?

A If I could I would delete the handrail basically between the upper two dots.

CHAIRMAN MILLER: You wanted to delete the handrail from what point?

Mr. Ketchen, why are you offering an exhibit when you're going to start deleting portions of it?

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MR. KETCHEN: Well Mr. Chairman, we had to do this in a rather correct -- the idea of the exhibit is to show not in exactness, but a relationship to the way a spent fuel cask would tip in the areas established. And I'm not really trying to delete it,as the witness indicated, in his haste he just misrepresented that portion of the drawing.

CHAIRMAN MILLER: We wonder what is the utility of proceeding with a drawing which is to correct something else which is also subject to correction as you go along, it doesn't seem very neat.

MR. KETCHEN: YEs, sir, I agree.

CHAIRMAN MILLER: Well perhaps you have a purpose.

MR. KETCHEN: No, I didn't have a purpose, I just noticed the discrepancy as I was cross-examining and I wanted to make sure the discrepancy was corrected.

CHAIRMAN MILLER: Okay. You may proceed.

BY MR. KETCHEN:

Q Mr. Kiessel, I'd like to direct your attention to Staff Exhibit Number 34, tothe upper circle that you had drawn in dashed lines, and I think it's marked with Number 2. And explain the reason for creating that circle and the dashed arrow and what this is supposed to demonstrate.

A (Witness Kiessel) Yes, sir. It is to demonstrate that if a cask were to fall from a position where it was in contact with the edge of the pool, that it would fall toward

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the -- I'm sorry, in contact with the edge of the cask pit, that it would fall toward the center of the pit and in a direction so that it would not fall toward the fuel pool at all. This would be the case anywhere along that edge where it did not have contact -- or where it was only in contact with the edge of the pit.

Q Thank you, Mr. Kiessel.

MR. KETCHEN: That completes my redirect.

CHAIRMAN MILLER: Any further cross-examination?

MR. RILEY: Yes, sir.

RECROSS-EXAMINATION

BY MR. RILEY:

Q Mr. Spitalny, I think that you and Mr. Kiessel may wish to combine on this one.

We've noted that the 50 foot per minute rate of movement of the cask on the rail is approximately 10 inches per second. And if an operator were bent on sabotage, would it be true that the first notification that others in the area would get that something was amiss would be when the line of centers of the cask crane on the third and final leg of crane movement was crossed. Is that correct?

MR. KETCHEN: Objection, Mr. Chairman, this is beyond the scope of the redirect.

CHAIRMAN MILLER: You may answer.

MR. RILEY: Mr. Chairman, we --

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CHAIRMAN MILLER: You may answer.

WITNESS SPITALNY: Yes.

BY MR. RILEY:

Q All right.

For the time for the cask, then, to go from that point to a position over the handrail side of the pit such that a portion of the base rested over the pit floor at that point be approximately five to six seconds?

(The witness panel conferring.)

A (Witness Spitalny) Yes.

Q Thank you.

MR. RILEY: That will be all.

CHAIRMAN MILLER: Anything further? Mr. McGarry?

MR. MC GARRY: No question, Mr. Chairman.

CHAIRMAN MILLER: Very well. I take it that's all.

MR. KETCHEN: Nothing further, Mr. Chairman.

CHAIRMAN MILLER: Thank you, the panel is excused.-- Oh, I'm sorry, my colleagues have questions.

DR. HAND: I had one question from some of that discussion yesterday concerning the stop that's going to limit the movement of the crane toward the fuel pool.

EXAMINATION BY THE BOARD

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BY DR. HAND:

Q I take it that stop is not there at this moment,

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that's something that's going to happen?

A (Witness Spitalny) No, it is there. I do have a diagram that may help you.

Q Well, what I wanted to know was does the crane that handles the fuel cask ever have occasion to go on over the fuel pool, is that crane used to handle --

A No, it is not.

Q -- fuel bundles?

A -- it is a crane that moves the fuel bundles, the fuel assemblies. The tracks that the cask-handling crane ride on do not extend over the fuel pool, they physically stop.

Q So it's a crane that stops, it's not removed for some other operation?

A There are no tracks that exist, the tracks acually stop so it cannot go chat way.

Q Fine. Thank you.

CHAIRMAN MILLER: Dr. Luebke?

BY DR. LUEBKE:

Q The word "administrative control" has been used quite frequently, and if the potential consequences are serious which probably prompted the original initiation of these analyses of cask drop cases, it seems to me a good administrative control would be to build a high solid wall between the cask pit and the fuel pool. Is there anything that mechanically prevents doing that?

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A (Witness Spitalny) Yes, I guess. There is need for the crane which handles the spent fuel assemblies, which is operating over the spent fuel pool area, to come over the cask area. When the fuel assembly is lifted out of the cask and removed from the cask unloading pit into the spent fuel pool area, you are using a fuel handling crane which would have to have the need to travel over the cask pit and the spent fuel pool.

Q And it needs all the clearance to the floor?

A It could be conceivably possible, I guess, to construct a wall which would have to have a gate in it to allow the passage of the fuel assembly as well as the hoist and anything that may get in the way. It would be a restriction as far as visibility and clear operating characteristics.

Presently, when you stand on the floor overlooking the cask pit and the spent fuel pool, you have good visibility to the operations that are going on, so it would be a hindrance in that respect. It would not be a physical hindrance as far as being in the way if that gate is provided.

Q The operator of the second crane is also walking around on the floor with control and he needs the visibility?

A I believe that the second crane -- and again I would like to refer to Duke -- this is a bridge crane which travels all over the spent fuel pool, but I believe

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that the operator is riding on this trolley, that is correct, the rider is on the bridge crane.

Q Well I don't mean to make it a condition today, but if push came to shove, and the radiological consequences of an accident really turned out to be serious, one could think about putting --

A I would also point out there are many other fixes which are much easier than that.

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CHAIRMAN MILLER: Anything further?

MR. RILEY: Yes, Mr. Chairman.

CROSS-EXAMINATION ON BOARD QUESTIONS

BY MR. RILEY:

Q Would you tell us what these other fixes are, Mr. Spitalny?

A (Witness Spitalny) There is the possibility of employing the use of a sling, which is a secondary means, in addition to that of the failure of the crane or the cable such that if the crane or the cable, something was to fail, the sling would hold the cask from moving in the direction of the spent fuel pool.

There is also something which is referred to as the magic crane, which has greater redundant mechanisms for failure modes, which is used in only extreme situations where for some reason there is a problem which is uncovered. It is usually above and beyond that that is required by the guidelines from the Commission, and if it is shown that you meet the guidelines and the criteria established by the Commission, the use of this crane is not needed. It could be possible to construct, rather than the wall, a similar structure just out of an I-beam structure which might --

Q Would that be essentially an open work structure where there is visual continuity between the pit and the --

A That's correct. And again, you'd have to make

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sure that the -- Let me back up a minute, if I may.

The crane that's involved in the spent fuel pool which is riding just on top of the pool, we might not be able to put it in the structure at that point. You cannot put in any structure because the crane does have to travel from the spent fuel pool over the cask pit. So we can't impede the traveling area of the crane.

It's a different type of crane than the overhead bridge crane.

Q Not to really cut off the flow of your other fixes, but just to get a bit more on this one:

Would it not be possible to firmly support in the fuel pool wall I-beams or pipes or rods so that you could make an open work wall where you did not have a visual barrier and it still did not interfere with the path of the crane?

A The crane is traveling on tracks adjacent to the walls of the spent fuel pool.

Q Right.

A And it is just a bridge crane which gaps the spent fuel pool. I am not sure -- Duke could probably provide what the distance is and the tolerance between the area being the top of the floor or the top of the pool and the bottom or lower portion of the crane. But I do not believe that you would be able to construct anything in that area which would leave clearance for the crane and still suffice

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to stop the cask.

Q Are you able to say what the dimensions are -- I guess you've just answered that question.

You're saying you do not know the height of the rail. You do not know the maximum height of travel of the fuel assembly crane hook.

I'm sure you do know the length of the fuel assembly.

A Yes, I'm familiar with what the length of the fuel assembly is. The fuel assembly is not taken out of the pit. There is a gate between the cask pit area and the spent fuel pool so that it is never taken out of water.

But you do have to have the room for the cable which is now holding that, or it may be a hard mechanism rather than a cable and an arm.

Q Would it be correct, then, to say that if you design a two segment wall which had open space for visability reasons that you could allow a slot for the cable to move through while it carried the assembly into the pit region?

A I don't believe we can build anything high enough that will allow for the clearance of the crane.

Q Could you tell us, find out for us what the minimum clearance required for the bridge crane is?

Well, if Duke is going to have witnesses in this matter, I can hold it until then.

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A I believe the Applicant is better qualified to respond to that than I am.

Q Now one question for Mr. Kiessel at this point, and that is that if we assume -- and this is a hypothetical now -- that there is some space for building up an acceptable type of wall, will not the kinetic energy requirements for the cask to get into the fuel pool be increased, producing the likelihood of the accident, or the possibility of the accident?

A (Witness Kiessel) Assuming that your scenario has started, yes. Then the probability of it going over this elevated barrier would be reduced.

Q Returning, Mr. Spitalny, to you, would you continue with your rehearsal of fixes?

A (Witness Spitalny) I think my rehearsal really has ended. I was just pointing out that there are some other techniques which, the use of the sling, for example, would be a much easier fix. The use of these other methods would be used only if for some reason it was determined that there was a need for it.

We have determined, the Staff determined that the crane that exists presently at McGuire with the use of these controls will preclude the accident.

Q All right.

One last question, Mr. Spitalny, and this is to

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make the record precise.

If we consider the rail direction of the crane for the cask at 90 degrees to the rail direction, is the 50 foot per second velocity, does it apply to both of these movements, or does it apply only to the rail direction movement?

MR. MC GARRY: I'm going to object to the question as beyond the scope of the Board's questions, and, thus, beyond any --

CHAIRMAN MILLER: Well, we'll permit the answer. This is the last question?

MR. RILEY: This is the last question.

CHAIRMAN MILLER: You may answer.

WITNESS SPITALNY: I do not know, nor do the members of the panel for certain. We would have to check it out. Maybe the Applicant can respond.

MR. RILEY: Thank you.

CHAIRMAN MILLER: Does that conclude, now, the examination?

(No response.)

CHAIRMAN MILLER: Very well.

The panel is excused. Thank you.

(The panel excused.)

CHAIRMAN MILLER: We'll take about a 15 minute recess.

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(Recess.)

CHAIRMAN MILLER: We'll resume the evidentiary hearing, please.

What testimony or witnesses do we have next?

MR. MC GARRY: The Applicant has some witnesses. Perhaps we'll call them at this point.

CHAIRMAN MILLER: Very well.

MR. MC GARRY: I'd like to call Mr. Hager, who has been previously sworn, to the stand, and Mr. Clarence Ray, who has not been sworn.

I would request that Mr. Ray be sworn at this time, Mr. Chairman.

CHAIRMAN MILLER: Very well.

MR. RILEY: May I interrupt for a moment, Mr. Chairman.

Would this be the time to introduce this exhibit that I referred to?

CHAIRMAN MILLER: Well, probably not. First let me get the witnesses sworn.

Mr. Ray, would you raise your right hand, sir?

Whereupon,

S. B. HAGER

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

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and

Whereupon,

C. L. RAY, JR.

was called to the stand as a witness on behalf of the Applicant, and, having been first duly sworn, was examined and testified as follow :

CHAIRMAN MILLER: What was your offer of evidence?

MR. RILEY: Could I offer a series of documents, all of which have been received by Staff and parties, in evidence?

CHAIRMAN MILLER: Why don't you wait until you proffer your testimony, and then you can do it all at once.

MR. RILEY: Thank you. I just didn't want to miss my opportunity.

CHAIRMAN MILLER: Thank you.

DIRECT EXAMINATION

BY MR. MC GARR :

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

A My name is Clarence Lee Ray, Jr.

Q Mr. Ray, have you prepared a statement of professional qualifications for use in this proceeding?

A Yes, sir.

Q Do you have that statement before you at this time?

A Yes, sir.

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Q Do you have any corrections or additions to make to that statement?

A No, sir.

Q Do you adopt that statement as your statement of professional qualifications for use in this proceeding?

A Yes, sir.

MR. MC GARRY: Mr. Chairman, Mr. Porter has handed out the appropriate number of copies to the Reporter, as well as to the Board and parties, and I would request that the statement of qualifications of Mr. C. L. Ray, Jr. be marked for identification as Applicant's Exhibit 26, and be received in evidence and bound into the record as if read.

CHAIRMAN MILLER: Are there any objections?

(No response.)

CHAIRMAN MILLER: Very well. It may be received into evidence and bound into the transcript.

MR. MC GARRY: Thank you, Mr. Chairman.

(Whereupon, the document referred to was marked as Applicant's Exhibit 26 for identification and was received in evidence.)

(The document referred to follows:)

QUALIFICATIONS STATEMENT
OF
C. L. RAY, JR.
DESIGN ENGINEER, CIVIL/ENVIRONMENTAL DIVISION
DESIGN ENGINEERING DEPARTMENT
DUKE POWER COMPANY

My name is C. L. Ray, Jr. My business address is 422 South Church Street, Charlotte, North Carolina 28242. I am a Design Engineer in the Civil/Environmental Division, Design Engineering Department, Duke Power Company.

I graduated from Old Dominion University in June, 1970 with a Bachelor of Science degree in Civil Engineering.

From June, 1970 to present, I have been employed by Duke Power Company in the Design Engineering Department. Assignments have been in civil engineering design work on thermal (coal and nuclear) and hydro plants. In May 1977 I was promoted to Design Engineer and assumed supervisory responsibilities for a group in the Structural Section of the Civil/Environmental Division in June 1977.

Since graduation from Old Dominion University in 1970, I have attended various continuing education and technical courses.

I am a member of the American Society of Civil Engineers and a registered professional engineer in North Carolina and South Carolina.

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MR. MC GARRY: I would propose at this time to commence direct examination of these witnesses, unless the Board or parties has some voir dire questions for Mr. Ray.

CHAIRMAN MILLER: Does anyone request voir dire examination of the experts?

MR. RILEY: One question, Mr. Chairman.

CHAIRMAN MILLER: Yes.

VOIR DIRE EXAMINATION

BY MR. RILEY:

Q Mr. Ray, I take it you are the engineer who was involved in the analysis of case three on the cask drop problem.

A (Witness Ray) For the NFS-4 cask.

Q For the NFS-4 cask.

And would the substance of the responses in a recent letter to Mr. Denton -- I'm sorry, a March 2nd letter to Mr. Denton concerning the case three matter be based, then, on your work?

A I'm not familiar with the letter.

MR. MC GARRY: If I may hand that letter to Mr. Ray.

MR. RILEY: Yes.

(Document handed to the panel.)

WITNESS RAY: Yes, sir.

MR. RILEY: That will be all. Thank you.

CHAIRMAN MILLER: Thank you.

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You may continue.

MR. MC GARRY: I'll address these questions to both members of the panel.

DIRECT EXAMINATION (Resumed)

BY MR. MC GARRY:

Q Gentlemen, are you the persons at Duke Power Company responsible for analyzing the cask drop scenarios at McGuire Nuclear Station?

A (Witness Hager) Yes.

A (Witness Ray) Yes.

Q And in this capacity has your attention focused on what has been identified just recently by Mr. Riley as case three cask drop accident?

A (Witness Hager) Yes.

A (Witness Ray) Yes.

Q Mr. Hager, would you please explain your role in analyzing the cask drop scenarios with particular reference to case three?

A (Witness Hager) I am chief engineer of the civil environmental division and as such the analysis was performed within one of my section, the structural section of that division.

Q Did you meet with members of that division --

A Yes.

Q -- on this particular matter?

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A Yes.

Q You discussed it with them thoroughly?

A Yes, I did.

Q You asked them for the basis of their conclusions and their analyses?

A Yes.

Q You satisfied yourself that you obtained all their relevant information?

A Yes, I reviewed it and determined that it was relevant.

Q And, Mr. Hager, based on your discussions with people in that division, were you able to reach a conclusion?

A Yes.

Q And what conclusion did you reach with respect to case three?

A My conclusion was I concurred with the individuals that performed the analysis that the cask would not fall into the pool.

Q Mr. Hager, has Duke Power Company to your knowledge submitted what can be styled as an administrative control that would be relevant to the case three scenario?

A Yes.

Q And what was the purpose of that submittal?

A The purpose of the addition of the administrative control was to add additional assurance which would prevent

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the cask from tipping into the spent fuel pool.

Q Is it your professional opinion that it would be likely that this administrative control would be violated?

A It is my opinion that it is not likely that it would be violated?

Q And what's the basis for that opinion, Mr. Hager?

A It is based on that we have detailed written procedures for the cask operator to follow. In addition, those procedures are audited to assure that the cask operator is following the detailed procedures.

Q Is the cask operator trained in these procedures?

A Yes. He is walked through the procedure.

Q In your judgment, Mr. Hager, is it likely that the administrative control would be violated, and while being violated the cask will drop?

A No. It is my judgment that those would not occur.

Q Is it your judgment that it is likely that the administrative control would be violated and the cask would drop, and when it drops it will fall on the precise spot that has been analyzed in case three?

A It is my judgment that all of those occurring simultaneously would probably not happen.

Q Mr. Ray, likewise, would you please explain your role in evaluating this cask drop situation?

A (Witness Ray) I performed the analysis of case

mpb5

one, case two and case three for the NFS-4 cask.

Q Would you please explain to the Board and the parties exactly the procedure you went through in analyzing case three?

A In analyzing case three we first obtained the Nuclear Fuel Services drawings of the NFS-4 cask to obtain the dimensional parameters and the weight of the cask. Using these parameters we first looked at a prefiled drop of the cask to the edge of the pit wall.

In evaluating this we considered the fact that there is an energy absorbing device on the end of the cask, and if dropped, this device will deform and provide some energy absorption from the free-fall drop.

Looking at this --

Q Mr. Ray, just so the Board and the parties can follow us, you made a reference to a device.

MR. MC GARRY: With the Board's indulgence, I'd like to --

CHAIRMAN MILLER: Yes.

(Pause.)

MR. MC GARRY: Mr. Chairman, may I just go off the record for a moment?

CHAIRMAN MILLER: Yes.

Off the record.

(Discussion off the record.)

CHAIRMAN MILLER: Back on the record.

MR. MC GARRY: Mr. Chairman, I've just handed to the Board and the parties, and three copies to the Court Reporter, a document I would request be marked for identification as Applicant's Exhibit No. 27.

CHAIRMAN MILLER: It may be so marked.

(Whereupon the document referred to was marked for identification as Applicant's Exhibit No. 27.)

CHAIRMAN MILLER: Is there any objection to this document?

(No response)

CHAIRMAN MILLER: It may be admitted into evidence.

MR. MC GARRY: Thank you, Mr. Chairman.

(Whereupon the document referred to, heretofore marked for identification as Applicant's Exhibit No. 27 was received in evidence.)

BY MR. MC GARRY:

Q Mr. Ray, would you please continue your description of your analysis of Case 3 and make reference to Applicant's Exhibit No. 27 as convenient, so the Board and the parties can follow precisely your methodology in approaching this problem?

A (Witness Ray) Yes, sir.

I was in the midst of discussing the assumptions involved in considering the casks being dropped from an elevation higher than that shown in the sketch at the top of Exhibit 27.

The large diameter end of the cask that is shown resting on the wall is an impact limiter. This device is made up of half-inch bottom plate with quarter-inch rings. It's approximately a 50-inch diameter quarter-inch ring with an interior ring, also quarter-inch, of approximately 38-inch diameter. --I'm sorry; 34-inch diameter.

This ring-- The exterior and the interior rings form an 8-inch void around the perimeter of the impact limiter, with the center portion filled with balsa wood.

There are some three-eighth inch stiffners. There are eight, equally spaced around the impact limiter.

Q Mr. Ray, just so the record is clear: The impact limiter you have just been referring to is the rectangle at the bottom of the very top figure on the page; is that correct?

A That's correct.

This device is designed to absorb energy during a drop of a cask.

If we consider that the cask is dropped from its four-foot elevation, or some other elevation, there will be some deformation of this device.

Q Mr. Ray, what is the maximum elevation that casks

can be dropped from?

A Four feet.

If the cask impact limiter deforms, the center of gravity of the cask, as shown in that sketch, would be lowered by the amount of the deformation.

Q Mr. Ray, excuse me. I apologize for inserting my comments. But, for clarity of the record, you just made reference to the center of gravity.

A That would be the circle with the hash marks through it and the darkened areas.

Q In the middle of the top figure; is that correct?

A That's correct.

Q And how far is that center of gravity from the lefthand side of the top figure? Do you have the distance?

A It's in the center-- The water jacket is approximately 39 inches diameter; I think the exact dimension is 39.2. So that dimension from the edge of the water jacket to the center of gravity would be half of that 39.2 dimension.

The location of the center of gravity used in the analysis of the plane of the cask pit wall was 19.5 inches. If you draw a line vertical from that lefthand wall that would be what I am referring to as the plane of the wall.

Q And the lefthand wall is that line which is touched by an arrow, and the arrow has a line, and on top of that line is "9 foot;" is that correct?

wb4

A That's correct.

Q And so the wall you're referring to is the lefthand side of that 9 foot line?

A That's correct.

Q --in the top figure; is that correct?

A Yes, sir.

If we assume that there is deformation of -- or if we take into account the deformation of the bottom impact limiter, as I said, the CG -- the center of gravity -- would be lowered. If the center of gravity is lowered, then it results--after the falling of the cask, then it requires more energy to tumble the cask into the fuel pool, or rotate the cask into the fuel pool.

Therefore in the analysis we assumed there was no deformation of the impact limiter and the cask would be resting on the wall at the point of release, as shown in the sketch at the top of the page where the truck cask is shwon in a vertical position with the center of gravity being 19-1/2 inches off the plane of the lefthand wall and at rest.

The cask is now assumed to be released and goes to the position, the next position of the cask where it is at an incline to the wall, as shown in the top sketch.

The water jacket itself is a very thin plate, and the dotted line shown on the cask is the actual structural shell of the cask. And as the cask strikes the wall the water

jacket would deform, and the point of impact would be on the stiff shell after some amount of energy absorption in this deformation process.

So the energy that is available is at its maximum just prior to thatinitial impact. This energy is the product of the weight of the cask times the distance that the center of gravity has been lowered in the process of the tipping.

As you can see, the center of gravity of the cask does line up with the point of impact on the wall. For this case there would be no effect of the impact on the rotational ability of the cask.

When doing an energy calculation we are going to take the energy that's available due to the drop, which is potential energy that has been transformed into kinetic energy, and use that to determine how much energy is left to rotate the cask on the wall.

Kinetic energy can be divided into two types of energy. There is translational kinetic energy and there is rotational kinetic energy. These two energies are represented by the term $1/2\ MV^2$, one-half the mass times the velocity squared, for the translational kinetic energy, and $1/2\ J_{in}$ polar moment of inertia times omega squared, or the angular velocity squared. And this is the rotational kinetic energy.

With the CG -- the center of gravity -- impacting, or in line with the point of impact, the impact has no effect

on the rotational kinetic energy.

In constructing our scenario of Case 3 we looked at these two types of energies and, as I said, assumed that we would conserve all rotational energy. Then we looked at the translational component of the energy.

We first looked at the case where all the translational energy is not absorbed, and we investigated what would happen if the energy was not absorbed. In that case there would be a rebounding due to the energy that is remaining if the energy is not absorbed. The rebounding would be away frm the fuel pool wall, therefore displacing the center of gravity farther behind the wall.

If the center of gravity is displaced farther behind the wall it will take more energy to rotate the cask to the position shown in the bottom sketch.

Therefore it was concluded that a conservative assumption would be that the translational component of energy is absorbed by the impact, by deformation of the cask and the flexure and deformation of the wall. If we assume this, then the center of gravity will remain in its closest position to the fuel pool and the rotational energy would have its full effect.

Therefore, at this point of impact we have absorbed the translational energy and maintained all rotational energy.

The cask, due to the rotational energy, will then

proceed to go to the horizontal position shown in the bottom sketch. It will then impact the wall on the surface of the top of the wall, the three-foot wall, and it still has retained the rotational energy.

There is some translational energy loss here, but it is very nominal.

We basically retain the bulk of the rotational energy.

Therefore the cask will now proceed to rotate about the fuel pool edge of the three-foot wall.

The energy that is remaining to rotate the cask will rotate the cask to the position shown in the bottom sketch, illustrated by the angle theta. This angle is approximately 41°. Once the cask rotates to this position it has lost all energy and motion is stopped instantaneously.

Then the cask will fall back to its horizontal position on the wall.

Based on this analysis we concluded that the cask will not fall into the fuel pool.

Q Thank you, Mr. Ray.

Gentlemen, is it your opinion that Cases 1, 2 and 3 encompass the most extreme cask drop scenarios for the McGuire Nuclear Station?

A Yes, sir.

Q Reference has been made, gentlemen, to the crane

that would carry the subject cask of Applicant's Exhibit 27. What is the size of that cask in terms of the load that it can carry? --of that crane; I'm sorry.

A The cask handling crane is a 125-ton overhead crane.

Q And, again, the size of the cask is how many tons?

A The NSF-4 truck cask is approximately 25 tons, or 50,000 pounds.

Q Is this crane, to your knowledge, tested, are the components tested? Does it have any built-in conservatism, to your knowledge?

A The crane is load tested to a load of 125 percent of the rated load.

The design is the crane is in accordance with our specifications, and also CMA-70, which is Crane Manufacturers Association No. 70, which requires that the rope and mechanical components of the crane have a safety factor of 5 against failure.

Q What does that mean in layman's terms?

A For instance, the rope is tested for breaking strength, and then the allowable load for the rope is the breaking strength divided by 5.

The gears are analyzed and the allowable stresses in the gears are one-fifth of their ultimate strength.

Q Gentlemen, to your knowledge, has Duke Power Company

ever dropped a cask in the situations that you have considered in Case 3?

A No.

A (Witness Hager) No, sir.

Q Have they dropped a cask, to your knowledge, in any situation?

A No.

A (Witness Ray) No.

Q To your knowledge, has any utility experienced a cask drop?

A (Witness Hager) No.

A (Witness Ray) No, sir.

Q To your knowledge, has Duke Power Company examined the consequences that would be associated with a cask falling into the spent fuel pool?

A Yes. An investigation was made of the consequences of dropping the NSF-4 cask into the spent fuel pool. The first part of that investigation was to look at the structural capability of the fuel racks themselves to determine whether there would be any substantial structural damage to the racks from the drop of this 25-ton cask.

Q What was the result of that structural analysis?

A The results of that investigation showed that there would be no major structural damage, only possible local bending of the immediate surface of the fuel racks.

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Q And what was the second phase of the examination?

A The Oconee fuel protrudes above the top of the fuel racks, therefore any fuel that the cask falls on would be damaged by the dropping of the cask. By taking the projection of the cask over the fuel it was determined that approximately sixty fuel cells would be damaged.

This information was provided to our nuclear engineers, and they investigated the consequence of the damage to these sixty Oconee fuel cells. Their conclusion was that there would be no offsite exposure in excess of the guidelines of 10 CFR 100, and stated that we were well within the guidelines of that document.

Q Mr. Ray, would you characterize the results of a cask drop into the spent fuel pool as a mechanical rupture or as a criticality event?

A The fuel damage would be a mechanical rupture releasing the gases and so forth from the fuel itself. There would not be a criticality problem.

Q And why not, sir?

A In order to have a criticality problem you have to get the fuel in what would be determined as a critical configuration. With no major structural damage of the racks the fuel is retained in its same basic configuration and, therefore, criticality is not a problem.

There is also the fact that the fuel pool is filled

W bll

with borated water, and the amount of boron, in the judgment of the nuclear engineers at Duke, is sufficient to prevent criticality even if the configuration, the critical configuration could be -- could happen.

But, as I stated, the structural damage is very minimal and, therefore, would not cause this situation.

Q Gentlemen, in conclusion, is it your conclusion that the cask will fall in the spent fuel pool under Case 3?

A No.

A (Witness Hager) No.

MR. MC GARRY: I have no further questions, Mr. Chairman.

CHAIRMAN MILLER: You may inquire, Mr. Riley.

MR. RILEY: Mr. Chairman, we have a small problem here that I would like to mention.

We would like to have the time to assimilate the testimony that has just been given, since there was no opportunity to prefile it. Would it be a proper thing to request an opportunity to do so?

CHAIRMAN MILLER: What is your request?

MR. RILEY: A little more time to study the information that was provided by applicant's witnesses, which was, ofcourse, just given in the last few minutes, and there was none of the usual opportunity to examine prefiled material.

CHAIRMAN MILLER: Well, prefiling is not essential.

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It is permitted but it is not essential. In fact I think we've allowed you, haven't we, on occasion to have direct testimony that was not prefiled?

MR. RILEY: That is quite correct.

Well I'll try to proceed, then, Mr. Chairman.

CHAIRMAN MILLER: Well, let me inquire of the staff.

Does the staff have any questions of the panel?

MR. KETCHEN: No, I have no questions.

CHAIRMAN MILLER: How much time are you requesting?

MR. RILEY: Well I certainly don't want to inconvenience the Board and the parties. Perhaps this, Mr. Chairman: Move it along until a reasonable luncheon recess time, and if I haven't gotten into these areas then perhaps do something with it during the lunch break.

CHAIRMAN MILLER: We can recess now until one o'clock, which would accelerate lunch perhaps for some, and give you time to cogitate on this problem.

MR. RILEY: If this is agreeable to the other parties as well as the Board, why, then....

CHAIRMAN MILLER: Let me inquire:

Is there anything further that any counsel have now of these witnesses other than the cross-examination by Mr. Riley? Anything further?

MR. KETCHEN: Nothing further.

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CHAIRMAN MILLER: Apparently that's all that remains with reference to this panel.

So, in that event, it is still an hour and a half that we'll be taking lunch, which we will accelerate by half an hour.

We will recess at eleven-thirty until one o'clock.

MR. RILEY: Thank you.

(Whereupon, at 11:30 a.m., the hearing in the above-entitled matter was recessed, to reconvene at 1:00 p.m., the same day.)

AFTERNOON SESSION

(1:00 p.m.)

CHAIRMAN MILLER: Are we ready to proceed?

MR. KETCHEN: Yes, Mr. Chairman. I'd like to bring a matter to the Board's attention.

CHAIRMAN MILLER: Very well.

MR. KETCHEN: During the luncheon break, or when I returned from lunch, I found on my desk an envelope to Counsel for NRC Staff with the instruction please distribute to all parties present at the hearing and to the Board members, Mr. Mallory, Office of the General Counsel of the Commission.

I have placed copies of a letter dated -- the letter in the envelope -- I have place copies of that letter before the Board on the bench and I have furnished copies to the parties' counsel and representatives.

CHAIRMAN MILLER: Thank you. The record will show that we have received the copies to which counsel alludes, the letter dated September 12, 1979 re the Transportation of Fuel Question, Route Information, signed by Leonard Bickwit, General Counsel. That is the document?

MR. KETCHEN: That is the document, Mr. Chairman.

CHAIRMAN MILLER: Thank you. The record will show that copies have been received and have been perused.

All right, who wishes to proceed now with our taking of evidence?

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Mr. McGarry, you had concluded the presentation of your panel, had you?

MR. MC GARRY: That's correct, Mr. Chairman.

CHAIRMAN MILLER: And had cross-examination been completed, Mr. Riley?

MR. RILEY: No, sir, Mr. Chairman. I would like to go forward at this point, but would like to preserve the opportunity to resume if, on reading the transcript, I find that there are some matters that I did not pick up as a result of only having my own notes. I would also like the record to show that I hand-delivered my testimony to Duke on this matter on the date prescribed, which was the 4th of September.

CHAIRMAN MILLER: Well I don't think we can enter into bargains for piecemeal presentations. If the opportunity presents itself and you have some matter you wish to go into, but I don't think we can keep on pyramiding the re-appearance of witnesses who are testifying.

We have accorded you, as a matter of courtesy, the opportunity to obtain information through counsel and the like, but I don't believe that we can extend either to you or anyone else much beyond that point. However, we're hopeful by your cross-examination you will be able to cover the matters you have in mind, Mr. Riley, so why don't you proceed?

MR. ROISMAN: Mr. Chairman, I don't understand.

These witnesses didn't prefile any testimony.

CHAIRMAN MILLER: That's correct, but they weren't required to.

MR. ROISMAN: Why not, Mr. Chairman? The cask drop issue was an issue that even the Staff prefiled on that issue. The parties were on notice. Mr. Riley did. Why was the Applicant exempted from it?

CHAIRMAN MILLER: Because it was not an issue. It became an issue, and we allowed amendment in the exercise of our discretion. It is true that the matter had come up, but it was subject to discussion between Applicant counsel, and it was picked up apparently by Mr. Riley. But it was not then an issue. It became an issue as a result of our exercising discretion.

MR. ROISMAN: Well, but as I understand it, the question of whether it was an issue was itself an issue. Why wasn't the Applicant required, and shouldn't they have been required to have produced the testimony in anticipation that it might become an issue on the 4th, as the Staff did and as Mr. Riley did?

Now Mr. Riley is forced without having a copy of their testimony in front of him to try to cross-examine them, which is, as we know, not favored in NRC proceedings. And I was asking for - -

CHAIRMAN MILLER: I won't go so far as to say

it's disfavored, though it's true that in the course of time we've gotten into this habit in NRC proceedings to prefile testimony, many times prefiled testimony prepared by somebody other than the witnesses, and they get pretty far removed.

I, myself, have never been happy with the practice, although recognizing it is permitted. I would much rather have testimony come directly in, and have the cross-examination proceed directly. I don't think there is any requirement I mean, that it's indispensible and I would regard that as prevailing in the latter stages of an evidentiary hearing.

We had indicated down in Charlotte on several occasions that we would exercise discretion to permit testimony that had not been prefiled by all parties in an effort to get to various issues that came up or were sharpened in the course of a big two or three different periods of time when we were in Charlotte.

MR. ROISMAN: But yesterday you bent over backwards to offer the Staff and the Applicant the opportunity to postpone cross-examining Mr. Riley for at least overnight on testimony which was prefiled on the 4th of September just because you were worried that they might be prejudiced by it.

Mr. Riley is doubly prejudiced by only hearing the testimony for the first time this morning. He's prepared to go ahead and cross-examine and has merely asked for the right that the witnesses be held overnight so that if tomorrow,

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after looking at today's transcript--we'll get to the issue of what's happened to the transcript, we're not getting them anymore at the moment--looking at the transcript, that he'll be able to see if they said something that he hadn't caught up on in listening to it orally and taking notes. It's a technical question.

CHAIRMAN MILLER: The reason that yesterday that we offered the time to the Staff and to the Applicant was not because of the prefiling question, it was because of the fact that we were allowing an amendment to make an issue that which arguably and probably actually was not an issue and a contention.

We were therefore giving that opportunity in order to pay heed to the contention requirements and yet modifying them sufficiently as we felt in order to achieve essential justice to Mr. Riley, who wished to bring forward a contention that he had not previously requested either in his original statement of contentions or in a request for leave to amend. The first time it came up was yesterday in the midst of the hearing, so we did use our discretion but our concern was because of our modification of a contention rule and practice--and of course, the discussion became apparent to us however there was no real or substantial prejudice because of the fact that all parties had some knowledge of the subject matter.

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We were, therefore, less concerned by the time the record was made as to the procedural due process aspects in allowing an amendment of a contention to create a new issue.

However, that is significantly different than the question of whether or not there is a requirement of the prefiling and of the question of cross-examination.

Now, since all the parties, it appears, have had some familiarity with this whole question and this subject came up last week, that includes Applicants, it includes Staff, it includes Mr. Riley. We, therefore, think it's no great hardship and no great prejudice to any party to go forward, have cross-examination proceed.

Now if the witnesses are readily available, we're not saying that they should be hidden or concealed. But on the other hand, we're not going to keep hanging on for this. This is Wednesday, we're not going to keep piling up and pyramiding. We've had a succession of requests to keep people available. We want to bring this hearing to a conclusion.

MR. ROISMAN: Well Mr. Chairman, we've got two more days, and we certainly have tomorrow. But the only question is that the Applicant, unless you do something to the contrary, will be free and, I submit, encouraged to ship these witnesses back to Charlotte and then claim they're

not available tomorrow.

And if that happens, Mr. Riley will lose the opportunity, even if we've got the time after Mr. Bateman is completed, where he could get to the witnesses.

And that seems to me to be unreasonably unfair to Mr. Riley for no legitimate reason. The witnesses can stay overnight. Mr. Riley can have a chance to look at the transcript, if we can figure out how to find one of them, which does seem to be a problem. And I said I'd like to --

CHAIRMAN MILLER: Mr. Riley is being given lenience in not asserting a contention in a timely fashion, though he has been spared the necessity of showing the five points of tardy filing which, to be technical, we could probably require. We don't wish to be technical. Having according him that right, we're not going to keep dragging that thing on. I made that statement yesterday and today.

MR. ROISMAN: Mr. Chairman, Allens' Creek made addressed that issue. I think you made the right decision yesterday even if the five factors were applied --

CHAIRMAN MILLER: That may well be.

MR. ROISMAN: But in Allens' Creek, the Appeal Board's ruling was that once you've let the contention in, you can't make any legal condition on the use of that contention. Mr. Riley's due process rights cannot be taken away, even if you now feel that yesterday you were more

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lenient than the law required you to be. I understood your ruling yesterday to be the contention was to be admitted, and it wasn't to be admitted on the condition that Mr. Riley operate with his hands behind his back in any way.

CHAIRMAN MILLER: No condition at all either way, either to have special privilege or to have hands tied.

MR. ROISMAN: That's right, and I don't think Mr. Riley is asking for special privileges, he's asking that the witnesses be held so that when he can see what they said -- it won't help the record for there to be something in there that they said that he didn't pick up in hearing it orally this morning and not being able to cross-examine them.

MR. MC GARRY: Mr. Chairman, I would simply observe that the examination of these witnesses was not lengthy. We were not talking about two or three hours. I think probably the time elapsed was a half-hour of hearing time, because we did go off the record so I could procure that exhibit. It was not a lengthy examination.

And therefore I believe Mr. Riley had ample time to understand and comprehend what these witnesses were saying. It was certainly -- what they addressed were matters that Mr. Riley has already addressed to the Staff. There were no surprises pulled, and I think Mr. Riley's cross-examination will pick up all the points.

MR. ROISMAN: Listening to technical information

orally is not a substitute for seeing it in writing, whether it's five minutes or 30 minutes. Mr. Riley's point isn't that he didn't have time to prepare, it's that he's worried that he didn't hear something or missed something that he will see in the transcript.

MR. MC GARRY: I submit he can ask that on cross-examination and we have to bear in mind we're talking about technical information. Mr. Riley has us at an advantage. He has a technical background as opposed to us lawyers. He doesn't have to go through that hurdle of a technician explaining to the lawyers exactly what's going on. Mr. Riley has demonstrated in his prefiled testimony, his knowledge of this situation based on the cross-examination he's already conducted, it's obvious to all that he's familiar with this subject area. And again, based upon the length of time of the direct examination, I see no burden that has been imposed upon Mr. Riley.

MR. ROISMAN: Mr. Chairman, if it won't delay the hearing, why can't the witnesses be asked to be held over? If Mr. Bateman is finished and there is time and Mr. Riley wants to have further cross of them because of something that he missed, why can't ne be given that opportunity.

If we run out of time on Thursday, then that then faces the issue of whether you are to delay the hearing or not

as a result of it, that's a separate question.

MR. MC GARRY: Mr. Chairman, believe it or not, the employees of Duke Power Company do have other jobs to fulfill rather than testify in this proceeding, and I submit that these gentlemen have such functions to perform. And we would request that they be excused upon the conclusion of examination.

(The Board conferring.)

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CHAIRMAN MILLER: Mr. McGarry, why was not prefiled testimony made of this panel?

MR. MC GARRY: Mr. Chairman, I think you have characterized the situation that explains why prefiled testimony wasn't filed. Indeed, the Staff did address this matter, but as I stated I believe on Tuesday when we discussed whether or not this should be a contention, the Staff addresses a lot of matters in the SER but we don't choose to present prefiled testimony. We address those issues that have been raised and indeed are contentions. So that was not a contention at that point in time.

(The Board conferring.)

CHAIRMAN MILLER: Well, the Board reluctantly will request the witnesses to remain overnight. We don't think that you should misunderstand us, Mr. Riley, or anyone else. We're not starting a new precedent. We're tired of the pyramiding. We think it's inefficient. We think it's getting to the point of unfairness.

So we're not going to do any more pyramiding for the information, supplying of data or witnesses. However we will permit it this one instance because of the unusual circumstances that appear to prevail now. We suggest that you cross-examine as fully as possible and we note that you are not without expertise both in the way that you presented the matter and in your own proffered direct

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testimony.

So we would expect you to cover it very substantially, if not completely. But you will get the opportunity.

MR. RILEY: I will cover all of the material I have, Mr. Chairman. And the only possibility of requiring more of the witnesses tomorrow would be what was triggered by a copy of the transcript.

CHAIRMAN MILLER: Well, what makes you think you're going to have a copy of the transcript?

MR. RILEY: Well, that's the next thing I wanted to address, Mr. Chairman.

CHAIRMAN MILLER: Well, I don't have a copy. I can tell you that. So if you've got some way of getting it, fine.

MR. ROISMAN: We understand the Staff is receiving split-day copy,that they will receive before the hearing is over this afternoon a copy of this morning's transcript.

CHAIRMAN MILLER: That may well be. The Board hasn't received it.

MR. ROISMAN: No, no, no, I understand that. We understand from the Reporters that the process that's now being used is that the Commission is buying one copy from the Reporter and then someone at the Commission makes copies of that and makes the distribution to anyone, including the Board, who's getting Commission copies.

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We wonder if the Board can suggest to the Staff that they make available the portion of the transcript that they are getting a split-day copy of that includes in it the direct examination of these witnesses for Mr. Riley to look at or even to xerox and take with him, so that he can have the benefit of the Board's ruling tomorrow, if absolutely necessary he can have further examination.

MR. MC GARRY: May I just make an observation? If this is indeed the case and this half-day transcript comes in some time during the day, if Mr. Riley, after completing his examination, looks at the transcript -- and again I submit it shouldn't be lengthy based on the time -- and see if he has any further questions.

Mr. Riley has been cooperative in the past what with not having Dr. Garrick come here, and I'm just suggesting if the time does avail itself it would certainly be helpful.

Maybe we ought to just see how the situation flows. But I'd just offer that as a suggestion.

MR. KETCHEN: Mr. Chairman, I will volunteer, when I get my split-rush copy today, to make it available for Mr. Riley's convenience for this afternoon or overnight.

CHAIRMAN MILLER: All right.

MR. RILEY: Thank you, Mr. Ketchen.

CHAIRMAN MILLER: All right.

MR. RILEY: Shall I proceed?

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CHAIRMAN MILLER: You may proceed.

Whereupon,

S. B. HAGER

and

C. L. RAY, JR.

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

CROSS-EXAMINATION

BY MR. RILEY:

Q Mr. Ray, I'd like to ask you first some questions about the bridge crane that's used to transport the cask.

A (Witness Ray) Yes, sir.

Q Are you familiar with it?

A Yes, sir.

Q Is it essentially capable of these types of movement: back and forth along the rails, perpendicular to the rail direction or the base of the bridge and up and down?

A Yes, sir.

Q And would you describe the nature of this motion? Perhaps it would be best to start with the driving mechanisms for each one of these motions.

Are they all an electric motor?

A Yes, they are.

Q And what type of motor is this in terms of the time

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it takes to get to speed?

A I do not know.

Q This is true for all three forms of motions that we've described?

A Yes, sir.

I'm a structural engineer. I'm familiar with the crane. But an exact type of motor I'm not familiar with.

Q Well, I may get back into your territory very quickly, and that is:

Does the motion stop when the motor is shut off and loses its rotational momentum, or is there a positive brake that immediately sets when the motor is no longer actuated?

A There are brakes on all motions that actuate as soon as the power is cut off.

Q Now would this mean, then, that the stop for each form of motion would be an abrupt stop?

A No, sir.

Q Will you please explain?

A I cannot explain the reason for it, but my experience with the cranes is that it is not an abrupt stop.

Q Well, the question I'm getting at is:

How long is the coasting period, then, between the time of shutting off the motor and motion ceasing?

A That is an extremely detailed question. I don't

mpb6

even think the crane manufacturer could answer it without detailed analysis. I don't have the answer.

Q Well, let's ask a hypothetical, then.

If a brake is set by the same action that the switch is turned off, is it not reasonable to expect that the coasting time will be quite short?

A Quite short is relative. Yes, it would be short, but that would need to be defined.

Q Would it be more than one second?

A I do not know. Without knowing what the coasting time is I can't say whether it's more or less than one second.

Q Have you watched one of these cranes operate?

A Yes, sir.

Q Have you operated one yourself?

A Yes, sir.

Q Couldn't you from your own experience give some order of magnitude sense of this behavior?

A Yes, sir. This crane is a very slow moving crane. All of our cranes used in this type of application are slow moving relative to other cranes that are used in other types of manufacturing. These cranes have five speed controls for each direction of travel --

Q Please repeat that again.

A They have five speed controls for each direction

pb7

of travel.

Q Let me interrupt just a moment.

We heard earlier testimony that the speed of the crane was 50 feet per second. If that --

MR. MC GARRY: 50 feet per minute.

MR. RILEY: You're quite right.

BY MR. RILEY:

Q What end of the speed scale is that?

A (Witness Ray) That is the maximum speed.

Q Right.

Is there any requirement to your knowledge about which speed is used by the operator?

A No, sir.

Q Let's consider, then, the maximum speed. Let's consider a cask in place on the cable on the hook and the crane is stopped. Will the cask swing?

A Yes, sir.

Q Now if the crane is put in horizontal motion, either lengthwise to the rails or cross-wise, will not the amplitude of the swing relate to the portion in a previous swing cycle that the motion starts?

A I don't understand the question.

Q Well, the load is a pendulum essentially.

A Yes, sir.

Q And if the pendulum is at rest there is an

pb8

inertial component here. When the bridge starts to move the load will lag back, and it will go through a certain maximum amplitude and then start to swing as uniform forward motion progresses.

Is that correct?

A It is correct in the sense that there is some finite amount of swing. But in the case of a cask and the height of the cask from the -- versus the elevation of the crane, that swing would be minimal because the crane must progress through the five speed points to get to the maximum speed. And it does accelerate very slowly.

Q Are you saying, then, Mr. Ray, that the brake does not set until the operator has gone through the lowest speed point?

A I was speaking of the acceleration. You said the crane was already stopped and then began moving.

Q Well, that is right.

A And I'm saying that would have very little effect in the form of swing of the cask.

Q Well, case one or case two was a swing study, and that's what I'm trying to get at.

Would you say that the acceleration is essentially primarily responsive to the hand control? I assume that there is a dial on there with five setting points, is that correct?

MR. MC GARRY: May I object, Mr. Chairman.

pb9

I would state the grounds of my objection. As I understand it we're talking about a swing situation which was the subject of case one and case two. These witnesses testified as to case three.

Mr. Riley's contention is directed and limited solely to case three. So if this line of examination -- and perhaps I'm presumptuous -- is leading to discussions of case one and case two, I object to that line of questioning.

MR. RILEY: Mr. Chairman, this is exclusively a case three question. It has to do with the violation of the administrative control portion of it.

The cask is going to have to be placed in motion, it's going to have to be stopped in case three. And if swinging is a normal consequence of moving the cask, it's fair to ask these questions.

CHAIRMAN MILLER: Well, so long as it has a reasonable, logical relationship to case three, yes, we do understand that to be the extent of the direct examination.

MR. RILEY: I'll repeat my question, Mr. Ray.

BY MR. RILEY:

Q Is the movement of the cask, then, primarily responsive to the position of a speed controller which I'm asking you has -- what? -- five buttons per speed or five points on a control knob?

A (Witness Ray) No, sir -- excuse me, I believe

pb10

you rephrased the question. Would you repeat it again?

Q Well, let's break it into two parts.

A You asked two things that time and one before. I think you said a dial indicating five speeds in your first question. No, there is not a dial indicating five speeds.

Q Would you describe how the speed control is?

A It is one button that is progressive. The farther you push the button down, it advances through the five speeds.

Q Now is there any administrative requirement on how rapidly the button is to be pushed in, or is this simply a matter of the operator's discretion for the task at hand?

A It is the operator's discretion for the task at hand.

Q The operator may then push the button very abruptly.

A Yes, he can.

Q Under this condition is the motor speed basically load limited, or does it rapidly come up to speed?

Do you follow my question?

A I follow your question. I believe it was basically the same question you asked earlier.

I don't know the details of the motor.

Q But you've operated the crane.

A Yes, and it gradually comes up to speed, the crane itself. What the motor is doing, I'm not....

Q Well, I assume there is a one-to-one link between what the motor is doing and what the crane is doing. Does that seem reasonable?

A Yes, sir.

Q All right.

You've used the word "gradually". How long do you recall that it takes when the button is pushed in rapidly for horizontal motion -- not lifting now -- for the crane bridge to get up to speed?

A I couldn't put a time on it.

Q Though you've done it, you couldn't say whether it's a minute or ten seconds or one second or what?

A No, sir.

Q Let's ask a hypothetical, then, Mr. Ray.

Assume that the load is set in motion by the acceleration of the crane in a horizontal motion.

A Yes, sir.

Excuse me, sir, when you say "horizontal motion" are you talking about up and down the page on the load path?

Q No, sir. I'm talking about three-dimensional reality, moving along the rail or at right angles to the rail along the bridge.

All right.

Assume the cask is set in motion as rapidly as it can be set in motion. Let us assume that the load has been

mpb12

behaving as a pendulum --

A Yes, sir.

Q -- as a result of a previous stop which was caused by the most rapid release of the button.

A Yes, sir.

Q Will not the pendulum amplitude as we continue be a function of the instant that the button was pushed? In other words, the phase of the pendulum swing.

A That would be a part of it. There's also --

Q I just want to know if it is a part of it.

A It is a part of it.

MR. MC GARRY: Mr. Chairman, just listening to the response, I was under the impression that perhaps the witness wanted to explain the answer. I thought that the ground rules were if there were an explanation in order that was permissible.

CHAIRMAN MILLER: Yes. If an explanation is reasonably necessary to interpret his answer, he will be permitted.

Would you wish to add to that?

WITNESS RAY: Yes, sir.

CHAIRMAN MILLER: You may do so.

WITNESS RAY: Mr. Riley has assumed a free pendulum, and there is a resistence to swing in the cask. And it is not, like I say, a free pendulum. So the amplitude

pbl3

is related to the speed that the crane is stopped or started. But there are many other factors that would go into that. It's not a free pendulum.

CHAIRMAN MILLER: All right.

MR. RILEY: All right.

BY MR. RILEY:

Q Accepting your clarification, it is your testimony, though, that the phase of the swing that the cask is in when motion is resumed will determine the subsequent amplitude of the swing?

A (Witness Ray) By "phase" I assume where it's at in its swing?

Q That's correct.

A That would be a factor in the subsequent amplitude.

Q Thank you.

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Are you familiar, Mr. Ray, with the investigation report which was referred to this morning and which I will now show you having to do with case three?

(Document handed to the panel.)

CHAIRMAN MILLER: Has that been given an identification number, Mr. Riley?

MR. RILEY: I do not know, sir.

CHAIRMAN MILLER: If it hasn't then it should.

MR. RILEY: All right.

WITNESS RAY: This appears to be a portion of the

mpb14

report, and I'm familiar with the report.

MR. MC GARRY: Mr. Chairman, this is a document that I objected to examination upon yesterday inasmuch as this document relates to the railroad cask and not -- to the 100 ton cask as opposed to the 25 ton truck cask.

Am I correct in that, Mr. Riley?

MR. RILEY: You did object to that, Mr. McGarry. And I think that we proceeded on the basis that it was an illustrative example, and perhaps he can clear up some questions quickly on that.

CHAIRMAN MILLER: Well, first of all, has it been marked for identification?

MR. MC GARRY: I don't believe it has, Mr. Chairman.

CHAIRMAN MILLER: If you're going to refer to it anyway let's have it marked for identification.

MR. MC GARRY: Could I request that we, for clarity of the record -- I've discussed this with Mr. Riley -- that his previous document was captioned CESG Exhibit 31. My records reflect that if we want to go with the appropriate numbers that it should be CESG Exhibit 11, and this would now be CESG Exhibit 12.

CHAIRMAN MILLER: Do you have any objection to numbering in numerical order?

MR. RILEY: I have no objection.

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CHAIRMAN MILLER: All right.

The record will reveal that Exhibit 31, identified by Mr. Riley this morning, would be renumbered as CESG Exhibit 11, and that the instant document which he will describe for the record will be marked for identification as CESG Exhibit 12.

(Whereupon, the document previously marked as CESG Exhibit 31 was REMARKED as CESG Exhibit 11 for identification; and Whereupon, the document referred to was marked as CESG Exhibit No. 12 for identification.)

MR. RILEY: The title of this document was read into the record during the earlier session with Staff this morning.

CHAIRMAN MILLER: All right. If it's already been identified that will be sufficient.

MR. RILEY: All right. I think we can quickly dispose of one matter.

BY MR. RILEY:

Q In here there was language saying that the

Licensee stated that the calculations are preliminary. This is on case three. That they are checked but not approved and are based on maximum hypothetical cask dimensions and weight, and do not consider energy losses such as from cask cooling, fin collapse or concrete deformations. That applies to the 100 ton cask.

And my question is:

Are there cooling fins on the NFS-1 cask?

A (Witness Ray) There are no -- none that I'm aware of that are external. There are internal fins to the water jacket. I could not state specifically that there are not some on the outside, but I could not identify that from the drawings.

Q All right.

Now the statement here, then, in the earlier response to the NRC, the calculations are preliminary and they are checked but not approved, was there a similar status involved in regard to the Applicant's communications with the NRC on the NFS-1 cask?

A No, sir. Those calculations there were determined to be inadequate, and that is the reason they were never subsequently approved. They were for an entirely different situation, different cask, and have nothing to do with this analysis.

The analysis of the NFS-4 cask has been properly

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checked and approved.

Q In the earlier case, why was it that case one and case two, which were submitted, had been checked and approved, but case three wasn't checked and approved?

MR. MC GARRY: I object to that question. That's strictly related to the rail cask and why something was done with respect to the rail cask. It is not related to this truck cask.

CHAIRMAN MILLER: Sustained.

BY MR. RILEY:

Q I'm going to show you, Mr. Ray, CESG EXhibit number 2. It's another I&E report. I am referring to page, for the record, 1-8, paragraph D, which I may as well read.

First let me ask, though, are you familiar with this?

MR. MC GARRY: Mr. Riley, does that paragraph appear on page 1-8?

MR. RILEY: Yes, that's correct.

MR. MC GARRY: Mr. Chairman, for the record, I would request that the witnesses be given an opportunity to read this short paragraph.

CHAIRMAN MILLER: Yes.

MR. MC GARRY: Thank you.

(The witness panel reading.)

WITNESS RAY: Would you repeat the question,

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please?

MR. RILEY: I didn't ask it yet.

CHAIRMAN MILLER: He wanted to know if you're familiar with it, and you said yes somewhat, and you took the opportunity to read it. I think therefore yes.

WITNESS RAY: Excuse me, I did not say yes. I am not familiar with this document.

CHAIRMAN MILLER: You have not seen it before?

WITNESS RAY: No, sir.

CHAIRMAN MILLER: Very well.

BY MR. RILEY:

Q Let's turn to Mr. Hager, then.

Did you read the document now, Mr. Hager?

A (Witness Hager) Yes, I did.

Q Are you familiar with it?

A No, sir, I had not seen it before.

Q Do you recall that it was your testimony earlier today that Duke operators are walked through procedures in regard to cask handling, and that you felt -- well, these weren't your words -- a strong sense of assurance that proper procedure would be followed?

A This was the crane operator. He is walked through the crane procedure.

CHAIRMAN MILLER: That's correct.

MR. RILEY: That is correct.

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BY MR. RILEY:

Q Here we have --

MR. MC GARRY: Mr. Chairman, perhaps I can just pose an objection, and again it may be somewhat presumptuous. But I anticipate that Mr. Riley is trying to link up some item in an inspection document that indicates that Duke hasn't followed certain procedures. But it does not pertain to the particular cask operator scenario. And if that's the sense of where Mr. Riley is going I object because it isn't related to their direct testimony.

And Mr. Hager's testimony, that was related specifically to the fact that the cask operator would be walked through certain procedures.

MR. RILEY: The thrust, Mr. Chairman, is this:

That Staff expressed confidence that the human factor wouldn't appreciably enter into the situation, that it was concerned to proceed as the Applicant proposed by administrative controls. And what this evidence shows is that a non-compliance was charged against the Applicant by the gentleman -- and I can bring in these papers if need be -- who had supervision over the cask handling area.

And the record can also be made to show that this gentleman was further addressed by management and instructed to follow procedure. The only point is there are human lapses, and I wanted to indicate that there was a lapse in

pb20

this area, and in an effort to establish the reasonableness that Mr. Hager's assurance would not be totally controlling for the future.

MR. MC GARRY: Mr. Chairman, an observation, and that is this appears to me to be a subject of proposed findings. Mr. Riley has this document in evidence and can draw whatever conclusions he wishes. And just hearing him speak right now, it would seem to me that I would see those in proposed findings and it should not be the subject of this cross-examination.

CHAIRMAN MILLER: That would seem to be true, Mr. Riley. The scope of the direct examination does within reasonable bounds limit the scope of cross-examination. You are certainly entitled to the benefit of all the evidence in the record, but it does appear to us that the proposed findings would be the place in which you would establish by reasonable logical inference and so forth rather than through these witnesses whose testimony was as to the number three case, really the cask situation.

MR. RILEY: Well, Mr. Hager expressed his confidence --

CHAIRMAN MILLER: Do you expect to shake his confidence by this?

MR. RILEY: No, sir.

CHAIRMAN MILLER: In that event, you're addressing

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the Board really, aren't you?

MR. RILEY: I just wanted to put on the record whether or not Mr. Hager was aware that there is frequently a slip betwixt the cup and the lip.

CHAIRMAN MILLER: Well, if you can ask him that in a little less elegant language, we'll let you have one question along those lines, but....

MR. RILEY: I think the matter has been adequately dealt with, Mr. Chairman. I'll proceed.

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CHAIRMAN MILLER: Very well.

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MR. RILEY: Mr. McGarry, perhaps you could help facilitate things. I have here a drawing of the NSF-1 cask, which I believe CESG has introduced in evidence. Would you please provide the exhibit number?

MR. MC GARRY: Number 1.

MR. RILEY: This is CESG Exhibit Number 1.

CHAIRMAN MILLER: Pardon me. Are the witnesses familiar with Exhibit Number 1 of CESG?

WITNESS HAGER: Yes.

WITNESS RAY: Yes.

CHAIRMAN MILLER: You may proceed.

MR. RILEY: Do the members of the Board have in front of them CESG Exhibit Number 1? I would be glad to provide it if they have not.

CHAIRMAN MILLER: We don't have it in front of us, we recall it from previous introduction, yes.

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BY MR. RILEY:

Q Now preliminarily to inquiring into this, I want to ask, Mr. Hager, with respect to the case three testimony that you gave earlier,as to whether or not there are a variety of case threes.

A (Witness Hager) I'm not sure I understand your question, a variety of case threes?

Q Yes. It very specifically showed the cask with a 19.5 inch space between the edge of the cask pit wall and the

line of centers.

A That's correct.

Q Are there not an infinite number of positions that the cask could occupy with respect to that wall?

A Up to a limit. You would go beyond the edge of the wall.

Q The only question is, in the span of 25 inches, which is the distance from the line of centers to the extreme reach of the lower impact limiter, are there not an infinite number of positions? It's not 25 inches, it's infinitely divisible.

A There are a number of positions, yes.

Q And are they not infinite?

A In terms of size of the increment, yes.

Q That's what I mean. That means then that to thoroughly examine the case three type of matter, one would do well to explore the sampling of that population of infinite positions, is that not correct?

A One could look at a number of positions, yes.

Q All right. Did you?

A No, we looked at one that we determined in our view would be the maximum energy when the cask hits th cask pit and fuel pool wall.

Q If you're judgment was incorrect, that might affect the result?

A It could.

Q Can you demonstrate that your judgment was correct?

A Yes. We looked at case three with the cask resting on the edge of the fuel pool wall, which would give the center of gravity of the cask at its highest position.

Q Now if the cask were elevated say four feet above the floor level there, would it not have a higher level of potential energy?

A Yes.

Q Is it not conceivable that it might convert to a higher level of kinetic energy?

A Yes. But at the point you're hitting the edge of the cask pit wall, which would absorb kinetic energy.

Q Would that not be very much a function of precisely where it hit?

A Yes.

Q Let's take a look now at Section BB on CESG Exhibit 1. These pair of vertical lines to the left and right of the line of centers with the legend drain valve and a line reaching towards the line of centers in-between these parallel and vertical lines?

A I see the drain valve location and then the two vertical lines.

Q The two pairs of vertical.

A Yes.

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Q All right. Would you tell us what they are?

A I do not know what those are.

Q Do you know, Mr. Ray?

A (Witness Ray) No, sir. I cannot identify from this drawing.

Q All right. Looking still at Section BB, above the line of centers and lying horizontally on this chart there are two more pairs of lines that are parallel. Do you see the lines that I refer to? Would it assist you if I point to them?

A (Witness Hager) I think I understand the two lines.

Q Do you know what they are?

A No, sir, they are not identified on this drawing.

Q All right. We've established that the weight of the cask is about 25 tons, is that correct?

A Yes.

Q And we've also -- well, no, let me ask this question.

That cask is going to be standing in a vertical position on the base of the fuel pit, is that correct?

A That is the location assumed, yes.

Q And that means that that 25-ton cask is going to have to have a substantial pedestal structure in order to stand without crushing the impact limiter, is that right?

A To stand on its own weight, I assume is what you're saying.

Q That's what I'm saying.

A Yes, I think Mr. Ray covered in his testimony the construction of the impact limiter.

Q I'm sorry, Mr. Hager, I didn't feel that he got to that point. We're not talking about the impact limiter, we're talking about a pedestal which is surrounded by the impact limiter.

CHAIRMAN MILLER: What was the question?

MR. RILEY: The question is identifying a set of lines in Exhibit 1, BB. The lines are parallel lines at right angles. And I would like to get from the Applicant what they are, what their function is and whether or not they are the strong structural base acting as a pedestal for the 25-ton weight of the cask.

CHAIRMAN MILLER: If the witness knows, they may answer.

MR. MC GARRY: I believe they said they did not know.

CHAIRMAN MILLER: They did not know?

MR. MC GARRY: Yes.

CHAIRMAN MILLER: In that event, you have the answer.

BY MR. RILEY:

Q Do we have the correct understanding here that you do not know?

A (Witness Hager) I do not know what these horizontal and vertical double paired lines that you mentioned are.

Q Can you tell us where in this drawing -- would you assume the reasonableness of a pedestal is strong for supporting the 25-ton weight would have to be built at the base of the cask beside the impact limiter?

A I think, as I understand your question, it is, the impact limiter structurally is designed such that the cask can be set on it and not deform it.

Am I understanding your question correctly?

Q Approximately. Let me rephrase it.

Are there two structures there, one of which is the impact limiter in the event of a collision, the other of which is pedestal for routine support of the cask when it's in a vertical position.

A I'm not sure that is two separate structures. It is a structure that would support the weight of the cask in the vertical position.

Q Would the impact limiter only, which is an eight-inch layer of balsa wood with some 3/8ths-inch stiffeners, would some 1/4-inch rings support the weight of the cask?

A It's my understanding this entire assembly is

the impact limiter and it is designed to support the weight of the cask in the static position.

Q Would you say that in your drawing that the 19.5 inch spacing between the line of centers and the cask pit wall where you would be resting on the outer region of that that you would effectively support the weight of that cask?

A It may or may not effectively at that point, because you're right at the edge of the wall. We have assumed that position as a conservative assumption.

Q Let's try this hypothetical. Let's assume that for a height of four feet over the floor level of the cask pit that the center of gravity is just inside the plane of the cask pit wall, do you follow what I am saying?

A Yes.

Q And let's assume that -- without swinging to complicate the problem any -- that the cask is released at this point and drops. How many foot-pounds credit can you take for energy absorption by the impact limiter?

A I do not know that number.

Q All right. Let's extend that a little bit. Let's assume that those vertical lines and horizontal lines that we were talking about a little earlier are a pedestal built in to routinely take the weight of the cask when it's in a vertical position on the pit floor.

Could you assign to an impact situation in which they were physically present as I just described, the same sort of energy absorption you could if the cask struck the impact limiter beyond the farthest radius of these hypothetical pedestal supports?

If you like, I'd be glad to illustrate what I'm talking about on the drawing.

A Yes, we need a clarification. We did not follow your --

MR. RILEY: With the permission of the Board, I'd like to do this.

MR. MC GARRY: Mr. Riley, may I also make an observation. You're addressing questions to Mr. Hager, and if he does not have the answer, it might facilitate matters in the examination if Mr. Ray has the answer that he give that. Is that amenable to you?

MR. RILEY: That would be completely amenable.

MR. MC GARRY: Thank you.

(Document handed to witness panel.)

CHAIRMAN MILLER: Off the record.

(Discussion off the record.)

CHAIRMAN MILLER: Back on the record.

Proceed.

BY MR. RILEY:

Q Off the record we have examined Section BB on

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Exhibit 1 and I have illustrated to the panel the nature of my question. And it's already been testified that there are support rings in the structure. And I think I'll be able to phrase the question now.

Does the area of the cask base -- excuse me a moment, panel. Would you like to have a moment just in preparation here?

A (Witness Hager) Go ahead.

Q Does the specific area having to do with cask design construction and the amount of that area have to do with the amount of energy that will be absorbed on impact from a drop, a given drop?

(The witness panel conferring.)

A (Witness Ray) The amount of area that the bottom of the cask impacts could affect the amount of deformation in the energy absorption but not necessarily the amount of energy absorption.

Q Can you say with assurance that it would not affect the amount of energy absorption?

A Not under any circumstance I could not say it with assurance.

Q Not under the circumstances in the context of the question?

A That's correct.

Q May I inquire what materials you're examining?

Do you have further information on the construction of the cask?

A I'm just looking at a drawing of the cask.

A (Witness Hager) A larger-scale drawing than the exhibit.

MR. RILEY: Might we recess one moment while these gentlemen have an opportunity to look at their drawing and perhaps be able to contribute more on the pedestal question?

CHAIRMAN MILLER: Are the witnesses having any difficulty in that regard?

WITNESS RAY: No, sir.

CHAIRMAN MILLER: They don't seem to be having any problem.

MR. RILEY: All right.

BY MR. RILEY:

Q Now just for me to be sure here, you have only calculated one cask tilt case, and it did not involve cask drop, is that correct?

A (Witness Ray) No, sir, that is not correct.

Q Then would you correct the record?

You've only testified to one, is that correct?

A No, that is not correct.

Q Would you kindly straighten us out?

A In my earlier testimony, I discussed the

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considerations that were made on the four-foot drop or less and how we arrived at the conclusion that the cask resting on the lip of the cask pit was the more conservative case.

Q Would you then give us the detail on those calculations?

A What I said --

Q Excuse me, please, let me define terms so you're able to respond. What we're interested in is potential energy, amount of energy absorbed by the impact limiter, the amount of energy converted to translational movement, the amount of energy involved in rotational movement, and if there are any other terms that you used, quantitative values on those.

A Excuse me, I'd like to review this just a second.

(The witness panel conferring.)

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A (Witness Ray) In the analysis of the NFS-4 cask drop we first assumed that the cask would be at a higher elevation, be it 4 foot, 3 foot, or otherwise.

If we assumed that, and dropped the cask on the impact limiting structure, there will be deformation of the structure.

Q What is the separation --I realize this is an interruption, but I think it will help -- between the line of centers and the plane of the cask wall?

A In the calculations we used 19-1/2 inches.

Q How many other calculations did you do?

A We considered conditions of 19-1/2 and less, and were determined as being not the conservative condition, because the center of gravity, if you reduce the 19-1/2 inches to some lower number, will impact -- at the impact with the wall, will be farther behind the wall, and is not the most conservative condition.

Q Assuming, of course, that the energy absorbed on impact will be essentially constant, regardless of this factor, will you agree that if at the 19-1/2 inch space position there is a higher level of energy absorption, but with the center of gravity coincident with the plane of the wall there would be a very, very much lower absorption, would that not make a difference?

A First of all, I feel like that I should have

completed the answer to the first question, but the answer to that question is that, no, if you move the center of gravity back, say, on the plane of wall in that direction, when it rotates down, if you'll look at the sketch in Exhibit 27, when the cask rotates down and hits the wall, the center of gravity will be farther away from the wall, and it will take much more energy to rotate the cask into the pool, and is a much less conservative condition.

Q I appreciate your answer.

Now, would you please answer my question, though, which had to do with the amount of energy available for rotation after the absorption of energy on the impact of the drop?

A Would you restate the question?

Q Well, let's be concrete:

How many foot pounds of energy do you have with the four foot cask elevation at the beginning of the drop with respect to, say, the level of the pit floor?

A I stated earlier that I did not know that figure, as a part of my answer. You asked me how did we consider the elevation and the dropping of the cask, and I was not permitted to complete that answer. And I believe that would answer the question.

CHAIRMAN MILLER: Please complete your former answer, then, if it's necessary, to eliminate this confusion.

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WITNESS RAY: Thank you. We looked at the dropping of the cask from four foot or otherwise. If you do drop the cask, there will definitely be deformation. Deformation enters into the thing and is more critical than the energy absorption, in that it has more effect on the total outcome.

If the cask deforms, the center of gravity will be lowered. If the center of gravity is lowered, it has a pronounced effect on the impact with the fuel pool wall, in that the center of gravity will impact behind the wall and will require additional energy to rotate it into the pool, and at the same time, the impact itself will provide a reversing moment which will cause some of the rotational energy to actually be absorbed.

Therefore, we assumed no deformation of the cask, such that none of the rotational energy would be absorbed, and that was stated as being the most conservative conditions.

BY MR. RILEY:

Q These are your conclusions, is that correct?

A (Witness Ray) That's correct.

Q Can you give us your data?

A (Pause.)

A This is a problem that's a quantitative problem that can be transferred in terms of numbers. On a go/no-go situation like this I really believe it will be of assistance to the Board and the parties to have the numbers in front of

us.

MR. MC GARRY: Perhaps for the assistance of the witnesses, you could ask the numbers that you feel are pertinent and the witnesses could provide the specific numbers if they have them.

WITNESS RAY: Excuse me just a second.

(The panel conferring.)

MR. MC GARRY: Mr. Chairman, I'm not sure of the situation. I'm assuming that the witnesses have information, and it may be a cumbersome process to provide all this discovery type of material.

CHAIRMAN MILLER: Well, the Board certainly doesn't know, one way or the other.

MR. MC GARRY: Mr. Chairman, --

CHAIRMAN MILLER: Are there any reports that were made, any studies, analyses, written reports or matter of that kind which would establish a data record?

WITNESS RAY: Yes, we've previously stated that we have performed an analysis that's been originated, checked and approved.

CHAIRMAN MILLER: Do you have a copy of that?

WITNESS RAY: And we have summarized those calculations. Yes, we do have a copy of the calculations.

CHAIRMAN MILLER: Do you have them with you?

WITNESS RAY: Yes, sir.

CHAIRMAN MILLER: All right, perhaps we could save some time if they were marked for identification, exhibited to Mr. Riley, and take a 10-minute or so recess, and that might serve to get the data out and get this show on the road a little better.

MR. MC GARRY: I was going to suggest, Mr. Chairman, that perhaps, with the Board's permission and Mr. Riley's acquiescense, that if I just discussed this particular matter with the witnesses to speed it up and see what information they have, so we can move along.

CHAIRMAN MILLER: All right, do you have any objection, Mr. Riley?

MR. RILEY: No objection.

CHAIRMAN MILLER: All right, we'll take a 10-minute recess, and the cooperation of counsel and witnesses will be appreciated.

(Recess.)

CHAIRMAN MILLER: Are we ready, Mr. Riley? You may proceed.

MR. RILEY: I'm not trying to be difficult, Mr. Chairman, but both yes and no.

CHAIRMAN MILLER: Let's take the yes first. I always like the affirmative approach. Proceed with your questioning.

MR. RILEY: Yes. We have been provided with --

MR. MC GARRY: Mr. Riley was about to indicate he had been provided with the information we had discussed just prior to the recess, and I would like this document to be marked for identification, Mr. Chairman, as Applicant's Exhibit 28.

CHAIRMAN MILLER: 28? All right, Applicant's Exhibit 28 for identification. What does it consist of?

MR. MC GARRY: Yes, Mr. Chairman. It consists of five pages, plus a sketch, and these sketches to my eye appear to be the sketches that are set forth in Applicant's Exhibit 27. And the first page, for identification, bears the incription, "McGuire Nuclear Station, Truck Cask Drop Analysis, Case Number 3."

I dread to say this is the only copy I have.

CHAIRMAN MILLER: All right, since it's for identification, let Mr. Riley examine it and use it if he wishes, and we'll go from there.

(Document handed to Mr. Riley).

(The document referred to was marked for identification as Applicant's Exhibit 28.)

MR. RILEY: Mr. Chairman, did Mr. McGarry take the responsibility for getting this duplicated for the record by his introducing it?

CHAIRMAN MILLER: Well, it's up to Mr. McGarry.

He hasn't really offered it into evidence.

MR. RILEY: I see.

CHAIRMAN MILLER: However, what are the merits of it? I don't want to get caught up in technicalities. This is something that's significant and important?

MR. RILEY: This is it.

CHAIRMAN MILLER: What does that mean?

MR. RILEY: I mean to say that this is the document and the information that I did request.

CHAIRMAN MILLER: All right. Can we get copies in some fashion, Mr. McGarry?

MR. MC GARRY: I'm sure we can, Mr. Chairman.

CHAIRMAN MILLER: All right, thank you. As a matter of courtesy, the copies will be provided.

MR. RILEY: Thank you, Mr. McGarry, and thank you, Mr. Chairman.

BY MR. RILEY:

Q The first thing I note, gentlemen, was that you have taken -- let me use your language: Going two-thirds of the way down the page marked 7, which is the first sheet of the actual content, you say:

Assume CG equals 102.5 inches from bottom of cask.

In a corresponding calculation, one of the parties did the same thing. It's not in evidence yet, but it came

out with 105 inches, which is a significant difference in this context.

Would you indicate how you arrived at your CG?

A (Witness Ray) We obtained the CG from Nuclear Fuel Services drawing 1A-A-1104, Revision 2, I believe.

Q Does the drawing specifically show the CG, or did you calculate it from parameters indicated on the drawing?

A The drawing does show the center of gravity of the cask, and indicates an approximate dimension.

Q As calculated by them?

A That's correct.

Q And is this for the cask loaded or unloaded?

A It does not state.

Q Does Duke employ a perforated metal or something like that canister to enclose the assembly when placed within the cask?

A I do not know.

Q The answer is you do not know? Not a negative answer?

A That's correct.

MR. RILEY: Mr. McGarry, do you have somebody in a position to stipulate that, just to move things along?

MR. MC GARRY: Can you just repeat what you wish to be stipulated to, and I think we can accommodate you, Mr. Riley.

MR. RILEY: Yes, it's a fuel assembly enclosed in a canister.

MR. MC GARRY: A basket, Mr. Riley.

MR. RILEY: And what is the center of gravity? Could you provide the center of gravity of the basket, which I assume occupies the full length of the cask?

MR. MC GARRY: I don't think we have the individual here who can respond to that.

BY MR. RILEY:

Q Is the actual number for the center of gravity given the 9 foot widths of the pit a critically significant factor in the outcome of such calculation?

Let me give an example:

Instead of being 102-1/2 inches, they were 112-1/2 inches, would your answer be different?

A (Witness Ray) Yes, sir.

Q Now, in carrying out a calculation like this, where you can't experimentally manipulate a fuel cask, you have to make some assumptions about how it will behave, is that correct?

A Would you repeat the question?

Q Yes. In a situation where you can't carry out the experiment with the cask itself because of the cost of the cask, you have to make some assumptions about how it will behave in doing an analytical study, is that correct?

A Yes, sir.

Q Now moving on to page eight of this exhibit, the center of the page, the paragraph that reads:

"Consider that only part of the translated energy is absorbed. For this condition, the cask will rebound away from the wall and then fall again with the center of gravity being farther behind the wall. This condition of rebounding would help prevent the cask from entering the spent fuel pool, and therefore, the assumption would be unconservative."

In using the word "consider" there -- and I'm taking it this is information that you put on paper, Mr. Ray, is that correct?

A Yes, sir.

Q Is the word "consider" used there equivalent to the word "assume?"

A In that sentence, yes, sir.

Q In that sentence?

A Yes, sir.

Q And the next sentence:

"For this condition, the cask will rebound away from the wall and fall again with the center of gravity being farther behind the wall."

Would that be correctly characterized as a qualitative statement?

A That's correct.

Q Do you reduce it to quantitative terms?

A No, sir. The reason being, if there was any rebound, it would result in a less conservative condition.

Q Would the magnitude of the rebound be important?

A No, sir, because in the calculation we assume no rebound, which was the most conservative case. As I stated, if there's any rebound, it is a less conservative condition.

Q Well we've already established that the distance from the base of the CG is a significant factor in whether or not the cask will fall in the pit. So if an error were made on the low side of that calculation, we could get a condition where the cask would be calculated to fall into the pit. And from that point on is not the magnitude of this phenomenon significant?

A If there was enough difference in the center of gravity calculation, I believe the example you gave earlier was one of 2.5 compared to 112 or a number thereabouts.

Q That's right.

A Yes, sir.

Q It would be then, is that your answer?

A Excuse me?

Q In that context, your answer is yes?

A If the location of -- the location of center of gravity is important in the calculation.

Q And if the circumstances are such that the cask would otherwise drop into the fuel pool, then the magnitude of this bounce-back effect becomes significant. If the effect were small, it would be trivial and if it were large, it could make the difference with whether or not the cask fell into the fuel pool.

A I guess your question is if the difference was small, there would be no effect, if it was large, there would be an effect? Is that the question?

Q No, it's not quite that, sir.

If the numbers in the other parts of the calculation were different and the initial CG to base level were larger and were sufficiently large that the cask otherwise would fall in the fuel pool, then the magnitude of this particular effect would become important. And if it were small enough, it wouldn't keep the cask from falling into the pool, but if it were large enough, it would, is that correct?

(The witness panel conferring.)

A I'm going to try to answer the question. It's not real clear to me but I feel like I know enough about it.

If the CG was different, substantially different, the rebound and the amount of it would have an effect on

whether the cask would or would not go into the pool.

Q That's the answer. Thank you.

Now, the following paragraph, the language is:

"Consider that all the translational energy is absorbed for this condition there would be no rebounding, and the rotational energy would keep the cask rotating about the impact point. This condition would be a conservative assumption, and will be used."

In this context, again, the word consider means assume?

A Yes, sir.

Q The next paragraph reads:

"The only deformation considered is the deformation of the thin water jacket surrounding the cask. Additional cask deformation and wall deformation are neglected, and this assumption is conservative."

Now, in regard to that, is it your professional opinion that the cask will, indeed, assume a horizontal position as shown, I believe it's position 4 in this exhibit?

A Yes, sir.

Q And would the energy absorbed there we a factor in how much kinetic energy was available to bring the cask to position 5?

A I assume you're talking about the second impact with the surface of the wall as it rotates to the horizontal

position?

Q Yes, as you flatten out the neutron shield tank.

A The amount of energy, if you look further in the calculation, that was absorbed, again it was only considered to be the translational part of the energy, is nominal. It was only 5 foot kips. It was a very nominal amount of energy absorbed in the second impact.

Q So you could rely very little on that particular mechanism for taking away from the kinetic energy?

A With the figures that we have --

Q For your set of assumptions --

A With the set of assumptions and the geometry.

Q Now, for the benefit of those reading the document, going to page 7, about the middle k of the page, under the heading "Position 2," you have k e sub 2. Would you tell us what that means?

A Kinetic energy at position 2.

Q Right. And then you have 1/2 -- is that j m?

A That's correct.

Q Omega 2?

A That's correct.

Q Rotational velocity is the significance?

A Angular velocity, yes.

Q Right. And then 1/2 m v sub 2 squared. v 2, would you please define?

A Linear velocity.

Q In what direction?

A V 2 can be in any direction.

Q It can be, but what direction is it in your example?

A In the cask?

Q Is this velocity with only a vertical component?

A No,sir, this is the velocity of the CG moving in space, without rotation, and following the path shown, going from position 1 to position 2.

Q Could you help the Board and parties to visualize that trajectory? Would you get that trajectory by, say, taking a compass on position 2, and drawing a line in an arc connecting the two CG's at position 1 and position 2? Is that correct?

A Yes, sir.

Q Is it true that there would be essentially zero vertical component to V 2 when you first started moving from position 1?

A That's correct.

Q And with respect to potential energy, then, would the effect be negligible?

A I don't understand the question. In position 1 the cask is at rest. There is nothing but potential energy there.

Q That's right. But I'm saying just after you've started to move.

A Yes, sir.

That wasn't answering the question. I was acknowledging --

Q All right.

The initial motion of the cask in your example, then, would be relatively slow, the initial motion?

A Yes, sir.

Q And v 2 would be at a maximum at the point where position 2 was reached, is that correct?

A Just prior to impact.

Q Just prior to impact. Or we could say at the instant of impact.

A Just prior to impact.

Q Hypothetically, impact occurs at zero time, for --

A Okay.

Q -- highly elastic surfaces, but we'll skip that.

Okay. Going on, then, the units in which you give your answer -- I'm sorry, we didn't go into p e 2 s, potential energy at position 2?

A Yes, sir.

Q At essentially instant of impact, or just before?

A Yes, sir.

Q And your answer is 59.4, and you show what looks

like an apostrophe, small k. Does that mean foot pounds?

A No, sir, that is foot kips.

Q Foot kips. Would you define a foot kip, please?

A That is, a kip is 1000 pounds. Therefore, that would be 59,400 foot pounds.

WRB fls

1D
WRB m/wbl
f: ndon

Q And your original potential energy in the same units is how much?

A It's potential energy relative to the floor, which would be the distance from the floor to the center of gravity, multiplied times the weight of the cask would be 427,000 foot-pounds.

Q All right.

Now could you help us get from the 5,125,000 what looks like foot-pounds to 427 foot-kips?

A Yes, sir.

If you notice, there are two apostrophes which indicate inches. And that is inch-pounds, then converted to foot-kips, which would be 427,000 foot-pounds.

Q Right; roughly half a million.

I think that takes care of some of these.

Going a little further down that page you have, three-quarters of the way down, 3,792. . .is that pound-feet per second squared?

C10

A Yes, sir.

Q And the next unit, then that simply would be thousands of pound-feet, thousands of pound-feet per second squared; is that it?

A That is kip-feet per second squared.

Q Now on page 9, at the bottom of the page, I'd like you to explain a statement there which reads,

"Only the translational KE" -- meaning kinetic energy -- "can be absorbed at impact and assuming rebound would be unconservative, therefore it is assumed that all translational energy is absorbed."

Can you give us the basis for that statement?

A Yes, sir, that's the same assumption that was used on the initial impact. Once the cask impacts the second time on the surface of the wall, if you assume you a rebound there you will have a moment that opposes the rotation of the cask. Therefore if you assume that the translational energy is not absorbed and that there is a rebound on that impact, then you would have a countering moment which would reduce the rotational energy. Therefore we assumed that if the translational energy was absorbed that there was no rebound, and therefore it is the most conservative assumption.

Q All right.

Now, going back to Position 2 in the drawing, you show at some period into the impact apparently where the edge of the wall has penetrated to the stiff shell of the cask a dimension of 4.14 inches between the CG and the plane of the pit wall; is that correct?

A 4.64 inches.

Q 4.64 inches. I see. This blueprint is not that clear.

Now, a hypothetical:

If the CG were six inches further along the axis of the cask, the CG then would fall in the other side of the plane of the pit wall; is that correct?

A That's correct.

Q And if there were a bounce effect such as you describe and a moment developed, this moment would tend to propel the cask further on in the direction of entering the fuel pool; is that correct?

(The panel conferring)

A Depending on the area of point of impact that could be a factor.

Q All right.

Now you stated that you took the most conservative assumption in having the center of gravity 19-1/2 inches from the center of the plane of the near pit wall, and, as a consequence, you had brought the center of gravity as near as you could to the plane of the far pit wall; is that correct?

A The cask diameter at the base is 50 inches, the radius is 25 inches. The cask-- The 19-1/2 inches could have been 20. If it was much smaller than the 19-1/2 inches you would have almost a point bearing on concrete of 25 tons.

The cask is a circle, and you have to have some bearing area for the cask. The 19-1/2 inches was, in our judgment, a reasonable assumption for Case 3.

Q Did you not previously testify that it was the most conservative assumption with respect to location of the center of gravity during the event?

A We stated that the cask, being stationary on the wall, was the most conservative assumption. We did not state that the 19-1/2 inches was the most conservative -- was a most conservative assumption.

Q All right.

Now is it not a matter of straightforward trigonometry that if the cask tilt that had initiated with the line of centers of the cask essentially over the inner edge of the pit wall, the center of gravity would be farther to the right and nearer to the plane of the farther pit wall?

A I'm going to try to repeat your question: If the center of gravity -- if the centerline of the cask on which the center of gravity lies is positioned closer to -- in other words, the 19-1/2 inches is reduced.... Is that the question?

Q No, sir, it is not.

I'd like to illustrate by referring to the drawing.

If the rotation point at the edge of the pit wall were essentially on the line of centers of the cask, would not the center of gravity be pushed farther away from that side and closer to the farther pit wall?

A No, sir, it would not.

Q Can you explain your reason?

MR. MC GARRY: Could I just interrupt to make the record clear so I understand Mr. Riley?

Are we talking about the pedestal in the first position, One, that is, the upright vertical position, would be advanced to the right?

MR. RILEY: No; it would be advanced to the left. And the axis would coincide essentially with this wall. And this would be at a higher point, and we would now have this as the point of contact.

MR. MC GARRY: I believe the record is clear now in that regard.

CHAIRMAN MILLER: Will you answer the question, please?

WITNESS RAY: Yes, sir.

If the center of gravity, the line representing the center of gravity is over the plane, or in the plane of the pit wall prior to starting its rotation, and rotates about that centerline of the cask, the center of gravity will be farther behind the wall because you have displaced the cask 19-1/2 inches away from the wall, and the result has to be that the cask is farther away.

BY MR. RILEY:

Q In Position 2 is the base at the center of gravity 19-1/2 inches away from the cask pit wall? I believe the dimension shows that, 6 point.... What is it? ....23? 6.83?

WRB/wb6

A (Witness Ray) That's the dimension after rotation.

Q That's what we're talking about.

A You cannot pick the cask up and put it up there, you have to start-- If it starts rotating-- If the point of rotation is on the centerline it has to start rotating from that centerline.

Q We are agreed.

A If you move the cask over and onto that position you will have to back the cask up 6.23 inches to get that bottom of the cask on the rotating point.

Q But will not the angle of the cask axis with respect to any reference plane have been changed and made smaller than 18.63 degrees?

A Yes, sir.

Q And will that trigonometric change not enter into the calculation of where the center of gravity will be?

A Yes, sir. And I believe it will move the center of gravity away from the wall and not toward it.

Q But you cannot tell us with assurance?

MR. MC GARRY: Mr. Chairman, I think the witness needs some calculations that perhaps Mr. Riley has.

CHAIRMAN MILLER: What is it you need?

(Discussion off the record)

CHAIRMAN MILLER: Are you ready?

WITNESS RAY: Yes, sir.

WRB 7

CHAIRMAN MILLER: Proceed.

WITNESS RAY: My original statement was incorrect. I did perform that calculation. And it will move back a fraction of an inch. The number in the calculations for the case postulated is 4.64. The number, if you put the line of the center of gravity in the plane of the wall, is 4.45.

BY MR. RILEY:

Q That means, then, that the original position of the cask with respect to the pit wall is not terribly critical in this context?

A (Witness Ray) That's correct.

Q And that means that an uncertainty of the order of several inches in the center of gravity would significantly bear upon the answer that you would calculate,and the problem; is that correct?

A If the center of gravity was several inches different than that assumed, then, yes, that would have a bearing on the results.

Q And you have testified that the center of gravity that you used you obtained from the drawing provided by the vendor; is that correct?

A That is correct.

Q And you have testified that you do not know the influence that a charge of spent fuel in this, a spent fuel assembly, would have on the location of the center of gravity?

wrb/wgbl

MR. MC GARRY: I believe this is repetitive, Mr. Chairman.

MR. RILEY: It's sort of a wrap-up.

CHAIRMAN MILLER: I take it this is a summary and you're about through with that point?

MR. RILEY: Yes.

CHAIRMAN MILLER: Very well.

Is that correct, as you understand it?

WITNESS RAY: The center of gravity was given in the drawing and did not indicate whether it was a charged cask or an empty cask.

CHAIRMAN MILLER: Does it make any difference?

MR. RILEY: May I phrase the question, Mr. Chairman?

CHAIRMAN MILLER: You don't like my phrasing?

MR. RILEY: Not quite, sir.

CHAIRMAN MILLER: All right. Well let me see what answer I get and then I'll give you a chance.

MR. RILEY: Thank you.

WITNESS RAY: There would be possibly some change in the center of gravity. This change, I believe, would be insignificant in that a fuel assembly weighs in the neighborhood of 1400 pounds. We're talking about that amount of weight influencing the center of gravity of a 25-ton cask or 50,000 pounds, and it would have a very small effect on the location of the center of gravity.

wb2 gb2

CHAIRMAN MILLER: Mr. Riley, you may phrase your question.

BY MR. RILEY:

Q Can I sum up your response then as being that, depending upon the location of the center of gravity of the fuel assembly placed in the cask, there could be some effect which you would not consider to be a large effect?

A (Witness Ray) I prefer to use the term that it would be an insignificant effect.

Q In your analysis, have you calculated the -- Strike that.

Do you have a copy, gentlemen, of the March 2, 1979 letter to Harold R. Denton signed by William O. Parker dealing with the cask drop matter?

(Document handed to witness panel.)

A Yes, sir.

Q Would you refer to page one of that letter?

A Yes, sir.

Q That describes case three. I will read the next to the last sentence:

"Energy losses at impact with spent fuel pool wall are conservatively considered, and the results of the analysis show that the remaining energy is not sufficient to cause the cask to fall into the spent fuel pool."

wr b3

Is that conclusion in the letter based on the studies that we have just been examining?

A Yes, sir.

CHAIRMAN MILLER: Are you getting toward the end of your examination, Mr. Riley?

MR. RILEY: Yes, I am, Mr. Chairman.

CHAIRMAN MILLER: Fine.

BY MR. RILEY:

Q Since the date of, I believe it is Applicant's 32 --

MR. MC GARRY: That should be Applicant's 28, Mr. Riley.

MR. RILEY: Thank you.

BY MR. RILEY:

Q There are two dates on it, 2/21/79 and 2/27/79. Would I be correct in assuming that the first date is when the work was recorded and the second date was when it was checked?

end1D

A (Witness Ray) Yes.

1E

Q Since that time, have you done any further studies on the case three problem?

A For that cask?

Q For that cask.

A No, sir.

MR. MC GARRY: Mr. Chairman, may I note for the

w gb4

record, I believe the half-day copy has just arrived, and perhaps the Staff could make that available to Mr. Riley?

CHAIRMAN MILLER: Maybe the Staff would disclose for the record how they succeeded obtaining one when the Board can't.

MR. KETCHEN: Mr. Chairman, I'll claim the Fifth on that.

(Laughter.)

CHAIRMAN MILLER: Mr. Riley, you're being offered the copy of the transcript.

(Document handed to Mr. Riley.)

MR. RILEY: Thank you, Mr. Ketchen.

BY MR. RILEY:

Q Are both of you gentlemen in a position to address the administrative control problem or proposal in case three?

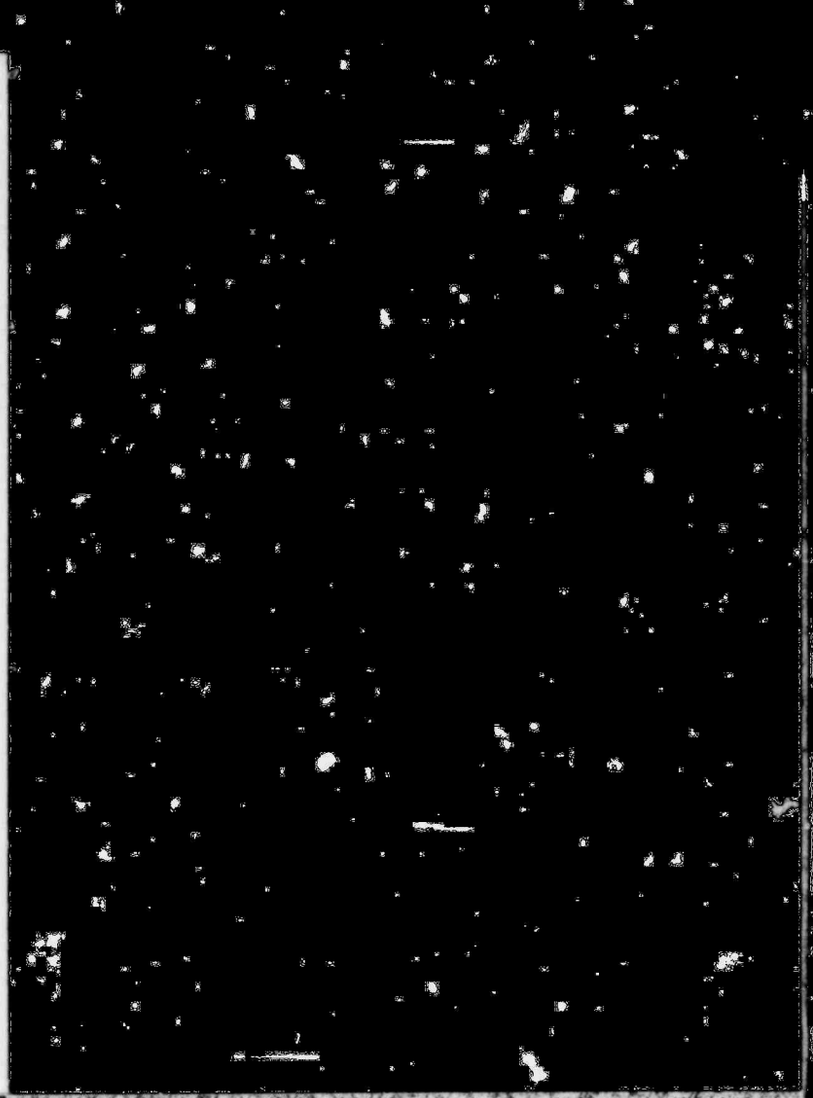
A (Witness Hager) Yes.

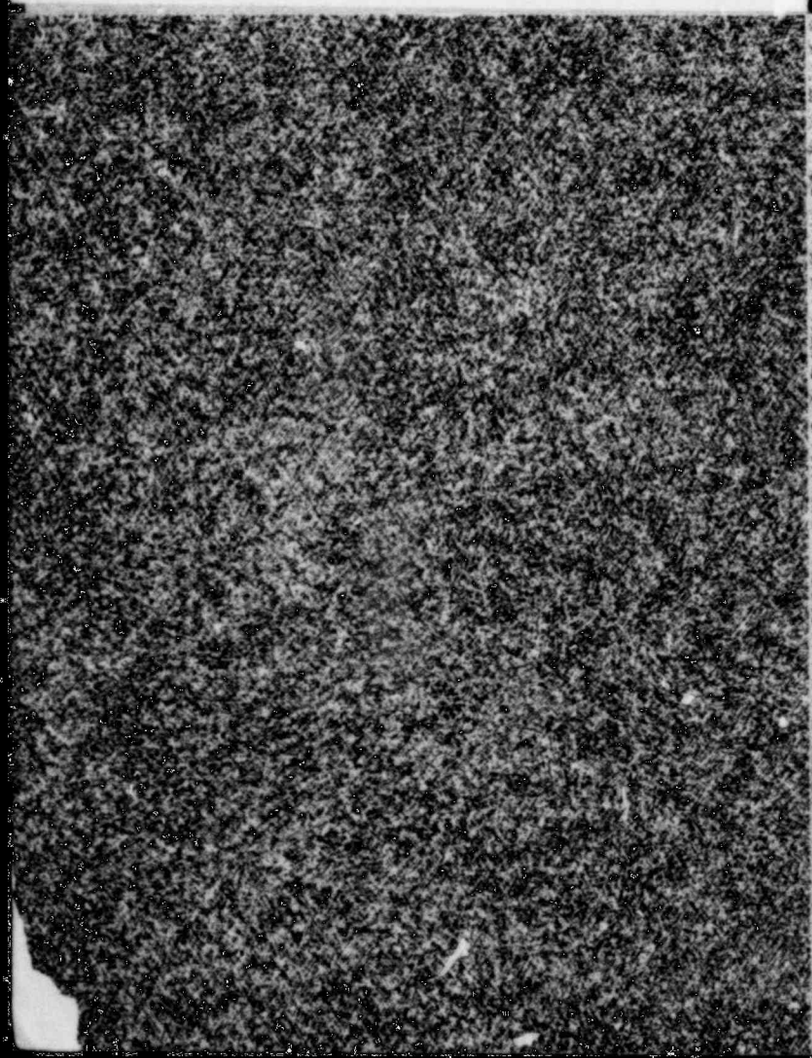
A (Witness Ray) Yes.

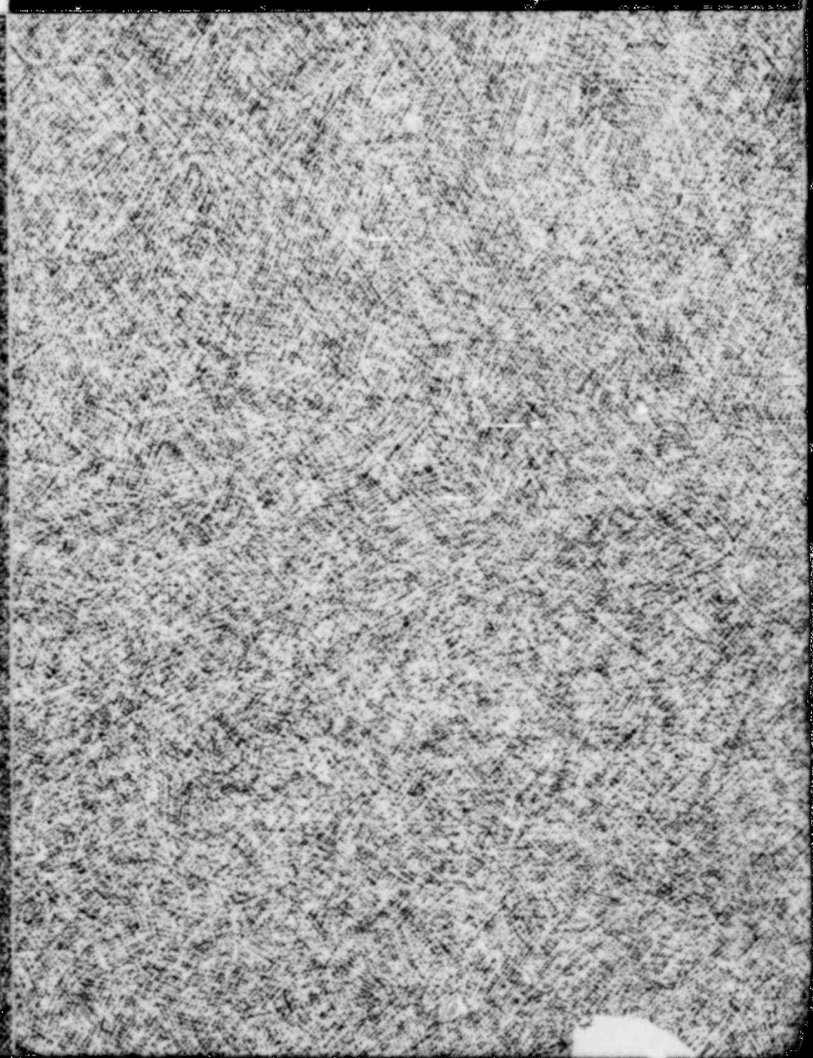
Q What other means did you consider of avoiding the cask drop accident no matter what, so to speak?

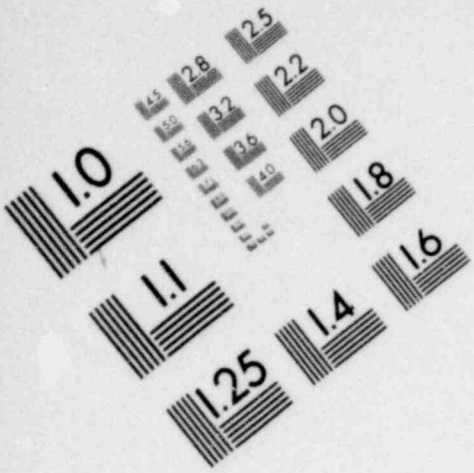
A After completing the calculations and coming up with the conclusion that the cask would not fall into the spent fuel pool, we proposed the administrative control as additional insurance that the cask would not fall into the pool. And it was done so in an effort to provide additional conservatism.

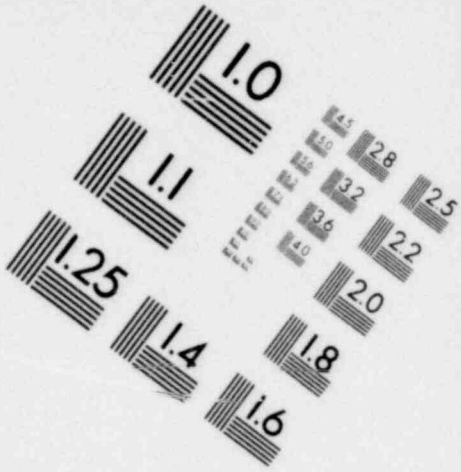
Q Is it your firm conviction that the cask could not











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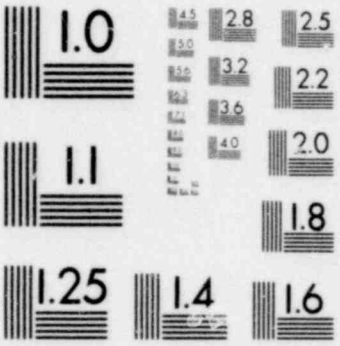

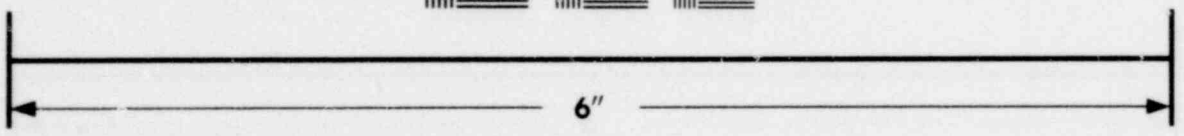

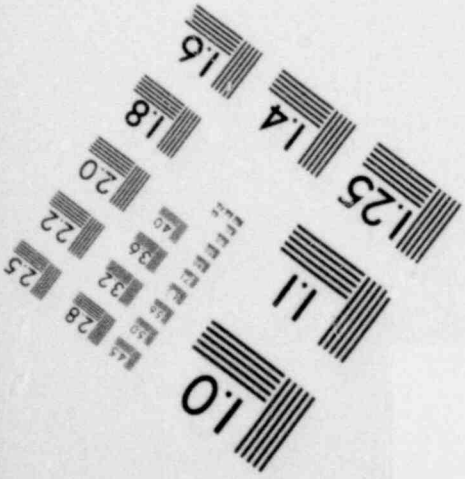

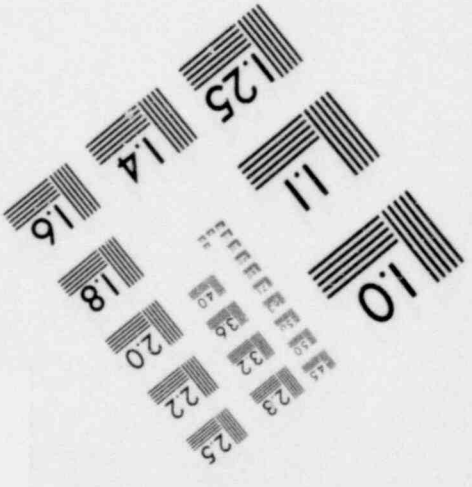

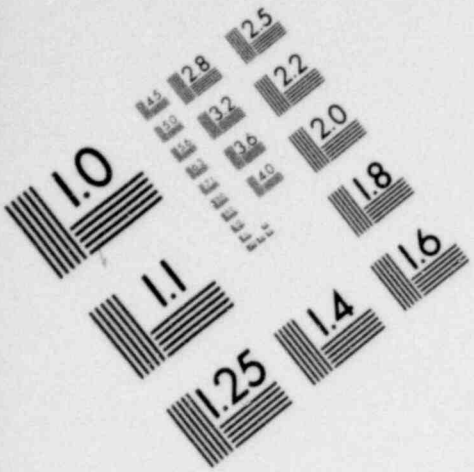

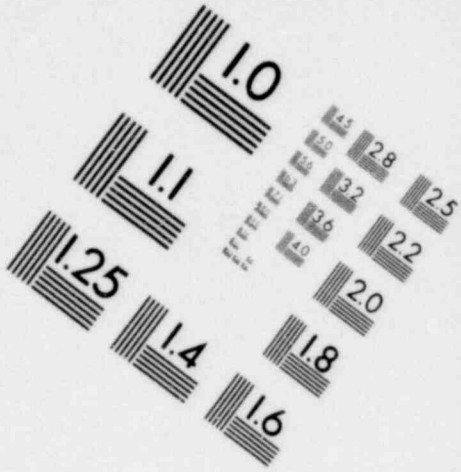

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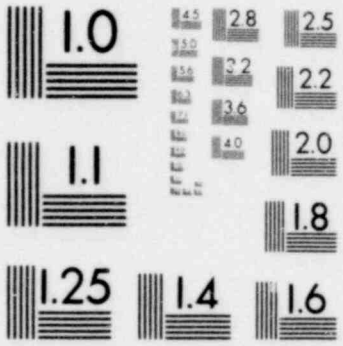

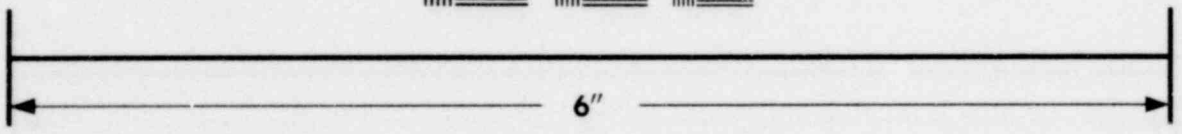

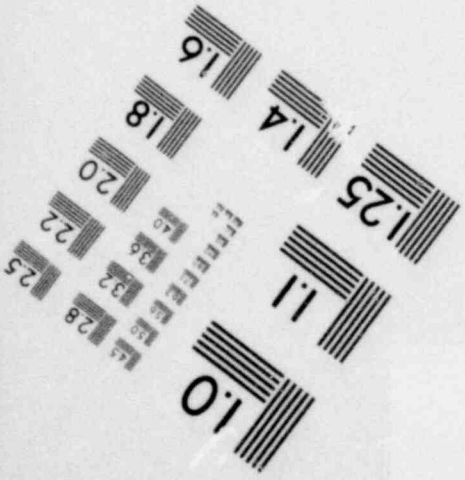

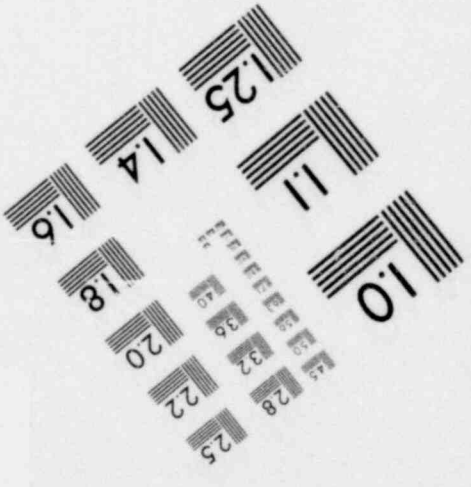

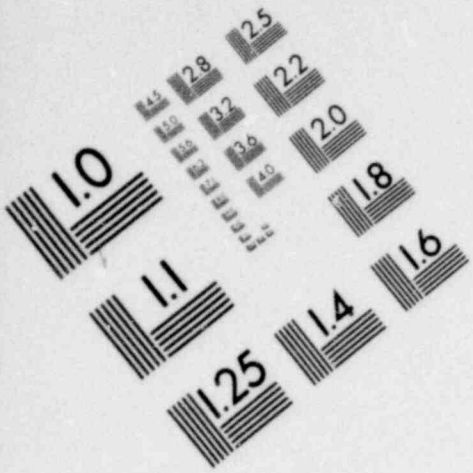

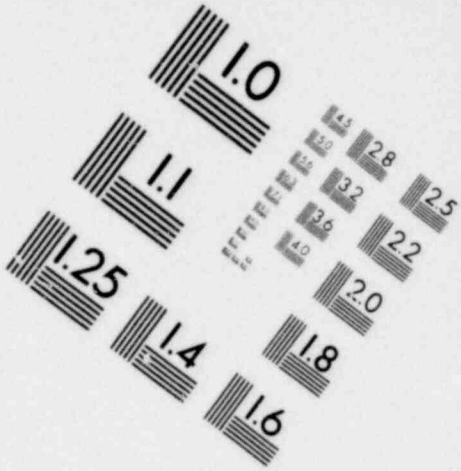

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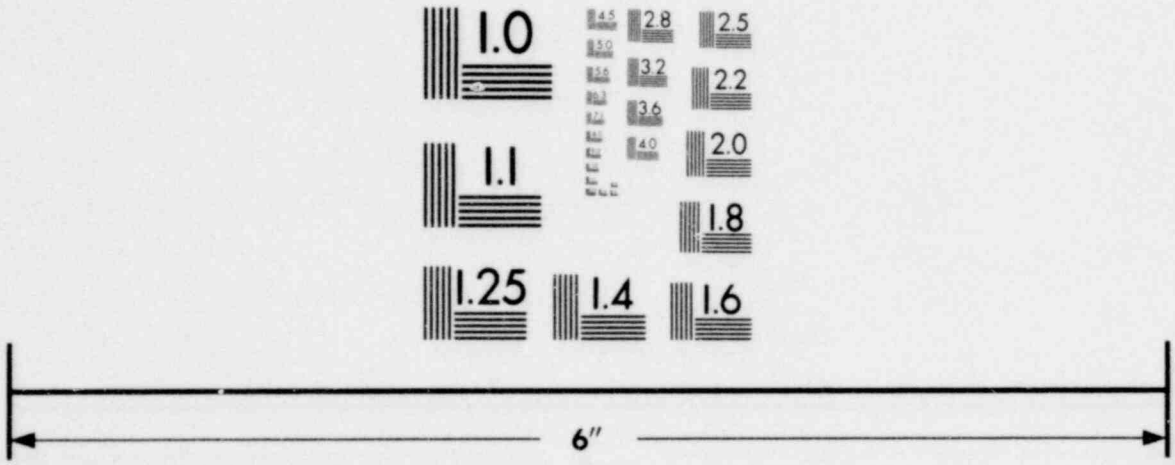

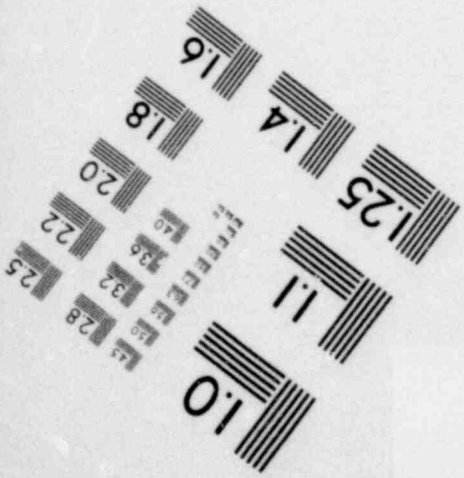

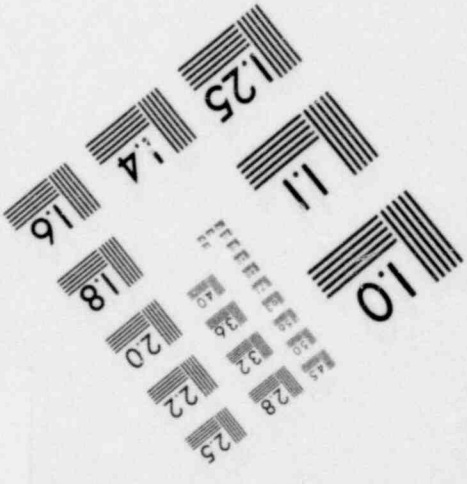

wj gb5

fall into the fuel pool and any conceivable tipping accident involving this cask and its use?

A Yes.

Q Why then did you add the administrative control aspects?

A To add additional conservatism.

Q Was that conservatism something that you sought on your own?

A Yes, it was.

Q Was that conservatism totally without being influenced by the concerns expressed by the NRC Staff?

0.320

A That is correct. That proposal is made on the last page of the calculations that I believe you have.

Q Which I have not yet seen, simply in terms of the time to leaf through it.

Did you consider more positive means?

A No, sir.

Q Did you have any conversations with Mr. Spitalny about the three fixes that he testified to earlier?

A (Witness Hager) No.

A (Witness Ray) No, sir.

Q In terms of cost, is the proposal that you made -- how would you cost it out?

A I couldn't put a specific cost on it. It does require additional time in the refueling process -- I'm sorry,

WRB/wb1

not refueling but the handling fuel process.

Q By changing the course of the cask then more than it otherwise would be?

A Any additional controls and restrictions require a time element.

Q All right.

What about the capital cost of the visual barrier?

A (Witness Hager) It existed prior.

A (Witness Ray) It already existed prior to. There was already a handrail, a removable handrail around the pit.

Q Will this removable handrail be in place when the transshipment operation takes place?

A Yes, sir.

Q And what is the height of this handrail.

A Our standard handrail is 3 foot 11 inches high. And in my opinion that handrail is our standard. I haven't checked the specific drawings, but we use typical handrail height of 3-foot-11, which is an OSHA standard, I believe.

Q Is that 3-foot-11 then above floor level, and it doesn't deal with penetration into a socket or something like that?

A Yes, sir.

Q How long are the segments of this removable handrail?

A I do not know the exact figure on that.

WRB/mb2

Q Is the handrail segmented?

A Yes, it is.

Q Could you give us an approximate notion, either you or Mr. Hager, of how long a segment is?

A (Witness Hager) I would say it would be in the range of six feet. The segment would be such that a person could lift it out.

Q That's what I was after. Thank you.

And it would require adherence to procedure to be certain that that visual barrier was in place during one of these operations; is that correct?

A (Witness Ray) The handrail is in place and would be removed around the other portions of the pit in the event of cask handling. It is typically left in place due to OSHA regulations.

Q In the drawings that we have -- and I believe it would be Staff Exhibit 33.... If you'll give me just a moment to find it.

Do you have this drawing in front of you?

MR. MC GARRY: Which drawing is it, Mr. Riley?

MR. RILEY: Exhibit 1 in Staff 33.

(Document handed to the panel.)

WITNESS RAY: Yes, sir.

BY MR. RILEY:

Q The handrail is shown as being inside of the boundary

WRB/wb3

of the cask pit.

A (Witness Ray) Yes, sir.

Q Is that a correct delineation?

A Yes, sir.

Q Does the handrail then have an offset in it, or do the sockets lie on the inside of the pit wall? Could you tell us about that?

A They are bolted to the inside face of the wall, the brackets that hold the handrail.

Q Could you give us an idea of the dimensions of the-- Would we be correct in assuming there are several horizontal rods and several vertical rods in a segment of this?

Could you give us a physical description?

A There are standards and regulations which have to be adhered to in design of the handrail. And there is the top bar which is a pipe, and an intermediate bar, I don't know the exact dimension, but approximately mid-way, a little higher than mid-way from the bottom.

And then there are vertical posts supporting those horizontal bars.

Q If we assume a segment of more or less six feet which you referred to, Mr. Hager, how many vertical posts are there in a segment?

A (Witness Hager) Two.

Q Two.

WRB/wb4

Could you give us the dimensions, approximately, of the vertical posts, whether it's a pipe and hollow or a rod and solid?

A (Witness Ray) It's a pipe and hollow.

Q In bolting the vertical member, then, to the side of the pit wall, could you describe the fixture?

MR. MC GARRY: Mr. Chairman, I would just like to interpose an objection. This is all very interesting about the handrail. But I think the Board inquired ten minutes ago if Mr. Riley was about to wind up, and he indicated he was. We are now going on for a good five minutes about [illegible] commonly recognized handrail. And, if it is leading somewhere, perhaps Mr. Riley could speed up the examination.

CHAIRMAN MILLER: Objection sustained.

MR. RILEY: Well, Mr. Chairman,--

CHAIRMAN MILLER: Objection sustained, Mr. Riley.

MR. RILEY: I assume the counsel or spokesperson can argue with the Chairman but it won't get him anywhere?

CHAIRMAN MILLER: That's correct. We now have the feeling we are getting toward peripheral aspects.

MR. RILEY: I was trying to close in on the likelihood of this handrail buckling under impact of the cask, sir, something we did get into before. And if it's a very substantial thing, why, one can say that the deflection of the cask would be minimal. If it's not very substantial we can say

WRB/wb5

well it might tear out the fixture and all the rest of it. And that really was the thrust of it. I was just trying to wrap that part of it up.

CHAIRMAN MILLER: Well, why don't you ask him directly.

BY MR. RILEY:

Q Could you describe the characteristics of the fixture, and so forth, and what sort of loading it could take? It is grouted in? Is it tied to a rebar? --the sort of thing that would give us an idea of how substantial it is, what sort of an impact it can take; or is it only designed to keep a man from falling into the pool?

A (Witness Ray) I think I can answer that without going into the details of the handrail.

The handrail in no way will resist the thrust of the cask. It is designed as a personnel barrier.

Q That's a very adequate answer. Thank you.

Are you familiarwith the Sandia report in which cask accidents and high speed impacts are considered, either of you gentlemen?

A (Witness Hager) Yes.

A (Witness Ray) Yes.

MR. RILEY: Before Mr. McGarry objects, perhaps I should lay a foundation.

CHAIRMAN MILLER: What's the purpose, Mr. Riley?

WRB/mb6

MR. RILEY: Well the purpose is this: In the Sandia study it is claimed that the use of models related very closely to the actual occurrences full-scale. What I wouldlike to do is find out whether the applicant has made any use of models with respect to confirming the assumptions of the way Case 3 will, in their opinion, operate.

CHAIRMAN MILLER: Just ask him.

BY MR. RILEY:

Q That's it.

CHAIRMAN MILLER: Do you understand the thrust of the question, gentlemen?

WITNESS HAGER: I think we understand the question to be have we used models.

CHAIRMAN MILLER: Yes.

WITNESS HAGER: And in the context of the Sandia report we have not modeled it in that fashion.

BY MR. RILEY:

Q In the context of Case 3 did you generate a model which you felt was physically a faithful replica to the cask, and put it through the cask drop scenario?

A (Witness Ray) No, sir.

Q This is just sort of a -- to finish up on something that came earlier: Did you make any estimate of how much the cask would bounce on impacting the wall between the pit and the pool?

WRB/wb7

A No, sir. Because any bounce at all would be an unconservative assumption.

Q We realize that. But you did not make the calculation?

A That is correct.

Q Would you know how to make the calculation of how much the cask would bounce? And I don't wish to be challenging your professional competence, which is obviously considerable. It seems to me it would be a difficult problem.

MR. MC GARRY: Mr. Chairman, I'm not going to object to the observation, but--

CHAIRMAN MILLER: Sustained.

MR. MC GARRY: I would like to note, though, that the witness has stated that he did not perform that calculation. That's his testimony.

CHAIRMAN MILLER: The record reflects that that's his testimony.

MR. RILEY: What I'm trying to establish is the difficulty of it, and whether the witness feels he could do it.

CHAIRMAN MILLER: If he didn't do it I don't think that the ease or difficulty really would be very significant.

MR. RILEY: Well sometimes one doesn't calculate something because it's too difficult. At least I've found that out.

CHAIRMAN MILLER: You're getting philosophical now.

WRB/wb8

MR. RILEY: The question is objected to, then?

CHAIRMAN MILLER: I sustained the objection.

MR. RILEY: Okay.

BY MR. RILEY:

Q In your calculations here -- which I have not had a chance closely and quantitatively to examine, Mr. Ray -- did you follow the course of the residual potential energy through the several events, Situations 2, 3, 4 and 5?

A (Witness Ray) If I understand your question, putting it into my terms: Did I calculate the energies at each location?

Q At each level, yes, and in each situation, to find out how much remained of the original potential energy?

A Yes, sir. But only to find out the velocities. If we assume no energy losses of the rotational energy then the energy stays constant, except where we take out translational energy.

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Q In the criticality calculations that you made, what was the array of racks that you considered to be involved? In other words, were there racks in the unit? If so, how many racks were in a unit?

A They are not modular racks. It is a continuous rack system with the fuel cells -- and I am quoting from memory -- I believe to be 15 or 15 and 1/2 inches. It's 15 and 1/2 inches on center.

Q Now you indicated that there would be just local deformation at the top of the individual recepticles for the assemblies.

A That's correct.

Q And what I want to know is a bit more about the structure of that.

Are these free standing from a common base? Are there linkages in horizontal lines between them? If so, where are they? What is their nature?

A The cage is a verticle structure that rests on the bottom of the spent fuel pool floor. They are horizontally restrained from motion by a lower grid of structural steel and an upper grid of structural steel near the top and near the bottom.

Q Could you tell us how far from the top the upper grid is?

A I cannot give an exact dimension.

mpb2

Q Could you give an approximate one?

A In the neighborhood of six to eight inches.

Q And what is the nature of this upper grid?

A It is a grid system of interlaced structural channels that go between each fuel cage on four sides.

Q All right.

Now is this structure tied in to this -- this upper grid structure tied in to the fuel pool wall itself?

A In a sense it is. It spans from wall to wall with a small gap at each end to account for temperature expansion.

Q And these channels lie either lengthwise or crosswise of the pool, there are no diagonal ones?

A That is correct.

Q And what is the size of the channel?

A I don't remember.

Q Do you remember the nature of the analysis you made which indicated there would not be sufficient deformation to cause a criticality event?

A I did not perform the analysis myself. An engineer under my supervision did. And I reviewed it. I do recall the nature of the calculation.

Q You testified that the fuel is normally borated. What is the borate level?

A I do not know the borated -- the boric acid

mpb3

content of the water specifically.

Q What is the K effective for the particular design of the presence of specified borate -- I assume it's specified?

A I believe I testified earlier that the information on the actual radiation levels and so forth that I obtained, the conclusions are from Nuclear Engineers. I am not knowledgeable in that field.

Q All right.

It was not expressed to you in K effective or anything like that?

A No, sir.

MR. RILEY: Mr. Chairman.

CHAIRMAN MILLER: Yes.

MR. RILEY: That finishes what I have, subject to the other colloquy I had on this.

I would like to bring to you another matter, if I may approach the bar.

CHAIRMAN MILLER: Yes.

Have you concluded your cross-examination of the panel?

MR. RILEY: In a qualified way, yes. That's why I gave a yes and no answer before.

(Conference at the bench.)

CHAIRMAN MILLER: All right.

pb4

Does the Staff have any questions?

MR. KETCHEN: No questions, Mr. Chairman.

CHAIRMAN MILLER: Mr. McGarry,do you have any redirect?

MR. MC GARRY: Just one second, Mr. Chairman, if I may.

CHAIRMAN MILLER: Yes.

(Pause.)

MR. MC GARRY: No questions, Mr Chairman.

CHAIRMAN MILLER: No questions.

MR. KETCHEN: Mr. Chairman.

CHAIRMAN MILLER: Yes.

MR. KETCHEN: I'm sorry I'm interrupting.

CHAIRMAN MILLER: No. Proceed.

MR. KETCHEN: I'm not sure whether the Board has any questions or not, but I have three matters that I'm obligated to bring to the Board's attention, I believe.

CHAIRMAN MILLER: The Board has no questions of the panel. They are excused, subject only to the limited recall that we have already discussed.

(The panel excused.)

MR. KETCHEN: The first matter I'd like to bring to the Board's attention is a -- and I would like to distribute these in accordance with the same instructions I had to distribute other material this morning. If you'll remember

pb5

the letter I distributed to parties and the Board of September 12th, it mentioned that there was a protective order enclosed. The package of documents that I received did not have the protective order in those documents, and I distributed the documents as they were.

Since that time the General Counsel has sent to me the protective order referred to in that letter, and I'd like to distribute that.

CHAIRMAN MILLER: Yes. You may do so.

MR. KETCHEN: The second matter I'd like to bring to your attention is the matter -- just information about Dr. Bateman.

My understanding from reading his response to Mr. Roisman's subpoena request was that he would answer the questions in writing. Yesterday we called just to confirm that Dr. Bateman would be here -- and I'm just passing the information along. I was under the impression or I was told that there would be written material some time today. My understanding is that the Department of Energy does not plan to file written material.

MR. MC GARRY: May I just, so the record is clear, that's our understanding, that this afternoon Mr. Bateman will have some statement available. We're endeavoring to get a copy of it, Mr. Chairman. That's as far as we --

CHAIRMAN MILLER: Your information is that he will.

pb6

Your information, Mr. Ketchen, is that he will not.

MR. KETCHEN: That's what I was told yesterday.

CHAIRMAN MILLER: That's fine.

MR. KETCHEN: I can just pass that along. For the record, I'm not representing him in any way; I just wanted to pass that along.

The third matter I'd like to bring to your attention is that last evening the Board requested that the Staff respond to the Board question on criticality, and we have been able to get the witnesses here by two o'clock today that could respond to those questions. And I think I have an obligation to indicate that we had to do quite a bit to get them here. They do have other obligations, I understand, in other areas of the country.

CHAIRMAN MILLER: We'll hear them right now.

MR. KETCHEN: I was going to request that they be heard as soon as possible.

CHAIRMAN MILLER: As soon as possible is right now. Who are they?

MR. KETCHEN: I'd like to call them at this time, then. I would call Dr. Jack Donohew, Jr., and Mr. John Zudans, and Ed Lantz.

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CHAIRMAN MILLER: Gentlemen, if you would stand and raise your right hands and take the oath, please.

Whereupon,

pb7

JACK DONOHEW, JR.,

JOHN ZUDANS

and

EDWARD LANTZ

were called to the stand as witnesses on behalf of the Regulatory Commission Staff, and, having been first duly sworn, were examined and testified as follows:

DIRECT EXAMINATION

BY MR. KETCHEN:

Q From left to right, starting with Mr. Donohew, would you gentlemen identify yourselves, please?

A (Witness Donohew) My name is Dr. Jack Donohew, Jr.

A (Witness Zudans) My name is John Zudans.

A (Witness Lantz) My name is Ed Lantz.

Q Dr. Donohew, just very briefly, will you identify who you're employed by, what your responsibilities are, and give a brief resume of your experience and educational qualifications?

A (Witness Donohew) I'm employed by the Environmental Evaluation Branch, Division of Operating Reactors, NRC. I am employed to do dose calculations, look at -- do environmental impact appraisals, look at the -- basically looking at the operating plants. It does involve looking at spent fuel pool modifications and the impacts of damaging spent fuel by such things as casks.

pb8

I have my doctorate and masters degrees from MIT. I have my bachelor of engineering physics from Cornell University.

I have been employed by Stone and Webster Engineering Corporation up to 1975, and I've worked for the Commission since 1975.

Q Mr. Zudans, would you do the same thing, give where you're employed, your responsibilities, and a brief resume of your educational and professional experience and background?

A (Witness Zudans) I'm employed by the Engineering Branch, Division of Operating Reactors. I'm the technical coordinator for all spent fuel pool modifications in the areas of mechanical materials and structural evaluations.

My education is that I have a B.S. in mechanical engineering. I'm working toward my masters degree in mechanical engineering. And I have been employed by Stone and Webster in the design of spent fuel pools;and also I've worked at Ingersol Rand Company.

Q Mr. Lantz, would you follow the similar procedure, and I think you know the questions. If you will respond to giving your present employment and your background, professional qualifications and educational background.

A (Witness Lantz) I'm presently employed by the Plant Systems Branch in the Division of Operating Reactors,

mpb9

NRC. For the past several years I've been reviewing the criticality and cooling aspects of spent fuel pool modifications.

I have a masters of science degree in physics from Union College in Schenectady, New York. I started as a nuclear engineer working for the Knolls Atomic Power Lab in 1956, and I've been in the field ever since.

Q Thank you, gentlemen.

Just to give you background -- and I'll lead a little bit -- have I in consultation with you called to your attention a Board question that was asked on Tuesday, September 11, 1979, and reflected in the record of this case?

A (Witness Donohew) Yes, sir.

Q And do you have a copy of the transcript with you which you have reviewed?

A Yes, sir.

Q And would you reference the transcript page on which I believe the summary of the question asked by the Board, Dr. Luebke, is contained?

A It's page 4272 of the transcript dated Tuesday, September 11, 1979, in the matter of Duke Power Company, Oconee-McGuire, Docket 70-2623.

Q Thank you.

MR. KETCHEN: I'm going a little bit fast, Mr. Chairman. I think after I finished the qualifications

pb10

questions I should have stopped, and I'm getting ready to go into the direct. I think I should stop now and offer the panel for voir dire.

CHAIRMAN MILLER: You may proceed -- have you finished?

MR. KETCHEN: I've finished with the qualifications part of their testimony and before I go to the direct I would --

CHAIRMAN MILLER: The Board has no questions. You may proceed.

BY MR. KETCHEN:

Q Dr. Donohew, I think I'll start with you. I would like for you, if you would, to just first of all give you understanding of what the Board question is that you are here to respond to.

A (Witness Donohew) Okay. I believe I'm to respond to the concern, the question about the release or dispersal of radioactive materials in the event of rupture of fuel elements caused by the cask falling into the pool.

Q And will you respond to that question at this time?

A Yes.

Concerning the Oconee fuel in the McGuire pool, I have reviewed the tech specs that are on the fuel in -- the Oconee fuel -- I have reviewed the tech specs on the Oconee

pb11

fuel with respect to the fact of a cask being able to come in, take the fuel, and to be shipped out. There is a period of 43 to 53 days, depending on which unit --

Q Let me stop you just for the sake of the record, stop you and ask you to clarify what facility you're talking about?

A Okay.

I'm talking about the fact of Oconee fuel being stored in the McGuire spent fuel pool, and to transfer that fuel to McGuire there is the tech spec on being able to bring the cask into Oconee to pick up fuel. There is limitation on fuel that can be put in the cask, and there's also to my knowledge a specification on what is the age of the fuel that can be transferred from Oconee to McGuire.

I'm aware of the requirements in terms of technical specifications. I'm also, having looked at the safety evaluation for Oconee, looking at their cask drop analysis that was done for them. Having looked at the fuel handling accident for Oconee and the fuel handling accident for McGuire, I can make conclusions about what would be required for fuel that would be in the McGuire pool and that may be damaged in the case that a cask may fall into that pool.

Now based on us looking at it, the fuel that could be damaged or that may be damaged by a cask falling on the

pb12

McGuire pool, if the fuel pool is full the fuel that would be damaged would have to have decayed something on the order of 43 to 53 days, based on the location of the fuel with respect to where the cask would be, this is -- these days, days decay, are what are in the tech specs for the Oconee Units 1, 2 and 3 in terms of you can not bring a cask in to remove fuel at an age of less than 43 or 53 days, depending on the unit.

Also the cask would have to have fuel of 120 days or more days decay on it for the fact of being used to move fuel.

Also there's a requirement that the fuel that will be moved from Oconee to McGuire would be at least a year old. My feeling is is that with those three requirements that are in place is that you would not have any Oconee fuel at McGuire that, given that the cask fell in and given that the pool was filled with Oconee fuel, that you would have any consequences that would be any more than at the most the potential consequence would be well within Part 100. And given that we would not expect any fuel there at less than a year old, there would be negligible consequences from the fuel being damaged.

Q Thank you.

Can you respond to the -- that was the Part 100 question. Who would be the appropriate witness to respond to

pbl3

the criticality question?

A Mr. Lantz.

Q Mr. Lantz, you have also reviewed the transcript at my direction, have you not?

A (Witness Lantz) I'm not sure I looked at the right page.

Q Well, let me do it this way, Mr. Lantz:

We did have discussions about what the Board questions were concerned about. Can you give us your understanding about what the Board question is on criticality and respond to that question?

A I guess the question is could it go critical in case a cask was dropped into the pool. Is that the question?

Q That's my understanding of the question.

A Well, certainly if they have the refueling concentration of boron in the water, soluble boron in the water, there is no problem. It cannot go critical.

3C flws

Q Could you explain that?

A Well, the refueling concentration of boron is such that when they are refueling a reactor they pull the rods out, pull all the control rods out and the reactor is still shut down. So there is no conceivable way that the assemblies in the pool, which will probably have some burnup on them -- even if they didn't have burnup on them -- could go critical with that refueling concentration of boron in the pool water.

pb14

Q Mr. Zudans, let me ask you a question.

In our discussions in preparation for responding to the Board question, did -- well, would you explain as far as your expertise is concerned how you would be able to address the Board question as posed with respect to the structural damage and effects to the pool from the postulated cask falling into the pool?

A (Witness Zudans) First of all, I have not reviewed McGuire structure or spent fuel pool racks. But we have reviewed -- amongst the pools we have reviewed, one was Oconee for the actual drop of a cask onto the pool floor. And in that particular case we determined that while the liner would tear during that accident, the leakage through the pool would be minimal.

I believe in Oconee it was on the order of some 25 gallons per minute. From that standpoint there was ample available water to be supplied to refill the lost water.

I think that should be the consideration at McGuire also. And although we have not reviewed the McGuire situation for the cask dropping, we believe that similar results could be obtained.

I guess generally what we're finding when we do review cask drop accidents is that the concrete has ample strength. The liners will tear, but the makeup systems

pb15

available at plants are such that we do not have any problem in those areas.

DR. LUEBKE: A clarifying question:

Which floor are you dropping this one, what location?

WITNESS ZUDANS: I believe that the Oconee was in the spent fuel pool floor. At McGuire I would say that if we were looking at McGuire we would have to say the main spent fuel pool.

DR. LUEBKE: I see.

I visualized in my mind that the cask would fall on this network of plates that positions the spent fuel storage, and the cask would be well above the floor.

WITNESS ZUDANS: It could drop there if there was any space. You could postulate dropping on the floor; that could also happen.

DR. LUEBKE: Well, there's this three foot wall that we've been talking about all day. Does it tip over or doesn't it tip over? What's beyond the three foot wall? Is it floor or is it racks?

WITNESS ZUDANS: I don't know that. I haven't gone to that.

DR. LUEBKE: Well, my mental picture is it's racks.

WITNESS ZUDANS: Well, in that case if it cannot reach the floor then we would be absorbing the energy of the

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-- then the energy would be absorbed by the rack itself.

DR. LUEBKE: Well, then, the problem with criticality has to do with deforming those racks with a 25 ton weight dropped on the racks.

WITNESS ZUDANS: I suppose so.

DR. LUEBKE: And has that been analyzed or considered?

WITNESS LANTZ: Yes. Like I said, with the refueling concentration of boron in there there's no possible way, nothing you could do, no deformation --

DR. LUEBKE: No geometrical squeezing together?

WITNESS LANTZ: Nothing could make that go critical.

DR. LUEBKE: And if it were just water, water by an operational accident instead of borated water?

WITNESS LANTZ: If it were pure water and you really squeeze the assemblies together, they would be far sub-critical also.

DR. LUEBKE: Still sub-critical.

WITNESS LANZT: Yes.

DR. LUEBKE: Because it's old fuel, used up.

WITNESS LANTZ: When you take water out from the fuel assembly itself between the fuel elements, then you decrease the reactivity of that fuel assembly.

DR. LUEBKE: And even if by chance somebody had

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put new fuel there, which you usually don't, it's still --

WITNESS LANTZ: Yes, even new fuel.

MR. KETCHEN: Mr. Chairman, that completes my direct in asking this panel to respond to the Board question.

CHAIRMAN MILLER: Are there any further questions?

DR. LUEBKE: Well, I'd like to follow up with Dr. Donohew about complying with Part 100.

EXAMINATION BY THE BOARD

BY DR. LUEBKE:

Q Do you have any numbers? Is it borderline?

A (Witness Donohew) Well, I said it's well within -- that's 150 rems, and the numbers I was giving you in which I said in looking at Oconee and in looking at McGuire and in coming up with numbers that I could today judge those plants because McGuire does not have a cask drop analysis with radiological consequences. The 43 to 53 days I gave you as a range of days I would expect that the fuel would have to be older than.That fuel which is in the vicinity of the cask is based on the dose consequences being a 150 rem. That's half of Part 100 on thyroid exposure.

Q And as I recall, the earlier testimony was that the Oconee assemblies are longer and they are protruding up above the racks. And so 76 assemblies order of magnitude all of the pins would be damaged and the gas would escape.

And this is how you do it?

pb18

A That's assuming every single assembly has the activity and peaking factor of Reg Guide 125. That's not taking into account the fact of the 76 for a -- let's say which was assumed for Oconee Unit 3 or the 205 which is being used for Oconee 1 and 2, of taking account having a lower peaking factor.

So assuming all of the assemblies are the worst assembly. So it's being conservative.

There's conservatisms that we have built into the calculation.

Q And the picture is that this gas, however small it is, escapes from the pins or the fuel elements? There's a ventilation system in this building and it gets out of the building and into the atmosphere and to the exclusion area and it's still safe?

A That's right. I read the safety evaluation for McGuire and it's discussed I believe in Supplement number 2. The concern was raised with the ventilation system and there was a further review from the first SER, and a discussion of that. It's all in Supplement 2 of the McGuire SER.

I don't happen to have the date for the second supplement here with me, but, I mean, there was a big discussion of that ventilation filter system, and that's taken into account.

Also, if the assemblies which have the year's

pb19

decay, which they should have because there's going to be a requirement on shipment of fuel between Oconee and McGuire that the fuel be at least a year old, the consequences would be negligible. I mean, it's not less than 150 rem, it's less than a rem.

What 150 rem was based on was the decay time of more like 43 to 53 days in the fuel. The cask itself, the cask that would be used to ship the fuel would have a requirement of something like 120 days decay on the fuel before it could be used.

So I would just mention there's three things that can be used that would show that the potential consequences would be at worst, assuming everything was -- that the minimum decay time was used would be 150 rem thyroid exposure.

What you would really expect in the potential consequences that you would calculate for such an accident would be much less than that, much less than one rem, because there is the requirement the fuel would be transferred with at least one year's decay. All the iodine will have decayed off. The noble gases left would be primarily krypton-85. The consequences would be almost no thyroid and very little whole body exposure.

Q I guess I wasn't too familiar with the one year requirement. What determines that?

A That is a requirement that is being imposed on

pb20

the Licensee on transferring of the fuel from Oconee to McGuire.

Q For what reason?

A I can't answer che question for what reason. It's obviously not needed to be within Part 100. I think it's a -- I believe that the part of NRC that is responsible for review, which is the Office of Nuclear Materials, I think should answer that. It is obviously not needed for the dose consequences to be within Part 100.

Q Well, I was just interested that the reason might go away and then you'd end up shipping younger fuel.

A Well, the thing is is that -- I can't answer that. That's more in the realm of policy.

Q Is there anyone on the panel that is familiar?

A No, sir. I think that's a question of policy because the requirements that we have imposed on Oconee as part of the review and evaluation we did on their modification imposed days like 43 and 53 days decay on the spent fuel.

Q Yes.

A Those requirements as part of their tech specs to my judgment would prevent the consequences of the accident at McGuire from Oconee fuel to be not only within Part 100 but to be well within Part 100, which is the 150 rem thyroid exposure.

Q All right.

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And the 120 day delay is determined by the cask specifications?

A That's right.

Q So we would then suppose that the window would be between 120 days and one year, which we don't quite understand where it comes from.

A And I think it shows that with just 120 days is that the consequences, if the cask should fall in, the consequences are going to be not only well within Part 100 but much less than that because there is the thyroid exposure which will fall off by a factor of two with every eight days' decay. And definitely the Staff would find it acceptable.

Q And, again, all of this is at the exclusion boundary?

A That's correct. And the exposures at the low population zone would be much lower.

DR. LUEBKE: That's all I have. Thank you.

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CHAIRMAN MILLER: All right.

That's all the questions that the Staff has. Does anyone else care to question?

MR. ROISMAN: Excuse me, Mr. Chairman.

I just wanted to find -- I was thinking that it was obvious that this aspect of the hearing will continue until the close of business today. And what I was going to try to find out is what the schedule is for tomorrow.

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CHAIRMAN MILLER: Well, at nine we're going to hear Dr. Bateman.

MR. ROISMAN: He is scheduled at nine, is that correct?

CHAIRMAN MILLER: Yes.

We previously indicated and we think we should adhere to that as the case.

MR. ROISMAN: Fine.

May I be excused until that time?

CHAIRMAN MILLER: Yes, fine. Certainly.

MR. KETCHEN: Mr. Chairman.

CHAIRMAN MILLER: Yes.

MR. KETCHEN: May I call Mr. Spitalny for one question, a clarifying question to make sure the record is correct.

We've got a slight communications problem on the timing. This witness indicated that he was using one figure -- I'm not sure it makes any difference, but I think the record should be clarified.

CHAIRMAN MILLER: Does it affect the testimony of this panel?

MR. KETCHEN: Yes.

CHAIRMAN MILLER: All right.

Mr. Spitalny can stay where he is if it's simply for clarification, and then this panel will resume and be

mpb23

open for cross-examination.

MR. KETCHEN: It's with respect to the year figure used by Dr. Donohew. And I don't know whether there's a communication among the technical people or not, but I'd like Mr. Spitalny to clear up the one year condition matter for the Board.

CHAIRMAN MILLER: Well, what's your question.

MR. KETCHEN: The question is:

What is the condition, the specific condition that Dr. Donohew referred to with respect to the time period on the age of the Oconee fuel?

Mr. Spitalny, I direct that question to you.

WITNESS SPITALNY: We, NMSS, have established in one of the proposed license conditions that the fuel decay for a period of time prior to shipment.

I did mistakenly also indicate to Dr. Donohew that it was going to be one year. Initially that was our decision. But we did change it to 270 days. So the actual time frame, the window that you're talking about, is 120 to 270 days.

The place where that number comes from, whether we're talking to one year, as Dr. Donohew had indicated, or the 270 days, was a proposed license condition that we have suggested be applied to the license if the license amendment was to be approved.

pb24

So it would remain as a license condition on the license if such shipments were to take place. And it would then be imposed as a requirement to the Licensee.

WITNESS DONOHEW: Can I make a statement concerning the difference between 270 and --

MR. KETCHEN: I was going to ask you if that affects your analysis and how so.

WITNESS DONOHEW: In no way. The difference between the 270 days and the 365 days in the year makes very little difference in terms of the amount of activity left. You're talking about in terms of iodine whether the exponent is 10^{-11} or 10^{-12} or $^{-13}$. It makes no -- whether it's 270 or 365 days, as far as the activity, it makes no difference.

MR. KETCHEN: Thank you.

Thank you, Mr. Chairman.

CHAIRMAN MILLER: All right.

Any questions, any cross-examination?

CROSS-EXAMINATION

BY MR. RILEY:

Q Dr. Donohew, what form are you assuming the radioactive iodine to be, which isotope?

A (Witness Donohew) That's considering all the isotopes. The activity would be in terms of iodine-131 through -135, which are in the highest abundance. But considering the decay -- and the decay times I was referring

apb25

to is like 43 days to a year -- it would only be iodine-131 that's left of any consequence.

Q Well, I just wondered if you'd give us the half-lives of the other forms of iodine.

A 133 I believe is 20 hours, and the rest are on the order of much less than that, like in minutes and seconds.

Q And the 131 is?

A The 131 is eight days, and 133 is 20 hours. And those are the only two of any significantly long half-life.

Q All right.

Now this assumes that all the technical specifications are observed and no errors are made, and that the fuel is no fresher than it's supposed to be in terms of your reaching conclusions?

A Yes, sir.

Q I would like to move to the third gentleman of the panel. And I apologize for not recalling your name, sir.

A (Witness Lanzt) Lantz, L-a-n-t-z.

Q Thank you, Mr. Lantz.

You indicated that the criticality depends on the boron concentration during refueling because I assume that the fuel pool and the reactor containment space, which is under water, communicate, they share the same borated water, is that correct?

A Restate your question again.

pb26

Q Yes.

You stated that the water would be borated because of refueling, and I say -- I asked you, this means that the water supply in the fuel pool communicates at least at some time with the water supply in the containment, which is used during the immersion of the reactor and the transfer of the fuel assemblies to the pool, is that correct?

A Yes.

Q Could you tell us what that borate level is? Is it a tech spec subject?

A I don't know, and I don't know what it is for this plant.

Q Can one of your fellow panelists perhaps help out there?

Mr. Donohew, do you have that?

A I don't think so.

Q Okay.

Are there circumstances under which the boration of the fuel pool would depart from the levels that are encountered in refueling?

A It's hard to conceive of. When the water evaporates water stays there. And since they know they're going to have to refuel periodically they don't take it out. So it's hard to conceive where you would lose very much boron.

Q Is the water in the fuel pool recirculated

pb27

more or less continuously over ion-exchange resins in order to remove radionuclides?

A Yes.

Q What's its effect on -- well, let me ask you another one.

Is the boron present as a salt like sodium borate : is it present as boric acid?

A It's boric acid.

Q What's the pH, then, of the fuel pool?

A I don't know.

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Q Are the ion exchange resins both cationic acid and anionic acid?

A I don't know, but the ion exchange doesn't take out large amounts of boron.

Q Are you tell us it takes out some boron?

A It might take out some small amounts, but it's very insignificant.

Q It was your testimony, I believe, that even if you had unborated water, just ordinary water in the pool, that you couldn't go critical, is that correct?

A No, I didn't say that.

Q That was my misunderstanding.

Would you then indicate the conditions under which you could go critical with the spent fuel assemblies?

A I'm not sure you could. If the whole pool was filled with racks, if you can't get the fuel someplace out of the racks, the only way you can get close to critical would be to somehow squeeze -- don't disturb the fuel assembly in any way, just have an undistorted fuel assembly but somehow push two or three fuel assemblies together.

But in this case, you're going to have stainless steel between them, so you can't get them together without stainless steel like they are in the reactor.

Q Well let's do a hypothetical, Mr. Lantz, let's suppose the physical control on the position of undamaged

assemblies, undisturbed assemblies, were somehow affected or missing or something. In pure water, what would be the center-to-center distance -- and I mean fuel assemblies center-to-center distance to go critical in pure water?

A This is without any stainless steel between them?

Q Without stainless steel between them.

A I don't know the exact distance. But in PWR assemblies, if you'd have two or three, you'd bring them relatively close together, you could get criticality.

Q Could you give us an order of magnitude number?

A How close together?

Q Yes. Let's indicate what the assembly diameter is, is it about 8.5 inches?

A Yes, the cross-dimension.

Q Right, the cross-dimension.

Now, with respect to center-to-center how close together would these two have to come approximately?

A Oh, I'd say maybe 18 inches or something like that.

Q Maybe 18 inches?

Now the reason I ask is that we've got high-density racks in these situations where the center-to-center distance is 15.5, so with the reduction of K-effective --

A I made a mistake. Let's see, 16 -- Oh, I'm sorry, I made a mistake. That's twice the number. It should be like

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8 inches.

Q Well the closest they could get would be approximately 8 or 8.5, is that correct?

A Yes. Okay. So say 9 inches, about 9 inches of water, right.

Q Now it is also your testimony that if you had borated water according to tech specs, that if you did make that assemblage of three fuel assemblies, no criticality would occur.

A That's right.

Q Mr. Zudans, I'd like to ask you a few questions also.

Is it your testimony that you have not studied the physical effect on the rack structure of the drop of a 25-ton cask such as we're considering?

A (Witness Zudans) Not for McGuire.

Q Not for McGuire.

Have you studied the effect on the racks of a corresponding drop on the fuel racks that actually exist at Oconee?

A We have reviewed the cask drop of the Oconee cask onto the spent fuel pool floor.

Q Now, only on the spent fuel pool floor, not on the racks.

A To the best of my recollection, yes.

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Q Right.

And if you were to make a study of a fuel pool, would it be relevant to you as to whether the racks were present in modules or whether they were all connected in a channel?

A Only on the basis of the stiffness of the racks and how they sit in the pool, yes.

Q All structural materials insofar as possible corresponding -- could you see a situation where you had modules where the weight of the cask might force apart several modules?

A Depending on how the rack is installed and whether it has feet that are allowed to slide, we could make that determination.

Q That will be all. Thank you.

CHAIRMAN MILLER: Is that all, Mr. Riley?

MR. RILEY: Yes, sir.

CHAIRMAN MILLER: Thank you.

Mr. McGarry?

MR. MC GARRY: No questions, Mr. Chairman.

CHAIRMAN MILLER: Staff?

MR. KETCHEN: No further questions, Mr. Chairman.

CHAIRMAN MILLER: Thank you.

Thank you, gentlemen, the panel is excused. We appreciate your coming.

(The witness panel excused.)

MR. KETCHEN: Mr. Chairman, that completes the Staff's direct case on that subject matter. I would like to move the admission of Staff Exhibit 34 into evidence.

MR. MC GARRY: No objection, Mr. Chairman.

CHAIRMAN MILLER: Without objection, it will be admitted into evidence.

(Whereupon, the document previously marked for identification as Staff Exhibit 34 was received in evidence.)

MR. KETCHEN: Just to remind the Board, there is still the outstanding Staff 33 but I assume that Mr. Roisman -- he was here, I tried to call him yesterday and didn't get his intent on Staff Exhibit 33 on the physical security at McGuire matter, I assume we can do that tomorrow.

MR. RILEY: Mr. Ketchen, I have advised him of the matter.

MR. KETCHEN: Fine.

CHAIRMAN MILLER: Yes, Mr. Roisman was excused at his request but he did indicate he would be here in the morning for the testimony of Dr. Bateman.

MR. MC GARRY: Mr. Chairman, while we're on that point, since you left the room, I suggested that I was going to endeavor to seek the commencement of tomorrow's hearing at

at 8:00 so we could take up any questions that Mr. Riley might have for the Duke witnesses, and then continue with Mr. Bateman, or Dr. Bateman at 9:00. And Mr. Roisman said he had no problems with that. I don't know what the Board's pleasure in that regard is.

But in talking to Mr. Riley, I think we may have a problem later on in the day with his availability, on Thursday, and on --

CHAIRMAN MILLER: Who's availability?

MR. MC GARRY: Mr. Riley's.

CHAIRMAN MILLER: Well Mr. Roisman has no problem because he doesn't intend to be here.

MR. MC GARRY: Well he had no problem if we start at 8:00, as long as it was the cask drop. He wished us well.

(Laughter.)

CHAIRMAN MILLER: Well we have given the opportunity to Mr. Riley to examine this material in the transcript overnight so we will start prior to 9:00. I don't know whether 8:00 or 8:30, the Board has no preference, we'll be here and we can convene whenever it's convenient for the parties and counsel who are interested in that.

What is your pleasure?

MR. MC GARRY: Our pleasure is as early as possible. I defer to the other members.

MR. KETCHEN: I have no objections to starting at 8:00.

CHAIRMAN MILLER: Good, we'll resume at 8:00 and we will take up the cask drop question insofar as Mr. Riley has had the opportunity to examine the documents and the transcript overnight.

At 9:00, regardless of where we are, we hopefully will have concluded that aspect prior to that time, but at 9:00 at any rate we will take up Dr. Bateman's testimony.

MR. MC GARRY: I would hope now, Mr. Chairman, that we could take Mr. Riley's direct case, and I think that would wrap up cask drop, except for what's hanging tomorrow morning.

CHAIRMAN MILLER: Very well.

MR. RILEY: Mr. Chairman, that's agreeable to me, too.

I would like to inform the Board that I have certain commitments that are going to require me to leave sometime Thursday. I would like to make the day as long as I could, but I will not be able to be here Friday, so I think Mr. McGarry's suggestions are quite appropriate.

CHAIRMAN MILLER: Very well.

MR. RILEY: I would also like to have a brief recess before going into my direct.

CHAIRMAN MILLER: All right. We'll have a short

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recess and then we will take up Mr. Riley's testimony.

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(Recess.)

CHAIRMAN MILLER: Are you ready to proceed?

Mr. Riley, I guess you're next.

MR. RILEY: All right. I would like to take the stand as CESG's witness in this proceeding. I've been previously sworn.

Whereupon,

JESSE L. RILEY

was called as a witness on behalf of Intervenor, Carolina Environmental Study Group, and, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION

CHAIRMAN MILLER: What is your exhibit number for the proposed direct written testimony of Mr. Jesse L. Riley?

THE WITNESS: Mr. McGarry, I think, could help us here. I think the next number should be a 12.

MR. MC GARRY: 13.

CHAIRMAN MILLER: Exhibit 13. All right. CESG Exhibit 13 for identification has been marked.

(The document referred was marked for identification as CESG Exhibit 13.)

CHAIRMAN MILLER: And I take it, Mr. Riley, this is your proposed direct testimony,that you are testifying under oath, having been previously sworn, and that you tender CESG Exhibit 13 as such direct testimony, is that correct?

THE WITNESS: Yes, with a few corrections, sir.

CHAIRMAN MILLER: All right, what corrections do you have?

THE WITNESS: Turning to page 2, the fifth line down, in parentheses there's something reading Case Number 3DBC March 21, 1979. The 1 should be deleted.

CHAIRMAN MILLER: Which should be deleted?

THE WITNESS: The 1. It should be March 2.

CHAIRMAN MILLER: Oh, March 2. I see.

THE WITNESS: And in the line below that, there's the two words "potential energy." For clarity, a comma should follow "energy."

CHAIRMAN MILLER: "Energy" followed by a comma. Very well.

THE WITNESS: On page 3, the fourth line from the bottom, there should be a separation between the word base and will.

CHAIRMAN MILLER: Page 4?

THE WITNESS: Page 3, sir.

CHAIRMAN MILLER: Page 3, fourth line from the bottom?

THE WITNESS: Right.

CHAIRMAN MILLER: That's the fifth line.

THE WITNESS: Fourth full line, sorry.

CHAIRMAN MILLER: And what's the correction?

THE WITNESS: "Base" and 'will" should be separated.

CHAIRMAN MILLER: All right. Any others?

THE WITNESS: Yes. On page 5, the last full line, starting with "essential," should have an insertion mark between "accident" and "in," and have these words written in: "or radioactivity released from damaged fuel rods".

CHAIRMAN MILLER: All right. Anything further?

THE WITNESS: It's quite possible I will want to introduce some supplemental testimony after having had the opportunity -- I'm sorry -- rebuttal testimony, after I've had the opportunity to read the material presented by the Applicant today.

CHAIRMAN MILLER: I take it that you want your last paragraph to be stricken, so that this will be in the form of prepared direct testimony? As well as your signature? On page 5?

THE WITNESS: Yes, that is correct.

CHAIRMAN MILLER: All right. Is there any objection to the receipt of CESG Exhibit 13?

MR. KETCHEN: No objection, Mr. Chairman.

CHAIRMAN MILLER: Mr. McGarry?

MR. MC GARRY: May we have a minute, Mr. Chairman?

CHAIRMAN MILLER: Yes.

(Pause.)

MR. MC GARRY: Mr. Chairman, just briefly, maybe

MR. MC GARRY: Mr. Chairman, just briefly, maybe some voir-dire as to Mr. Riley's expertise in this regard.

VOIR-DIRE EXAMINATION

BY MR. MC GARRY:

Q Mr. Riley, I take it that this document is an analysis of what has been styled as Case 3, the cask tipping accident, is that correct?

A Essentially that's correct.

Q Have you, aside from this analysis, ever performed an analysis involving the tipping of a cask into a spent fuel pool?

A Aside from this, no.

Q Aside from the Case 3, there's also a Case 1 and 2. Have you performed any analysis of any cask drop incident, other than what's before the Board today?

A I have not.

I will qualify it by saying that I read through the analyses presented by the Applicant on Case 1 and Case 2, and found that they appeared to be reasonable. And simply as a matter of conservation of energy, I did not go further.

Q Mr. Riley, in your job you don't have an occasion to perform analyses such as this, is that correct?

A Not necessarily, because it wouldn't involve casks, obviously, but I do have physical computations to make on occasion, not necessarily strictly similar to this, but

involving the principles of physics.

Q Very briefly can you explain what information you relied upon to perform the calculations that you performed, and the analysis that you performed?

A Yes. We obtained discovery of what is now called CESG Exhibit 1 from the Applicant. It provided the dimensions. The Handbook of Chemistry and Physics provided density information with respect to stainless steel, lead, balsa wood, water of course, and the other components of which the cask is prepared. And this made possible some calculations about the center of gravity of the cask.

I have received, as far as I know, correspondence that has been addressed to the parties in this case bearing on the cask drop matter, and I have familiarized myself with it.

Q Maybe one final question, Mr. Riley.

(Pause.)

MR. MC GARRY: Excuse me, Mr. Chairman, I think this next question will go over to cross-examination, as opposed to voir dire.

So I have no objection.

CHAIRMAN MILLER: There being no objection and no questions by the Board, the CESG Exhibit 13 will be admitted into evidence.

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(The document heretofore marked for identification as CESG Exhibit 13 was received in evidence.)

CHAIRMAN MILLER: Thank you, Mr. Witness. You may step down.

MR. MC GARRY: No, no, Mr. Chairman. I had questions as to his expertise of a voir-dire nature. Now I do have questions on cross-examination.

CHAIRMAN MILLER: Oh, you have cross-examination?

MR. MC GARRY: That's right, Mr. Chairman. I'll try to keep it as brief as I can.

CROSS-EXAMINATION

BY MR. MC GARRY:

Q Turning to page 2 of your testimony, Mr. Riley, did you have information that was sufficient and precise so as to enable you to calculate the center of gravity which you have calculated as 105 inches?

A I'll have to give the context before I answer that affirmatively.

My calculations showed that there was so much energy available for permitting the cask to tip into the fuel pool, that relatively small errors with respect to base of CG distance would have had essentially no influence on the final result.

Q Is it safe to say, Mr. Riley, that some subjective judgment came into play in your derivation of 105 inches?

A Very little. I very closely read the dimensions on the cask and would feel very comfortable in meeting with Applicant's people to determine whether they also agree it was 105 inches.

The distance difference is 2-1/2 inches, as I'm sure you know.

Q Which drawing are you making reference to with respect to ascertaining 105 inches?

A The CESG Exhibit Number 1.

Would you like it more clearly defined?

Q That would be helpful, Mr. Riley.

A The title box of the drawing reads, "Nuclear Fuel Services, NFS-4, for PWR/2BWR Spent Fuel Shipping Cask," and there's a number which appears to be E10078. It's also designated Figure 2.1.1.

Q Mr. Riley, you heard today the 102.5 figure that the Applicant used, is that correct?

A I did.

Q Do you quarrel with that figure?

A Just slightly.

Q Mr. Riley, you have down at the bottom of that -- what I'll call the first full paragraph, three lines from the bottom, you refer to the neutron shield as 40 inches.

A That's right, and it was your testimony -- or your witnesses' testimony -- that it was 39 inches.

Q And I look at your Exhibit 1, and under section BB I make out something that appears to be 39.2 inches. Would you accept that figure?

A I'd have no problem with that.

However, Mr. McGarry, I'm having a hard time locating it in my drawing.

Q If we look at Figure BB, Mr. Riley, perhaps I'll speed it along and show you where I am.

(Document displayed to the witness.)

A Well, on my copy it's essentially illegible, and I had not read it previously. But it will pass for 39.2 inches.

Q Mr. Riley, in the next paragraph you indicate that the lowest elevation of the center of gravity would be 15 inches, is that correct?

A That's correct.

Q And the basis for that would be your reference to the Duke Case 3 drawing, is that correct?

A No, it would be in reference to this drawing, where the diameter of the outer shell is shown to be 30 inches.

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Q Now, Mr. Riley, I call your attention to Applicant's Exhibit 27: that's the one-page Case 3 diagram. Do you have that before you?

A I do not believe I do. Can you show it to me, please?

(Document handed to the witness)

Thank you.

Q Now, Mr. Riley, if we look at the bottom diagram with the cask in the horizontal position-- Do you follow me?

A I do.

Q And looking at the center of gravity, you would say that would be 15 inches; is that correct?

A Between the center of gravity and what I have previously referred to as the floor; yes.

Q Now if we direct our attention to the top figure, and looking at the cask in the angled position as opposed to the vertical position--

A Yes.

Q Directing your attention to the center of gravity in that instance,--

A Yes.

Q --does that not appear to be lower than 15 inches?

A It appears to be. And I very carefully examined the physical drawing on Applicant's submission, and I found that if one takes the pains to get a millimeter scale and scale

WRB/wb2

off the position of the center of gravity, it's bouncing like a rubber ball. And I feel that one is entirely unable to rely on that particular drawing with respect to the location of the center of gravity.

Q Well, Mr. Riley, if we take the centerline of gravity and that centerline is angled on the top figure of the diagram we're making reference to, that would be 15 inches; is that correct?

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A Would you please repeat what you said, because I was looking for a piece of paper at the moment and my attention was distracted.

Q Certainly, Mr. Riley.

Directing your attention to Applicant's Exhibit 27, to the top figure on Applicant's Exhibit 27, to the angled figure on Applicant's Exhibit 27--

A Yes, sir.

Q --to the center of gravity. If we take the centerline of that center of gravity, which centerline on this figure as it is at an angled position, would not the distance from the center of gravity to the wall be 15 inches?

A Yes, it would.

Q And if we draw a perpendicular line from the center of gravity down paralleling the wall, would we not get a vertical distance that would be somewhat less than 15 inches?

A Only if that truly represents the position of the

WRB/wb3

center of gravity.

If you, in the same figure, move to the right along the axis of the center of gravity so that a perpendicular through it -- that is, perpendicular to the axis through it, does not coincide with the pivot point, you will place the center of gravity at one point at 15 inches above and, a little farther out, at more than 15 inches above.

So it depends on the fidelity of the drawing, which I have found to be unreliable. And also it depends upon the precise location of the pivot point, which, as earlier examination showed, is not a constant thing and does depend upon the first pivot point which is on the lefthand side of the cask pit.

Q To speed this along, Mr. Riley, is it not possible that the lowest center of gravity could be below 15 inches?

A I've calculated one case in which it is. But I've calculated a number of cases in some of which it isn't.

Q Directing your attention to the table that appears on the bottom of page 2, directing your attention to the column captioned "Potential Energy,"--

A Right.

Q --am I correct in understanding that your calculation of, say, the first figure, 637,500, was derived by taking the distance of four feet and multiplying that by the 50,000 pounds?

VRB/wb4

A No.

Q Would you please explain? You factored in the 105 inches; is that correct?

A That's correct.

Q Would you just go through the calculation in simple terms, Mr. Riley, how you derive that 637,500?

A Yes.

In any potential energy calculation you have to have a reference plane which may be arbitrarily chosen. I thought that a convenient arbitrary choice was floor level for the cask pit wall, fuel pool wall. And adding four feet, the distance from the base above that reference plane to 8.75 feet, my calculated distance from the base of the center of gravity along the axis gave 12-1/4 feet, multiplied by 50,000 pounds gave a potential energy of 637,500.

Q I believe you said 12-1/4. You meant to say, I believe, 12-3/4 feet; is that correct, Mr. Riley?

A Thank you for the correction.

Q Now you applied that calculation to all these figures; is that correct?

A That type of calculation.

Q Did you use a different calculation for the different numbers here under the potential energy?

A Well, certainly, when I had the base 2-feet, 11-1/2 inches above the floor I used different numbers. I again,

WRB/wb5

however, added the 8.75 feet, took the sum and multiplied it by 50,000, et cetera.

Q Let's just take one, just double checking, the base on the floor.

A Right.

Q What figure did you use?

A 8.75 feet and 50,000 pounds.

Q Do you have a calculator before you?

A No. But I'll pull it out of my pocket and place it before me.

Q Would you perform that calculation for base on floor, please?

A I get 437,500 pounds; which, if you will excuse me, I will take a look at myoriginal notes and see whether that 8.75 is a typo.

(Pause)

The number should be 437,500, and I would like to make that correction.

Q And would there be a corresponding correction to the available energy figure for the base on floor situation?

A Let me check it.

(Pause)

Yes. It would be 375,000, not 425,0[illegible].

Q Mr. Riley, directing your attention to the paragraph just above the table, the last sentence:

WRB

"The available energy for gyration of a cask* * *"

Am I to assume that what you mean by that is that energy that is set forth under the column "Available Energy?"

A That is correct.

Q Now, Mr. Riley, you have heard today reference made to the translational energy and the rotational energy, have you not?

A I did.

Q And did you take both translational and rotational energy into account?

A I did not make that type of analysis.

Q Should you have taken it into account?

A No.

The answer is this: That the dominant boundary conditions have to do with the energy levels of a cask at rest at the beginning of the event and at rest prior to its last movement, either back into the pit or on into the fuel pool, if indeed it does come to rest. And based on the conservation of energy, be it translational, rotational or kinetical, the boundary conditions are met and it's an adequate calculation.

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WRB/agbl

Further to that, to do a proper calculation on moments, the Applicant has not done that. It is a not-easy-to-do calculation and I would like to point out why.

If we have a fixed pivot point for a rotating object, and that object is either symmetrical or the axis is vertical, the entire energy that it can store dynamically will be rotational.

The case as modified with a translational component, if we have the case at hand and the first pivot point is, just generally speaking now, similar to that shown in the upper portion of the exhibit which we are addressing, at the intersection of the base with the edge of the cask pit.

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Now the moments of rotation would depend upon the radius of gyration. The radius of gyration is not a number that you easily pull out of a hat, because there are density fluctuations along the length of the cask, there has been no specification of the position of the canister or where it locates the fuel assembly--we are assuming a loaded cask here--and there is the displacement of the denser portion of the system above the reference plane by the impact limiter and pedestal, all of which results in really a very hairy situation in terms of calculating radius of gyration.

But let's assume that we have all the necessary information and we run it through a computer and get a radius of gyration with respect to that fifth point. When the cask

WRI b2

impacts the wall between the pit and the fuel pool and does some crushing of the neutron shield tank and starts to rest on the outer shell -- which is a reasonable assumption, I believe -- we have a whole new radius of gyration picture. And the new radius of gyration will be smaller than the original radius of gyration, and the result will be a considerable increase in the velocity of angular rotation, in other words, a real rotational acceleration.

Now when the cask continues on to what we have been viewing as a horizontal position on that sketch, a new scene comes about. And in terms of the conservation of rotational momentum, we are going to have a third radius of gyration about this new pivot point.

So the problem is it's a really complex one. I have not had the materials to address it. As has been clear from the prior discussion of the matter, this approach has not been used by either Applicant or Staff.

Q You recognize there are two components of kinetic energy, is that correct?

A Certainly.

Q Turning to page three, the top paragraph, the last sentence, you indicate that certain amounts of energy will be dissipated by various incidents, is that correct?

A That is correct.

Q Have you calculated how much energy will be

wrb 3b3

dissipated?

A I have no basis for making that calculation. I have examined carefully all the material now provided by Staff and Applicant, and I find that they have made no such calculation either.

I would suggest that that would be better empirically determined in this context or by a suitable model and calculated.

MR. MC GARRY: I'll move to strike the last.

CHAIRMAN MILLER: Disclaimer allowed, answer stricken.

THE WITNESS: Excuse me, please, Mr. Chairman, I didn't understand what just happened.

CHAIRMAN MILLER: Well I granted the motion, the disclaimer of the testimony as being not responsive to the question on cross-examination, which was within the prerogative of the cross-examiner and it was therefore stricken.

THE WITNESS: I see.

BY MR. MC GARRY:

Q Mr. Riley, directing your attention to the second paragraph on page three.--

A Excuse me. If I may put on my spokesman cap for one second.

MR. RILEY: Does that strike the entire answer, sir, or only the portion that involved the matter objected to?

wr gb4

CHAIRMAN MILLER: I think the entire answer was non-responsive as I recall it.

MR. MC GARRY: Mr. Chairman, I believe, with all due respect, I think the first part of the answer, whether or not he had performed the calculation indicating how much energy would be dissipated, was responsive to the question and thereafter was the --

CHAIRMAN MILLER: I'm sorry, that's correct, Mr. Riley, it would be the non-responsive portion following the first part of your answer.

MR. RILEY: All right.

CHAIRMAN MILLER: -- that was stricken. The first part stands.

MR. RILEY: Would it be desirable for the record to define what that material is, then?

CHAIRMAN MILLER: Not necessarily.

BY MR. MC GARRY:

Q Mr. Riley, directing your attention to the second paragraph on page three, you make reference there to Sketch 3 DPC.

A Right.

Q And is not that document what has now been received in evidence as Applicant's Exhibit 27?

A It is.

Q And you indicate there that the center of gravity

lies in the plane of the pit wall, is that correct?

A Let me read the paragraph aloud:

"The most critical circumstance for the tipping accident, that is, the least conservative, occurs when the base is at floor level, and the center of gravity lies in the plane of the pit wall."

Now that's at the initiation of the event. And I refer to Sketch 3 and it would be the upper portion of Sketch 3, with the cask in the vertical orientation but moved to the left so the center of gravity coincides with the pit wall.

Q But in that Sketch 3, the center of gravity on Sketch 3 in the top figure in the vertical position, that center of gravity does not correspond to the plane of the pit wall, is that correct?

A That is correct, Mr. McGarry. And in the context, I simply want to help the reader visualize the situation, but to apply the guiding information which you gave, which would call for a displacement of that vertical cask to the left.

Q And as I understand the sense of that paragraph -- not to be critical, Mr. Riley, and maybe you can help me here -- but you indicate the most critical circumstance and then you style that as least conservative.

With that in mind, I ask you the question are you suggesting that if one were to move the cask such thatthe center of gravity would be in the plane of the pit wall that

that would be a less conservative example than the one that Duke Power Company has evaluated?

A May I explain my language, Mr. McGarry? I think it'll answer your question.

By the most critical circumstance, I mean the one in which the tipping into the fuel pool is least likely to happen.

Q Fine. Thank you.

CHAIRMAN MILLER: I think this would be a convenient point to recess. We'll resume at 8:00 in the morning.

MR. MC GARRY: If it helps the Board, I have very little left, but whatever the Board's pleasure is. I would say I could wrap it up in five minutes.

CHAIRMAN MILLER: Can Mr. Riley wrap it up in five minutes?

MR. MC GARRY: I can't speak for Mr. Riley.

CHAIRMAN MILLER: Well we intended to stop at 5:00. It has been our experience once you keep on, you're good for another at least 15 more minutes, which would be beyond the time we would wish to stop.

MR. MC GARRY: Mr. Chairman, I indicated that we would make copies available of Applicant's Exhibit 28, which has been marked for identification. I'd like to hand those out now to the Board and the parties.

CHAIRMAN MILLER: The record will show they are

being handed out by counsel.

(Documents distributed.)

CHAIRMAN MILLER: That's Applicant's 28?

MR. MC GARRY: Applicant's 28.

(Whereupon, at 5:05 p.m., the hearing in the above-entitled matter was recessed, to reconvene at 8:00 a.m., the following day.)