ORIGINAL

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Title: **CONAM INSPECTION, INC.**

Itasca, Illinois

License No. 12-16559-01

EVIDENTIARY HEARING

Docket No.: **30-31373-CivP**

Location: **Chicago, Illinois**

Date: **Thursday, September 17, 1998**

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the matter of: :

CONAM INSPECTION, INC., : Docket No. 30-31373-

CivP :

Itasca, Illinois :

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Federal Building

536 South Clark Street, Room LLA

Chicago, Illinois

Thursday, September 17, 1998

The above-entitled matter came on for evidentiary hearing, pursuant to notice, at 9:00 a.m.

BEFORE:

CHARLES BECHHOEFER, Chairman

RICHARD F. COLE, Administrative Judge

CHARLES N. KELBER, Administrative Judge

APPEARANCES:

On Behalf of Nuclear Regulatory Commission:

MR. CHARLES BARTH

MR. DENNIS DAMBLY

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On Behalf of Conam Inspection, Inc.:

MR. MALCOLM (CHIP) BROOKS

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ALSO PRESENT:

WILLIAM GEOFFREY WEST, NRC Staff

THOMAS YOUNG, NRC Staff

CINDY JONES, NRC Staff

C O N T E N T S

E X H I B I T S

NUMBER	IDENTIFIED	RECEIVED
Joint Exhibit 9		1013
Joint Exhibit 23		929
Joint Exhibit 24		880
Joint Exhibit 32		957
Joint Exhibit 38		928
Joint Exhibit 40		883

P R O C E E D I N G S

[9:05 A.M.]

CHAIRMAN BECHHOEFER: Ready to go?

MR. BARTH: Yes, Your Honor. I apologize for being late. We didn't really plan the truck wreck on the road in front of us. Those things happen.

Dr. Cool, I remind you that you're still under oath.

CHAIRMAN BECHHOEFER: Let me tell the reporter we're on the record. Good morning, everybody.

MR. BARTH: I thought you said you were ready to go.

CHAIRMAN BECHHOEFER: Yes. Mr. Barth, you may continue now.

Whereupon,

DONALD A. COOL, Ph.D.,

a witness, was recalled for examination by counsel for the U.S. Nuclear Regulatory Commission and having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION (Continued)

BY MR. BARTH:

Q Dr. Cool, would you please provide us with a brief description of the duties and functions and jurisdiction of your office in Washington, sir?

A Yes, sir. My division -- I'll back up for just a moment. The Office of Nuclear Materials Safety and Safeguards is the office within the Commission that is responsible for the licensing inspection and associated regulatory activities for materials which do not involve the reactors. Within that, there is a very wide range of activities, from the fabrication processing that goes into making the fuel for the reactors; gaseous diffusion plants; fuel fabrication facilities; the transportation activities for the agency; the back end of the fuel cycle and other activities; all of the waste disposal, both high level waste and low level waste; responsibility for the de-commissioning activities; responsibility for the licensing, inspection and other activities for the by-product material uses. So anything that doesn't directly involve the reactors, principally falls to the Office of Nuclear Materials Safety and Safeguards.

Within that, my division is specifically responsible for the functions associated with the by-products uses of materials, that ranging from things like radiography and similar sorts of industrial activities, to various kinds of other commercial and academic activities, medical activities, a whole series of those. The division itself, between the headquarters office and the individuals in the region who are also part of my net program, conduct

the licensing, the inspection, the allegation follow up, the enforcement, the event response, all of the activities associated with that program.

Q Dr. Cool, I would like to refer you to Joint Exhibit 10. There's a notebook in front of you basically prepared by the licensee which has these exhibits.

A Yes, sir.

Q Exhibit 10 is a Conam dose reconstruction by Tom Young and Geoff West. Have you seen this before, sir?

A I have.

Q Is this the dose reconstruction prepared by the NRC for Mr. Chastain's exposure on February 27, 1996?

A It is.

Q Have people in your office reviewed this document?

A They did.

Q Have you reviewed this document?

A In general terms?

Q Yes, sir.

A Yes.

Q Is this the kind of material which is within the jurisdiction that your offices work?

A It is.

Q Is it a fair statement to say that you and your office is the definitive authority within the NRC to make

these kinds of determinations; that is, determination of what dose was received under the NRC regulations?

A Yes, it is.

Q Concluding on this subject, do you approve, did your office approve the reconstruction as it is in your hands?

A We did.

Q Thank you.

JUDGE KELBER: Could you repeat that?

THE WITNESS: We did.

JUDGE KELBER: You did approve it?

THE WITNESS: Yes. Let me amplify on that just a bit for you, if you'd like.

Another piece of the process which Mr. Lieberman was talking to you yesterday about, our office, being the program office responsible for these kinds of licensees does get involved in a number of these cases. We, as a matter of routine and practice, look at and participate with the Office of Enforcement and the regional office in looking at cases, and where there are specific instances like this, where we have to go in and do things like reconstructions, time motion studies or if we were dealing with internal contaminations, the kind of modeling and similar things that go along with that, then it's very common for members of my staff who have particular

expertise in those particular areas to be very intimately and carefully involved as we go through that process. That was the case in this instance as well.

BY MR. BARTH:

Q Dr. Cool, are the general agency parameters for constructing the dose reconstruction, which is Joint Exhibit 10, found within 10 CFR Part 20?

A Yes.

Q Are you familiar with 10 CFR Part 20.

Please don't smile when you make your answer.

A I'm sorry. That's impossible to do.

Yes, I am.

Q What was your role or did you have a role in the creation of the present regulations which are found in 10 CFR Part 20?

A I did have a role at several stages in the process. In particular, I'll note two of them. I was the Office of Nuclear Materials Safety and Safeguards representative on the staff working group which took the proposed rule and all the public comments and prepared the final rule text statement of consideration and supporting documents for review by management and the Commission.

At about the time that process initiated, I accepted the position of branch chief of the Radiation Protection and Health Effects branch and in that role was

actually the cognizant SES manager responsible for that rule making, shepherding it through the Commission review and its publication.

It was also my branch in the Office of Research, that Radiation Protection and Health Effects branch that was responsible for the generation of the associated regulatory guides that were published in the early 1990's, '91, '92, '93 which supported that rule making.

Q Let me tell you the purpose of my next question, and then ask the question. I want the record to reflect, for reading by the public, in general terms the scope, complexity of the work and the size for the rule making proceeding that went into the making of Part 20 of which you were such an intimate part, this would include such things as how long was the hearing; what is the size of the record; public comments upon it; consideration of public comment. At the same time I don't wish to unduly burden the Board with all the explanations it would certainly take to do this carefully.

So I ask the question, could you describe in your own terms the magnitude and scope and complexity of the rule making that went into formulating the rules which are now 10 CFR Part 20, please, sir?

A Part 20 was perhaps one of the first rules that the Commission ever did which attempted to do a large

measure of public outreach during its development process. The rule making actually took something on the order of 12 years, from the initiation of the rule making process to the publication of the final rule.

The Commission received over 800, I don't remember the specific number, of major comment letters associated with the publication of the proposed rule. The proposed rule was available for public comment for almost nine months. The documents that you have in front of you on the transcripts represent perhaps a rough order of magnitude of the amount of paper that was part of the package which we transmitted to the Commission, including the statement of considerations, the regulatory analysis, the environmental impact statement, the back fit considerations, the O & B clearance processes and the other ancillary and supporting documents which go into that rule making.

The staff briefed the Commission on multiple occasions. The staff, in fact, in response to Commission direction on a first version and a subset of particulars issues went back and did additional work and brought additional information back to the Commission in the form of ancillary or amended, what are referred to as SECE papers, papers which are logged by the Office of the Secretary of the Commission for Commission consideration.

The final rule making was in front of the Commission for over a year, as part of that analysis process to respond to Commission considerations and to answer additional questions. The regulatory guides that were associated with that took approximately two years beyond that to develop, and in fact, the process of refining and working on Part 20 is a never ending process, as it is for any of the regulations. There have been numerous amendments and clarifications which have occurred as specific issues and identified industry needs have arisen.

Q Dr. Cool, thank you. Did other federal agencies have input in final rule making by the NRC?

A They did.

Q I don't know whether all is the right word. Certainly the Department of Transportation did not. Did all of the federal agencies which had an interest in this kind of field or a statutory interest made contributions and had the opportunity to make contributions to the final rule making?

A Actually Mr. Barth, the Department of Transportation did, too.

Q Thank you for the correction.

A To varying extents obviously, depending on the varying interest in terms of our interactions with other

agencies. By far the largest interactions were with the Department of Energy, with OSHA, Occupational Health and Safety and with the Environmental Protection Agency, EPA being the federal agency which has the mandate for overall radiation protection standards, what are referred to as generally implicable environmental standards which the other federal agencies, NRC included, would have to conform to.

During the time period of the development of the proposed rule, EPA published and the document was signed by the president, the revised federal guidance on occupational exposure which Part 20 implemented when it was published in final form, with EPA's agreement that that rule making in fact met and implemented the occupational federal guidance.

Q Did the states participate or make contributions to the rule making?

A They did. One of the unique aspects about the materials program is that a majority of the materials applications and uses in the United States are in fact conducted and overseen by the states. In particular, under the agreement state program of which there are now 30, Massachusetts having joined last year, over two-thirds of the licenses for materials uses, including radiography, are in the agreement states. The states commented heavily on the proposal. The staff interacted closely with the states

in preparation of the activities, including briefings of individuals and the organization of agreement states in the Conference of Radiation Control Program Directors. We continue to do so.

Q Is it a fair statement to say that for an outsider to tinker with or try to find some way to maneuver the regulations would be looked at with great care?

A I think it is fair to say that any change that would be proposed or considered for Part 20, as it would be for any regulation, but Part 20 in particular, being the standards for protection, has to be very carefully considered because it will almost inevitably have ramifications across a wide range of activities and a wide variety of activities. It's actually somewhat difficult at times to anticipate where some of those ramifications might go when you start to change even what may look to be, I'll put this in quotes, "an administrative or simply an editorial change," because of the nature and use of this regulation.

CHAIRMAN BECHHOEFER: Dr. Cool, let me just interrupt. We've heard five or ten minutes worth of the process of developing Part 20. How much, if any, of that process was specifically devoted to the organ dose weighting factor?

MR. BARTH: We intend to address that later, Your

Honor, in our discussion.

JUDGE KELBER: How much later? We're short on time.

CHAIRMAN BECHHOEFER: We're trying to move it along. We would like to find out how much, if any and who commented on that particular aspect, whether there were comments.

MR. BARTH: This is disruptive of the cogent presentation of the witness, but I will certainly defer to the Board's judgment.

CHAIRMAN BECHHOEFER: Could you just briefly summarize to what extent in that consideration of the rule? We are more or less aware of it in any event.

MR. BARTH; Your Honor, to get a cogent answer, could I refer Dr. Cool to the statement consideration that considers this?

CHAIRMAN BECHHOEFER: Yes.

JUDGE COLE: Are you testifying instead of Dr. Cool?

MR. BARTH: I'm asking whether I may present the Federal Register discussion of this matter or Dr. Cool's consideration so we may cogently answer your question, sir.

CHAIRMAN BECHHOEFER: Yes, you may.

MR. BARTH: Thank you, Your Honor.

Miss Jones has provided me with copies. For the

record this is 56 FED., F-E-D period, register, R-E-G period, 23368 through 23369, May 21, 1991. I will provide copies to the people and I will request that the Licensing Board authorize this to be bound into the record as read forth at length. At the same time, since you may want surrounding material, I ask to take official notice of the publication in the Federal Register of the statement of considerations which accompany the rule making. The statement of considerations begin on page 23360 of the Federal Register on May 21, 1991. Thank you, Your Honor.

[The document referred to reads as follows:]

asurements, the Commission has ...ided to use the smaller area of 1 cm^2 for routine skin dose evaluations. The 1-cm^2 area is consistent with the prior recommendations in NCRP Report No. 39 [17] and ICRP Publication No. 9 [18] as well as the smaller area recommended in ICRP Publication No. 26.

Within the past several years, there have been instances where very small (5–250 μm) "hot" particles of fuel or activated corrosion products have been discovered in reactor facilities, on workers or their clothing, and, in a few isolated cases, in workers' vehicles or homes. These particles are generally too large to pose a significant risk from inhalation, but are capable of producing intense beta-radiation doses over very small areas of the skin. The principal ...d appears to be skin ulceration if ...articles remain localized on the skin surface. The primary uncertainty associated with evaluating the hazard of these small particles is determining the skin area or tissue volume to which the dose is to be computed (or even whether "dose" is the most appropriate indicator of the hazard). The NRC requested the National Council on Radiation Protection and Measurements (NCRP) to ...nto the hot particle issue and make ...mendations. The NCRP's recommendations have been published in NCRP Report No. 106 [19] and use a criterion based upon the number of radioactive disintegrations that have occurred (μCi-hours) rather than dose. The NRC staff is reviewing these ...endations and has issued an ...tion Notice on a modified enforcement policy for hot particles.

Final rule: The amendments to part 20 in this final rule specify an area of 1 cm^2 for skin dose evaluations.

Comment: Effective dose equivalent for external exposure. The most prevalent comment concerning the effective dose equivalent is the restriction in the proposed rule of the risk-weighted organ dose "effective dose" concept to internal doses without permitting a similar approach to be employed for external doses. There were several comments that noted the desirability of using organ weighting factors for external doses.

Response: The ICRP and NCRP recommendations and the 1987 Federal guidance on occupational radiation exposure in principle permit the use of external weighting factors. However, none of the principal standard-setting organizations has included specific recommendations for the use of weighting factors for external dose.

The application of weighting factors also entails calculation of organ doses instead of whole-body doses from external radiation. One component of this calculation is estimation of the attenuation of the radiation as a function of the depth of the organ in the body. There are practical problems in the determination of the type and energies of the radiation involved and of the orientation of the individual with respect to the source of the radiation that have to be considered in making such calculations. Therefore, application of weighting factors for external exposures will be evaluated on a case-by-case basis until more guidance and additional weighting factors (such as for the head and the extremities) are recommended.

Final rule: External doses to the head, trunk (including male gonads), arms above the elbow, or legs above the knee are to be treated as whole-body doses. For the purpose of weighting the external whole-body dose (for adding it to the internal dose), a single weighting factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure may be approved on a case-by-case basis upon request to the NRC.

Comment: Allowance for exposure after limits are exceeded. Commenters noted that allowance of an additional 1 rem per quarter dose limit for a worker who had already exceeded the 5-rem annual limit might be counterproductive. Workers who remain under the annual limit, and whose dose was X rems, would be constrained to receive (5 − X) rems, whereas workers who received more than 5 rems in the first quarter could be allowed an additional 4 rems (1 rem in each of the four quarters). One commenter suggested that this could provide an incentive for individuals who are approaching the dose limit to deliberately exceed the limit and thereby protect their employability by taking advantage of the extra dose allowance available to those who have exceeded the limits. Another commenter believed that such a blanket authorization to exceed the limits was inappropriate and preferred prior NRC review of the use of these extra doses on a case-by-case basis.

Response: The purpose of the dose allowance was to protect the worker's employability after having received a dose above the dose limits. Although intentionally getting additional exposure might be in the worker's interest for employability reasons, such an action would not be in the worker's interest with respect to health protection. Licensees having workers with critical skills who are approaching the dose limits early in the year or workers who have received an accidental overexposure should consider use of the planned special exposure (§ 20.1206) to permit continued employment.

Final rule: The allowance of an additional 1 rem per quarter following an exposure in excess of the limits has been deleted.

Proposed Section 20.202 Compliance with Requirements for Summation of Internal and External Dose [Section 20.1202 in This Final Rule]

Comment: Implementation burden. Many commenters felt that the burden of adding external and internal doses was substantial, particularly as most licensees would be faced with either external exposure situations or internal dose situations, but not both.

Response: The NRC staff disagrees that there will be a substantial recordkeeping burden because this summation will be required only if both the internal dose and the external dose are each likely to exceed 10 percent of the dose limit. Thus, in most situations, as noted in the comments, only one component will be required to be measured and, consequently, summation of internal and external doses will not be required.

Final rule: The requirement remains that the committed effective dose equivalent and the deep-dose equivalent should be summed to give the total effective dose equivalent. However, this summation need only be performed if both components are required to be monitored (i.e., exceed 10% of an applicable dose limit). If the summation of doses is not required, then the limit applies to the component (internal or external) that is measured. The NRC is planning to issue additional guidance in the form of a regulatory guide. This guide will be on procedures to be used in estimating committed effective dose equivalents and deep-dose equivalents and guidance on when internal and external doses have to be summed.

Comment: Use of individual metabolic or dosimetric data. Several commenters thought that the proposed rule required

[17] National Council on Radiation Protection and Measurements, "Basic Radiation Protection Criteria," NCRP Report No. 39 (January 15, 1971), page 79, paragraph 207. (Available for sale from the NCRP, 7910 Woodmont Avenue, suite 800, Bethesda, MD 20814–3095.)

[18] International Commission on Radiological Protection, "Recommendations of the International Commission on Radiological Protection (adopted September 17, 1965)," ICRP Publication No. 9 (1966), page 6, paragraph 28. (Available for sale from Per... Press, Inc., Elmsford, NY 10523.)

[19] ...nal Council on Radiation Protection and Mea...ents, "Limit for Exposure to 'Hot Particles' on the Skin," NCRP Report No. 106 (December 31, 1989). (Available for sale from the NCRP, 7910 Woodmont Avenue, suite 800, Bethesda, MD 20814–3095.)

BY MR. BARTH:

Q Dr. Cool, I will hand you an excerpt which is page 23336 through 23369.

Dr. Cool, I refer you to the column that starts on the left hand that says final rule comment effective dose equivalent. This is approximately an inch up the text, in the column to the left that you have, sir. It's from the bottom.

A Yes, sir. Mr. Chairman, I think the answer to your question is relatively straight forward. There was consideration. There were discussions. There was comment received. I cannot tell you today, some ten years after we prepared the rule, exactly how many of those 800 and something comments, had a specific line item related to the weighting factors, although there were a number of them.

What you have in front of you was the response in the statement of considerations, the staff's view as approved by the Commission; therefore, the Commission's view on the weighting factors, the inclusion of the weighting factors proposed by the Commission that had been in the proposed rule and the conclusion that, for a number of reasons, and you find those in the full paragraph in the document which Mr. Barth has just handed you, has a bar next to it, the rationale for not including as part of this rule a provision for the use of a weighting factor other

than one, for external exposure.

At that time there was not a consensus or a methodology available which would all the translation of external doses or external fields, to be more precise, various fields or beams. I think pinpoints was used the other day by Mr. Brooks, and there was no methodology established or agreed upon, nationally or internationally for trying to translate that to doses in the individual organs.

JUDGE COLE: This was in 1991?

THE WITNESS: The rule was published in 1991.

JUDGE KELBER: With the comments received, you said at that time. And this extended over a considerable period of time. Could you narrow the time a little bit more with respect to this particular topic? I'm sure you didn't consider all the comments up to the date of final publication.

THE WITNESS: No, although in this particular case it was much more of an editorive process than you might imagine.

JUDGE KELBER: Oh, I'm aware of that.

THE WITNESS: The proposed rule was published in January of 1986. The comment period was open for the majority of that calendar year. The majority of the staff consideration of those comments occurred in the summer and

fall of 1987. The first version and interaction with the Commission started in about the middle of 1998. There were in fact editorive versions and comments on particular topics, although not this one, through that time period in '91.

JUDGE KELBER: I appreciate your comment about it. You answered my question. You did say 1998. I'm sure you meant 1988.

THE WITNESS: Yes, sir. I'm sorry.

JUDGE KELBER: The transcript takes every slip of the tongue and records it for posterity.

THE WITNESS: Time flies when you're having fun.

BY MR. BARTH:

Q Dr. Cool, let me slightly modify the Board's question. Is there currently today a consensus internationally and nationally as to what factor should be used or what methodology be used which would presently allow consideration of changing the rule? Does such a consensus exist today?

A No, sir.

JUDGE KELBER: Have you attempted to find out if there is a consensus?

MR. BARTH: I think he answered the question, sir.

JUDGE KELBER: You stated that there is not. I'm

asking if he attempted. I understand that he is in a position to be able to testify as to whether or not, for example, a national standards body has achieved a consensus standard in this area.

THE WITNESS: The answer to your question is yes. There is an ongoing consensus process in place.

JUDGE KELBER: Thank you.

THE WITNESS: The ANSI Committee N-13 which deals with health physics has published, just in the last year or so, a standard dealing with multiple badging. The Commission, as one of its strategic assessment initiatives, is in fact looking at what kind of processes the staff should use in interacting with various standard setting organizations and industry to move in a direction of when such standards are developed, how and to what extent to incorporate those into regulatory structures. By regulatory structures, I don't necessarily mean always into a regulation. It might be into a guidance document or maybe only for use in specific license amendment applications.

There was, in fact, a meeting just I think two weeks ago, the first week of September, here in Chicago with industry on that particular topic of how to move forward in looking at consensus standards vis a vis the regulatory structure. And the staff posed the Commission

some recommendations by the end of this year. So there are a number of things which are certainly in process.

JUDGE KELBER: Thank you very much.

BY MR. BARTH:

Q Dr. Cool, looking at the present Part 20, if someone had a question as to the meaning of any particular terms or words, how would they go about finding an answer to their questions at the very beginning?

A There are actually, Mr. Barth, several possibilities. The staff undertook a rather extensive effort to try and answer question following the publication of Part 20. A lot of people had questions. That was not terribly surprising. We undertook to try and answer those questions and to make those publicly available. There was, in fact, a whole series of what were referred to as Qs and As, questions and answers which were publicly made available. They were actually published as a new reg document. I'm sorry. I do not have the specific citation with me today where they were made publicly available. I believe they are on the NRC web site. You could get to those.

As a routine matter, licensees will call the regional office that is responsible for their particular licensing and ask questions all of the time. Most of those questions can be answered almost immediately by the

regional office. Those which they don't have an immediate answer to will find their way to my group or whatever is the appropriate in headquarters and we will try to get an answer back to them.

MR. BARTH: If I may have a moment, Your Honor.

BY MR. BARTH:

Q Dr. Cool, I would like to refer you to 10 CFR Part 20 1003, the definition section for the definition of weighting factor. Do you have that available in front of you, sir?

A I do.

Q Let me preface this question that there is some feeling by some persons that the statement that the whole body weighting factor is one. Do you see that, sir?

A Yes, I do. You're referring to footnote two?

Q No, I'm referring to organ or tissue, it says whole body, with a bunch of dots, the vertical line, the footnote for two and it says one. So the weighting factor for the whole body dose is one.

A Yes, sir.

Q And there's a footnote to that, footnote two. There is some feeling that an individual, such as myself, could prepare a dose calculation using weighting factors other than one, send them into the --

CHAIRMAN BECHHOEFER: Mr. Barth, you're sort of

leading your witness.

MR. BARTH: I am prefacing the Licensing Board's attitude as expressed to me in the beginning of what it is. I'm giving him the background on how this question came around. I ain't going to lead him anywhere. He's going to answer his own questions his own way. I suggest no answer to him. He's quite capable of answering with or without a suggestion, and if the Board determines the suggestion, as we've been through before, you can discern whether or not he's telling the truth. I have great confidence in that. I've forgotten where I was, but we'll try to get back there.

And there's some feeling that a person from the outside, such as myself, prepared a dose calculation, to prepare it using weighting factors other than one, uses a paper to be submitted to NRC and that would be acceptable. What is your view of that scenario, sir?

THE WITNESS: The regulation requires the use of a weighting factor of one. Any licensee can propose, under the regulations, for approval by the Commission for an alternative, whether it is this particular part of the regulation, this particular definition or any other portion of the regulation. In fact, and Mr. Barth has noted footnote two, because there was no consensus at the time that the rule was put out and because, as was noted in the

statement of considerations, there are a large number of variables that go into attempting to take a radiation field external to an individual and translate that into actual doses in specific locations.

The Commission determined that a case by case approach, to look at a particular proposal for a pre-planned activity and determine whether or not that proposal would be satisfactory in terms of being able to measure the radiation field at the various points of the body and the methodology was appropriate for taking those measurements and translating them into a dose of the body. A licensee could propose that. The staff would review such proposals and would either agree or disagree.

JUDGE KELBER: You said pre-planned activity. Where in the rule does it say pre-planned? Are those words found in the rule?

THE WITNESS: No, sir.

JUDGE KELBER: Are they found in any regulatory guide?

THE WITNESS: I think you will find that word in some regulatory guide, but I cannot give you the citation.

JUDGE KELBER: Would they come in a regulatory guide applying to this topic?

THE WITNESS: There is not a regulatory guide on specifically weighting factors.

JUDGE KELBER: Thank you. So pre-planned is your own interpretation; it's not the rule?

THE WITNESS: Pre-planned is a statement of the standard health physics practice of understanding the environment into which an individual would be placed in order to be able to conduct surveys required under Part 1501, provide the appropriate radiation dosimetry as required by Part 20 and to obtain compliance with the limits.

I would note to you that there's a specific section in the rule also associated with planning. It's called planned special exposures which gives a licensee an opportunity when confronted with an unusual circumstance with specific planning and activities. That for the record is 10 CFR Part 20. The specific section is 1206, to conduct activities, and in fact, have the dose accounted for separately than the normal occupational dose in 1201.

JUDGE KELBER: That section does in fact call for the necessity for prior approval.

THE WITNESS: That's correct.

JUDGE KELBER: This section does not. Can you tell us why there is that difference between the two based on your familiarity with the rule?

THE WITNESS: The section itself on weighting factors deals with definitions. As such, as a definition

would not in itself have used the word planned, pre-planned or other activities. I would note to you that the whole scope and purpose of Part 20 deals with the control of occupational and public exposure and while, once again, sir, you are quite correct, you probably will not find the specific word is based on the premise of a priority control of activities rather than a postiori reaction to unanticipated events.

JUDGE KELBER: That's an important distinction you've just made. Is that a standard consideration in health physics published in some general handbook that health physicists and radiation safety officers should be familiar with?

THE WITNESS: I cannot cite you chapter and verse. I can take you back to Herman Sember, one of my original professors way back when in the health physics training that I know I received and individuals received over the course of time, all of which is premised on a organization and operation, a concept of operations, if you will, which bases first on the premise of understanding the situation that you're in, then being able to apply factors to provide protection of time and distance, shielding, to look at what actions might or might not be reasonable under the application of the as low as reasonably achievable principle and providing the appropriate surveys and

protective equipment for that situation.

JUDGE KELBER: I understand that a rule cannot anticipate every occasion and that some reliance must be held on general principles. Do you consider that in this strange footnote two that it was written with the tacit understanding that approved on a case by case bases means that some form of prior approval for a planned test of some sort would be standard practice?

THE WITNESS: Yes, sir.

JUDGE KELBER: That tacit approval. The tacit approval was never, however, given voice. Thank you.

BY MR. BARTH:

Q Dr. Cool, in part of your answer you referred to an effort to control dose, control how it is assessed. Would reg guide 8.34 relate to this matter, sir, the title being monitoring criteria and methods to calculate occupational radiation doses?

A I would expect that it would. I have not read that document lately.

Q We'll pass to other matters then. Since we're at the definition, which I got there early, if someone wanted to use a whole body weighting factor of other than one, how would they do this in compliance with the regulations, Dr. Cool?

A They would request the agency for approval to use

a weighting factor other than one in that particular circumstance. I would expect that as part of that process, as is typical for any amendment or exemption request, that they would include the specific conditions or activities that they were looking at, their plan and proposal for protecting health and safety, their characterization or their understanding to the extent that they have it at that time, the particulars of the radiation field and how they would go about implementing that particular activity.

My staff would look at that. In a process where the application most likely would come into the region, this would be one of the cases that would undoubtedly be referred to my office as a technical assistance request because of it's unique nature, given that we have never had one, we would review it very carefully and probably would seek agreement from the Executive Director and perhaps even the Commission and if all of the technical issues were appropriate resolved, then authorization would probably be granted.

Q To the best of your knowledge has your office received or processed such an application from Conam in regard to their use of a whole body weighting factor other than one?

A To the best of my knowledge we have not had any such application, either from Conam or any other licensee.

Q You probably answered my question, but please indulge me. Has the agency received the fee for the license amendment to accomplish such?

A I don't believe Mr. Funches has had any such fee. Mr. Funches is the Controller of the agency.

JUDGE KELBER: Excuse me. Are you introducing an assumption there, that may or may not be warranted that such an action would be a license amendment or did you mis-speak?

MR. BARTH: I thought I asked the question whether he got a license amendment fee and he said no.

JUDGE KELBER: That's what I asked him. Why did you use the term license amendment when it has not yet been decided that this would be a license amendment? In his earlier statements, Dr. Cool did not use the term license amendment. I think you should rephrase the question.

CHAIRMAN BECHHOEFER: Dr. Cool, were you more or less making equivalency between the case by case approval which is referenced in Section 1003 and just arbitrarily another one. If you look at Section 20.1301(c).

MR. BARTH: Mr. Chairman, I have great difficulty hearing you because of the dulciveness of your tone and my aged ears, both.

CHAIRMAN BECHHOEFER: I'm sorry. I asked Dr. Cool to compare the process he's talking about, about

asking for a different dose weighting factor with what is specifically required. Now, for example, there are other places, but in 20.1301(c), is an example.

THE WITNESS: Mr. Chairman, the answer to your question is yes. The particular section which you have cited specifically requires an application and contained a number of specific conditions, because that particular arena was an arena where the Commission was sufficiently confident of the kinds of information that it would need, that it could provide that information in the regulation.

In the case that we were referring to a moment ago with regards to weighting factors, the Commission did not even have sufficient information to articulate clearly and concisely the kinds of information it would need in order to be able to judge the acceptability of such an application. I believe that's one of the reasons that you find the difference the relatively greater specificity here and in some other sections of Part 20, and the rather lack of specificity, which you have quite correctly keyed on, because there was no specificity and no information available to allow the staff to recommend to the Commission a set of conditions under which it would be able to accept such an activity.

CHAIRMAN BECHHOEFER: Now, would an application under 20.1301(c), would that be a license amendment?

MR. BARTH: Your Honor, with the absolute greatest respect for all three Judges, I would really like to have you indulge the staff to try to develop this in a coherent manner. We're jumping all over the place. It's hard for me to keep track of what we covered and haven't covered. We intend to cover the areas in which you're interested. I would really appreciate, Your Honor, if you'd let us do so and hold back your questions until the end. You're asking basically a number of the questions that the staff will get to.

CHAIRMAN BECHHOEFER: With that representation, why don't you go forward quickly. We were trying to get information which we will need.

MR. BARTH: Thank you kindly.

CHAIRMAN BECHHOEFER: To reach a decision.

BY MR. BARTH:

Q Dr. Cool, going back before this recent exchange, can you give us examples of pre-planned activities that may be appropriate for use of weighting factors?

A That's a pretty general question, Mr. Barth. To answer that, I'm going to make the following presumption. That presumption is that what you want to focus on is a situation where weighting factors other than one and an external field were involved in the circumstance. I can cite you a couple of particular examples.

The one that comes immediately to mind as being very common and which was, as I recall, behind a number of the comments that were received, is actually in the medical community where a source will be used in radiology or in brachytherapy or other activities. The patient will be attended by one or more individuals who will, as a matter of radiation protection practice, wear a lead apron. Therefore, certain portions of the body, the arms for example, will not be shielded, but other portions of the body, the central organs and the torso would be shielded. That would be a clear case where I believe a representation could be made of the advantages of using the shield for protection purposes, and a reasonable scenario with regards to the use of two or more badges because you know where the shielding is, you know where the source is. We've run into that consistently.

There are a number of other situations. You could go to the reactors and, reaching up into steam generators or into particular beams or fields, where you have a good characterization of the radiation environment and distinct differences in the radiation environment over very short locations.

Q Thank you, Doctor. I'll go back to the Board's last interest.

If a licensee wanted to use a whole body

weighting factor of other than one, what NRC action would be required in order to do so, sir?

A The licensee would need to request approval or granting of that approval would almost certainly be the form of an amendment to their license.

Q Do you recall what section of the regulations relates to amendments of licenses for materials?

A There are actually several sections. The general sections for by-product material licensees, radiography included, are contained in Part 30, I believe 30.30, contains some specifics with regards to making application and the form of that application. 30.33 I believe -- I specifically looked it up just now -- contains a number of general requirements and conditions that an applicant has to satisfy in order for the Commission to approve the request. And there are a number of other sections, as well as specific sections in each of the parts, Part 34 being the part which deals specifically with radiography.

Q Were you here yesterday when Mr. Lieberman, the Director of the Office of Enforcement, testified, sir?

A I was.

Q Do you recall Mr. Lieberman testifying that in order to get such an approval, the licensee would have to provide a plan so the NRC could study and analyze whether or not the suggested use of weighting factors other than

one was appropriate under the circumstances? Do you recall that?

A I do.

Q He testified from the point of view of enforcement. You're here as an expert in the agency's interpretation and construction of protection and designing these regulations to limit dose. Would you please tell us what a licensee would have to do to satisfy this from your point of view?

A As strange as this may sound, our views are the same. The testimony which Mr. Lieberman provided gets to the same central issue that I was referring to in terms of pre-planning and understanding and putting together the particular activities that you're going to be conducting. That is consistent whether you're looking at it from the standpoint of fundamental health physics practice, whether you're looking at it from the standpoint of compliance with the regulations. You get to compliance with the regulations with good health physics practice. And good health physics practice done correctly will keep you in compliance with the regulations.

Q Dr. Cool, 20.1201(a)(1) requires the licensee limit dose to five rems. If a worker, Mr. Chastain, would receive a dose in excess of five rems, would that be considered by you to be an accident?

A It would, yes.

Q You've already answered, but indulge me. Would it be outside the scope of pre-planned activities?

A Any situation that would result in a dose which would exceed the dose limits would have to be outside of the scope of pre-planned activity, except in the context of Section 1206, the planned special exposure.

Q I'll go back to Dr. Kelber's comments. Have you received a paper and money and a request from Conam to amend their license to provide for the use of a weighting factor of other than one for a whole body dose, externally received dose?

A To my knowledge, we have not.

Q There were representations earlier that Conam may have made such a request. Let me read two things to you, sir. This is from the transcript of the pre-hearing enforcement conference, and Mr. Slack who is the radiation safety officer stated --

MR. BROOKS: Excuse me. I'm not sure if the question is being asked or Mr. Barth is attempting to read something into the record here. I'm not sure that it's appropriate for him to be just reading something into the record at this point. If there's testimony to be elicited from the witness or from some other witness, obviously that's fine. I have an objection because I don't

understand whether we're asking questions or making statements.

MR. BARTH: Well, Your Honor, I'm reading from the pre-hearing conference transcript which was put into evidence by the licensee. It's already in the record.

Now, may I continue?

CHAIRMAN BECHHOEFER: Why don't you refer him to the section and then ask your question?

MR. BARTH: Because I was going to read this sentence and give this citation second, rather than give the citation first and the reading second. If it's transposed at the beginning or the end, I do not care, sir.

JUDGE COLE: Maybe if you were to give the citation we could also see it.

MR. BARTH: It's transcript pages 30 and 40 of the pre-hearing conference.

CHAIRMAN BECHHOEFER: Which exhibit is that?

MR. BARTH: The transcript.

CHAIRMAN BECHHOEFER: What exhibit is it?

MR. BARTH: Exhibit 30, Your Honor. The pages are 30, 40 and 41. I apologize to the Board. I was attempting to, as the Board suggested, speed this up rather than spending a great deal of time looking for books.

CHAIRMAN BECHHOEFER: We can understand the question better if we have the transcript.

MR. BARTH: With the admonition, referring to the document, may I ask the question, Your Honor?

CHAIRMAN BECHHOEFER: Yes.

MR. BARTH: Thank you.

CHAIRMAN BECHHOEFER: That's fine.

BY MR. BARTH:

Q I will read to you because you have the document, that the radiation safety officer for Conam, Mr. Slack handed, at the enforcement conference, an analysis to the NRC.

MR. BARTH: I understand the page reference is wrong, Your Honor. Give me a moment to find it, will you, please?

CHAIRMAN BECHHOEFER: Yes.

MR. BARTH: I would ask kindly for a two minute adjournment while we find the page number.

MR. BROOKS: Can we just move on?

MR. BARTH: No, this is important. This is a matter you brought up. I request that we not move on.

JUDGE COLE: When you find it, could we move quickly?

MR. BARTH: All right.

CHAIRMAN BECHHOEFER: We'll wait while you look.

BY MR. BARTH:

Q I'll ask you a hypothetical question, Dr. Cool.

If the NRC inspectors in the regional office were handed a document which computed a dose for the whole body using a weighting factor other than one and said simply, I hand you this document and you ought to look at it, would you consider this to be a formal application for license amendment?

A No.

JUDGE KELBER: Would you consider it to be a request for approval on a case by case basis of a weighting factor other than one, as described in footnote two of the notorious table?

THE WITNESS: Would the language that Mr. Barth has just used --

JUDGE KELBER: No, not his language, in my language.

THE WITNESS: Could you repeat your language then?

JUDGE KELBER: If you received a document referring to the use of weighting factors other than one, would you consider that as being an application under footnote two?

THE WITNESS: Simply being handed a document containing such a calculation, I would not consider to be an application.

JUDGE KELBER: Suppose you got something in a

response to demand for information, referring now to Exhibit 16, which contained calculations and an explanation of what they meant and involving the use of external weighting factors, would that be an application for approval on a case by case basis?

THE WITNESS: No. In my view, that would be an answer to a question which I asked.

JUDGE KELBER: What form would such a request normally take? I gather there has been no experience so I'll strike that. Okay.

In other words, there is some form yet to be defined, is it, requesting this?

THE WITNESS: It would be the form which is used every single day to request an amendment to an application. Were they to hand such a document to us outside of the context of this particular proceeding, if you were to come and say, I have this and the cover note said we request your consideration and approval of this document, it could be a three line note signed, with the calculation attached, I would process that and examine that to determine whether or not that could be approved.

JUDGE KELBER: Was this response to demand for information circulated to you for review?

THE WITNESS: I believe it was. I believe we had access to all of the document that were being generated.

JUDGE KELBER: It was circulated to you for review, not when this case started, but when the document -- well, not when this hearing started, but when the document was actually sent to the NRC.

THE WITNESS: In the context of the ongoing enforcement action and the answers to the questions which we had asked in the demand for information. So yes, it was circulated in that context and we would have looked at it in that context.

JUDGE KELBER: In that context. In that context, there was -- I will not pursue it. You did in fact look at it with respect to a formal document, namely a response for demand for information. Thank you.

CHAIRMAN BECHHOEFER: Dr. Cool, let me go on, on one item that really troubles me, and that is where anywhere in these regulations does it say that when you seek approval on a case by case basis you must request a license amendment and follow the forms and procedures. Where does it say that? How would a licensee know that that's what he had to do?

THE WITNESS: I would refer you -- first, let me say that I'm not going to be able to cite you off the top of my head a particular 10 CFR citation which contains the precise words, you must always apply for a license. What de facto in reality is, Part 30 and each of the licensing

parts contains specifications for licensees obtaining authorization to conduct activities. Licensees ask questions that request things every single day to each of my regional offices and to ourselves. Those come in, in a variety of forms seeking approval. They do not always have amendment stamped in bold letters across the top. But the granting of such an action requires me to have a formal acknowledgment or approval and that granting, and I believe this is what I said, that granting would inevitably take the form, in my particular arena, as an amendment to the license, because then that officially becomes part of the body of information which they are bound to adhere to in the conduct of their activities.

CHAIRMAN BECHHOEFER: And would that be true on an individual case basis, allow approval one time to do one thing?

THE WITNESS: It is. I will give you case in point. Again, I will use the medical arena, where a particular procedure is needed on an emergency basis and the licensee will call the region and provide the information that they have the following kind of patient, need to do the following kind of activity. They will follow that up with a fax. The region will grant them that amendment to their license. Usually within an hour or two that becomes part of the record. It is an amendment. They

happen every day.

CHAIRMAN BECHHOEFER: I see. And they get charged for that?

THE WITNESS: Sometimes. Let me be perfectly clear. There are certain kinds of amendments, and we could spend the entire rest of the day talking about Part 170 and the fee structure. There are certain kinds of amendments which, as emergency authorizations, administerial changes, do not require fees. There are other kinds of changes which do require fees, and I'm not the right person to talk about the fee structure of the agency. I apologize.

CHAIRMAN BECHHOEFER: You were asked a question relative to the fees.

THE WITNESS: Yes, sir.

CHAIRMAN BECHHOEFER: In answering that, I take it you were not making any representations that a fee should have been sent in.

THE WITNESS: I believe all I was attempting to do was answer the question of did we receive one, and to my knowledge we did not.

BY MR. BARTH:

Q Dr. Cool, by this time are you familiar with the general Chastain situation of an exposure in Indianapolis?

A Yes.

Q Are there any circumstances, if a licensee now

applied to you to use weighting factors other than one, to compute Mr. Chastain's dose, some 940 days later, would you approve such a request in the form of a license amendment?

A My recommendation to my management and the Commission would be that they not approve such an action.

Q You've covered this before but please indulge me. Would you approve license amendment for accidents in general, after that accident had happened?

A No, sir.

Q I wish to emphasize, your approval of a weighting factor other than one would require a submission of a plan by the licensee which would able you to evaluate their use of dosimetry in ordinary normal working conditions, is that correct, sir?

A Yes.

JUDGE KELBER: On the basis of that view and the considerable discussion here, would you look favorably on a minor revision to clear up the ambiguity in footnote two? Or do you think footnote two is not ambiguous? Mr. Lieberman did, but I don't hold you to the same view.

THE WITNESS: I think the answers are yes and yes.

JUDGE KELBER: Okay. Very good.

BY MR. BARTH:

Q Dr. Cool, 20 CFR 20.501(a) requires licensees to

make surveys and 10 CFR 34.43(b) also requires survey. The latter citation is to a survey required to be made by Mr. Chastain. As a preliminary to this I would like to have you look at Exhibit 20 and 21 which are eight and a half by ten photographs. I represent to you this is the room in which Mr. Chastain was exposed on February 27th at Eli Lilly.

A I'm sorry, Mr. Barth. Could you refer me to those exhibits again. 20 does not appear to be a photograph. 21 certainly is.

MR. BROOKS: You mean 21 and 22.

MR. BARTH: 21 and 22. Thank you.

THE WITNESS: I apologize for being confused. I have Exhibit 21.

BY MR. BARTH:

Q Would you tell us, what is the purpose of Mr. Chastain making his survey? Beside it, you also have a ladder which is very similar and you have an Amersham camera which is a model. It's not quite the same thing, but very similar to what Mr. Chastain had.

Would you tell us, what is the purpose of Mr. Chastain making a survey?

A There are actually several purposes, depending on what he was doing at that moment. One purpose would be to ascertain the appropriate distance for the two millirem per

hour exclusion area when he was actually making a shot. A second purpose would be upon the completion of the shot to ascertain and determine that the source was in fact in its fully shielded position, such that when he did whatever was necessary to set up for the next shot, move the equipment or otherwise, that he was not working in a radiation field. There may in fact be additional things that he would want o survey, but I believe the one that you're primarily referring to is to make sure that source is inside the camera and that he's not going to inadvertently walk into a radiation field, significant radiation field.

Q Would an adequate survey indicate whether the source was fully within the shielding or partially out of the shielding?

A It should.

JUDGE KELBER: Pardon? It should?

THE WITNESS: It should. Yes.

MR. BARTH: I will continue the question, if I may, for a few moments.

JUDGE KELBER: Excuse me. This is an important consideration.

MR. BARTH: I understand. That's why I would like to work on the word should.

JUDGE KELBER: But he said should, not you.

MR. BARTH: I understand that. If you let me

work on it, I'll get to it.

JUDGE KELBER: I don't like a filibuster, Mr. Barth. Can we get on with it then?

BY MR. BARTH:

Q The licensee has testified that they had verified, after the accident, that the survey meter was in operable condition. Accept that as a premise. Now, if Mr. Chastain had a survey meter in his hand which was fully operable, would an adequate survey disclose whether the material was fully shielded and protected or whether it was partially exposed?

A Yes, it would.

Q We were working on the word should. You answered with a statement, that it would or would not in your best judgment. I do not intend to lead you. I don't care what you answer.

A When I attempted to answer the first time, I apologize for the conclusion introduced. An adequate survey, as a matter of definition of adequate, has to be able to detect the radiation fields that may be present. In the particular circumstance as I understand the circumstances, where the source was in the front edge of the camera and not fully retracted back into the S-tube, an adequate survey would have included moving the meter around the camera, including the front entrance and the exit cable

points. Presuming, as you have asked me to presume, an operable survey meter, that survey meter should have told him that that source was still out there, resulting in a radiation field at the front part of that camera.

MR. BARTH: Dr. Kelber, he's again used the word should. I'd refer this time to you, if you have questions, please do so, sir.

JUDGE KELBER: I'd like to focus on adequate. In the demonstrations we saw, and in the descriptions that we received from various individuals including Mr. Chastain and some of the investigators, a survey was described as taking the meter around the top of the camera. Now, I indeed asked the same question that you did, a common sense one, that is, pass it in front of the exit port. And yes, of course, the back.

Apparently the practice was affected by all parties of surveying around the top of the camera to be adequate. Is there a handbook, guide or some other document which describes that it should it fact be passed in front of the exit port?

THE WITNESS: Your Honor, I cannot cite you a particular line item. I know that that has been discussed nearly on enumerable occasions about the particular importance of surveying the front of the entrance and exit ports. I expect that it is in fact addressed in the

regulatory guides associated with Part 34 and the more recent new reg, which consolidates all the guidance in that arena, about the importance of that type of survey. But I cannot today off the top of my head give you a particular page reference.

JUDGE KELBER: Have you run into cases in your experience where radiographers routinely made surveys which under this condition would not be adequate?

THE WITNESS: Unfortunately this is not the first time at all, where in adequate surveys have been a contributor to a problem.

JUDGE KELBER: Would you be willing to entertain a minor revision to the regulations which would enforce this idea of an adequate survey?

THE WITNESS Yes.

JUDGE KELBER: Okay. Thank you.

While we're on this, the original idea promulgated by the initial investigators that the survey did not occur, was an inference drawn from the fact that they expected the radiation field in the neighborhood of the front top of the camera to be similar in magnitude to the field at the film badge. I note that on page four of the appendix A to the order imposing a civil penalty, it is stated that the dose field from the radiographic exposure device was non-uniform. I'm not sure quite what those

words mean, but I know what non-uniform means to me. If the source pellet were in fact partially shielded we then have a shadow shield problem, don't we?

THE WITNESS: Yes, sir, you do.

JUDGE KELBER: And it did require a computation to assess whether or not the shadowing affected the field at the top front of the camera.

THE WITNESS: Yes.

JUDGE KELBER: That computation was not made, is that correct?

THE WITNESS: I'm not in the position to know that.

JUDGE KELBER: But you were asked earlier if you approved of Mr. West's reconstruction of the dose field.

THE WITNESS: Yes.

JUDGE KELBER: So did that include a computation of the shadowing effect of the shield?

THE WITNESS: At this moment I do not recall the details that were provided. I know that there were assumptions about partial shielding, where the field would be non-uniform. I cannot tell you sitting here on the basis of the review which I conducted to what extent a detailed calculation of shadow effect and the gradiate of dose that you would observe as you moved through an angular distribution.

I don't know that that kind of detailed calculation was made, sir.

JUDGE KELBER: Okay. So that the Office of Investigation personnel were willing to accept as adequate and that may not be technically correct but they were willing to accept that as a less than adequate a survey which went around the top of the camera. You do not know at this time whether the perturbation of the dose field caused by any shadowing from the shield would have removed the logical basis for their inference that such a survey was not made? That's a tangled one.

They made an inference. The inference was that they expect the field at the top of the camera to be of the same order of magnitude as the field at the film badge, that the survey meter did not indicate that. They therefore made a conclusion. And this is included in the testimony.

MR. DAMBLY: Excuse me. Just so it's clear, the staff's position on the inadequacy of the survey, there was testimony from West and others that it couldn't have possibly been done. Our position is Mr. Chastain's statement to the staff and on the stand that he didn't do it.

JUDGE KELBER: Yes, but he also made a statement to Mr. Slack, and Mr. Chastain's testimony varies with

time.

MR. DAMBLY: Well, what he told the staff and what he told you on the stand is what we're relying on.

JUDGE KELBER: You're relying on that and not on the fact as was testified that it could not have been because it would have registered --

MR. BARTH: No. We're relying on both, Your Honor. We're relying on the evidence of the entire case, in its totality. Mr. Dambly is quite correct that the NOV, the violation was based upon the statements to the staff. But you heard the full record. We have absolutely very good testimony that a survey could not have been done.

JUDGE KELBER: Yes, based on the logical inference drawn from the reconstruction of the dose field.

MR. DAMBLY: I would say based on the --

MR. BARTH: The film badge, Your Honor. The film badge.

JUDGE KELBER: The dose field at the top of the camera was assumed, and this is in the testimony, that it was assumed that it was on the same order of magnitude as the field at the film badge and therefore, logically one would conclude that if that were the case, the survey meter, had it been employed, would have registered, either therefore, the survey meter, as stated, was not used, turned off. But the case where the pellet was partially

shielded and the field at the top of the camera was thereby on a lower order of magnitude was not examined. That's all I wanted to develop.

MR. BARTH: Thank you kindly, sir.

MR. DAMBLY: Just so it's clear, that is not what Mr. West testified.

MR. BARTH: Could we continue?

JUDGE KELBER: I asked him directly.

MR. BARTH: We'll let the record speak for itself and we'll all examine it carefully.

BY MR. BARTH:

Q Dr. Cool, finally back to you. You had a rest period, now you can get back to work.

The source in this instance was Iridium 192, and Mr. Chastain's exposure was somewhere in the neighborhood, on the badge held by his body, on his body somewhere of approximately 4.5 rem. The exact figure is in debate. The exact position for all time might be slightly in debate.

Would a survey meter detect that the Iridium 192 was not fully retracted into the camera if a survey were made with an instrument which was operable by Mr. Chastain?

A Mr. Barth, you've made one assumption which let me make sure is on the record, which is that four rem occurred over a period of a few minutes.

Q That is how I'm standing. This was the actual

exposure, sir, 4.5.

A With that assumption, an operable survey meter should have -- yes, would have detected that field.

JUDGE KELBER: Would it have detected it, for example, at the entrance to the room?

MR. BARTH: We again would like to develop this, sir.

JUDGE KELBER: Excuse me. Would it have detected it at the entrance to the room?

THE WITNESS: I cannot answer that information.

JUDGE KELBER: Would it have detected it at the back of the camera?

THE WITNESS: Perhaps.

JUDGE KELBER: Perhaps. Would it have detected it at the top of the camera if the source pellet in question partially shielded?

THE WITNESS: I would have expected that there would have been a greater than normal background reading, even at that point. Whether he would have reacted to that is a different question.

JUDGE KELBER: All right. Thank you.

THE WITNESS: Detection, as a pure would the meter had been someplace different, I think the answer would have been yes, because of scatter. But as we have just gone through the shadow factor, how far and what scale

he was on, as opposed to getting in front of it where it would have slapped over, there is a lot of possible variations there to what the meter, the physical meter response would have been.

JUDGE KELBER: There is another question that I have in that regard. I asked it once before and perhaps you can help on this. This survey meter does have a certain time constant. I'm not thinking of the time constant of the guide and Mueller tube which is relatively fast under these conditions, but of the circuitry used just to move the needle. Do you have any idea what that magnitude is?

THE WITNESS: For that particular instrument?

JUDGE KELBER: Yes.

THE WITNESS: I do not have any specifics on that. I will tell you that the folks that were here, called back early in the week, after you had asked the question the first time, I had some of my staff go to see if we had any technical information on that because that particular instrument is no longer in service. Unfortunately we did not have such archival information, so unfortunately I'm not able, I would have liked to been able to give you a little more about the circuitry response of that kind of device.

JUDGE KELBER: Have you seen some demonstrations

either in this instance or other circumstances of the way in which radiographers take their surveys?

THE WITNESS: I have seen demonstrations of how radiographers take surveys, yes.

JUDGE KELBER: Do some radiographers proceed deliberately and others rather rapidly?

THE WITNESS: As is the case with all humans, everyone does it a little bit differently in speed, in detail, in length of dwell.

JUDGE KELBER: So a radiographer in fact moving a survey meter rather rapidly, perhaps because he's under time pressure, it is conceivable that the time constant, which is perhaps of the order of a tenth of a second -- I'd be surprised if it were shorter -- would not allow him to register completely.

THE WITNESS: I think that is a physics possibility. Again, depending on the angle, if you went across the front of it, I'm going to speculate, but this is pure speculation, that he would have had to have been moving that meter very rapidly, not for there to have been some deflection if he actually went across the front of the camera.

JUDGE KELBER: This went to your earlier statement that you would consider a minor revision to the rule, describing more precisely what an adequate survey is.

Yes, I agree.

THE WITNESS: We would always entertain such a suggestion. It's my personal view that how to conduct surveys and issues associated with surveys of radiography cameras has been pretty well covered within the guidance documents available, not the CFR, but the associated guidance documents.

MR. BARTH: Could I interject at this time. Dr. Kelber?

THE WITNESS: It had been the subject of numerous discussions with the industry groups who have also recognized the differences in human behavior and the performance shaping factors that get humans to doing some very strange things when there is pressure or tiredness or dangling off of the ends of things in an unbalanced situation and on and on.

JUDGE KELBER: Okay. Thank you.

MR. BARTH: I apologize for interrupting you, Dr. Kelber. I didn't realize it.

BY MR. BARTH:

Q Dr. Cool, how many licensees are there approximately, something like 23,000 that have materials licenses?

A Yes.

Q Have there been over-exposures of employees of

some of these licensees?

A Yes.

Q Have you ever, from one of these licensees to date, received requests to use a weighting factor other than one?

A No.

Q I would like to go back to the survey for just a few moments. The survey in this case was performed by Mr. Chastain with a hand held survey meter. Do you understand that, sir?

A Yes.

Q If Mr. Chastain does not look at the dial and read what the dial is saying while he's making a survey, does that vitiate the entire concept of survey?

A Yes.

Q I realize this is silly. Is a survey without knowing what you're surveying, constitute a survey for the purpose of NRC regulatory requirements?

A No.

Q Would going around the camera with the survey meter, all the way around the camera, and not at all times read what the needle says provide you with an adequate survey under NRC regulations?

A No.

MR. BARTH: May I have five minutes with my

colleagues, and then we're going to get to the Board's questions?

JUDGE KELBER: Dr. Cool, has very kindly, in the course of our discussions, answered most, not all, but most of the kinds of questions I expressed in one form or the other. So if you could just move on.

CHAIRMAN BECHHOEFER: Should we take a break?

JUDGE KELBER: We can take a break, yes.

MR. BARTH: Dr. Kelber, I thank you kindly. I'll take you up on your offer. And Your Honor in the center, I'll take you up on your offer of the break.

CHAIRMAN BECHHOEFER: If we take our ten minute break right now, then that will include the five you asked for.

JUDGE KELBER: We'll reconvene at 10:37.

[A recess was taken.]

[Back on the record.]

CHAIRMAN BECHHOEFFER: Proceed.

MR. BARTH: Dr. Cool, I have a concluding question to ask you. I ask you to assume that the film badge is slightly above or at the same level at the top of the survey meter which you see on the ladder, camera, beg your pardon, step. And that this film badge showed a reading of approximately 4.5 REMS, the time duration being four minutes according to the NRC, according to Conam's

arrythiums, estimations, perhaps -- so you have a range of two to four minutes resulting in the exposure of 4.5 REM, would the survey meter have detected the arrythium 1.91 being 1.92, not being fully retracted.

DR. COOL: A survey meter at the location of that film badge would have certainly been able to detect abnormal levels of radiation, which have been interpreted as the source not being properly retracted. That would have been a radiation level far in excess of what should, of what would have been detected if the source was in the fully shielded position at any point of the camera.

MR. BARTH: Doctor Cool, I thank you for your patience in answering the questions as thoroughly as you did, mine and the Boards. I appreciate your coming from Washington for us here. I have no further questions and it's open for the Board or Mr. Brooks.

JUDGE KELBER: As a matter of fact, I have no further questions myself. If Mr. Brooks or my own Board members may have. And I think Mr. Brooks should proceed and they can follow on.

MR. BROOKS: That's fine, however, we can do it.

CROSS EXAMINATION

BY MR. BROOKS:

Q I guess, Dr. Cool, is it fair to say that the system of dose limitation for occupational workers is meant

to protect the health and safety of those workers?

A Yes, sir.

Q When we're talking about doses is it important for us to express those clearly so we all know what we're talking about, is that correct to say?

A Yes.

Q Now I proposed a hypothetical ad nauseam here before and I'll try to cut it down. But I just want to use it to launch it off of something. Is it fair to say that a whole body exposure of 34 REM, meaning the all parts of whole body receiving uniform exposure creates a high risk of stochastic effects than would a measured 34 REM dose to one spot on the thigh?

A Yes.

Q And under the regulations using a -- factor of one, is it true that for the purpose of the regulations those two would be treated as an equal risk of stochastic effects?

A No.

Q Why not?

A Because the purpose of the regulation is simply to define compliance or non-compliance with a limit not as an absolute and completely accurate indicator of biological effects. Now, certainly, those two concepts are related to each other but I could say to you innumerable examples, if

we had all day and probably go into the happy hour tonight. Because no measurement will ever translate to the exact same health effect every single time.

Q At what level of radiation exposure would one expect begin to see, let me strike that. Let me just ask you, how do you first see the effects of a radiation exposure? How are they first noticeable?

A It's a very broad question, Mr. Brooks, it depends on the amount of radiation. The duration of the exposure. If you're talking about high levels of energy imparted over short periods of time, then you'll get to what our earlier scientists in the field got, which was erythema and reddening of the skin of various and high dose rate effects of the body.

Q -- solely see the effects of radiation than that?

A There is. Those came along as we learned more about the process, if you'll indulge me for just a moment. As those folks, Rutherford and various other people went through that and discovered that they were having some significant problems, they decided that, you know, those kind of energy levels probably weren't doing a whole lot of good. So they started to cut back and over the course of time the dose limits have come to the amount of allowable radiation has come down to the point of where those sorts of old effects are not seen. What are called now, most

typically as deterministic, where the magnitude of the effect were to appear for some sort of threshold, an ulceration.

What you're referring to, the induction of cancer or a genetic effect is observable only much later. And is a situation where the magnitude of the effect is not what is related to the dose but the probability of the occurrence of the effect is related to the dose when cancer appears or doesn't appear.

Q Is that what you just described would also be called a risk of stochastic effects or is that a more precise term?

A Well, when you use phraseology, risk, of stochastic effects, in the end you're referring to a mathematical calculation of the probability of the induction of a particular cancer as a result of that amount of energy being given to the body. And you can go through an equation that uses the data bases that have been generated over time associated with probabilities of induction of a cancer. And it depends on the cancer. It depends on the organ, leukemia is one thing. Solid tumors are another and depends where the solid tumors, there's a lot of variables with that.

Q And as a general matter to carry on the example that we took earlier, is it fair to say that the, we assume

that the higher the dose exposure, there's a direct relationship to a higher risk of stochastic effects? Given other things being constant or equal.

A The operating principle that's used in radiation protection, pragmatically is to assume that there is a linear relationship between those two terms. The scientific evidence is not available at the kind of level that we are referring to, to either prove or disprove that theory which is why you get another one of these wonderful ongoing never ending debates.

Q Now, you're familiar with the definition of waiting factor that Mr. Barth referred to in the regulations, 20.1003?

A I am.

Q And you're very familiar with the fact that that refers to comparisons of risk of stochastic effects?

A Yes.

Q And those waiting factors are used for the purposes of determining compliance with the regulatory limits including those for occupational workers?

A Those waiting factors are used in the regulations, part of the calculation of the term, committed dose equivalent, which is the one portion of the total effective dose equivalent. And its purpose is to relate the amount of material, the energy deposited in any

particular organ in such a way that you can then go through and add it up. It's a way of trying to convert your bananas and your apples and your grapefruits into something which you can just call fruit, if you will.

Q In -- I think what you're talking about that was the internal dose waiting factors?

A That's correct.

Q Let's talk about how those work for a second. Let's say hypothetically that we can measure that I've received a dose to my right lung and only my right lung, that's an organ, right?

A Lung is an organ.

Q Of 8 REM, fair enough?

A Yes.

Q For the purposes of the regulations, do we call that an 8 REM whole body dose, what you'd call a committed dose equivalent, is that what you called it?

A You have to give me a little more information first.

Q Okay, I'm sorry. And, you know my level of ignorance but I'll do my best.

A How did you deliver that energy?

Q Let's assume it was some form of internal exposure.

A So some amount of radioactive material you

inhaled and however, your particular physiology works, it all ended up in one particular lobule of the lung. And then you went through the standard human physiology calculation, you came up to the dose of the lung as 8 REM.

Q Right.

A Okay.

Q We use waiting factors to apply to a situation like that under the regulations, correct?

A That's correct.

Q Then why do we use waiting factors to apply to a situation like that? Let me ask you a different question first. Would you explain to the Board how the use of waiting factors would apply to that assumed 8 REM exposure only to my right lung, under the waiting factors used in the regulations?

A I'll attempt to do so. The system created was to try because when you take radionuclides into the body, they distribute themselves sometimes in very highly asymmetric ways, preferationally going to certain locations or by root of the administration, such as inhalation to particular locations.

The original modeling was done to understand where that material went, how it distributed over the course of time. How it was excreted. And what that then meant when you calculated, use the word, dose, very

broadly, general, what that meant in terms of energy imparted through the cells of the body wherever that was.

What was developed was a system and a methodology for relating that and a process that attempted to take and this is what the waiting factors were, Mr. Brooks is referring to, attempts to take the energy deposited in various parts of the body and added up under some systematic logical standardized base line. So that you could then get a representation of what, again approximately, all of this is modeling. That energy departed meant in relation to something which at the time this was all being developed was much better understood, which was an exposure isotropic full field covers the entire body to be able to understand the relationship between what that meant inside your body and a full field external exposure would be in terms of the kinds of consequence in energy deposited.

So the waiting factors have been used to relate. And what the waiting factors actually are in, let me see if I can do this relatively simply. Is a representation of that portion of the probability of cancer induction, that that organ contributes to the totality of cancer induction in your body. So for example, pardon me, Mr. Kelber for doing this to you --

JUDGE KELBER: Excuse me, maybe we could speed

things up a little bit. I basically referring to ICRP 26 and its rationale.

DR. COOL: 26 and similar methodologies, NCRP has also done this and others. That rationale says that if I put you in a radiation field of X amount, you have a mathematical probability of inducing some cancer of Y. And I don't know what cancer it might be because every organ of your body was irradiated to the same energy level.

Now conversely, if I have you inhale some material, CZ Iridium, people have done that by the way, we'll talk about that over lunch too. That material will result in irradiation of only one particular part of you, the lungs. The radium level doesn't move around very well in the body. And so the waiting factor attempts to relate how much of the probability of lung cancer you get versus the probability that lung cancer would have contributed if your whole body had received that same amount of material. And it provides you one mechanism for being able to add up different contributions.

Q So what we have for the purposes is a base line set of known risks for whole body uniform exposures, right? That's the sort of base line to which we are comparing other exposures.

A You have a base line of contributions of cancer incident rates in different organs.

Q Okay, I'm not talking about different organs now. I think what I understood you to say and I quite possibly could have misunderstood it.

A I'm sorry.

Q Was that we're using the internal dose waiting factors to create a set of contributions that when added up can be compared to the known set of risks associated with uniform whole body exposures, is that it?

A Yes.

Q Okay. So the thing that we are comparing are waited calculations to, is what I'm calling a base line, there may be a better word. But a set of known risks predicting the risk of stochastic effects emanating from a uniform full body exposure, right?

A Yes.

Q So the units of the internal dose waiting factors is to translate, if you will, particular exposures to particular organs into a calculation of some of those that can be compared to our known set of risks, right?

A Yes.

Q Now why wouldn't we, going back to my example, if we have a known exposure to my right lung of 8 REMs, let's just start with that. How would you convert that so it can be compared to our known data for uniformed full body exposures using the waiting factors in 1003?

A Again, with the Judge's permission, let me confirm, you're still talking the case where you had some Iridium which you inhaled into your lung.

Q Is that an internal exposure?

A Yeah.

Q Okay. And therefore those waiting factors would be applicable?

A That's correct.

Q Okay, is that what you're getting at?

A Right.

Q Okay.

A I want to make sure, then you can go to the calculation which indicates to you how you calculate the committed effective dose equivalent which provides you with the equation. You put your data into the equation and you punch the computer button and it pops you out the mathematical solution.

Q And if I look at it, it's really not very complicated. If I look at the organ dose waiting factors in 1003, it has a waiting factor of .12 for a lung exposure?

A Correct.

Q Is the mathematics of calculating my problem that I hypothesized .12 times 8?

A Yes.

Q No more complicated than that?

A That's true.

Q So expressed, now we converted the waiting factors what's my real total effective dose equivalent for my 8 REM exposure?

A Your committed effective dose equivalent is 8 times .12, you can do the calculation --

Q Just under a REM.

A Just under a REM.

Q So if we just stopped at 8, assuming I'm not the occupational worker, we would say that I had exceeded my annual dose, right? If we didn't use the waiting factors.

A But your hypothesizing a situation which is inconsistent with the way the regs ask you to calculate dose.

Q Right. Let's leave the dose calculation alone for just a moment. And just say, if I stopped today, we'd say I exceeded my occupational dose limit, right?

A Well, if you stopped at 8, the limit that I would compare you to would be your 50 REM organ dose limit and I would say you had not exceeded the dose limit.

Q But if we used the waiting factors that are specified in the regulations than we've got no violation for the 5 REM annual limit, do we?

A In your situation, in calculating a committed

effective dose equivalent, that's correct.

Q Okay. Now are there existing in the world, not in the regulations but in the world, waiting factors that are applicable to non-uniformed external radiation doses?

MR. BARTH: Objection, your Honor, to this because we're here to discuss NRC regulations not what exists somewhere else. The violations are of the NRC regulations not of some other standards somewhere in the world.

(Panel discussion.)

CHAIRMAN BECHHOEFFER: We'll overrule the objection on the grounds being that one of the purposes of this proceeding is to determine whether other, quote other waiting factors should apply, if so, how?

MR. BARTH: I appreciate the ruling. I abide by it. I take exception to it because in the view of the staff, the purpose is to determine whether or not he was overexposed according to NRC regulations not by some other standards or other factors. Thank you, your Honor.

CHAIRMAN BECHHOEFFER: The standard that I'm referring to is in the regulations right now, other waiting, I'm reading from the regulations.

MR. BARTH: Not for an externally exposed dose under 10CFR 20.103, your Honor. Thank you, I'll be quiet.

MR. BROOKS: Let me go back to my hypothetical

with my lung for a second and I'll get back to the question that Mr. Barth objected to.

BY MR. BROOKS:

Q What's the most accurate way to express in terms of the risk of stochastic effects, the exposure that I received to my lung, is it more accurate of the depicter of the risk of stochastic effects to call it an 8 REM, TEDE or 1 REM TEDE?

JUDGE COLE: TEDE? TEDE.

MR. BROOKS: TEDE, total effective dose equivalent, I guess, committed effective dose equivalent for an internal dose, right?

DR. COOL: I'm sorry, Mr. Brooks, those two things don't exist in your model. You either have an 8 REM dose equivalent to the lung, which is a very accurate representation, which you can then compare to the risk of the lung. And there's a body of knowledge and that's perfectly appropriate or you could go through the calculation and try to use the waiting factors that are available that represent the fraction of cancer induction in the body, that the lung represents, to get to what the NRC has defined as, total effective dose equivalent. And then you would be comparing it against a similar and additional body of knowledge about cancer induction effects.

If you wanted my personal view on the lowest accurate one, I would actually tell you to take the 8 REM lung dose equivalent and use that with the information available on the specific induction of cancers in the lung. I would not make the conversions you just introduced in calculations which add uncertainty.

MR. BROOKS: So, I wouldn't compare it then to the depth and uniform full body exposures, is that what you're saying?

DR. COOL: For purposes of attempting to understand the implications of that energy to that organ.

MR. BROOKS: Got it. Now I asked a question a moment ago whether there are existing in the world methodologies involving the use of external dose waiting factors applicable to non-uniform external radiation doses?

DR. COOL: There is actually a great deal of information that different people have attempted to model to try and explain different circumstances and relate them. The set of factors that you have here is one set, they were developed over the course of time by a variety of individuals and continued to be refined in terms of our knowledge of cancer induction of various forms and organs.

Other groups have attempted to take that information and then, as Mr. Brooks has suggested, attempt to figure out a methodology to use that information in the

context of what you might be able to measure of external fields impacting the body in a non-uniform manner.

JUDGE KELBER: Excuse me for interrupting but you are a delegate to one of the ICR people, I'm sorry, committee.

DR. COOL: I have been a member of ICRP committee for impractical applications of radiation protection. I am not at this moment.

JUDGE KELBER: Not at this moment.

DR. COOL: That term concluded last year.

JUDGE KELBER: I regret that. Do you know if there's an ICRP publication or well, let's say an ICRP publication that relates to this sort of activity?

DR. COOL: ICRP has updated both their biological models and their waiting factors for internal use.

JUDGE KELBER: Thank you.

DR. COOL: To my knowledge, ICRP has not made any recommendations on a particular methodology or application to apply external fields to those. They simply relate the dose to an organ.

JUDGE KELBER: Thank you.

MR. BROOKS: Dr. Cool, have you in the course of your work with the US NRC ever had occasion to make use of external dose waiting factors for application to non-uniform external dose exposures?

DR. COOL: Can you restate the question, please?

MR. BROOKS: Sure.

BY MR. BROOKS:

Q Have you used external dose waiting factors for non-uniformed external exposures?

A No.

Q Has anyone within your division, to your knowledge, used such waiting factors for any purpose?

MR. BARTH: Could you clarify that for any NRC purpose, people may introduce this into their home.

JUDGE KELBER: Would you accept that change, Mr. Brooks?

MR. BROOKS: Sure.

MR. BARTH: Thank you, Dr. Kelber.

DR. COOL: And the answer is no.

BY MR. BROOKS:

Q Are you familiar with individuals in your division using external dose waiting factors for purposes outside of NRC work?

A There are a number of my staff who have participated in various groups have worked with committees and otherwise, it would not surprise me that an attempt to understand the specific and biological situations. And that's why the clarification about NRC in terms of dealing with a particular complaint versus an understanding from a

radiobiology and implications point of view.

I would expect that in the latter case, yes, people have probably attempted to do all sorts of things to try and refine the understanding of a particular circumstance and its implications to an individual.

Q I see on your resume you're a member of the Health Physics Society.

A I am.

Q Would you describe what that organization is?

A The Health Physics Society is a society made up of individuals involved in radiation protection. A fairly large organization. Deals in a number of particular arenas, provides opportunities to exchange and gather information and serves as a secretariat for a number of committees, groups and organizations to try and to pull together industry consensus on particular activities.

Q When you say, pull together industry consensus, what do you mean?

A Well, I apologize. I guess, I thought that was a fairly clear statement. The consensus process as a whole means attempting to define and write down that other people can agree or more precisely, at least not disagree, with a particular set of technical issues or approaches or a, one, maybe one of several one possible methodology for dealing with particular activities. Those change over the course

of time as people learn more. ICRP and NCRP are two varying or lesser extent, developing consensus on topics. That's why you see revisions to publications, revisions to recommendations as the science is updated. The process goes on.

Q Have you participated in committee work through the Health Physics Society having to do with the development of industry consensus standards on various activities?

A Yes.

Q Have any of those have anything to do with the use of external dose waiting factors?

A Yes.

Q Are you familiar with a publication called, we refer to as ANSI, N13.41?

JUDGE KELBER: For the court reporter's help, would you please spell out the 2. ANSI.

MR. BROOKS: Sure. A-N-S-I.

BY MR. BROOKS:

Q And what does that stand for?

A American National Standards Institute.

Q What is that standard or the publication actually that I just referred to?

A That is a standard which was done under the auspices of the Health Physics Society Standard Committee

for defining when the use of multiple badges might be appropriate in the R priority planning for work activities in Health Physics Community.

Q Okay. Did you serve on that Health Physics Society Standard Committee that was involved in the development of that publication?

A My involvement in that process was as a result of my serving as the NRC's representative to the N13 Consensus Committee which reviewed the standard. To elaborate briefly for the Judges, the process normally is for a working group to work to develop the draft. And then there are, in fact, two independent separate series processes which review that, first within the Health Physics Society itself and then through the ANSI, N13 being the particular committee dealing with radiation protection.

And I am the NRC's current representative on N13. So I did not participate in the draft. I apologize if there was any confusion associated with that. My participation was as part of the review process.

Q How long have you served in that capacity as part of the review process? Specifically with relation to the ANSI N13.41 publication?

A Mr. Brooks, I think you've asked two questions. As I understand the question, the first question, how long have I been a representative of NRC on the ANSI N13

Committee and I think that dates back to 1989, so that now would be nine years.

The answer to the second question, quite frankly, I don't know the answer to in terms of the amount of time that particular document might have been in the development process.

Q I appreciate it. I was only trying to ask the first. But I appreciate you trying to answer both. I'll be a little more precise.

The standard for the publication that we were discussing, ANSI 13.41, contains a set of external dose waiting factors applicable to non-uniform exposures, does it not?

A It contains from my recollection a series of compartment factors which the working group developed on the basis of the organ waiting factors. Trying to provide some translation of what was generated on an organ basis by ICRP and others to larger compartments that might match to some reasonable multibatching scenario.

MR. BROOKS: For the record, I'm going to hand you what was marked as Joint Exhibit No. 24.

Dr. Cool, I ask you, if you could identify for the record what Exhibit 24 is.

DR. COOL: It's a piece of paper that you handed to me, indicates, it's code number at the top is HPS,

space, N13.41-1997. It's title is, American National Standard-Criteria For Performing Multiple Dosimetry.

BY MR. BROOKS:

Q Are you familiar with this document, sir?

A I have seen this document.

Q Is this what we've been referring to as the ANSI N13.41 publication, that you and I were just discussing?

A It is.

Q Is this the document that you reviewed as part of the N13 Committee?

A It was.

Q And could you point out to us where in this document it contains a set of waiting factors applicable to non-uniform external dose exposures?

A With the Judge's permission, it may take a moment.

If I can rephrase my understanding of your question?

Q Sure, it'd be better than my question. Go ahead.

A The standard identifies in Table 1, Page 15, this consensus standards suggestions for compartment factors that would be, that could be used in a situation of multiple badging for trying to make a determination of the exposure to various parts of the body.

Q Thank you. You just referred to this as a

consensus standard. Is it fair to refer to this document as a consensus standard?

A That's what the ANSI standards are. They represent a industry consensus, not necessarily the only viewpoint, but one viewpoint which that particular group and the reviewers found some measure of agreement or lack of disagreement over.

Q You reviewed this document as part of your work on the M-13 Committee?

A The M-13 Committee reviewed this document and I was a member of that committee during that time.

Q Did you express, on behalf of the NRC, an opinion about the document when you initially reviewed it?

A Your Honor, I do not know for certain whether or not the agency submitted comments on the draft process or not. That would have been several years ago and my recollection is not sufficient to know whether or not we submitted specific comments on this particular document. There are a number of standards that come through and, at this point, I cannot tell you what comments we may have made because this may have been seen multiple times during the review process.

JUDGE KELBER: Excuse me, you submit comments as a representative of the agency? In other words, yours is an agency document or is it a personal, professional

submittal?

A The expectation that I have, that the agency holds, is that individuals who are participating in the consensus organizations will, to the extent that they can, attempt to reflect what the agency would wish to have as part of that process. My routine is, quite honestly, to try and have some of my staff who are, have the particular expertise in the various documents, because these standards cover a broad spectrum, and provide their input and suggestions to me. Sometimes I pass those on directly, sometimes they're modified, sometimes they don't go.

JUDGE KELBER: Okay. Thank you.

MR. BROOKS: Before we go any further, could I move the admission of Exhibit 24?

MR. BARTH: We have no objection, Your Honor.

CHAIRMAN BECHHOEFER: Without objection, 24 is admitted.

[Exhibit 24 is received into evidence.]

BY MR. BROOKS:

Q Dr. Cool, if I could show you something to refresh your recollection with respect to commenting. And I guess what I'll do is...Charles would you -- the objection, if I can just refresh his recollection, say it. Or I could mark it as an exhibit.

MR. BARTH: Give me one second.

MR. BROOKS: Yes.

MR. BARTH: Mr. Brooks, why don't you just it into the record, if you please? Have to identify this thing.

BY MR. BROOKS:

Q Dr. Cool, I've handed you a document that is three pages long. The top of the first page of which says M-13 letter ballot, and underneath that it says, Topic: Proposed Standard M13.41, is that correct?

A Yes.

Q Do you recognize that document?

A Yes.

Q What is it?

A This is the standard form which the M-13 committee uses for balloting standards.

Q And is this particular document, on the first page, bear your signature?

A It does.

Q Are these the comments that you expressed with respect to the M13.41 proposed standard in 1994?

A They appear to be.

MR. BROOKS: Your Honor, I guess at this point, since I've gone this far with it, I propose to mark it as an exhibit and have it admitted. It wasn't where I was

headed with an admission initially, but.

MR. BARTH: Staff has no objection, Your Honor.

CHAIRMAN BECHHOEFER: Which number?

MR. BROOKS: Would this be 40 at this point? So it'd be 40?

CHAIRMAN BECHHOEFER: Exhibit 40 will be admitted without objection.

[Exhibit 40 was received into evidence.]

BY MR. BROOKS:

Q If I could direct your attention to the last page of the document. Do you see the section that says dose assignment for multiple dosimetry?

A Yes.

Q Looking at the second to the last sentence in that section it says, while the NRC agrees with a waiting factor approach? Do you see that?

A Yes.

Q Was that true as of 1994?

A I have no reason to say it was not.

Q Okay. And when we say that, we're talking about a waiting factor approach for non-uniform external exposures?

A We were commenting in the context of the draft standard.

Q Okay.

A If you take a complete sentence, I think you will find the second half of that sentence suggests our view that a single set of factors, rather than two different set of factors with different compartments, would reduce confusion. I think that that's a comment which we made to the organization.

Q Fine. And as a matter of fact, in the ballot that I've handed you and we've marked as Exhibit 40, your initial vote on the standard was no, right?

A This so indicates.

Q Now, after the comment period on the standard, or was there a comment period on the standard?

A Yes.

Q And after that comment period, were changes made to the proposed standard?

A I presume that they were.

Q And a revised standard was circulated for a voting?

A I presume that it was.

Q And in the subsequent vote on the revised standard, was your vote that you abstained?

A I presume that, in a moment, you can produce that vote. I don't recall right now.

Q Strangely enough, rather than mark it as an

exhibit, let me just hand you a document that's a letter dated December 22, 1995, from Donald A. Cool, Director, to, of the Division of Industrial and Medical Nuclear Safety to Nancy Johnson, and ask you if that refreshes your recollection?

MR. BARTH: Could we have a copy of the document counsel could look at?

MR. BROOKS: Sure. I don't intend to mark it as an exhibit. I was just trying to refresh the witness's recollection -- choice.

A Could you repeat your question?

BY MR. BROOKS:

Q Sure. My only question was, when the document, the M13.41 proposed standard came around again after the comment period, whether you voted to abstain rather than to vote no on the standard?

A This document indicates that.

Q Well does that refresh your recollection that that's what you did?

A Yes.

Q Okay. Now, you mentioned, in your direct examination, that you were at a meeting in Chicago just a couple weeks ago?

A Yes.

Q And I don't remember the context in which that

came up.

MR. BARTH: Your Honor, it slightly misrepresents the testimony, Mr. Brooks. He testified, the meeting was held but not that he was there.

BY MR. BROOKS:

Q Oh, I'm sorry.

A Mr. Brooks, unfortunately that's correct. The meeting was held here. I was, at that moment, chairing the meeting of the International Atomic Energies Radiation Safety Standards Committee in Vienna, Austria, which precluded my attendance elsewhere.

Q I appreciate that. The meeting in Chicago that you were talking about but did not attend, what meeting was that?

A Your Honor...that meeting was a public meeting conducted by the Nuclear Regulatory Commission for the purpose of obtaining public comment and industry views with regards to how the agency should consider the use of various industry and other consensus standards and information within it's regulatory process. It was not a decision meeting. It was open. Noticed in the federal register and comments received.

Q Among the standards, to your knowledge, that were on the agenda for that meeting, were included in that waiting factors found in the ANSI 13.41 document?

MR. BARTH: Since he was not there, I don't think he's qualified to, he hasn't laid the background to show so that he has the agenda. It would be easier just showing the agenda, or put the agenda in.

JUDGE KELBER: If he's a member of the M-13 committee, he would probably, I think he would be qualified to know what M-13 committee is doing with it's standards.

CHAIRMAN BECHHOEFER: If he does or doesn't know, that's...

A Your Honor, I think I can answer the question in the following way. ANSI, I believe...ANSI...

MR. BARTH: I'm having trouble hearing you, sir. Thank you.

A There. We have some shielding again.

As I was saying when we were interrupted. It was an NRC meeting. I am not sure that there were any particular standards that were discussed in the context of a particular standard. The purpose of the meeting was to discuss with industry, and I know that there were a variety of representatives. I expect some who could represent views from ANSI, although perhaps not necessarily M-13 in particular. And the purpose was to discuss process and approaches, not the specific resolution of particular standards. As best I recollect the planning that was going into that meeting before it occurred.

BY MR. BROOKS:

Q Is there currently consideration of incorporating the waiting factors found in the M13.41 document into the regulations?

A Mr. Brooks, I think there's two answers to that question.

Q Okay.

A The first is in the general context of the commission's moving to implement federal law. The commission is in the process of trying to determine, for itself, how it will look at, and the processes that it will use to incorporate ANSI, IEEE and other industry standards into the regulatory structure wherever that appropriate spot might be. And, once again, I would like to note, that might or might not mean that they would be actually incorporated into the regulation published in the federal register. So, in that context, there is certainly consideration going on for this and all other standards in terms of processes that would be pursued.

If you, the second possible answer is that you may wish to know whether or not there is a specific action currently under way to incorporate this particular standard at some particular point in the NRCs regulatory structure, and the answer is no. There may be following the commission's decision with regards to how to pursue

industry standards, but there is no such action at this moment.

Q Okay. You're saying just the commission hasn't got to that point yet, and if it does get to that point, you're not sure what decision it will make, is that fair?

A Quite frankly, sir, I don't have a crystal ball who is nearly good enough to predict that.

Q Fair enough. In terms of external doses from non-uniform sources, let me ask a different question. Let me direct you to take a look at Exhibit 19 in your book, if you would. You're familiar with the order imposing civil penalty in this case?

A I have seen that order.

Q Direct your attention over to the appendix to that document, Page 4.

A Yes.

Q And, specifically, the first sentence of Item 2 on Page 4. Go ahead and take a moment and read that first sentence.

A Okay.

Q What does it...you see where it says, and I'm going to take out the middle of the sentence, the NRC acknowledges that the radiographer's thigh may not be an appropriate predictor of biological effects. Do you see that part?

A That's an interesting truncation of the sentence. Yes.

Q I'll read the whole sentence if you'd like.

A It's fine.

Q It seemed to me that you could drop out that middle clause without doing damage to the part that I read. But, would you rather that I read the whole thing?

A No.

Q Okay. First of all, do you know who wrote that sentence?

A In specific to a name, no. I expect that this portion was drafted within headquarters and probably was done by my staff, although there were a number of individuals in my staff who worked on this document at various times, so I can't tell you specifically that it was.

Q Fair enough. This concept comes from your staff, let's put it that way.

A I believe that's correct.

Q Okay. Let me just ask, just give you a real soft ball question here. What does it mean to say that the radiographer's thigh may not be an appropriate predictor of biological effects?

A As I testified a little bit earlier today, the dose limits, although established based on risk

information, biological information, are not the end-all and be-all in terms of the actual consequences of a particular exposure to a particular individual. That's going to be true no matter what the exposure is.

In this particular context, because the rule is constructed in a way to provide order and system to the system of radiological protection, an exposure of only one portion only logically means that that may or may not have the exact same predictive quality in terms of how it might be related to how you originally derived the underlying basis of health defects, as a different type of exposure.

But the dose limits are not intended to be specific predictors of a biological effect. They're intended to be criteria used to judge the acceptability or unacceptability of a licensee's program and radiation protection activities.

Q Let me ask you if, apart from what the regulations say, let's not be bound by those for a moment, but simply as a matter of trying to get to the most accurate understanding of what happened to Mr. Chastain. And assuming he got a non-uniform dose just to his thigh, is that a case where the use of waiting factors would assist us in understanding more accurately the risk of stochastic effects resulting from that exposure?

MR. BARTH: Objection, Your Honor, because the

waiting factors of the ANSI standard do not apply to accidents. This was an accident situation.

JUDGE KELBER: I beg your pardon. I think we've gone over this, Mr. Barth, before. I'm going to recommend to the presiding officer that he overrule on the basis that the waiting factors are not the standard, they are part of the standard. An important part, but they are not the standard.

MR. BARTH: Only a Philadelphia lawyer could parse the sentence which appears on Page 9 so, Your Honor. It says that the standard does not address the cases in -- accidents.

JUDGE KELBER: I beg your pardon. I repeat, and perhaps you can understand me if I repeat it often enough. The waiting factors are part of the standard. They are not the full standard, they are part of it, and the discussion is, as has been for quite some time now, on the use of waiting factors. I think I'm going to recommend that you overrule on the basis that we are discussing the use of waiting factors. And the standard...

CHAIRMAN BECHHOEFER: I will overrule on that basis.

JUDGE KELBER: The standard does direct the footnote to the possible consideration of the waiting factors.

CHAIRMAN BECHHOEFER: The board will overrule that.

MR. BARTH: I'll accept your overrule with my usual bad grace, Your Honor.

CHAIRMAN BECHHOEFER: And Dr. Kelber gave me the reasons, so.

A Mr. Brooks, given the rule soliloquy, will you indulge me and repeat your question.

MR. BROOKS: I was afraid that was coming.

JUDGE COLE: It was a very good question.

MR. BROOKS: I wish that one of us could remember it.

JUDGE COLE: Well, maybe we could have the court reporter read it. Could you do that?

[Question read back.]

THE WITNESS: Thank you. In the context of attempting to understand the particular implications of a particular exposure, absent all other regulatory considerations. I'm not a radio-biologist and I'm interested in trying to figure out what happened to you. Any information generated by a consensus standard by scientific researchers, modelling, reconstructions, or anything else that might shed some light on the particular distribution and the particular tissues that received radiation would be useful in trying to understand the

biological implication of that particular exposure.

BY MR. BROOKS:

Q And specifically, with respect to the non-uniform exposure to Mr. Chastain's thigh, would the use of waiting factors give us the most accurate and useful attainable predictor of the risk of stochastic effects to him resulting from his exposure?

A Well, I take it from the way you've asked the question that we have not specified the waiting factors. And so, in that context, uses of things such as waiting factors and other modifiers in an attempt to understand the implications of that exposure, would lead you to a more accurate, I'm not sure I would ever say the most accurate, understanding of that particular situation.

Q Let me ask a related question. As between using a waiting factor of one, and using the waiting factors identified in the ANSI 13.41 standard, which would give us a more accurate predictor of the risk of stochastic effects to Mr. Chastain resulting from a non-uniform exposure only to his thigh?

A For the purposes of understanding biological implications, those factors would likely allow a refinement. I would dare say that if we were able to do sufficient techniques, if we were able to go to the underlying organ waiting factors suggested by the ICRP, we

could do yet a little bit better. I would dare say that if we could refine that a little bit farther, such that I could understand the energy deposited in each of the particular organs and go the more specific organ risk factors, that I could do yet a little bit better again. All of this only in the context of trying to understand the biological implications of that particular event. And that's totally separate from any construct of where you might be vis a vie a system of radiological protection or a set of requirements.

Q Thank you. Let me address for a moment the implications of your answer, because you were referencing that your answer was independent of trying to establish a system of regulation, correct?

A Separate from.

Q Correct. But as I understood your testimony with respect to questioning on direct, with respect to the need for approval on a case by case basis, your answers were given in the context of trying to maintain a system of regulation, correct? That was a bad question. I'll withdraw it.

A Thank you.

Q In your direct examination I think you said that you wanted to interpret the footnote to the way you got your definition as requiring some form of prior approval,

right?

A The case by case analysis is stated in that footnote. The statement of considerations, which I think was submitted a little bit earlier, notes that that approval would be by the Commission and in the context that all of the radiation protection activities, as we discussed in our discussions back and forth with Your Honors a little bit earlier, in terms of the planning and conduct of activities, then it would be an approval to use a particular kind of situation that you intend to do. Not after the fact trying to figure out what happened.

Q And I understand that one of the reasons that you said that is you don't want your licensees to have an occupational exposure like this and just, on their own, decide whether or not they are going to report based on a weighting factor that you've never seen or approved, is that right?

A In order to have in coherence and consistency in any protection system, you've got to have a set, defined playing field. You are always, as the regulatory authority, in a position where you can adjust that playing field based on the information that you have available for a particular activity that you can predict in the future. What you don't want to do is, after the fact, decide the playing field was a different size or different shape or

something like that. If we were to do that Mark McGuire probably wouldn't have sixty-three home runs, and Sammy Sosa.

Q In a consistent set-up, a system of reporting would include, for example, the requirement to report as the dose, the film badge result if you believe that the film badge was generally closest to the source, is that right?

A Let me rephrase that understanding just a little bit --

Q Sure.

A -- to put it Part 20's term.

Q Fine.

A Under the presumption that that film badge represents the location of greatest exposure, that would be the exposure that you would have to report. That's what the regulation states, the location of greatest exposure.

Q I'm sorry, are you done?

A I'm done.

Q You know about the facts of our case here, that's what CONAM did, right? They reported the film badge result?

A I understand that the film badge information was made available. I understand that there were a variety of re-enactments being done. I understand that there have

been numerous discussions with regards to isometric dose distributions, otherwise, and that's in fact precisely why I made the distinction I did a minute ago about the presumption of whether or not that badge in fact represented what the regulation requires which is the exposure, which is the dose at the point of greatest exposure.

Q But in terms of the initial reporting concept that you are expressing as a concern, CONAM reported, based on the film badge result, that it believed was in the region of highest potential exposure, correct?

A I'm sorry, I don't have a basis to be able to answer that question.

Q Okay. Fine. I'm sorry, I thought that you were there.

Doing that and determining reporting requirements is an initial pass based on 1201C which is the concept that we were talking about, right?

A Yes.

Q Doing that comports with and is consistent with your concern for a uniform system of reporting regulation, correct?

A Could you repeat the question?

Q I'm just asking you if it is consistent with your concern for having a uniform and known set of standards for

licensees to judge when they are to report; for CONAM to have made it's decisions on whether or not to report based on whether the film badge it believed was in the region of highest potential exposure.

MR. BARTH: Objection, Your Honor. This one is just not an issue, it's beyond the issues. The two issues were were they exposed and was a survey made. Reporting is not an issue, Your Honor. I have wanted to talk about reports and my colleagues won't let me because it's not an issue.

MR. BROOKS: Well if I can respond. All I'm really trying to get to with the witness is to say what CONAM initially did was to report film badge results in a fashion that was compliant with and took into consideration the uniform set of guidelines that Dr. Cool has expressed legitimate concern for as expressed in 1201C. And if the approval that we're seeking is to use the weighting factors in the context of a particular case as subsequently develops so that it does not raise the specter that he was expressing concern for. That licensees are willy-nilly going to be falling out and using weighting factors that have not been approved. After that initial reporting stage of consideration, I'm saying, our conduct here does not fall within the range horribles that are imagined.

MR. BARTH: Your Honor, I move to strike and

expunge the diatribe be the counsel for the testimony on this. This gratuitous testimony. The issue is whether or not reporting was an issue. Reporting is not an issue here. It's beyond that and these speeches by counsel to influence the judges, I think, are inappropriate, Your Honor. I ask you to strike and expunge the speech as well.

MR. BROOKS: I was just responding to your objection.

JUDGE KELBER: Could you please repeat your original objection?

MR. BARTH: The original objection is that the -- thank you, Dr. Kelber. There are three issues here. Was Mr. Chastain overexposed above five, was an adequate survey made and, the one which is with your discretion, was the penalty imposed by NRC appropriate. Reporting is not related to any of those nor is the speech about what licensees should do and how they should be informed part of it, Your Honor. This was reported. It was reported after the enforcement conference, months after this happened. That's not an issue here.

JUDGE KELBER: Please don't use terms like diatribe and gratuitous and then repeat that sin.

CHAIRMAN BECHHOEFER: I'm going to overrule that because my view, at least, or the Board will overrule. In my view, at least, whether 4.5 which was reported we're not

question that as good, bad or indifferent, is very relevant to what is before us. So I think it's a question that may be answered.

MR. BARTH: My I have your permission, Your Honor, to have my usual bad grace?

CHAIRMAN BECHHOEFER: You may answer.

THE WITNESS: Your Honors, once again there is sort of a two part answer to this question. Certainly the badge reading is one of the relevant pieces of information associated with both understanding the event and understanding whether or not the event should be reported. Mr. Brooks has referenced me to 10C Part 20 1201C and I would note to you that survey and other radiation measurements for the purpose of demonstrating compliance, I've accepted one phrase from particular section of the regulation. And so, while the answer to the question is that the badge reading is certainly an appropriate piece of information for understanding whether or not to report, it is not the only piece of information which would be relevant under this regulation.

BY MR. BROOKS:

Q But you would agree that if you get a badge reading of 4.6, and based on your understanding and reconstructing of the events, you believe the badge to in the source or in the region receiving the highest exposure,

reporting the badge results is the correct result, right?

A Within in the constraints of the assumptions you've made, which were numerous, with regard to the badge reading, with regard to your reconstruction, with regard to your understanding of the situation, that would be a reasonable and prudent course of action to take. Your Honors, when you have a badge reading which in up in the vicinity where it approximates the dose limits, one of the things that you will not find this any where in the regulations, this is another part of good Health Physics practice is to make sure you have a clear understanding of what did or did not happen because your are, at that point at risk or in danger of being in a situation where even slight variations in your understanding may make a significant difference in your position visa ve the regulations.

MR. BROOKS: Can I have just a moment? I'm thinking I'm winding down here or getting hungry.

Dr. Cool, let me just express on behalf of CONAM Inspection that we appreciate very much your time and your thoughtfulness in answering these questions. I've got no further questions.

THE WITNESS: You're welcome.

JUDGE COLE: Just a couple questions, Dr. Cool. Exhibit 35, I think it is, is the result of the

blood test conducted by the Oak Ridge Institute of Science and Education. Do you have that, sir?

THE WITNESS: I do.

BY JUDGE COLE:

Q And I believe you've indicated that you are familiar, in general, with the work of the Oak Ridge Institute, is that correct, sir?

A That's correct.

Q Have you had a chance to look at the report for the analysis of Mr. Chastain's blood?

A In general terms, yes.

Q I'm looking at Page 2, the comments. And particularly to the next to the last sentence there, where it says, "However within wide limits of statistical error, the bicentric frequency of two cells per five hundred cells is equivalent to whole body dose of about six RAD YENORADS. And then the next sentence it says, "Taking into account statistical error associated with this estimate, we are ninety percent certain that his dose did not exceed twenty RAD."

Are you familiar with the statistics that they might have applied to this?

A Well, Your Honor, in very general terms, yes. I don't know which particular statistical tests they may or may not have applied. I haven't asked them lately about

how they view the distributions and whether they are using high squares or poisons or other sorts of distributions to obtain their confidence intervals.

Q So it's difficult to make detailed comments on that?

A It would be very difficult, sir.

Q For example, the question I would like answered is they've indicated that the two per five hundred cells is equivalent to the whole body dose of six RADS, but then when they say they've got a ninety percent chance that the distribution is between zero and twenty, that looks to me like a pretty funny distribution and my question would be well what would the probability be of it being five or below?

A Well sir, that's a very good questions. Unfortunately, I'm not in a position to be able to answer that questions. Oak Ridge had done biological counts, the counts of bicentrics and other abnormalities in the chromosome condensation that you do that has become fairly routine technique. There is a fair amount of information that they have collected with known exposures, known. You have to accept the statistics associated with how well that particular exposure was or wasn't known. However, I'm not in a position to really be able to answer the question about whether they have the statistical power or what they

would say was the answer to that particular parsing of the distribution.

Q They might have the data of the distribution from which they made these estimates just based on the periodical data that they have collected.

A I would expect that they have that data there and that's the data base that they draw upon to make these conclusions.

I don't have that data set.

Q Well, considering the fact that the average person would have one per five hundred cells and Mr. Chastain had two per five hundred cells, I difficulty in attaching the kind of statistical significance I would like to attach to it. Do you have the same problem, sir?

A I most certainly understand your concern. I would express that, I think, maybe a slightly different way. Based on my understanding of the power of this particular test, you are in a range below which I would ever the consider the results to be valid. You really need to be in dose ranges above ten RAD or so before you start to have enough statistical validity to it to make me want to cover it with any thing other than a very large coin. A six number is a number I am little, -- they can equate it, they have that power of that distribution, that's down at the bottom end of the frequency. It probably has a low

statistical significance.

JUDGE KELBER: Excuse me. Just of the sake of the laymembers of the Board and others, what is the conversion between RAM and RAD because both terms have been used here?

THE WITNESS: Except that it would be off the record, I would suggest that we do that over lunch, Your Honor.

JUDGE KELBER: With respect to the tissues being discussed.

THE WITNESS: Well, RAD is the first term which represents energy deposited. The conversion then to REM associates with it a quality, that terms has been used, or a radiation weighting factor, W sub R occasionally gets used as to representation, which represents the effectiveness of that energy deposition at creating damage within the cell. For gamma or X-ray radiation, it is essentially one. For alpha radiation, which is very highly ionized in radiation, that factor is twenty. So for the situation that we are dealing with there is essentially no difference between RADS and REMS.

JUDGE KELBER: Thank you.

BY JUDGE COLE:

Q Really, just one more question, Dr. Cool, maybe two.

Does the use, and I'm asking your professional opinion you can leave your NRC hat on if you wish, but does the use of external dose weighting factors appear to have promise from a scientific and technical viewpoint with respect to moving forward with our level of knowledge in the assessment of radiological damage?

A Yes, it appears to have some promise.

Q In the current situation where we have in individual who was exposed at a certain rate and there have been some questions raised as to exactly what that dose is and the particular individual who received the dose has given a couple different versions of how we behaved during that. Certainly we are responsible for certain actions being taken. You have already indicated that the use of external weighting factors would require prior action of some licensee and not after the fact use of the weighting factors because it would disrupt what you would consider to be the desired mode of regulation. You want to know what's up front, you have to have, or it should be for good regulation, you should know what the playing field is beforehand. You shouldn't use it as an after the fact justification because it could create destruction. I understand that point, sir. Is there some way that a particular instance like this where scientific evidence might be produce reasonable basis where an exemption to

certain regulations might be applied for based upon scientific evidence?

A Well, Your Honor, I suppose you could hypothesize that kind of situation. I don't believe that our office of the Commission would act favorably towards a request for exception post-accident situation.

Q All right, sir. You indicated that when a dose in excess of five REMS is received in a industrial setting you consider that to be an accident scenario. I believe you stated that.

A That's correct. I would not ever expect that the dose limits would be exceeded as a result of the routine, preplanned conduct of licensed activities.

Q All right.

A That's what the purpose of the dose limit is.

Q All right, sir, so it might also apply to doses below five might also be considered accidental using that same rational, would it not, sir?

A That's quite correct.

Q How far down would you go in your view?

A Your Honor, that's almost impossible to predict. It's not so much the dose received, as whether or not you anticipated the situation and the process that you were in. It could be a very small exposure, but it could still be an accident because it was not anything that was anticipated

and planned for in the conduct of activities.

Q All right, sir, I understand. Thank you.

MR. BARTH: If Your Honor has concluded --

JUDGE KELBER: Excuse me, Mr. Bechhoefer is searching for a reference before he asks some questions.

MR. BARTH: Thank you, Dr. Kelber.

CHAIRMAN BECHHOEFER: Dr. Cool, do you know and I don't see one so maybe I know the answer, do you whether rules or staff guidelines have any definition for accident or incident?

THE WITNESS: No, Your Honor, I don't believe that they do. The regulations contain specifications when you get to certain levels of consequences of accident, but I don't think they contain the kind of distinction that I was just making with your associate about, in the words that you are probably looking for, in terms of planned versus unplanned during usual circumstances. The regulations set up a construct with has certain thresholds in terms of consequences for limiting actions, reporting actions, recording actions and taking actions.

CHAIRMAN BECHHOEFER: The Board has no further questions. Mr. Barth.

MR. BARTH: I would respectfully request that we listen to Dr. Cool's admonition and break for lunch at this time, Your Honor, it's 12:15, he's been going on since 9:03

when I walked in the room.

CHAIRMAN BECHHOEFER: Well, are there further questions.

MR. BARTH: The staff will have redirect, Your Honor.

CHAIRMAN BECHHOEFER: Pardon?

MR. BARTH: The staff has further questions.

CHAIRMAN BECHHOEFER: Extensive or not, because we were wondering whether we could complete before lunch.

MR. BARTH: I think you ought to give some consideration to the witness' well being as well as the well being of everybody else. The witness has expressed a desire he has been on the frying pan in spite of my use of language, Dr. Kelber for over three hours and he wants to eat lunch. Now let's be a little human here, guys.

JUDGE COLE: He did not make any representation like that, Mr. Barth.

MR. BARTH: I apologize for my mis-temper, Your Honor. I really do.

CHAIRMAN BECHHOEFER: We were really hoping we could get through with the staff's case.

MR. BARTH: Well the licensee has of course canceled a couple of witnesses out on us, we are moving very rapidly and we have great hopes that we will be done quickly.

JUDGE KELBER: I don't think -- I think we would all appreciate, though, if you allow sufficient opportunity for the licensee to present their case.

MR. BARTH: I'm shutting him off, I'll be here until it's done. It's not bothering me, Your Honor.

JUDGE KELBER: Yeah, but some of us --

CHAIRMAN BECHHOEFER: Okay, let's break for an hour.

JUDGE KELBER: 1:15.

CHAIRMAN BECHHOEFER: Yeah. We'll break for an hour, be back at 1:15.

[Whereupon the hearing recessed to reconvene at 1:15 p.m. this same day.]

CHAIRMAN BECHHOEFER: Back on the record.

MR. BARTH: Your Honor, in a very preliminary matter before lunch, I told you that Mr. Cool had expressed a desire for lunch, I have been informed that I had misunderstood his words and that he did not express a desire to quit and go to lunch as I informed you. I misinformed the Board and I apologize both to you and Board for it. It was inadvertent, nothing really intentional.

REDIRECT EXAMINATION

BY MR. BARTH:

Q Dr. Cool, the term TEDE and total effective dose

equivalent have been used a number of times here. Would you please tell the, the licensee board record where the full name and the acronym came from and what are its uses and what is it particularly confined to, if you please?

A Yes. Your Honors, the term total effective dose equivalent is a creation of the Nuclear Regulatory Commission. It is a term which we coined, if you will, created, during the process of preparing the rule making part 20. If you go to ICRP publication 26 or the similar NCRP documents, you will find that they talk about limitations and doses too, and then you will find a relatively long sentence, the sum of the, and it, it runs on for some number of words. As we were attempting to put together the rule making, we were faced with a choice of either doing a similar sort of thing and saying that the limit applied to the, and writing that all out each time. Or trying to standardize the process, because any time you start to do that a number of places in the context of an actual regulation, rather than a set of recommendations, you need to be very consistent about what that definition is. So total effective dose equivalent is a term that's only applicable to the NRC regulations and only applicable to the definition in the NRC regulations as the sum of the deep dose equivalent, that portion of the body from external exposures, and the committed effective dose

equivalent from internal exposures. Does that answer your question, Mr. Barth?

A Thank you, Sir, it does, it certainly does. Earlier I believe you stated, Dr. Cool, that there was and present, an ongoing NRC effort or process to term how to use standards. Would that include such standards as the NCN 13.41?

A I would assume that once the Commission has determined what process will be used, that it will direct the staff to apply it to that process consistently across the board, including health physics standards such as that document, yes.

Q Dr. Cool, I would like to refer you to Exhibit, pardon me, Sir, number 7.

A Yes, Sir.

Q I represent to you that after the Chastain exposure, very close to the 28th of February, the day after, a calculation was made by Conam which is set forth in the printed text, it says whole body 9 to 36 REM, actual whole body 4.6 REM. Do you see that, Sir? It's in the middle, one, two, three, four, five --

A Yes, I do.

Q If the licensee had calculated from the information data given to them by Mr. Chastain, that he had received a dose in the range of 9 to 36 REM, would you

expect the licensee immediately to report that to the NRC?

A Yes.

Q I now direct your attention, if I may please, Sir, to Staff Exhibit, to Joint Exhibit 24. That is the, that is the HPSN 13.41 1997 to which we refer to so often. I would like you to look at the first sentence in the last full paragraph on the left hand side of the page, and the page number is 9.

A You'll have to pardon me, after lunch. Can you give me the location on that page again? When you gave me the page number, I lost the first --

Q It's page 9, the first sentence in the last paragraph on the left hand side, Sir, left hand.

A Okay.

Q Under what part of this standard does that paragraph fall? From that, you're going to have to go back and read the title of this section.

A I presume you're referring to the section which is entitled Scope?

Q Yes. Would you read the, the single sentence, if you please, to which I have referred you, which starts, this standard does --

MR. BROOKS: You want him to read the sentence or that fragment of the sentence?

MR. BARTH: I would like him to read the first

sentence, which commences, this standard does.

THE WITNESS: This standard --

MR. BARTH: I would like you to read it out loud. Thank you, Mr. Brooks.

MR. BROOKS: Oh, I'm sorry, I see.

THE WITNESS: This standard does not address the cases of internal deposition of radioactive materials, external contamination of the body, or working conditions which do not permit job planning.

BY MR. BARTH:

Q Would you read the second sentence now, Sir?

A Certain or unexpected changes in the radiation environment as might occur during accidents, are beyond the scope of this standard.

Q I would ask you to turn to page 11, if you please, Sir. And are there weighting factors at the bottom of the left hand column, bottom of the column, the left hand column on page 11?

A There are.

Q I ask you to turn to page 15, if you please, Sir. At the top of table 1, does it set forth various compartment factors?

A Yes.

Q I ask your indulgence, would you please turn to page 16 to look at table 2. Does that also contain

compartment factors?

A That table utilizes the data from table 1 in an example.

Q Thank you, Sir. Read in --, do you consider that those tables of the various weighting factors are part of HPSN 13.41-1997?

A They are.

Q Would you differentiate between the standard and the weighting factors, or is weighting factors a part of the standard formulated by the standards institute?

A I would have viewed those as being part of the standard.

Q In your professional expertise and experience, do you consider that the Chastain situation of exposure was an accident?

A Yes, I do.

Q Would you consider that the Chastain exposure situation falls within the parameters of the NSI HPSN 13.41-1997, Sir?

A It does not.

JUDGE KELBER: Excuse me, what do you think he meant by, Mr. Barth meant by parameters?

THE WITNESS: The conditions under which that standard would apply and to use my --

JUDGE KELBER: Is that also called the scope?

THE WITNESS: And to use my answer, I refer to the scope, which specifically excludes those kinds of situations.

JUDGE KELBER: Fine, that's, I just want to make sure that --

THE WITNESS: Yes, Sir.

JUDGE KELBER: -- parameters in this case meant scope.

THE WITNESS: Yes, Sir.

BY MR. BARTH:

Q Dr. Cool, earlier Judge Cole asked you about the 20 RAD dose value in the Oak Ridge blood report, that's the report about Chastain's blood analysis. Is that number comparable to the type of REM that is the highest dose to any part of the body used in the NRC staff technical evaluation?

A No, it's not.

Q If it's not, I would appreciate your explanation.

A No, it is not. The dose which is obtained from a blood analysis is a measurement, is a way of measuring, if you will, the dose received by the net blood volume of the body. And so it's a measure which might or might not represent the whole or a part. In this particular case, a portion, if you went through all the, a portion of the blood volume was radiated. And that portion when then

homogenized, if you will because the blood continues to circulate, would be interpreted with a certain value. That does not mean it should be interpreted as being the direct indication of the localized exposure which actually caused the radiation.

Q Do you feel that your explanation explains why there is no technical inconsistency between the 34 REM NRC dose estimate and the Oak Ridge blood test results?

A I don't believe there is any inconsistency at all between those two pieces of data under this situation.

Q I'd ask you one final question. What would be, what is, your best estimate of the dose received by Mr. Chastain under the regulations in this situation?

A The value I would use would be the best estimate that was obtained from Mr. West's analysis, which was 34., and I'm not sure I have all the decimal points in my head right now, REM.

Q Dr. Cool, we have concluded our direct examination of you, and I do appreciate your courtesy. You've come from Washington, you've got a busy schedule from, going from Vienna to Chicago might be a come down, but we appreciate your doing so, and I would like to make it, for the record, known that Cindy Jones from his office was sitting beside me is the technical expert who has been an enormous help in this whole process for us. We have no

further questions, thank you.

CHAIRMAN BECHHOEFER: Why don't you go next, and then you can --

RECROSS EXAMINATION

BY MR. BROOKS:

Q Sure, just a couple of questions. Dr. Cool, is it appropriate to use that 34 REM dose that you said was the best estimate of dose to Mr. Chastain, is it appropriate to compare that to the known risks of stochastic effects from the result of uniform whole body doses?

A Could you repeat the question, Mr. Brooks?

Q Sure. As a matter of fact, let me back up one step. Can you remember when I was giving you my right lung example? And I said is it, would it be appropriate to compare by 8 REMS to my lung, or to you to predict the risk of stochastic effects resulting from that irradiation to my right lung, based on data or figures resulting from whole body uniform exposures? Without the use of weighting factors?

A And I believe I answered before, and my answer would continue to be that that 8 REM dose delivered to that organ, in your particular example the lung, would be used quite well with the data available on the potential for effects in the lung. Likewise by analogy, a dose to the

thigh, if you want to be in the mode of comparing potential health effects, ought to be compared to whatever data may be available on stochastic effects following the irradiation of the thigh. Now certainly part of the blood forming organ is in the major bone, which is right in that region. Beyond that, quite frankly, it has absolutely nothing to do with whether or not that value is within or outside of compliance with the dose limit in part 20. You are talking about things which are vastly different.

Q You're saying that predicting risk of health effects is something that is different from, and outside the scope of, the limits expressed in part 20? Is that what you're saying?

A The dose limits are not intended as a representation of health effects. The dose limits are one of the mechanisms in the regulations for establishing control of licensee programs.

Q So is it your testimony, then, that the dose limitations expressed in part 20 are not intended to have anything to do with the risk of stochastic effects to the individuals being monitored?

MR. BARTH: This, we object, Your Honor, this mis-characterizes his testimony which has been quite clear.

JUDGE KELBER: I'm sorry, but I don't, I don't understand what you're referring to.

MR. BROOKS: Let me try again, then. All I'm trying to understand is whether our system of dose limitations expressed in part 20 is intended to, or not intended to, have any relationship to the risk of stochastic effects to the individuals who come within those regulations.

THE WITNESS: The dose limits are intended to be a measure of whether the licensee is or is not conducting an adequate radiation protection program. Given that every single human individual reacts differently to any dose, irrespective of whether it's internal, external, ionizing or not ionizing, it can never be a definitive predictor of the health effect that you might get to that individual. The limit simply can't serve that purpose.

MR. BROOKS: So is your testimony, then, that these, this system of dose regulation in part 20 dose not, and is not intended to, have any relation to risk of stochastic effect?

MR. BARTH: That's not what he said, Your Honor. This is again the mis-characterization. If you've got your record of what Dr. Cool stated, we could probably just go with that rather than keep on rephrasing it and mis-phrasing it.

JUDGE KELBER: Perhaps I could try and resolve this.

MR. BROOKS: Okay.

JUDGE KELBER: Is it your view, your professional view, that the weighting factors are derived from consideration of the stochastic, risk of stochastic effects?

THE WITNESS: Yes.

JUDGE KELBER: That the limits placed by the NRC have no necessary relationship to whatever risk of stochastic effects might or might not exist?

THE WITNESS: That's also true, Sir.

JUDGE KELBER: Does that clear up the matter?

MR. BROOKS: Thank you. Dr. Kelber, when I was at --

JUDGE KELBER: No, that one is Cool.

MR. BROOKS: I'm sorry, Doctor.

JUDGE KELBER: You wouldn't dare.

MR. BARTH: You're absolutely right.

BY MR. BROOKS:

Q Dr. Cool, this morning when you and I were talking, you said that if we're outside the regulatory process, and seeking only to understand the risk, the biological impact of the dose to Mr. Chastain, it would help us to use extra dose weighting factors. Correct?

A What I indicated was that it would be useful to use whatever factors or information would allow you to

refine your understanding of the situation, and whether or not those particular factors are the right or wrong factors, is for me not necessarily critical. If I wanted to truly understand the implications there, I will go beyond the factors that I think you were trying to suggest, but that's not in the context of evaluating whether or not the program and the situation was in compliance with the regulations. And it's not a matter of whether or not the NSI standard is or is not in effect, and in fact an accident situation, the standard doesn't apply to an accident situation. However, pieces of methodology might always be used by someone totally separate and outside of any particular evaluation for whatever purpose it is, and why I have to keep coming back to, quite frankly is, what is the purpose of the evaluation? Because I, my understanding of your purpose, while a valid purpose is very different from another purpose which is understanding whether or not a proper radiation protection program, proper controls and proper licensee actions were being accomplished. I'm sorry, I happen to feel fairly strongly about that.

Q And supposing that the weighting factors found in 13.41 would assist us in understanding the risk of stochastic effects, does it make them any more or less useful for that purpose if we characterize what happened to

Mr. Chastain as an accident or as a routine occupational activity?

A I'm sorry, I'm not quite sure what question you're actually asking.

Q Fine. I think you testified this morning that the weighting factors in NSI 13.41 would be of assistance to us in determining the risk of stochastic effects to Mr. Chastain, if that was our goal. Correct?

A If your goal is solely to understand the implications of radiation received by Mr. Chastain, then those factors and any other factors, if that allows you to understand the situation better, could be useful.

Q My question, you said they would be useful. I'm not saying they're most useful, but would be useful, correct?

CHAIRMAN BECHHOEFER: He said could, I think.

THE WITNESS: Mr. Brooks, I don't know what word I used this morning.

MR. BROOKS: Okay.

THE WITNESS: My memory is not that good, I believe it's something I, technician 99M, every six hours half of it's gone and it's, so it's close to gone at this point.

BY MR. BROOKS:

Q Fair enough. Does characterizing what happened

to Mr. Chastain as either an accident or as a routine occupational activity, make those weighting factors more or less useful for the purposes of determining the risk of stochastic effects to Mr. Chastain?

A Those factors, as part of a methodology, are what they are. In this particular case, you want to apply a set of information you generated after the fact to learn more about that particular situation. So be it. It doesn't change the fact that it's inappropriate in terms of assessing whether or not that situation was or was not within the system of boundaries as provided by part 20.

Q Did I understand your answer to be that how we characterize the incident doesn't change the utility of the methodology?

A That's correct.

Q Thank you. No further questions.

JUDGE KELBER: Before you, I must say, you've been very helpful as has Mr. Lieberman before you. I assume that the two of you often times work very closely together.

THE WITNESS: Yes, not necessarily in perfect harmony, we have some wonderful dialogues, I can tell you.

JUDGE KELBER: I have been with the NRC for many years, I understand the notion of harmony. I'd like to direct your attention to the order imposing -- penalty,

which is exhibit something or another, Exhibit 19. And specifically to appendix A, page 4, the top paragraph. If you could read that first sentence, which starts, based on the findings, you would notice that it says, the radiographer of the NRC concluded that the radiographer received a TETE of 6 REM.

THE WITNESS: Yes.

DR. KELBER: Is this consistent with the earlier usage that you made of 34 REM?

THE WITNESS: It is because in the end, what the NRC has used as its final point, is another one of the data points within the best estimate, the set of estimates, not the, the set of estimates provided by Mr. West.

DR. KELBER: You perhaps were not here when he represented in testimony in response to a question from Dr. Cole, that the estimates were, best estimate, least, great, upper bound, lower bound, etc., based on his engineering judgement, he did not do a regression analysis.

THE WITNESS: Okay.

DR. KELBER: Are you, do you still view those as statistical, as estimates with some statistical value?

THE WITNESS: Your Honor, I'm not sure I'm in a position to be able to understand exactly the levels of statistical significance that Mr. West may have applied to each of his estimates. He did go through what I thought

was a reasonable and appropriate analysis in trying to find the range of values. And the final number in this notice is in fact consistent with the approach that the agency has taken on a number of occasions where the best science is in fact not to give you a number, but in the end because you must give a number, the agency has on a number of occasions that I'm aware of, selected the lower end of that range in terms of the final document, or the final number, that it would suggest be placed into things like the official agency record.

JUDGE KELBER: All right. I suspect that we will not be able to revisit that issue later on. One other question which I think you may have answered to my complete satisfaction but, you may want, maybe you could amplify a little bit. I noticed in the, under starting under paragraph two, the licensee's use of ICRP 26, etc., you say the, no specific recommendations were included concerning the use of weighting factors for external dose because there are practical problems with such use. To what extent has NCN 13.41 resolved those practical problems, in your professional opinion?

THE WITNESS: Well Sir, what I would actually suggest is, it hasn't solved any of the problems, but it has suggested a methodology which, if the licensee were on a now priority basis to apply that --

DR. KELBER: I'm not talking about the licensees, I'm just talking about dose estimation.

THE WITNESS: Well --

DR. KELBER: Committed dose. In other words, I'm asking you as a radiobiologist, if you have a problem, do you think that NCN 13.41 would help you to resolve that problem in a practical way?

THE WITNESS: Within the context and scope of that standard, it serves as at least one possibility for how you might proceed, and that scope is very limited. Our priority planning, the obtaining of information, the understanding of the field, not to a retrospective what happened now that the dust has settled.

DR. KELBER: Well, I was talking about the methodology of assessing a dose, I'm not talking about licensing actions and such. I'm just trying to get a better understanding of your view, and I think I understand it, and I also was wanting to know about practical difficulties met, and I appreciate your work. Thank you very much.

THE WITNESS: You're welcome.

CHAIRMAN BECHHOEFER: The Board has no further questions, do you?

MR. BARTH: The Staff has no further questions, Your Honor.

MR. BROOKS: Dr. Cool, I just wanted to express again my thanks for your time and your patience.

CHAIRMAN BECHHOEFER: We appreciate your testimony and thank you very much.

THE WITNESS: You're welcome.

CHAIRMAN BECHHOEFER: You're excused.

THE WITNESS: Thank you.

CHAIRMAN BECHHOEFER: Mr. Brooks, have you prepared your first witness?

MR. BROOKS: You bet.

CHAIRMAN BECHHOEFER: Okay.

MR. BROOKS: One thing before we proceed. Mr. Barth and I have discussed the admissibility of an exhibit that had not been referred to but, I believe if we could stipulate to its admissibility and I just thought maybe we could take care of that now, which would be Exhibit 38, which is just the Staff's response to our discovery requests.

MR. BARTH: Staff has no objection, Your Honor.

CHAIRMAN BECHHOEFER: We will not object to Exhibit 38 being admitted.

[Exhibit 38 was received into evidence.]

MR. BARTH: Along the same vein, Your Honor, I'd like to rule into evidence, Exhibit Number 23.

MR. DAMBLY: As I understood this morning, Mr. Morrill will not be here to testify, this was his affidavit, or admission that he took the photographs that are 21 and 22, and they show what everybody has said they show.

MR. BROOKS: You're going to supply those.

CHAIRMAN BECHHOEFER: We haven't got that yet.

MR. DAMBLY: It's done, it's in the pipeline.

CHAIRMAN BECHHOEFER: Oh, okay.

MR. BROOKS: With respect to Exhibit 23, Your Honor, we've got no objection. And in a sense, this is a substitute for the testimony of Mr. Morrill, who in large part was here to say that he took the pictures.

JUDGE KELBER: Okay.

MR. BROOKS: Okay?

CHAIRMAN BECHHOEFER: Okay.

MR. BROOKS: There. There's a half a day. Thank you, Sir.

CHAIRMAN BECHHOEFER: If the Staff is without objection, Exhibit 23 will be admitted.

[Exhibit 23 was received into evidence.]

MR. BROOKS: We are ready to go?

CHAIRMAN BECHHOEFER: Yes.

MR. BROOKS: Okay. We would like to call Robert

Slack as our first witness, for his second tour of duty.

CHAIRMAN BECHHOEFER: Mr. Slack, you're still under oath.

ROBERT SLACK,

a witness, having been previously duly sworn, resumed the stand and testified as follows:

MR. SLACK: Yes, Sir. Thank you.

MR. BROOKS: You guys --

MR. DAMBLY: I'm ready.

MR. BROOKS: You're the man?

MR. DAMBLY: So they say.

MR. BROOKS: I believe it.

DIRECT EXAMINATION

BY MR. BROOKS:

Q Mr. Slack, you testified a little bit on your direct examination with, in part one of our case about Conam and your background, but would you please take a minute and just tell the Board what business Conam is in generally?

A Conam Inspection performs non destructive testing. For the purposes of this case, we're talking radiography.

Q Does Conam perform other forms of non destructive testing?

A Conam also performs ultrasonics, magnetic

particle testing, liquid penetrant --, current, things like that.

Q In what locations does Conam do non destructive testing, including radiography?

A Conam operates throughout the, the country and actually the nation. We are in Hawaii, California with offices, Colorado, Texas, Illinois, Indiana, Columbus, Ohio; Philadelphia, Boston, Mass.

Q How many employees does Conam have?

A Approximately seven hundred.

Q How many employees at Conam are involved in doing radiography?

A Between two and three hundred.

Q For what purposes does Conam do radiography? What are the functions of it?

A The results of radiography verify the integrity of a part or an item without destroying it.

Q And give some, a couple of examples of types of things that would be radiographed, other than the welds that we already know of.

A We work on nuclear power stations, we would radiograph wel-, or sorry, valves for their integrity, concrete to find locations of re-bar and anything that you don't want to take apart to find out if it's good, that's what we radiograph.

Q Who, at Conam, is in charge of radiation safety?

A I am.

Q And what is your position at Conam?

A I'm the Radiation Safety Officer for Conam.

Q How long have you been in that position?

A That particular position, since 1989.

Q Now, as of February, 1996, can you describe generally what Conam did to assure the radiographer knew how to properly and safely operate cameras? Radiographic cameras?

A We do a number of things. Initially, when we hire a person, we test them for radiation safety, we test them for other things, but we test them primarily for radiation safety, in this case do what is called a field examination, which is basically a practical, show me if you know how to use the camera, if you know how to safely use the monitoring equipment.

Q And how does that field exam process work? Who conducts that process?

A Generally, the Radiation Safety Administrator for personnel, be it a radiation safety manager at a Bedecia, California operation, or a radiation safety officer in a Houston, Texas location. But individuals that have had radiation safety training and meet the criteria of our radiation safety administrative manual, which is approved

by reference in our license.

Q How many people at Conam are approved as part of the radiation safety administrative program, at the administrator or radiation safety officer level?

A I don't have an exact number, but if I envision a page, I would say at a minimum, twenty.

Q Now is there a checklist you use for the initial field exam that you reference for radiographers who may begin at Conam?

A Yes, there is.

Q Okay. And what types of items are on that checklist?

A It is a checklist that starts off from setting up the camera, verifying that there's dosimetry, verifying that surveys are done properly, that the camera is operated properly both positioning the source and retracting the source. It is a, a point system that you would check off and it is listed in, I was going to say part 20 but I don't know if it's part 20 or part 34 requires that a field exam be done and documented.

Q Could I direct your attention in the Exhibit book to Exhibit 9, please.

MR. DAMBLY: Exhibit what?

MR. BROOKS: Nine.

MR. DAMBLY: Thank you.

BY MR. BROOKS:

Q Mr. Slack, can you identify what I've been given you has been marked as Exhibit 9?

A As indicated in the lower right hand corner of page 4, this comes out of Conam inspections RSAM, which is a radiation safety administrative manual. And it is personnel training and qualification requirements.

Q Does this document set forth the training that Conam provided to radiographers as of February, 1996?

A Yes.

Q Did Mr. Chastain go through the initial field examination procedure that you have identified?

A Yes, he did.

Q Did that procedure include instruction and training on how to manually lock the camera?

A That particular procedure documents how he did it, it does, it doesn't train him how to do it. It documents that he did it.

Q Now, after the initial field exam, are there other forms of monitoring that are done of Conam radiographers?

A Conam performs periodic audits on their radiographers on a quarterly basis, that basically is the same process as a field exam, same points are checked so we make sure he does it the first time and then as we go out

and check, we make sure that he's doing it continually.

Q Who conducts those quarterly audits?

A Again, the radiation safety and administrative personnel for Conam.

Q And where are those quarterly audits conducted?

A Quarterly audits are conducted either at a permanent radiographic facility, or at a field site.

Q When you say a field site, what does that mean?

A Well, if we differentiate the two, a permanent radiographic facility is a defined item in the records that says you have to have a, a facility that has shielding, that has permanent alarms and it has locking ability and is in a building and you only shoot in that particular vault, is what we call it. The entire other area would be temporary job sites, which we would go to a customer site and set up, if we were to go to a refinery or to a nuclear power station, we would set up a radiation area using signs and cable to prohibit the access to the temporary job site.

Q Are the radiographers of Conam given any procedures or instructions on how to carry out their radiography in a safe manner?

A Conam supplies to all its radiographic personnel the state and federal regulations, the NRC or state license and its emergency and operating procedures.

Q What's an O & E manual?

A The same, emergency and operating procedures, actually, operating and emergency procedures.

Q Okay.

A I'm being dyslexic.

Q Is there anything in the O & E manual with respect to proper operation of a camera?

A There are instructions as to how to manipulate the camera, or the source and the camera, how to crank the source out, how to lock the camera, yes.

Q Does Conam do anything to make sure that its employees have read and understood the O & E manual?

A With the O & E manual, the other documents I mentioned, we supply those and instructions to the radiographers initially the same time as we do the field exam, we have them sign a sheet that they have received, read and understand the documents that they've received.

Q In terms of the equipment used for radiography, what does Conam do to make sure that the equipment used can be operated safely, or is operated properly as apart from what the radiographers are doing?

A You'll have to re-ask that.

Q I'm sorry. Do you inspect your equipment?

A Yes, Sir.

Q In what ways?

A We do a quarterly maintenance of the equipment,

we do a daily inspection of equipment.

Q What equipment do you inspect?

A We inspect, our radiography equipment is looked at as being a system. We have the cranking method as the camera, the guide to, and we call that a system, so we would inspect the system to make sure that it's operating properly, that the positioning cable end hasn't frayed and ready to break off, as unfortunately some of them have there recently, not ours but industry. We check the guide tube to make sure there is no denting so that the source will travel freely, we check the camera itself to make sure the locking mechanism and all the mechanical portions of it are operating, that the source connects properly to the cable, to the positioning cable, pretty much a general, overall review of the moving and mechanical parts of the system.

JUDGE COLE: Mr. Slack, how often do you do that?

THE WITNESS: We do it on two bases. We do it daily.

JUDGE COLE: Daily?

THE WITNESS: Yes. Radiography, it's like anything else, shooting a gun or driving a car. I know you don't maintenance a car daily but, you check it daily. And the things we that we know have failed and caused problems, we have instructed our people to look at, like I mentioned

the sledged tip on the cable that positions the source. Here recently there have been, I believe, four disconnects throughout the industry. And if --

MR. DAMBLY: I'm sorry, could you keep your voice up a little bit while that truck's going outside? It's, I know you have a very soft spoken voice and it's so hard to hear you.

THE WITNESS: The cable has become frayed, so we instruct our people to check that, so they check that on a daily basis.

JUDGE COLE: Just exactly how do they check that?

THE WITNESS: Both visually and then what they do is they hook it up to the source and if you need an explanation now, I can show you or I can describe it to you.

JUDGE COLE: Well it seems to me that a visual examination of a connection of a source, that could be a dangerous operation unless you do it a certain way, and if you do this on a daily basis for every piece of machinery you have, it seems to me you would need some different kinds of equipment that you might not have.

THE WITNESS: For inspection purposes of the NRC? Not really. Industry, we follow manufacturers' regulations or instructions, and what I was getting to about checking the other check other than visual, is that a number of

years ago, it was dictated and I don't know if it was through regulation or a suggestion by the NRC but, you hook up to the source and then you pull on the cable, make sure you, that can't be pulled apart before you put the shielded guide over. So they do both. They look at it and they, they do a pull test.

MR. BROOKS: Mr. Slack, I think what Dr. Cole might be getting at, in part was, is, if you're doing a daily inspection, is there exposure to radiation involved in performing that inspection?

THE WITNESS: Is that it?

JUDGE COLE: Well, yes, that would be my concern.

THE WITNESS: No. No, there is not. There's, if this was hundred curies source in this camera right now, and the port end had the plug in it, the check that is done that I described is no more unsafe condition than just taking the back end of the selector off, which is the normal function to hook up the source. There, the radiation level is, I believe, Amersham's statement was, it meets the regulations.

JUDGE COLE: Yes, I guess I should have known that they put these things together -- okay.

BY MR. BROOKS:

Q Mr. Slack, what does ALARA mean?

A ALARA is a concept throughout radiography and I'm

sure throughout all of the industries that utilize radio isotopes, if he says low as, I'm sorry, as low as reasonably achievable. And the thought is, what you do and when you do it and how you do it needs to be in a manner that would best prohibit you from receiving unwanted doses, not that you want any but, it's a fact that through our operation we do get dose, it's a simple fact.

Q As I understand it, as of February, 1996, Conam had an office in Gary, Indiana?

A Yes, Sir.

Q What kind of an office did Gary have, or did Conam have in Gary, Indiana?

A Gary had a -- Gary had a facility that had a shooting vault and also dispensed the radiographers into temporary job sites.

Q As of February, 1996, how many radiographers were working out of or from that Gary office?

A I would approximate twenty individuals.

Q Now what was the status of the Gary office as of February, 1996?

A Status.

Q Were you going to keep it open?

A We were at a point of transition, we had expected to consolidate the Gary lab, Gary, Indiana with a western suburb, Itasca, Illinois where we had another permanent

facility.

Q What was going to happen to that Gary office?

A It was going to be, for all intents and purposes, shut down.

Q Shut down?

A Yes.

Q What was going to happen to the radiographers working out of the Gary office?

A There were two directions, there were some radiographers that were located on Mobile, Amoco, Citco type of refining sites where they, they always went to work, so they didn't have to go to Gary. The other individuals would then be transferred to Itasca, Illinois.

Q When was that decision announced?

A I, I can't be specific but, around that time frame.

Q Prior to --

JUDGE COLE: What time frame is that?

THE WITNESS: February 1, February 2 of '96.

JUDGE COLE: '96?

THE WITNESS: '96, yeah, I don't know.

BY MR. BROOKS:

Q How did that announcement that you were closing the Gary office go over with the radiographers working out of that office?

A Those radiographers that were required, I guess I shouldn't say required, they were given the choice to come to Itasca, the majority of them were disgruntled or disenchanted about that.

Q What happened to most of the radiographers that were working out of your Gary office?

A Between February and October, the majority of radiographers or radiographic personnel terminated.

Q Meaning you fired them, or meaning they quit?

A Meaning, of their own volition, they terminated.

Q Meaning they quit?

A Yes, Sir.

Q How about Bill Chastain. What happened to him?

A I believe Bill quite in October of 1996.

Q And let me ask you about Mr. Chastain's work during the month of February 1996. Are you familiar with where Mr. Chastain was working during that month?

A During February of '96, Bill Chastain was scheduled to work and did work in Indianapolis, Indiana at the Eli Lilly Corporation for one of our customers, Freitag-Weinhart.

Q During what part of the month was Mr. Chastain performing work at Eli Lilly?

A The majority of the month, actually I believe he was out there for six weeks, some time in January, maybe

eight weeks, some time in January to, into February.

Q He started that job in January?

A Yes, I believe so. I don't know if he started it, I know he was working there, it may have even been prior to that.

Q And was he working at that Eli Lilly facility continuously throughout the month of February, 1996?

A Yes he was.

Q Approximately what hours was he working?

A Bill worked from 3:00 P.M. to 3:00 A.M.

Q How many days a week?

A I believe it was five, I think it was bumped up to six.

Q Wholly apart from the incident on February 27th, based on your experience, what would you have expected his film badge to show for the month of February through February 26th?

A Approximately one hundred to a hundred and fifty MR.

Q Now, we've talked a great deal about where the source was in his camera, and did you hear Mr. Chastain testify at the hearing here that he cranked it, was able to crank it in after the episode between a third and a quarter of a turn?

A Yes, I did.

Q And what did he tell you on February 28th about that when you interviewed him?

A Bill said he cranked, he cranked the source back in approximately one third to one half turn.

Q Had you attempted to determine where a third or half turn would put the source within the camera?

A Yes, I did.

Q Okay. How did you do that?

A Basically by taking the crank, determining a hundred and twenty degree angle and a hundred and eighty degree angle and cranking it out. It came out to be about, oh, inch and a quarter from the front to two and --

Q An inch and a quarter for what?

A I'm sorry, for a half turn from the front plate of the exit port end of the camera back into the shielded position approximately one and a quarter inches.

Q That's for a half turn?

A Yes.

Q How about for a quarter turn?

A I did not do a quarter turn.

Q I'm sorry. How about for a third of a turn?

A Third of a turn, approximately two and a half, two and three quarter inches from the same face plate.

Q In the front plate of the camera?

A Of the exit port, yes.

Q Now based on what Mr. Chastain told you on February 28th, do you have any reason to believe that he willfully failed to lock the camera?

A No, Sir.

Q Why not?

A When I talked with Bill and asked him to perform his reenactment for me on the 28th, Bill said that he, at the end of his, or the end of his description, said he reached back over to unlock the camera. Bill had been shooting at least all of February performing the same functions, he's testified that he, he did fifteen -- I shouldn't say testified, I'm sorry. He had indicated he did approximately fifteen welds prior to that, each one was done, surveys were done and we was operating by rote, so I, if he were to say to me, he reached back to unlock the camera, it also would have meant to me he was following the procedures and had locked the camera.

Q Now we know that he didn't lock the camera, is that right? Or did we just believe that he didn't lock the camera?

A We know that the camera was not fully locked.

Q How do we know that?

A By his description and that the slide bar was in a particular position that physically would not allow it to be.

Q Mr. Slack, and especially with this noise, you're going to have to speak up and point your voice toward the Board, as loud as you can. Unless we send out a hit squad to deal with the noise. Mr. Slack, following the incidents involving Mr. Chastain, what corrective action did you or Conam take?

A Initially, Bill was removed from radiography, he was suspended for his actions two weeks without pay, he needed to receive additional outside radiation safety training, and then he was instructed to perform a safety "seminar" for lack of a better word, for the radiographers.

Q He was required to do what for the radiographers?

A Basically instruct them as to what happened, why it had happened and what you should do to not have it happen.

Q Including instructions on locking the camera?

A --

Q Well you said he was re-trained. Who re-trained Mr. Chastain?

A I can't address that, I don't know.

Q Did you issue any memoranda to radiographers or to your radiographic managers?

A On February 29, I issued a directive to the radiation and safety administrative personnel, the managers, the supervisors of the occurrence and gave them

an explanation, indicated to them that henceforth, we would operate basically in compliance with our written instructions and our O & E manual, that this was their responsibility and it was their responsibility to tell the radiographers it is the radiographer's responsibility and that if occurrences like this were to again come up, that the individuals would be subject to disciplinary action up to and including termination.

Q Would you turn to Exhibit 8, which is already admitted, and I hope might be in the book. Is that the memo that you were referring to?

A Yes, Sir.

Q Who did you send this memo to?

A The individuals that are checked off on the distribution sheet on the page 2 of the responsible personnel at various locations and are the radiation safety administrative personnel.

Q Those individuals are your various radiation safety management team?

A Yes, Sir.

Q Now did you do anything to cause this memorandum and this information to be communicated to the radiographers themselves?

A Other than instructing management to do this, we sent out envelope messages in the paychecks, we sent out

not only radiation safety information but general safety information, any regulatory information, not only NRC but OSHA and EPA.

Q If you'd look at the second page of Exhibit 7, please. Are you there?

A Yes, Sir.

Q You see where it says, please apprise all radiographic --

MR. BARTH: I'm sorry, you said 7? That's 8.

MR. BROOKS: Oh I'm sorry, 8. Sorry. Exhibit 8, second page, the last text. Would you read that, please, where it says please apprise?

THE WITNESS: Please apprise all radiographic personnel of these instructions as they will be held accountable for compliance.

BY MR. BROOKS:

Q That was a direction to your radiation safety managers to talk about this memo, or to distribute this memo, to all radiographic personnel?

A Yes, Sir.

Q Did you do anything to make sure that that happened?

A Yes, I contacted the individuals on the list and asked them to verify in writing for me that they have done this.

Q And did you get verification?

A I did.

Q In what form?

A In a form of signatures from the managers and the individuals.

Q Did you do anything with respect to your audit process or to, did you give any instructions to your auditors following this incident?

A First off, these are some of my auditors. Following the incident, these individuals and others not listed on the distribution on page 2 of the exhibit were instructed to give added attention to the function of the radiographer for locking, or I'm, stop, for rotating the selector on the back of the camera and locking the camera after every exposure. And they were told that they could indicate that, since it wasn't on the form, indicate it in the comments section of the, of the form.

Q Now Mr. Lieberman made a few comments yesterday about your corrective action, and I'd just like to ask you a few questions to follow up on that. Is it possible for Conam to do surprise audits?

A Say it again, please.

Q Is it possible for Conam to do surprise audits?

A Yes, it is.

Q Does Conam do surprise audits?

A Yes, they do.

Q Is it possible for Conam to test on multiple exposures?

A Yes, it is.

Q Does Conam test on multiple exposures?

A By test, you mean observe?

Q Yes.

A Yes, they do.

Q Where, when you're auditing your radiographers, is it that Conam does tests for multiple exposures?

A I would say for the most part, it's on the temporary job sites that have been set up at power stations or petroleum plants. Customer sites.

Q Do you generally do multiple exposure tests in, tests your own labs?

A No.

Q Why not?

A A number of reasons, but the main reason is that it does not follow ALARA.

Q It does not follow ALARA? What does that mean?

A If we were to continually set up, or if we were to continually set up radiographic operations and have individuals crank out the source where they would not normally be doing that, I, that would not meet the ALARA principle.

JUDGE COLE: Would that be unnecessary exposure?

THE WITNESS: Yes, Sir.

JUDGE COLE: --

THE WITNESS: Possibility of unnecessary exposure, yes.

JUDGE COLE: Would ALARA be a valid excuse, even for not doing an audit or not performing a test, just because doing so would cause somewhat more radiation?

THE WITNESS: We couldn't achieve anything if we didn't do our tests, so we would have to do our tests. But we try to keep it as low as reasonably achievable.

JUDGE COLE: Yet consistent with audit requirements?

THE WITNESS: Yes, Sir.

CHAIRMAN BECHHOEFER: Yes. They would not do an audit in the lab, in their own labs, if I understand it right, be a test of sorts and perhaps they wouldn't keep it as low as reasonably achievable absent of auditor, but would it not still comply with the ALARA requirements if you are supposed to do a test there? That troubles me a little bit, the potential inconsistency there.

THE WITNESS: Let me explain why we do it in the lab. Well first of all, we do conduct business in the lab. We, at the permanent facility, so we could stand there and watch a radiographer perform his radiography on a multiple

basis. Yes, we could if he was continually performing it. Primarily, we perform always at a permanent facility, we perform the audits at a permanent facility to assist in not, not having to go -- let me rephrase that. Because there are so many radiographers and so many jobs, and the schedules are so divergent, if Joe comes in the shop and he's due for an audit in three days, and the manager knows he's going to send this gentleman out for a four week stint in the field and he's never going to see him, he says, I have to do an audit on this fellow before I let him go, otherwise I have to drive 85 miles to watch him operate a radiographic operation and we would watch him do what he does. Now, I, whether or not that meets ALARA, I believe it does because it's, at least at the Glendale Heights facility, the four feet of concrete for our shooting vaults, but if we did not do that, and the gentleman was unable to be audited, then we'd be in violation. So this has us stay in violation, or I'm sorry, has us stay in accordance with the regulations.

JUDGE KELBER: Mr. Slack, I'd like to tear away from the audit for just a minute. I'm still looking, we're still on page 2 of the Exhibit 8. I note that you're a -- advice to your, or command, I should say, to your radiation safety administrators. You say, after completing each exposure, a full and accurate survey of the

calumniator guide to camera exit port, a complete -- of the camera will be performed. Was this instruction included in the basic training or in the O & E manual for the, this camera? Or is this a new instruction?

THE WITNESS: I don't believe I have indicated anywhere else other than here the exit port statement.

JUDGE KELBER: Okay. So, prior to issuance of this memo, exit port was not mentioned?

THE WITNESS: I do not believe so.

JUDGE KELBER: Okay. Thank you.

CHAIRMAN BECHHOEFER: Mr. Brooks?

BY MR. BROOKS:

Q Did you add exit port here and specify it because of the Chastain incident?

A Yes, I did. It's emphasized, basically.

Q Just to follow up on what Mr. Bechhoefer was asking, is there any form of required audit or safety procedure that you failed to perform because of ALARA?

A No, Sir.

Q You do everything that you're required to do?

A Yes, Sir.

Q But in the course of doing it, you're just saying that you limit the amount of radiation, or try to limit to amount of radiation your radiographers receive?

A Multiple, viewing multiple operations of the

camera during an audit over fulfill compliance to the regulations. So by viewing one, not that we only do it because it's one, but by viewing one operation of the camera, that is compliant with the regulations.

Q Could we take just a short break at this point in the day, and then I probably only have another fifteen minutes with Mr. Slack?

JUDGE COLE: How much time do you need?

CHAIRMAN BECHHOEFER: How much time you want?

MR. BROOKS: Oh, maybe just a five minute break?

CHAIRMAN BECHHOEFER: Okay.

[Whereupon a short recess was had.]

CHAIRMAN BECHHOEFER: Back on the record.

MR. BROOKS: Fine. Thank you.

BY MR. BROOKS:

Q Mr. Slack, I would like you to turn in our exhibit book, if you would, to Exhibit 32. For the record, Exhibit 32 is a letter to Robert Slack dated April 4, 1996. Mr. Slack, can you identify specifically what that document is?

A This is a reply from Radiation Detection Company, who was our film badge processor, on a film badge dosimeter report for William Chastain.

Q Is this a document that you received shortly

following April 4, 1996?

A Shortly following what date?

Q April 4, 1996.

A Correct.

Q Had you made some request to which this document is a response?

A Yes, we did.

Q What request did you make?

A We requested that the film badge be reviewed to see if they can give us any additional data.

Q What kind of data were you looking for?

A We needed to know whether the exposures were uni-directional or multi-directional, what the filter pattern showed, if there was any kind of shielding to the badge, things like that.

Q Could I direct your attention to the second to the last paragraph beginning the film also appears. Do you see the reference to the approximately of the energy of Sesium 137?

A Yes, sir.

Q Was the source in Mr. Chastain's camera on February 27, 1996 Sesium 137?

A No, sir.

Q How do you -- can you explain this reference in Exhibit 32?

MR. DAMBLY: I would object to the question. I don't know how he's in any position to know what Mr. Souza was thinking when he wrote this. That's basically what the question is at this time, and I don't think he's competent to testify.

MR. BROOKS: I don't mean to ask what Mr. Souza was thinking. I'm only asking, I mean, I assume Mr. Souza's report in fact. I'm only asking whether Mr. Slack can account for that fact.

CHAIRMAN BECHHOEFER: I think we will overrule the objection. I think that's legitimate.

THE WITNESS: My presumption from the statement on here is that he's telling me what the source of the radiation was.

MR. DAMBLY: I'd move to strike that as non-responsive. I don't think that had anything to do with his question.

JUDGE KELBER: I think he's correct. I don't think that's responsive.

CHAIRMAN BECHHOEFER: That isn't responsive to what you asked.

BY MR. BROOKS:

Q No, I understand. We'll try again. I understand that he's saying that it has the appearance of the energy of Sesium 137, but given that to your knowledge the source

was Iridium 192, can you account for or explain that discrepancy?

A No, sir, I can't.

MR. BROOKS: I would move the admission of Exhibit 32.

MR. DAMBLY: I have no objection.

CHAIRMAN BECHHOEFER: Without objection, 32 is admitted.

[Exhibit 32 was received into evidence.]

BY MR. BROOKS:

Q Mr. Slack, remind me again what Mr. Chastain told you on February 28th when you asked him about how long he had been on the ladder? February 28, 1996.

A Mr. Chastain said he was on the ladder between one and four minutes.

Q Did you do a time study on February 28th?

A The only time that I approached with Bill was where were you in certain positions. I didn't clock it.

Q And when you saw the reenactment that was done at Conam on April 11, 1996, was there any timing of his various positions?

A Yes, there was.

Q On April 11, 1996?

A Oh, I'm sorry.

Q Was there on April 11, 1996?

A No, there was not.

Q Have you ever seen any time study done with respect to this event?

A Yes, I have.

Q Okay. Is that the time study shown on the videotape that the Board has seen?

A Correct.

Q Can you just explain briefly the circumstances that led up to the making of that videotape?

A Conam had had a number of scenarios posed to us as to where the radiographer was and what position he was in relevant to the camera and the ladder and the pipes. We were unaware of what time it would take. We had approximations from Mr. Chastain. So it was our intention to basically see how much time would it take under normal radiographic operations.

Q How did you go about doing that?

A We contacted Eli Lilly and asked them if we could use their facility. We told them what had happened and they were gracious enough to allow us about two hours in the building. They shut down their lines. I believe it was a vacuum pump room and if you think this is loud, that was screaming.

Anyway, they shut it down so we knew we had their

systems down and we took the full two hours to go through our processes of determining where the pipe was or approximate pipes, reviewing some of the photos in the exhibits as to the location of the ladder, tried to recreate it, tried to recreate the entire situation as described.

Primarily we were interested in how much time it took and, you know, what was the location of the fanny pack, things like that. How did that ring true.

Q Who directed that reenactment?

A Carol Berger, who is a consultant for us with IEM, and myself conducted it.

Q Was Carol Berger present for that?

A That is correct.

Q Who else was present besides yourself and Carol Berger?

A Conam's counsel, Chip Brooks, and Cliff Lake and Steve Fay. Steve Fay is the employee of Conam.

Q Were there other individuals present beyond that group during the time of the reenactment?

A Myself and then there were, I think, three or four Eli Lilly employees from their RSO to the local safety representative.

Q What function was filled by Steve Fay at the reenactment?

A Because of Steve's prior ability to perform in radiography and because of his knowledge of working in areas like this, we asked him to be the radiographer.

MR. BROOKS: For the record, Steve Fay is now sitting next to me at the table here.

MR. DAMBLY: Star of stage and screen?

MR. BROOKS: And the video is already in evidence, right?

JUDGE KELBER: Correct.

MR. BROOKS: So we don't need to go into that.

BY MR. BROOKS:

Q Mr. Slack, in this case there is an order imposing a civil penalty in the amount of $16,000, right?

A Yes, sir.

Q Why is Conam fighting that? Why are we here?

A Conam is not fighting the fine. Basically we're here to verify that we told the truth in our decision making, that 4.6 on a film badge based on what Conam was told in its reenactment is the dose that we should be using. Whether or not 1201C and any calculations are needed or exist, that particular regulation along with others were reviewed and, based on what Conam was told, based upon history, Conam took and still takes 4.6 to be the legal medium dose for Mr. Chastain's exposure. And when I say medium, I don't mean medium range. I mean film

medium.

Q When you say based on what Conam was told, what are you referring to?

A The February 28th reenactment by Mr. Chastain for myself.

Q Did you have to make a decision at that point about what the dose was?

A I didn't have to decide what the dose was. The actual dose to Mr. Chastain, what I did was make a determination based on an inverse square law as to what an individual could have received, what range was available, based on what the individual told me, and when we got the film badge back, based on what he told me, the figure of 4.11R seemed to be in the ballpark we expected it, and we took the film badge as the dose.

Q Why did you take the film badge instead of any of your calculations?

A Because the calculations are just guesses. It fit in the best guess, but they're just guesses. The film badge is a legal medium. It always has been.

Q I'm sorry. What did you say?

A The film badge, at least in the radiography industry, has always been the legal medium that we have always used for our doses. To my knowledge, we have never changed the dose based on a film badge dose.

Q Did you check whether you had any regulatory reporting obligations as a result of this incident?

A As I said earlier, yes, I reviewed the regulations and based on what we knew, I did not find that we had any reporting criteria.

Q Mr. Slack, at this point in the hearing we've heard about a lot of different calculations and theories and variables. Has any of that changed your mind in any way about what the right dose to conclude would have been on February 28th or 29th, 1996?

A You're right. There's a lot of it. And after a while you kind of stop listening. But no, I don't believe my mind has been changed that the 4.6 is the proper dose.

Q Is Conam opposing these violations at this proceeding because it doesn't want to pay the monetary penalty?

A No. Conam has paid out more money than those fines are a long time ago. Money is not a consideration.

Q What is the consideration?

A The consideration is that what Conam Inspection did and how it viewed the regulations and how it acted was correct. And basically that's it.

Q Would there be any impact on Conam were it to either admit to or be found to have had a Level 2 violation?

A Yes, there would.

Q What would that be?

A We're continually asked by our customers are you in compliance with OSHA? Do you have any OSHA violations, any fines, and the like. And the same in regards with the Nuclear Regulatory Commission. It's not just our nuclear customers that ask us this. It's everyone.

If we were to give up, our record, I believe, would have documented and have been documented improperly for the industry. I don't think we can afford that.

MR. BROOKS: Thanks very much.

JUDGE COLE: Mr. Slack, you've been working for almost ten years as a radiation safety officer at Conam, is that correct, sir?

THE WITNESS: Yes, sir.

JUDGE COLE: You have direct knowledge of the compliance history of the company, is that correct?

THE WITNESS: I do.

JUDGE COLE: Could you tell us about that?

THE WITNESS: Conam has an excellent safety program. Of course, that's not to say that we haven't had fines, as have other radiographic companies. We haven't had violations. Those have occurred. But for the most part, Conam's operations have always been directed to function in compliance with the regulations. I can't be

specific at this time if you wanted to know certain situations.

I'm knowledgeable of it, but I can't cite chapter and verse.

JUDGE COLE: From your experience as the radiation safety officer, can you recall any, and if any, how many, of your radiographers exceeded or attained close to, sufficiently close to the annual limit where they had to cease their functioning as a radiographer for a time period?

THE WITNESS: I'll give you two answers. The answer is, first a question, on a one-shot basis or a continual yearly accumulation or dose? Or it doesn't matter?

JUDGE COLE: Does this happen, and you're handling, at least right now, 200 to 300 radiographers?

THE WITNESS: Sure.

JUDGE COLE: Each one of which can come close enough to an annual limit where they have to stop where they're doing at the end of the year. How many of those do you get a year on the average, on a percentage basis or an actual number basis, if any?

THE WITNESS: Approaching?

JUDGE COLE: Approaching?

THE WITNESS: A number?

JUDGE COLE: Whatever number. Say five.

THE WITNESS: Okay. One since 1996.

JUDGE COLE: Okay. What about before '96?

THE WITNESS: Okay. Presuming it's always five and not twelve, because the regulations have changed.

JUDGE COLE: Whatever the limit was at that time. You know when the occurrences reached whatever limit.

THE WITNESS: Right. To my knowledge, none.

JUDGE COLE: None except Mr. Chastain?

THE WITNESS: Correct.

JUDGE COLE: And that's now in dispute, plus one. Now, you said since '96.

THE WITNESS: No. Mr. Chastain is one.

JUDGE COLE: Oh, he's the one?

THE WITNESS: Yes.

CHAIRMAN BECHHOEFER: Okay.

JUDGE COLE: All right. Thank you.

JUDGE KELBER: You said that you were unaware of any precedent for changing of the recorded dose received from that indicated by the film badge, correct?

THE WITNESS: That I utilized.

JUDGE KELBER: Pardon?

THE WITNESS: That I utilized.

JUDGE KELBER: That you utilized?

THE WITNESS: Yes.

JUDGE KELBER: Do you know of any instances within the industry where that has happened?

THE WITNESS: No, sir. I'm not aware of that.

JUDGE KELBER: Thank you. One further question. Did you or do you have plans to try and follow through with instituting the new ANSI standard as part of your routine or have you changed those plans on the basis of the statements made today?

THE WITNESS: Institute it as part of our routine. Can you explain?

JUDGE KELBER: Well, you have, as your job is radiation safety officer, the necessity to be prepared to do an analysis if there is an accident or an overexposure.

THE WITNESS: Yes, sir.

JUDGE KELBER: Your previous guidance has been in Part 20 at the table and Section 1003.

THE WITNESS: Correct.

JUDGE KELBER: And 12001C, I believe. Now, you have proposed to use in this instance a new set of weighting factors and compartment factors corresponding to an industrial standard, consensus standard.

THE WITNESS: Yes, sir.

JUDGE KELBER: Adopted by the American National Standards Institute.

THE WITNESS: Correct.

JUDGE KELBER: Have you any plans to propose to the NRC that in the event of an overexposure you be able to use these?

THE WITNESS: Through whatever procedure it is decided we will go forward to use the ICRP.

JUDGE KELBER: Your procedures decided by, how would that procedure get decided?

THE WITNESS: Well, number one, I don't know what the procedure is. I've had a lot of people tell me a lot of different things. So in the outcome, whatever the procedure is, whether it's through this panel, whether it's through a license amendment, however it is, we intend to go forward with it. We would like it as soon as we could get it, but we intend to go forward.

JUDGE KELBER: Thank you.

CHAIRMAN BECHHOEFER: Before we turn it over to the staff, just a couple of clarifications. Are you or were you the radiation safety officer at both Gary and your headquarters at the same time or how does that work?

THE WITNESS: It works differently for different operations. Yes, I was the corporate radiation safety officer for the NRC license. There was a radiation safety manager at Gary. Illinois, where our location is, has its own license. Texas has its own RSO. So, but generally, from the corporate standpoint, I am the radiation safety

officer for the company.

JUDGE KELBER: Please excuse me. There was another question that I see here that I had prepared. Has any officer at Conam, yourself or any other officer, discussed with NRC staff the problems of estimating the TEDE prior to the incident of February 27, 1996?

THE WITNESS: You're speaking of calculations?

JUDGE KELBER: Yes, the process of estimating TEDE?

THE WITNESS: Not to my knowledge.

JUDGE KELBER: Not to your knowledge. Okay.

CHAIRMAN BECHHOEFER: My last follow-up, and it may just be a nitpick. Do you know, talking about Exhibit 32, which you testified about, do you know whether the energy of Sesium 137, this is just offhand, not from reading a document or anything, is similar or comparable to that of Iridium 192?

THE WITNESS: I do know. It is not similar and it is not comparable.

CHAIRMAN BECHHOEFER: It is not similar?

THE WITNESS: Correct.

CHAIRMAN BECHHOEFER: Okay. Thank you. Mr. Dambly?

MR. DAMBLY: Thank you.

CROSS-EXAMINATION

BY MR. DAMBLY:

Q Mr. Slack, if I can turn your attention, first of all, to Exhibit 8, your February 29, '96 memorandum.

CHAIRMAN BECHHOEFER: Which?

MR. DAMBLY: Exhibit 8.

CHAIRMAN BECHHOEFER: Eight. Okay. I just didn't hear you.

BY MR. DAMBLY:

Q And on the front page, the, I guess, third paragraph, which would also seem to be the third sentence, stated, the survey to assure the source was in a secured position was performed now with full attention given to the reading coming from the exit port of the camera. You wrote that statement?

A Yes, sir.

Q Was that the conclusion that you drew after talking to Mr. Chastain on February the 28th?

A Not solely because I spoke with him, but after I spoke with him, yes.

Q I call your attention to Joint Exhibit 16, which is Conam's response to the Demand for Information. Do you have that in front of you?

A Yes, sir.

Q And if you would turn to page two of the actual

response to Demand for Information, which is the fourth page in on the document, I believe. Are you there?

A Yes, sir.

Q And the first complete paragraph, the first sentence states, Mr. Slack's first conclusion in his February 29th memorandum was that the survey of the source to determine that it was in a secured position was not performed properly because the radiographer incorrectly read or interpreted the survey instrument reading from exposure to the exit port of the camera.

A Yes, sir.

Q Did you review this document before it was submitted to the NRC?

A Yes.

Q Did you concur with that statement?

A That was my first conclusion, yes.

Q If I could call your attention to Exhibit 18, please. Do you have that in front of you?

A Yes, sir.

Q If you would turn to page seven, and for the record, Exhibit 18 is Conam's response to the Notice of Violation and Proposed Imposition of Civil Penalty, is that correct?

A Correct.

Q Would you turn to page seven, the, I guess, last

paragraph on that page. Starts off, Conam's view of the facts involved in the incident are substantially different from the facts alleged in NOV. Okay. And you skip a sentence and it states, the radiographer, William Chastain, a Conam radiographer three years prior to the incident, on one occasion failed to properly lock his camera after complete exposure. He then failed to properly read a survey meter when he performed a radiation survey in a 360 degree motion around the camera. You see that?

A I see it.

Q Did you agree with that and did you review this document before it was sent to the NRC?

A I reviewed it.

Q Did you agree with it?

A I agree with the July 7 dated document and statement at that time.

Q Now, if you could turn farther into that document to what's labeled at the bottom as Exhibit 1. It's a separate document that says reply to a Notice of Violation.

A Reply or answer?

Q It's reply. It's a document that's further in.

A All right.

JUDGE COLE: It says answer to a Notice of Violation?

JUDGE KELBER: No. It says on the bottom Exhibit

1. 1.

MR. DAMBLY: It says Exhibit 1. It's probably halfway into this document, a little more than halfway into the document. Conam submitted both an answer and a reply.

MR. BROOKS: I think that's what the rules provide for.

MR. DAMBLY: We appreciate that.

CHAIRMAN BECHHOEFER: I have it now. What page of the reply?

MR. DAMBLY: I'm on the first page.

CHAIRMAN BECHHOEFER: Oh, okay.

BY MR. DAMBLY:

Q Second paragraph. It states, Conam denies violation in Section 1B of the NOV. And I believe we're all aware that that's the failure to do a proper survey. Further response to this alleged violation, Conam states that on February 28, 1996, the day following the incident alleged, the radiographer expressly stated to Conam's radiation safety officer, and that would be you, is that correct, Mr. Slack?

A Say again?

Q I said you are the radiation safety officer referred to in that paragraph?

A That is correct.

Q That the radiographer had performed a full 360

degree circumferential survey of the radiographic exposure device. Now, you saw this reply before it was submitted?

A Yes, sir.

Q Is it your position that the regulations require a survey to be properly performed or that somebody tell you they performed the proper survey?

A The regulations, without having them in front of me.

Q Okay. You want them in front of you?

A I didn't ask for them.

Q 34.43B.

MR. BROOKS: Before you give it to them, I don't think he asked for them. I think he was trying to answer the question.

THE WITNESS: The regulations, without having them in front of me, I presume say that a full, actually, let me read it. Excuse me. What was the number?

BY MR. DAMBLY:

Q It's 34.43B, as I recall.

A 43B says that a survey with a calibrated and operable radiation survey instrument is made after each exposure to determine that the sealed source has been returned to its shield position. The entire circumference of the radiographic exposure device must be surveyed. If the radiographic exposure device has a source guide tube,

the survey must include the guide tube.

Q All right. Does that in fact require that the survey be done or just that somebody tell you that they did the survey properly?

A They must make it after each exposure.

Q And having seen the, I guess, three instances in which you have stated in various documents you yourself in your February 29th document and then the two submissions that we just went through a statement from Conam that he did not do a proper survey. Can you explain the denial that the violation 1B and the statement that he told you something different?

A When we told me what he told me, he told me a full 360 degree. He told me he did the guide tube, which is exactly what this says. Based on that, that was the basis for our saying that he did a full complete survey.

Q And I have a little problem here understanding that. You have, as we went through this, on at least three occasions stated an improper survey was done. Am I now correct that you're saying that you denied the violation because he told you, in spite of your conclusions to the contrary in three different documents, is he told you on the first day that he did a complete, even though you concluded different than that, because we just went through that, that there's no violation because he told you he

didn't do anything wrong.

A From what he told me, in the interim period to the period now, so many different things have been proffered that there is a good chance he did a correct and acceptable and adequate survey.

JUDGE KELBER: Mr. Dambly, if I could interrupt, maybe we can extricate this a little further.

MR. DAMBLY: Thank you.

JUDGE KELBER: When you just read the regulation regarding the surveys, was the exit port mentioned?

THE WITNESS: No, sir.

JUDGE KELBER: Did Dr. Cool this morning state that he thought a minor revision to include the monitoring of the exit port would be appropriate?

THE WITNESS: I believe so.

JUDGE KELBER: Did you, prior to this incident, require your radiographers to monitor the exit port?

THE WITNESS: Not per se.

JUDGE KELBER: You do now?

THE WITNESS: Yes, we do.

JUDGE KELBER: In other words, you're in advance of the Commission?

THE WITNESS: On a documented basis, yes.

JUDGE KELBER: And would it be the case that a person could perform a circumferential survey which did not

include the exit port, and I'm talking about this is prior to February 29th or 27th, whenever you issued that, could a person make a circumferential survey not including the exit port, report to you that he had done so and he would have been in full compliance with both the regulations issued by the NRC and your own manual and instruction?

THE WITNESS: Having been told that the individual received a dose reading on his survey meter indicating it was functioning, having been told that it was a 20MR dose at the side of the camera, which is a normal dose at the side of the camera, I would say yes.

JUDGE KELBER: Thank you.

MR. DAMBLY: Were you done with that?

JUDGE KELBER: I'm done, yes. I hope that's helped everybody understand the distinction they made.

MR. DAMBLY: It hasn't helped me, but I'm kind of dense.

BY MR. DAMBLY:

Q Again, on the same date in which you claim in the Reply to Notice of Violation that you did not commit the violation 1B because Mr. Chastain told you he performed a full 360 degree circumferential survey, and the attached document which we just saw on page seven, there is the statement, he failed to properly read the survey meter when he performed his survey in a 360 degree motion.

Now, the only way I can square those two, and you have to help me, is if you're saying it's a proper survey, he did not read the meter.

A Mr. Chastain read the meter.

Q He read it properly?

A Well, if it said 20 on the meter and he said it was 20, I would say it was proper.

Q You would say it was proper. Did you have a conversation with Mr. Chastain after you got the film badge back showing a 4.6 REM exposure?

A We told Mr. Chastain what the dose was, yes.

Q But after that, did you call him back in and say, let's talk again, Bill, about how all this happened and what you did?

A Not to my knowledge.

Q So getting the film badge back with a 4.6 REM reading on it didn't cause you to question the propriety of the survey that showed nothing but 20 millirem on the side that was supposedly a 360 circumferential survey?

A At that time I didn't consider that, no.

Q That doesn't send off any bells and whistles in your head as to how the --

A There are a lot of bells and whistles in my head, and there's a lot of things that don't make sense in all of this. I don't think I can reconcile it.

Q But you didn't ask him any more questions about it?

A Not on that basis.

Q Okay. And tell us again exactly what he told you on the 28th?

A About what subject?

Q About the survey he did.

A Bill said that he performed a complete 360 degree survey up and down the guide tube and --

Q Did you understand up and down the guide tube to include going back to the source of the guide tube, which is the exit port?

A I understood it was the guide tube as is indicated in Part 34. I can envision a guide tube and I know where it hooks up. I don't know if I mentally said, oh, yeah, that's the exit port, but it would have been the entire length of the guide tube as best he could get to it.

Q Okay.

A This is what he said.

Q I appreciate that's what he said, and you concluded on the following day that in point of fact he didn't do a proper survey because he must not have read the meter right. That's what your February 29 memorandum says.

A It says a number of conclusions have occurred throughout with additional information being proffered.

Q Now, when you got a film badge reading 4.6 REM back, I'm sorry. Maybe I should have used sirens instead of bells and whistles.

You got a 4.6 reading on the film badge returned to you. You had an employee who told you he surveyed the guide tube. And you took that to mean the entire length of the guide tube, which would have included the exit port. You didn't call him back in and ask how this could have happened?

A We did not discuss that, no.

Q Why not?

A I can't answer that.

Q Well, were you interested in the health effects to Mr. Chastain?

A Yes.

Q And that didn't cause you at all to think, well, maybe it was a different exposure than just 4.6?

A No, sir.

Q And why is that?

A Because I don't have the same expertise as the individuals that have been offered as experts in that.

Q Sorry. I couldn't hear the last.

A I don't have the same expertise as the individuals that have been offered in those areas.

Q That have been offered?

CHAIRMAN BECHHOEFER: Yeah.

BY MR. DAMBLY:

Q Oh, okay. I'm sorry. You don't have the same expertise as Dr. Cool and Mr. West and whatever?

A Correct.

Q Is a 4.6 REM exposure on a given day for a radiographer a routine event at Conam?

A No.

Q So it was a fairly unusual event?

A It was an unexpected occurrence.

Q Now, also along those same lines with the reenactment, if I understood your testimony correctly, Mr. Chastain -- you did not have a ladder, is that right, on the 28th?

A Correct.

Q And you had no camera?

A Correct.

Q So Mr. Chastain basically stood in front of a table and went through some kind of motions as to what he did?

A We stood in the middle of the room and he explained to me.

Q And you took it to be that his fanny pack was positioned at the closest point to the camera throughout the entire operation of what he was doing?

A As he explained, yes.

Q As he explained. And that was the basis for your calculation?

A Basis for my calculation?

Q Calculations you made on the Marriott stationery, whatever that is, 33 or thereabouts? Let me see.

A The calculations are based on a simple inverse square law.

Q That's right. It's Exhibit 36. And as I recall your testimony, when you got back the film badge they agreed with one of those figures that you calculated?

A They fell in the range of Mr. Chastain's described actions.

Q And the described action that fell, that actually came close to that number would have required Mr. Chastain to be standing on that ladder with his film badge in front of him and at a position three feet back from the exit port?

A I don't know if it would have been three feet back or three foot above or three foot to the side. I don't know that.

Q Well, in order for it to be the closest, it would have to be three foot back, because if it was three foot above, his leg would be much closer to the exit port than his film badge, wouldn't it?

A His what would be?

Q Leg. Can you stand three feet above that without your leg being lower?

A No, sir.

Q We're not suggesting he was standing on his hands?

A Absolutely not.

Q Okay. Can you stand behind it three feet away? Of course, he didn't tell you he was standing. He was on the ladder.

A No, he didn't. That's correct.

Q There's only one way to stand on the ladder and be three feet back with your film badge closest, is that correct?

A No.

Q Okay. What's the other one?

A I suppose you could turn around and put the fanny pack behind you and lean away from it.

Q But that's not what he told you?

A No, it's not. But you're asking what way could it happen and I told you what would happen.

Q What I'm trying to get at is the reasonableness of your conclusion that it was a reasonable figure, 4.6, given your calculation of 4.1 required what was demonstrated the other day as an impossible situation.

A The other day didn't occur on the 28th.

Q You didn't think about that again?

A No, sir.

Q So we've heard a lot about the reasonableness of your actions.

A Yes, sir.

Q Nothing went off and the survey meter didn't work and nothing went off in your mind when the scenario described to you is physically impossible. You didn't bother to follow --

A I didn't believe it was physically impossible.

Q Why didn't you think it was physical -- did you test it?

A No, sir. I just said I didn't believe it was physically impossible.

Q Why not? I mean, did you think about it?

A No, sir.

Q I see. Now, when you were present when the NRC inspectors came out on April 11th and did the reenactment at that time?

A I was.

Q And at that time Mr. Chastain actually had a ladder and a camera, is that correct?

A Conam supplied, yes.

Q Conam supplied the camera and the ladder. All

right. And when Mr. Chastain climbed the ladder and assumed his positions, A, B, and the range of things in between, did at any time you see a position where his fanny pack was the closest point on his body to that camera and three feet away from the exit port?

A Not to my knowledge.

Q Did that cause you to say, well, gee, maybe I better rethink what I did?

A No, sir.

Q Why not?

A I didn't give consideration to it.

Q Basically once you got a film badge of 4.6, and you knew you didn't have to report by your definition, you didn't really care about the rest of the situation?

A That is absolutely untrue.

Q Well, then what did you do to follow-up and make sure it was accurate?

A Not caring and not following up are two different things.

Q Oh. You cared but not enough to follow-up?

A I had no follow-up direction. 4.6 was the film badge. The regulations say we have to have film badges and we have to use the dose. We use the dose. That's it.

Q But you are a radiation safety officer, that is correct?

A I am a radiation safety officer.

Q And you know that 4.6 could only be the actual dose if that happened if the film badge at all times was the closest point to the exit port?

A Say again.

Q Do you know for a fact as the radiation safety officer the only way 4.6 could be the official, whatever, reading here is if, and you testified Mr. Chastain told you, it was the closest point to the exit port during the entire operation that he performed?

A Correct.

Q And then you saw him assume positions but said that's not true. At any rate, you saw a reenactment which at no time, well, I won't say at no time, but throughout it his film badge was not the closest point at all times to the exit port?

A That is correct. You're talking about April 11th?

Q April 11th?

A Yes.

Q And that will tell you that the 4.6 would not be necessarily the maximum dose that he could have received using NRC regulations and a weighting factor of one?

A Is that a statement?

Q That's a question.

A I'm sure it could be taken that way.

Q How else can you take it?

A I didn't say it would be taken any differently. I didn't take it, period.

Q Well, you've been here for the past four days and heard Mr. Brooks ask ad nauseum the question. If his fanny pack and the film badge are the closest point to the exit port at all times, then the film badge reading of 4.6 would be right.

A Correct.

Q And conversely, if it wasn't the closest point, then that's not necessarily the accurate?

A It's not necessarily the accurate what?

Q If other portions of his body were closer?

A It's not necessarily the accurate?

Q The accurate dose.

A The film badge is not necessarily the accurate dose?

Q The highest exposure to a portion of his body which is defined as part of the whole body under the NRC regulations?

A Correct.

Q And having seen that, you didn't go back to do anything to check in your own studies whatever, say, should I be repeating this? Is there a higher value?

A No, sir. I thought we were compliant.

Q And why did you think you were compliant?

A What Mr. Chastain showed on April 11th was entirely different from what he showed me. What's the truth?

Q Are you familiar with Reg Guide 8.34?

A No, sir.

Q Monitoring criteria and methods to calculate occupational radiation doses?

A No, sir.

Q As a radiation safety officer, do you not keep yourself apprised of regulatory guidances issued by the NRC?

A I receive guidances. I read them. I can't quote them chapter and verse. I may have seen that at some point in time. I am not familiar with it.

Q Well, let me read you a paragraph under 2.1 on the Reg Guide, it's on the second page. Third paragraph states, if post exposure evaluations indicate that the maximum dose to a part of the whole body was substantially higher than the dose measured by the individual monitoring device, an evaluation should be conducted to estimate the actual maximum dose. Did you do that?

A Why?

Q Well, you watched a recreation that showed that

it was not the closest point at all times?

A I watched the recreation that showed me it was, and that's what I made my decision on, period.

Q It says if post exposure evaluations, in other words --

A February 28th is a post exposure evaluation.

Q And once Mr. Chastain told you something on February 28th and the film badge came back that says if what he told me that day was good, I'm home free, you didn't care and you didn't do any more evaluations no matter what happened?

A Absolutely wrong.

Q What else did you do? When did you change?

A We asked to have our consultant, IEM, perform calculations.

Q When did you ask them to do that?

A I don't know.

Q Is that after you received the inspection report?

A That was post exposure.

Q After there was a potential violation noted in the inspection report?

A I can't say that. It's most possible, but it's post exposure.

Q IEM did a, in point of fact, an evaluation for you. It would be one of these things.

Exhibit Number 14, if you would turn to that, please. And if you would note on Exhibit 13, which is the previously one, which is dated November 18th, 1996, that's the inspection report. What's the date of the IEM? Would you look at the first page of Exhibit 14, pursuant to your written request of November 22nd, 1996, does that refresh your recollection at to when you decided to get your consultant in?

A To get my consultant in?

Q To ask IEM to perform an assessment.

A It refreshes my memory that we requested in on November 22nd.

Q Now, have you read the IEM report that is Exhibit 14?

A At one point in time.

Q At one point in time. When did you do it?

A I couldn't tell you.

Q You haven't read it since in preparation for this hearing or anytime recently?

A I haven't read it in preparation for this hearing, no.

Q At the time you received it, which would have been approximately December 10th, is that correct?

A I'd have to say yes to approximate.

Q When you read it shortly after receiving it, did you concur with the report and the statements made in it?

A We asked IEM to supply us a calculation that would give us a final whole body dose to see if there was any difference between the 4.6 whole body dose that we received and we received I believe it was 2.5 or 2.9 whole body dose, and yes, I agree with that.

Q Did you agree with all the statements that are in here?

A I can't say I even understand all the statements in there.

Q Did you take exception to anything in there?

A No, sir.

Q There's a whole list of information on the first two pages of this report. It says things that were supplied on which IEM based its opinions in here. What information did you personally supply to Miss Berger for use in this?

A From recall, I can't say. But from what we have been discussing, I presume it was the measurements that were taken in April.

Q The NRC measurements.

A The NRC measurements, yes.

Q And you also supplied, because it's listed on here, somebody from Conam, who was the go between IEM and

Conam?

A Myself.

Q Okay. So you also supplied your memorandum of February 19th, is that correct? We can start with the top. Let's start with the first thing. You supplied the investigative report, is the correct?

A I'm sorry. What exhibit are we on?

Q We're on 14, first page.

A Okay.

Q It says for this assessment I relied upon the information contained in a number of documents that were provided to me by Conam. You told us you were the Conam person that did this.

A Correct.

Q The first one was the inspection report, the investigation report, correct?

A Yes, sir.

Q Then there's your memo of February 29th, correct?

A Yes, sir.

Q And then there's Mr. West's dose reconstruction, correct? I'm sorry. If you'd look at Exhibit 11, please. Do you recall that's the document that's referenced as the fourth document in the IEM list, third document. I'm sorry.

A Yes, sir.

Q Okay. Then you provided a letter from Mr. Thomas Young on the confirmatory action letter. You provided the dosimetry report which we have as an exhibit in this case. Isn't that one of the documents?

A The three indications of film badge dose for Chastain.

Q Right.

A Yes.

Q It's 33. Is that the dosimetry report you provided?

A Correct.

Q And then the document that you just went over in your direct, the film dosimeter report that indicated the issue about CZM 137?

A Correct.

Q Then the satisfaction of confirmatory action letter. You provided cumulative occupation exposure. You gave them Mr. Chastain's events of February 28th, the thing he wrote up. I think it's Exhibit 7, is that correct?

A Yes.

Q Okay. And then the next to the last dot there, there's a document referred to as written communication to Carol Berger, IEM from Robert Slack, Conam Inspection, mock up exposure, date unknown. Could you tell us what that document is?

A No, I can't.

Q How did you convey to Miss Berger the statements that were made to you by Mr. Chastain on February 28th, your, quote, unquote, "re-enactment" that you did with Mr. Chastain on February 28th?

A How did I --

Q Did you provide her what Mr. Chastain told you in your mock up on February 28th?

A Oh, I'm sorry. I'm looking at mock up exposure as being calculations. If that's the mock up exposure of the 28th, yes.

Q I don't have the document. I'm asking you if that's what you think that is.

A I don't know, honestly.

Q Did you ever convey to her the information that Mr. Chastain imparted to you on February 28th?

A Carol's talking about these being documents. It says documents. If she says there's a document and I sent it to her, then I would say yes, I conveyed it to her that way.

Q All right. To your knowledge did you ever have a conversation with Miss Berger in which you told her something different about what Mr. Chastain told you that you testified to here concerning February 28th, the mock up you had on February 28th? Let me try it this way.

To your knowledge have you ever told Miss Berger anything other than on February 28th Mr. Chastain told you, when he did his radiography on the 27th at Eli Lilly, his film badge was in front of him, with the closest point to the exit port at all times?

A With respect to that description, I don't believe I told her anything different about the description.

Q Okay. By the way, while you were at Conam or anywhere else, for that matter, as a radiation safety officer, have you ever used weighing factors or weighting factors in deciding the dose to assign under NRC regulations to an external dose covered by NRC regulations?

A No, sir.

Q So this would be the first time that you've employed those in some manner?

A This would be the first time we've pursued them, yes.

Q Now, you indicated during your direct testimony with Mr. Brooks that you do surprise field audits. Would you tell me what you mean by a surprise field audit?

A Basically we don't tell them we're coming.

Q Okay. You don't tell them you're coming. Do you witness them when they know you're watching them?

A Yes.

Q So whether it's in your Gary office in the vault

or whether it's out in the field, you're observing a radiographer who knows he's being observed performing an action and that's the basis on which you're doing your audits, is that correct?

A I'll speak for myself but probably I'm speaking for the majority of our managers. I would say yes.

Q You hear Mr. Lieberman testify yesterday that these people and as you've stated, you have an extensive training program. They know how to properly operate an Amersham 660. You train them well and you show them the rules. You test them initially on turning the selector ring, depressing the lock, correct?

A Correct.

Q Would you be surprised to go out in the field and find somebody that didn't know how to do that when they were being watched?

A They didn't know how to do it when they were being watched?

Q Yes.

A Would I be surprised? Can you ask that differently?

Q I'm sure I can.

A There's some negatives in there I can't put together.

Q Okay. How many times have you gone out or to

your knowledge has one of your auditors gone out and observed one of your radiographers set up an Amersham 660, take a shot, or least a mock shot, crank out the source, bring it back in, and not demonstrate the ability to turn the selector ring and push the plunger?

A To my knowledge, none.

Q Does that surprise you then that they know how to do that when they're being watched?

A That they know how to do it?

Q Yes.

A It doesn't surprise me that they know how to do it, period.

Q So from your perspective, what are the audits accomplishing? I mean I know how to stop at a red light, too. If you put a cop in my car with me, I guarantee you I will stop at the red light.

A The audits are accomplishing compliance to the regulations. The regulations ask us to comply with them.

Q Subsequent to the enforcement action at issue, have you changed your audit program to perform unobserved audits?

A Subject to which?

Q Subsequent to the enforcement action, when you were notified in the inspection report of potential violation, began corrective action. As part of your

corrective action, have you instituted any process by which would do unobserved audits of people in the field?

A Unobserved?

Q Right.

A No, sir.

Q Okay.

CHAIRMAN BECHHOEFER: Mr. Slack, is it possible to do unobserved audit, an audit if a person didn't know he was being audited? What would you have to do, send personnel unknown to him or what? How would that work?

THE WITNESS: That's a good case right there. I don't know if I've heard testimony earlier or if this is just something that I know, state inspectors sit up on the hill with binoculars and watch radiographic operations. That would be unobserved.

BY MR. DAMBLY:

Q An important fact. The shoot in question here, at Eli Lilly, with the double doors with the window, the crank is outside and it's outside the boundary. If you would have had an auditor unknown to Mr. Chastain in a Lilly lab coat walk by the window, he could have observed that, couldn't he?

A That is correct.

CHAIRMAN BECHHOEFER: Okay. I wasn't sure how it could be done.

MR. DAMBLY: I'm sneakier than a lot of people.

THE WITNESS: Unfortunately at Lilly you have to gain access, which is one of the problems.

MR. DAMBLY: But we got access for our re-enactment.

THE WITNESS: Certainly did. It took us three weeks.

BY MR. DAMBLY:

Q Mr. Chastain was there for six weeks, according to your testimony?

A He certainly was. And we never agreed to do audits in the fashion you're discussing.

Q You also said, during your direct, that in response to a question -- well, back up, because there was one before that.

When you did this crank distance, or how far the source moved based on a third and a half turns of the crank, what camera were you using or how were you making that determination?

A A camera similar to this one.

Q In other words, a mock up?

A So you could view it. Yes.

Q And I guess --

A Those aren't exact numbers, if you're wondering.

Q I'm just wondering, to your knowledge --

obviously you seen we had a mock up, too, and I guess you make a lot of mock ups. Exactly how close to an approximation of what it really --

A I'd say very close. I'd say very close. I don't have any dimensions for you.

Q Did you take the camera at issue, for example, and crank it a full turn and see where the source was, then crank this one a full turn and see where the source was?

A The camera at issue would not be anyplace to be in front of, if I cranked it out a third of a turn to see where the source was.

Q I'm saying if you cranked it a full turn and it was actually exposed, then you stood 50 feet away with a telescope or binoculars so you could see how far out it was, did you try that?

A No, sir.

Q So you don't know the actual crank and the actual camera, whether it would have been a difference or not from what you did?

A I do not know that.

Q Now, in response to a question as to whether you had any reason to believe he willfully failed to lock the camera, as I recall your statement was no, because he was operating by rote and the camera I guess had been locked every time until he noticed the bar wasn't slid over one

time.

A That's not exactly what I said.

Q What did you say?

A Up to the point where you described the bar, I said, and he reached back to unlock it. That indicated to me that he was functioning by rote, meaning he locked the camera, he unlocked the camera, he locked the camera, he unlocked the camera.

Q So you took that to mean, when he said I reached back to unlock it, you felt that the bar only partially slid over, slud over, whatever the word is.

JUDGE COLE: I guess I took that to mean something else. When he reached back to unlock the camera, meant to me that he reached back and turned the key to release it. That's what that meant to me. Is that what it meant to you?

THE WITNESS: Yes, sir.

BY MR. DAMBLY:

Q You mean you took his statement then, not that the camera -- he was relying on the automatic lock, but you took it to mean when he reached back over to unlock the camera --

A The physical manipulation of unlocking the camera with a key and rotating into the operate position.

Q That's kind of interesting, because the key, if

you look at that camera, is all the way up on the top, isn't it?

A Yes, sir.

Q So if you reached over to grab that key, you wouldn't feel the slide bar at that time, would you?

A I don't know.

Q Eyeballing it from here, it's probably three inches below the key, isn't it?

A He said he reached over to unlock it and felt that the slide bar wasn't all the way in the right position, or whatever it was that he said. I don't know if he could see what he was doing, put his hand in the wrong place, I don't know.

Q If you take a look at the camera for me, tell me if you think if you reached over to just grab the key on the top you would have felt the slide bar.

A If that's where his hand ended up, he would have been above the slide bar. If his hand didn't end up there, I don't know.

Q Do you think it's possible that he reached over to unlock it and by unlocking it, he meant push the slide bar from green to red so he could turn the crank?

A I don't know, sir.

Q Did you ask?

A No. He said a lot.

Q Did you ask him -- I mean at the time you had this conversation on February 28th, you obviously knew that he hadn't locked it. He couldn't have had the key plunger lock depressed and the selector ring turned. I guess you got to do it in the opposite order -- and still have that slide bar halfway open, is that correct?

A I would say you can't successfully do that.

Q So you know, in fact, he didn't do it?

A No, I'm not saying that he didn't do it. I'm just saying you can't successfully do it. He may, by what he told me, locked the camera. He may have reached over. He may not have. I don't know that. But he said he locked the camera.

Q Did you ask him what his normal practice was?

A No, sir. I presume his normal practice is in accordance with the O & E.

Q Pardon me?

A I say I presume his normal practice is in accordance with the O & E.

Q Again, you made some statement and I think we're talking Exhibit 8 here, about envelope messages and paychecks. But I wasn't clear. Are you stating that, to your knowledge, your February 29th, 1996 memo was put in envelope messages in all the employees' paychecks?

A No, sir.

Q Okay. So you don't know that all employees actually got this memorandum.

A Our managers weren't instructed to give that to them.

Q How were they instructed, by the way?

A How were they instructed what?

Q To communicate this. How did you tell managers what to do with your letter?

A What exhibit?

Q Eight. Referring to the last sentence, please apprise all radiographic personnel of these instructions.

A Please apprise.

Q How did you verify that that was done?

A I asked the individual managers to supply a letter of verification that it had been done.

Q Did you supply those letters to the NRC?

A I don't know.

Q Did you make any checks with radiographers in the field to see if they either received a copy of your letter or had been instructed?

A I didn't expect that they would receive a copy, so I would not have asked them. As to whether they had been instructed, yes. I personally ask radiographers when I go out on my audits whether or not they had been apprised of that.

Q Now, you also indicated that instructions were given to auditors to give attention to rotate and lock. How were those instructions given? Was that orally? Was there a written document?

A Not having a document, I would have to believe it was orally, but I would be able to take that from this February 29th letter.

Q There was also some discussion about alora and multiple exposures. I don't want to really go into that. I believe Chairman Bechhoefer has done an outstanding job in that area.

In terms of auditing multiple exposures, as opposed to a single set up where you set up the camera, properly go through unlocking, exposing the source, cranking it back in, locking it up because you're going to move it someplace else, can you do an audit of a multiple exposure by watching the second exposure a person is doing and with the camera in the same place?

A I guess we would need a definition of multiple exposure.

Q If the intent is to try and find out if somebody with a stationery source is performing in a different manner than if they have to pack it up and move it every time, you could watch one of the middle shots and see what their routine is in the middle of the three shot shoot.

Did that make any sense at all? And that would give you an indication of how they performed in the, I will call it, different function, where you're not actually packing up the source and moving it from place to place each time.

A Multiple exposures or multiple shots could be viewed in either case.

Q But you wouldn't have to observe more than the shot at issue that Mr. Chastain did at Eli Lilly on the infamous February 27th, 1996. If somebody was standing out there watching him come back in the door, survey whatever, they would have seen the middle of a multiple shot routine?

A Correct.

Q And you would agree that a radiographer might well do something different in a multiple shot routine than in a single shot situation?

A I don't know that I agree with that or not.

Q Okay. Now, I'd like to get to the video tape for a second. You indicated that because a number of scenarios had been proposed and you were interested, you decided to do this video tape time study, is that correct?

A I didn't quite get the first part. We did a video tape time study.

Q I believe on direct you said the reason was because a number of different scenarios had been proposed and you decided to see the effects on time of what those

scenarios would do.

A How much time it would take to do them, basically.

Q You did that study in August of 1998, is that correct?

A Yes.

Q Two weeks ago approximately?

A It seems like a year.

Q To us all. At that point, point of fact, you did that study in anticipation of coming to this hearing?

A Correct.

Q You weren't really examining exposures that might have happened to Mr. Chastain in order to reach a conclusion of what his exposure was in any real time frame in which it had occurred?

A That would have been ancillary I think to what we would have found out about time, but we did look at that.

Q You had Miss Berger with you at this August 26th re-enactment?

A Yes, sir.

Q Did you take any measurements of the position of Mr. Fay when he was on the ladder, the relation between where his film badge was, where his thigh was? Did you take any measurements at all?

A No, sir. Not other than viewing it.

Q You would agree from viewing it that Mr. Fay's thigh was closer to the exit port than his film badge?

A In certain cases.

Q Did you see any case there where it wasn't?

A I don't remember it, but that wasn't the point of the operation.

Q So you tell me, the point of the operation then was totally to come up with a time table?

A To see how much time it would take in those conditions, yes.

Q And to your knowledge, what would that have accomplished for you?

A We needed to know if Bill was correct in his statements about four minutes or one minute or just how much it might take in that environment.

Q Why did you need to know that?

A We would hope that it would be utilizable to our benefit here today.

Q You did that study with a consultant present without the knowledge that in the way things worked out when you do these, time really basically factors itself out of the equation.

A Say again?

Q You did this study with your consultant present without the knowledge that time basically would factor

itself out of the equation when you do these numbers.

JUDGE KELBER: Excuse me. I think you are misleading the witness in asking a question like that. In the study they relied on, as you see by reading, for example, on page nine and some of the other pages, time did in fact make a difference in the results.

MR. DAMBLY: Time did what?

JUDGE KELBER: Time does make a difference. The reason it cancelled out in Mr. West's -- we've gone through this ad nauseam. The reason it cancelled out in Mr. West's calculations was that each time he evaluated a different position, he readjusted the intensity of the source. In the consultant's calculations that was not done. It's more like an avinitial calculation, and the time does indeed make a difference.

I would refer you in particular to the last paragraph on page nine on Exhibit 14. So I think you're misleading the witness in your question.

MR. DAMBLY: Last paragraph, page nine.

JUDGE COLE: Start with the last sentence for example.

(Mr. Dambly reading document.)

MR. DAMBLY: Then as a result of doing this since time was important in the calculation, do we have a recalculation, was that done, provided?

THE WITNESS: Not in this point in time.

BY MR. DAMBLY:

Q And again as a result of Ms. Berger being there and you being there, the stop watch and the three scenario's and whatever, did they make any attempts to change these calculations to reflect the actual special relationships, et cetera, demonstrated during those --

A We utilized what we have seen in the tape for anything other at this point in time other than determining how much time it would take in a real environment.

Q And then you didn't use the time figure either.

A I'd say, we haven't made any determinations yet.

MR. DAMBLY: I would respectfully suggest that after tomorrow it might be a little late.

I only have and I hesitate to say it, one other question.

BY MR. DAMBLY:

Q You indicated that the impact from a Level 2 violation was a serious matter. And you were asked by potential clients, customers or whatever what your OSHA compliance things are. What your NRC -- violations, I would be interested in what you tell them now about these violations?

A I tell them nothing. These are not violations until the fat lady sings, I guess.

MR. DAMBLY: Okay, thank you.

(Panel discussion.)

JUDGE KELBER: Let me try something and you can correct me.

Mr. Slack, as the, as events progressed starting with the incident itself and up to the time when you were preparing for this hearing, you have from time to time made different descriptions of the survey and whether it was properly done, improperly done, what might have happened, what might not have happened, is this an -- process of yours or is it a, simply a change to reflect circumstances which may have been described to you or how can you reconcile these differing descriptions of the survey?

CHAIRMAN BECHHOEFFER; The various ones that you were asked about --

MR. SLACK: I understand. The descriptions become confusing.

MR. DAMBLY: I can't hear.

MR. SLACK: I'm sorry.

CHAIRMAN BECHHOEFFER: We can't hear.

MR. SLACK: The descriptions become confusing and with that I'd become confused as well. I guess rather than try to determine what I said and when I said it and so on, I guess I would ask you to ask me about a survey and that would, that I can yes or no to, that will end all of this

discussion.

JUDGE KELBER: Well, Mr. Dambly has done that which is, is that not correct --

MR. DAMBLY: Yes, except that I would take exception to one thing that was said. All the descriptions that I have read are virtually identical. Mr. Slack has said he did a survey and improperly read the meter. On all three of those descriptions, the last two of which, at least have to be an admission and those shouldn't even be an issue in this case on surveys at this point.

JUDGE COLE: But there was another statement that's --

CHAIRMAN BECHHOEFFER: Well, there's one in the response.

JUDGE COLE: -- yes, there's one in the response. There's a statement made that the radiographer told him.

MR. DAMBLY: And I questioned on that. And clearly the regulations do not, are not met by somebody telling you they did it right there. And I'm saying that's the only distinction they drew between their reply and their answer. In their answer, they admitted he didn't do it right. And in the reply, he said he didn't do it.

JUDGE COLE: I think we understand your point.

(Panel discussion.)

JUDGE COLE: Mr. Brooks.

CHAIRMAN BECHHOEFFER: Okay.

MR. BROOKS: No further questions for Mr. Slack. Mr. Slack, thank you very much for your time and patience here.

JUDGE COLE: Thank you, sir.

CHAIRMAN BECHHOEFFER: Thank you.

MR. SLACK: Thank you, gentlemen.

CHAIRMAN BECHHOEFFER: For the second time.

JUDGE KELBER: Does anybody need a break at this time?

MR. DAMBLY: I'd appreciate just a five minute rest period or something.

MR. BROOKS: Our next witness is going to be Mr. Fay and I suspect that's going to be pretty quick.

JUDGE KELBER: Let's take a five minute break.

CHAIRMAN BECHHOEFFER: Five Chicago minutes.

(Short break taken.)

CHAIRMAN BECHHOEFFER: Back on the record.

MR. BROOKS: Can I take care of a couple housekeeping matters before we get Mr. Fay up?

CHAIRMAN BECHHOEFFER: Oh, okay.

MR. BROOKS: The first is --

CHAIRMAN BECHHOEFFER: Don't you want to be on the record?

MR. BROOKS: Oh, sure, if I could.

CHAIRMAN BECHHOEFFER: Back on the record.

MR. DAMBLY: I was going to say, this tape was pretty messy.

MR. BROOKS: The first is with respect to Joint Exhibit 9, which I had Mr. Slack identify and discuss but I think I neglected to move its admission.

MR. DAMBLY: I believe that's correct and I have no objection.

CHAIRMAN BECHHOEFFER: Without objection, Exhibit 9 will be admitted.

(Exhibit 9 was received into evidence.)

MR. BROOKS: Great. Maybe we can take care of that detail now, Ms. Berger's report, Exhibit 14 was identified. Mr. Slack read from it, maybe if we could just, if I could close the admission of that document at this time. It will save us time later.

MR. DAMBLY: No problem. All right, I didn't even know it wasn't in.

MR. BROOKS: One final matter.

CHAIRMAN BECHHOEFFER: Oh, okay. Exhibit 14.

MR. BROOKS: One final matter with respect to the video tape, I have given a copy of the video tape to the recorder here. I have a copy I can give to the Board. Do I need to send another copy to the Secretary also?

CHAIRMAN BECHHOEFFER: Technically, yes.

MR. BROOKS: Fine, I'll do it.

CHAIRMAN BECHHOEFFER: It might be helpful to send ours to our office.

MR. BROOKS: Done. We'd like to call in Mr. Steve Fay.

Whereupon,

STEVEN LEO FAY,

witness, was called for examination by counsel for Conam Inspection, and having been first duly sworn was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BROOKS:

Q Would you state your full name.

A Steven Leo Fay.

Q Mr. Fay, where do you live? You can go ahead and address the Board.

A Roselle, Illinois.

Q Where do you work?

A Conam Inspection, Glendale Heights, Illinois.

Q How long have you worked at Conam Inspection?

A Approximately 12 years.

Q What is your current position at Conam Inspection?

A Laboratory Manager.

Q What are your responsibilities as a Laboratory Manager?

A Primarily day-to-day operations, radiation safety and general employee safety.

Q General what?

A Employee safety.

Q Just briefly describe, let's start with, when did you begin your work at Conam?

A In the fall of 1984.

Q Can you describe just briefly the positions that you held at Conam beginning in 1984 coming up to the present.

A In '84, I graduated from Vocational School in Hutchinson, Minnesota. And started out as Assistant Technician.

Q Assistant Technician doing what?

A All aspects, radiography, MT, UT, PT. Went up the ranks, was certified low to, in all disciplines. And in 1986 the Minneapolis Lab was closed. I transferred down to the Chicago Itasca facility. When I arrived in Chicago, I was responsible for radiation safety in the Radiography Department.

As time progressed, I was promoted as Lab Manager. I believe that was 1993.

MR. BARTH: I did not catch your words, sorry,

sir.

THE WITNESS: What's that?

MR. DAMBLY: The date?

MR. BARTH: '93.

THE WITNESS: For Lab Manager? Approximately 1993. I was Utility ProgramManager prior to that when I came back down in '90.

BY MR. BROOKS:

Q In your capacity as Laboratory Manger since 1993 are you generally performing radiography in your work?

A Yes.

Q Do you go on jobs to perform radiography?

A Yes, I do.

Q And what other duties do you have as Laboratory Manager?

A Day-to-day duties would be supplies, consumer rules, radiation safety audits, radiation safety compliance, things like that.

Q I would like to direct your attention to, if I could to August 26th, 1998, do you remember going to Eli Lilly on that day?

CHAIRMAN BECHHOEFFER: 1998?

MR. BROOKS: August 28th, the 26th, 1998. I'm going through our video tape at this point.

CHAIRMAN BECHHOEFFER: Oh, okay.

THE WITNESS: Yes, I do remember.

BY MR. BROOKS:

Q Who asked you to go to Eli Lilly for that re-enactment?

A Bob Slack.

Q What did he ask you to do or what did he tell you were going to do with the re-enactment?

A If I would come down and -- my best effort re-enact what Bill Chastain had provided his testimony.

Q Who was in charge of the re-enactment on that day?

A Bob Slack and Carol.

Q Would you say Carol Berger here?

A Berger, yes.

Q First of all, let me ask you a question. How tall are you?

A Six one, a little over six one.

Q Now where at Eli Lilly was the video tape made?

A I believe it was a vacuum pump room down in the basement.

Q I would like you to have a quick look at Exhibit 20 and 21 in your book there or 21 and 22, I'm sorry.

A Okay.

Q Are those pictures of the room where the video tape was made?

A Yes, it was.

Q Did you have copies of these pictures present on that date?

A Yes, I did.

Q When you first got to the room on August 28th, what was the first task or first thing that was done?

A I tried to position the ladder as close as possible to the different views that we had of these photographs.

Q Now, Mr. Slack testified that he had about two hours in the room there, how much of that time was taken up with trying to accomplish this set up?

A Almost the whole time.

Q Why was that?

A We had a really hard time trying to figure out where this exposure was, because things had changed a little bit since, I believe, the time they were down there with insulation. There was some new, it looked like some new piping that was installed after these photos. And to try to get up to where it looked like that colonator was and actually perform an exposure, it was extremely difficult.

Q Why was it so difficult?

A Well, for me it was hard to get up in there.

Q Let's start with the positioning. How would you

try to get the ladder, what did you do to try to get the ladder in the correct position?

A Well, just by going out with some of the bracing, some of the meters and some of the instrumentation that you see in the photographs. You see on top, you see that dial indicator, that yellow dial indicator. It looks pretty close to being almost right up above the ladder.

Q Were you confident that you found the correct height that Mr. Chastain was radiographing on that date on February 27th, 1996?

A No, I don't think so.

Q Why not?

A Nothing lined up. His deposition said, he was about 20 inches from the left. And when I got up there, I couldn't find anything 20 inches away that, where this sources position would really line up to do. The type of radiography, the technique involved. I couldn't find where he was shooting.

Q You said, you were instructed to try recreate what Bill Chastain said he did on that date?

A Uh-hum.

Q Were you given any specific instructions or did you read anything?

A Yeah, I read his deposition.

Q Could I direct you to Exhibit 29 in the book,

please. Which I will represent to the Board are excerpts from Mr. Chastain's deposition, not the full thing.

You want to glance through those for a second, Mr. Fay?

A Which part of it.

Q Just see if, my question to you is going to be whether Exhibit 29 contains the pages of Mr. Chastain's deposition that you were shown on August 28th, as your set of instructions?

A Yes, sir, it looks correct.

Q Were you given any instructions with respect to whether you should go fast or slow or how you should do the work?

A No.

Q When you did work, which is shown in the video tape, were you trying to go particularly fast or --

A No.

Q Now were you successful, as far as you can tell, in recreating on the video tape exactly what Mr. Chastain said he did in his deposition?

A I was close but I had a hard time duplicating what he said he did. That was the best I could do.

Q Explain a little bit in more detail why you're not sure that you were able to recreate exactly what he did?

A Well, a lot of the piping was insulated. There was some piping up above where he had said he laid some film which I had a hard time getting to, even with my height. There was an I-beam in particular, he referenced he laid film. Well, the I-beam that I found was about six inches off the ceiling of the room. And I just don't know how he could have got, get up there. So I never did use the I-beam as a film placement.

Q Now in some of that, the first couple of tries, in the first try I think you ended up spending most of your time facing forward toward the ladder.

A Yeah.

Q And in the second one, you ended up kind of half and half.

A Right.

Q Were you trying to do that that way?

A Well, I believe his deposition did say that he was facing the front of the ladder with his back towards the camera. And, it's almost impossible. You won't get a ladder, it's not made to stand backwards on the ladder. You tend to want to fall off of it. So --

Q Were you able to assume that position, your third --

A Yeah, yeah.

Q -- did you have to move the ladder on that third

trial in order to be able to do that?

A Yes, I did. Yes, I did. I moved it forward.

Q Based on your experiences at the re-enactment on August 28th, 1998, August 26th, can you tell us for sure what position Mr. Chastain was in when he did his work on February 27th, 1996. In terms of whether he was facing toward the ladder or away from the ladder?

A No, I can't.

Q Why is that?

A It -- radiography a lot of times, in particular in this pump room is extremely difficult. You know, you almost have to be a contortionist. So, I wouldn't be surprised if the ladder was moved throughout each exposure, you know, get down reposition it. Okay, this won't work, I got to move it over to the right/left, like I had to to get up there.

Like I said, the re-enactment was a best effort for me to try to get up there and duplicate an exposure.

Q Now on the video tape which you've seen, I'm not going to replay it. You're in a number of different positions and in a number of different attitudes to the ladder, if you will.

A Okay. I've never seen it, so.

Q We may show it in a minute here.

MR. DAMBLY: I think you're going to.

MR. BROOKS: Okay. I guess you're going to see it.

BY MR. BROOKS:

Q Is that typical of the actions that would be performing that sort of radiography?

A Yes.

Q In your experience can you say whether or not Bill Chastain would have been making those same lateral side to side and toward the ladder and away from the ladder movements that are shown on the video tape that you did?

A Yes, he would have had to.

Q Why?

A Because of the distance between where the film gets placed and the source placement and he can move back and forth. It was, you know, 20 inches away as a minimum. So the ladder's only so wide. So you do have to move from side to side. There's measurements that are involved. You line a sight to make sure that, you know, the source is aimed correctly. You do have to move back and forth.

MR. BROOKS: Just give me a second. Mr. Fay, thanks very much. I believe the Staff would like to ask you some questions now.

MR. BARTH: Mr. Fay, I'm Charles Barth. I'm an attorney with the NRC and I have two questions to ask you.

CROSS EXAMINATION

BY MR. BARTH:

Q You say you have not seen the film?

A I've not seen the film in its entirety.

Q Were you told the purpose of the film?

A Yes, I was.

Q The making of it?

A Yes, I was.

Q And what was the purpose of the making of the film?

A To try to re-enact and get a time study on, based on William Chastain's testimony.

Q I believe you testified you had no special instructions to hurry up or slow down?

A No, I wasn't.

Q Were you given any kind of instructions to where to stand on the ladder?

A Yes.

Q If we look at the film, to the best of your knowledge, would this represent how you would do this in the normal course of your business?

A Yeah.

Q And from that I, do you think we could take a stop watch and take a look and calculate some of the times

that it took to do this?

A I believe you could.

Q And you tried, you say the best you could to emulate, duplicate what Mr. Chastain had done?

A Right.

Q And you have, with all of your 12 years with Conam, did you do this kind of work. You got 12 years experience making kind of radiographs?

A Right.

Q It was a pretty routine -- pardon me. Was it a pretty routine thing for you to do, sir? Pretty routine type of thing for you to do to climb a ladder and make these.

A Yeah, it was tight though. It's routine. Sometimes you do have to get up on a ladder.

Q I realize you're taller than Mr. Chastain, let's put that aside. If I looked at the film and looked at something besides just in time, I looked at where you were standing and how you went up and how you went down and how you turned, do you think what you did would represent what is normally done by a radiographer in that kind of position?

A Yes.

Q So if I could make a kind of judgments of what step you were on or how far you were from one side to the

other, do you think those would be valid for the scenario you went through?

A I would assume so.

Q And to the best of your ability, that was the same scenario Mr. Chastain went through?

A Similar, yes.

Q And if I took over to where the, what do you call it, the camera, the Amersham 600 was located and your relationship to that camera as exit port your body, that's how it would normally be?

A Yes.

MR. BARTH: I have no further questions. Thank nyou for, just a second. Counsel made the best suggestion of the day, you were the movie star of the tape and I think you ought to see the tape to verify that is what you went through. And we had a movie director here and the cast, the full cast and we have the tape, your Honor, and had him watch it once or twice to familiarize. Then routine questions, so at the end this is what you did and this is what you saw and this is what you went through, verify it. I think it would be very helpful, sir. And I so move.

CHAIRMAN BECHHOEFFER: Any objection?

MR. BROOKS: I don't know that it needs emotion. The witness is on cross examination, if that's what Mr. Barth wants to do.

CHAIRMAN BECHHOEFFER: Well, anyway, you may do that. Set up.

MR. DAMBLY: The tape is right over here and all we got to do is move the ladder.

JUDGE KELBER: That's what you have to do when you do radiography.

(Video tape being played for witness.)

BY MR. BARTH:

Q Mr. Fay, at the beginning I saw and should find out, starting at the second step from the top, then Mr. Slack reached over and tapped the third step from the top. Was this a signal to you to not go to the second step from the top, sir?

A No, I wasn't aware of that.

Q Did Mr. Slack tell you not to go to the second step from the top?

A No.

Q Do you think in view of the size and height of the room, Chastain was shorter, you say it was difficult to reach and you had to go to the second top from the top?

A It all depends were that weld was that he was shooting how high he had to go.

JUDGE COLE: Were there other pipes there that could have been pipes that he was working on?

THE WITNESS: Oh, yeah. They were all over.

JUDGE COLE: Both higher and lower levels?

THE WITNESS: Yup.

JUDGE COLE: You're not sure you were at the right pipe?

THE WITNESS: No, I'm not.

JUDGE KELBER: Was there any possibility of an additional I-beam having been installed to mold the film?

THE WITNESS: No, I doubt it. That room's been there for quite a while. What they did is did a modification upgrade of the pipe.

[Whereupon a video tape was played and in some portions overrode the voices of Mr. Barth and the witness.]

BY MR. BARTH:

Q Do you recall from this scene that you saw then sometimes your gonads were the closest part to exit port of the camera?

A Yeah.

Q As a matter of routine, have you done this kind of situation before where the pipes were in relation to the ladder that you were on this job, sir?

A Yes, I have.

Q In those situations is it your normal practice to

turn your fanny pack around from your front to the back?

A I don't carry a fanny pack.

Q Why did you move the fanny pack from the front to the back of this?

A Bill Chastain's deposition said that he moved it once he climbed up the ladder from the front to the back.

Q Have you read Mr. Chastain's handwritten note to Mr. Slack on February 28, which was right the day after the incident?

A No, I have not.

Q Just to be careful, was it offered to you and you didn't read it or was it never even offered to you to read?

A I'm sure I read it when this incident occurred, but not before this hearing, no. Or before the re-enactment.

Q Now if I can find this thing and go on to the second one.

At that instant when you had turned, your fanny pack was in back, was that correct?

A I guess I wasn't noticing. You'll have to rewind it.

Q At that position your gonads are closest to the exit port, is that correct, sir.

A It appears that way, yes.

Q And there your left thigh is closest to the exit

port, is that correct?

A Correct.

Q Go ahead, go ahead. At this point your gonads are directly the same level as the exit port before you climb down. Then you climb back up, now you're climbing back up the second step. I'll give the dialog, keep on going on here, please. Thank you.

You're on the second step from the top, is that correct, sir? But the thighs are closest to the exit port?

A Right.

Q The fanny pack was behind.

A Right.

Q You badged the fanny pack so the radiation has to go through the body to get to that badge, is that correct sir?

A Yes.

Q Correct me if I make mistakes. I do all the time.

Keep on going.

When you make a survey like that do you have the window so you can see the window at all times?

A Yeah.

Q For the record he's making a survey holding the survey meter in his hand with the needle with the window towards his eye so he can see it, he passes it around the

Amersham.

Thank you.

And I saw the end of it aimed straight at the exit tube, is that correct, sir?

A Yes.

Q When you do your surveys, do you do them above the camera or solely using the middle camera and cover the exit tube?

A Say that again.

Q Do make an effort to cover the exit port of the camera when you make a survey?

A Yes.

Q Thank you.

Now your back is to the camera and your fanny pack isn't back, I don't see it, is that correct, sir?

A Correct.

Q This is the third scenario --

A Right.

Q -- the guy [inaudible due to video tape] at this position you're on the which step?

A Second from the top.

Q You're turned around on the ladder so that your nback is to the ladder and your toes are pointed out?

A Correct.

Q And would there -- what kind of distance do you

think between your body and the exit port, some kind of guess?

A From my leg?

Q Yes.

A A few inches, maybe.

Q And now you are turning to your right facing away from the ladder, is that correct, sir?

A Uh-huh, correct.

Q And the freeze-frame, take a look at that, it frame or so back. Was your thigh closer to the exit port than the fanny pack do you think?

A I don't know if you measured it it's probably pretty close. I mean you're going at two different diagonals there.

Q Freeze it, please. As I see it your pocket is above the top of the camera. It would be better for the record, actually, Mr. Fay, if you described the relationship of your fanny pack to the exit port and your left thigh, back of the left thigh to the exit port, as far as what kind of distance they are. Which is closer or is one closer?

I make no suggestion of any answer.

A On that view it looks like my thigh is closer.

Q Thank you, kindly.

To people normally have you tape one of these

things?

A Yeah. If the cassette falls down?

Q Are these kinds of radiographs usually done by yourself or anyone else in the room or do you have a partner with you?

A Partner.

Q Do you have any reason to understand, to know why Mr. Chastain didn't have a partner with him on the 27th?

A No.

Q Thank you.

Again, is your thigh closer to the exit port of the camera than the fanny pack?

A It's hard to tell, but it does look closer in that view.

Q Do you think the fanny pack is farther in front of the exit port than perhaps the thigh due it protruding out from the body?

A It's possible.

Q Just a quick one. What all was in the fanny pack when you went up there?

A Dosimeter, rate alarm and film badge.

Q Did you put them in in any particular order? Do you have any knowledge or idea whether badge was the farthest --

A No.

Q -- piece of material out or other stuff was in front of it, or was it mixed up, do you have any idea what relation the badge is--

A No idea.

Q -- to the fabric or the outside?

A No. No.

Q Thank you, sir. Stop.

At this point, your fanny pack -- would you describe the relationship of your fanny pack to the exit port, your thigh to the exit port and some kind of concept of distance? I know we do not have a tape measure. I can ask these directly if counsel -- in fact when ever you want.

Is your fanny pack further from the exit port than your thigh?

A Yes.

Q By that I mean you left thigh?

A Yes.

Q Is your left thigh substantially closer to the edge of the port?

A I don't know about substantially, but as thick as my body.

Q It's at least your body closer?

A Yes.

Q As I look at this your left thigh is very close

to the exit port, but I wish you would take a look and say this is right, wrong and different. Is it an inch away, two inches away, four, five inches, do you have any kind of guess?

A Six inches, maybe.

Q Is there any way you can do a set up shot like that and have the fanny pack turned, for instance so it's closest to the exit port at all times? Have the fanny pack the same level of the exit port and have it three feet away from the exit port?

A Off that ladder?

Q Yes, sir.

A Pretty difficult.

JUDGE KELBER: And could you do that with the fanny pack one foot away?

THE WITNESS: Oh, yeah.

JUDGE KELBER: Thank you.

BY MR. BARTH:

Q Now because I don't know, you're going back out to crank the film, crank the source out so you can get the film shot, is that right?

A Correct.

Q When you leave the first time?

A Correct.

Q Thank you.

MR. BARTH: Just a few moments with my co-counsel.

BY MR. BARTH:

Q As you have already observed, you're taller than Mr. Chastain. Would he have, in your judgement, had to have been as high on the ladder or higher on the ladder to reach the I-beam, the top of the W-section where he put the film in the pipe in which he was working?

A He'd have to be at least the same level I was on.

Q And do you have any kind of feel, have you worked with Mr. Chastain for some years?

A I know who he is, yes.

Q And you stood up with Bill.

A Yeah, he's shorter than I am. A few inches.

Q Is he much shorter? How much shorter?

A A few inches shorter than me.

Q Thank you very kindly and I appreciate your -- did you like your film?

A Yeah.

Q Did you think your director had to really compensate you for this star performance?

A Say that again.

Q Did your director adequately compensate you for your star performance?

But in a more serious light, this is a pretty

routine sort of thing for you, is it not?

A Yes.

Q And the film, is it not, it's pretty representative of what goes on, at least in your experience as a radiographer?

A Yes.

Q Have you seen other radiographers do this kind of work on a step ladder --

A Yes.

Q -- with a camera on top?

A Yes. It's not advised, but yes.

Q Just as a judgement call by you, do you think that they pretty much do the same thing that you just showed us on these three examples?

A Yes.

Q One moment, sir.

Mr. Fay, I have enjoyed this exchange. I really have. It's been pleasant. You've been very cooperative. I appreciate your time. I have no more questions and I do appreciate your attention to the detail in the video. I think it has been helpful for us all to understand just how this thing goes and how it happens and on behalf of the Government, I appreciate you coming here, sir. Thank you.

A Thank you.

JUDGE COLE: Mr. Fay, in the set up you made your

best effort to reproduce the situation as depicted in Exhibits 21 and 22?

THE WITNESS: Correct.

BY JUDGE COLE:

Q Did you have those pictures with you --

A Yes.

Q -- and try to duplicate them.

A Yes, I did.

Q Just one more questions. How long is the yellow cord?

A Seven feet.

Q Seven feet? So based upon that knowledge, and this is a six foot ladder, how far above the top of the ladder would be the exit point or the end of the probe?

A I figure about four foot high.

Q Four foot above the top of the ladder I assume?

A Yeah, above the top of the camera about four feet.

Q All right.

CHAIRMAN BECHHOEFER: Mr. Fay, would it be, I shouldn't say possible, because anything's possible, but could you or the person who had radiographic exposure reasonably, could you reasonably have had the fanny pack situated between yourself and the source so that it would be, during the whole time of your operation, --

THE WITNESS: Yes.

BY CHAIRMAN BECHHOEFER:

Q -- closest to the source, could it be done?

A Oh, yes. Yeah. In fact I don't understand the reason for changing it from front to back as I read in his deposition in fact it was like "on my mind to make sure I changed it once I made my way up the ladder." I don't understand why he would change that from front to back.

Q So it would be --

A In working backwards off the ladder.

Q -- not unusual not to have the fanny pack --

A You can't work backwards off the ladder.

Q Well, no. I know that, but --

A It's tough.

Q -- in front of it always through out the whole operation.

A Right.

JUDGE COLE: Do you know other radiographers that wear fanny packs with their --

THE WITNESS: No, I do not.

BY JUDGE COLE:

Q -- with their equipment in it?

A Nope.

CHAIRMAN BECHHOEFER: Well, if you don't have a fanny pack, where does the badge go?

THE WITNESS: I buy special holders that sit on your belt. It sits right here.

BY CHAIRMAN BECHHOEFER:

Q Okay.

A You put the film badge descender in this pouch. And slide the rail on when you go.

Q Would you wear that in front?

A Yes.

Q Thank you. That's all I have.

MR. BARTH: I have a question on the Board's question.

CHAIRMAN BECHHOEFER: Go ahead.

BY MR. BARTH:

Q Mr. Fay, as a unit if you turn on the ladder, as you turn do you remove your badge from being pinned on your belt so that it's always closest to the source?

A When I'm working?

Q Yes, in your normal course of your business.

A No.

Q You pin it on and you leave it on.

A That's correct.

Q You take it off and you go home?

A That's correct.

Q Thank you kindly, sir. I have no more questions.

REDIRECT EXAMINATION

BY MR. BROOKS:

Q Let me ask you a couple of questions and I need to ask my friends here something.

If the ladder had been moved, let's say forward.

A Uh-huh.

Q Four inches from where you had it there?

A Uh-huh.

Q And you were working on the same weld, would that have changed the distances between your body and the exit port of the camera?

A You still have to climb the ladder, so.

Q Let me just ask you a question, I don't know where it's going but, the panel's questions. You had three different scenarios of what Mr. Chastain did, at least three in the case here.

A Right.

Q One being what he told Mr. Slack the day afterwards that he was facing in on the ladder, toward the ladder the whole time and twisting as he did the operation with his fanny pack in front of him.

A Okay.

Q You got a second story that he told the NRC on April 11th that he was facing forward during part of it and

turned away from the camera during part of it but with his fanny pack in front of him.

A Okay.

Q And then the third scenario that he testified to here on Monday that he was faced away from the camera with is fanny pack in back of him the whole time, what you read in his deposition.

A Right.

Q Just based on your experience of doing this re-enactment, do you have any opinion as to which of those would be most likely.

A Facing forward to the ladder. You don't climb a ladder and turn around. If you have to turn around, you get down and move it so it's in the proper position.

Q How about fanny pack?

A I wouldn't think that you would move your fanny pack around. Why do you put it on. I don't see anybody, you know, see any reason to.

Q No other questions. Thanks very much.

A Okay.

JUDGE KELBER: Thank you very much, sir.

MR. BARTH: I would like to make one follow up on Mr. Brooks.

CHAIRMAN BECHHOEFER: Yes, Mr. Barth

RECROSS EXAMINATION

BY MR. BARTH:

Q You mentioned that the ladder moved and I believe you testified you thought that Chastain may have moved the ladder, is that correct, sir.

A No, I don't think I said he may have moved it. During the normal course of radiography the ladder does move to get to the right spots.

Q Thank you kindly. You corrected me. I didn't understand.

CHAIRMAN BECHHOEFER: Anything further?

MR. BROOKS: Nothing further, Judge.

CHAIRMAN BECHHOEFER: Mr. Fay you're excused. I appreciate your efforts.

THE WITNESS: Thank you.

CHAIRMAN BECHHOEFER: Your showmanship.

Would you like to have Ms. Berger introduced and sworn, any technical materials introduced, then referring to her testimony, the substance would go for tomorrow, like we did for Dr. Cool.

MR. BROOKS: Sure. That would be fine.

CHAIRMAN BECHHOEFER: I know she's here and we would like to save as much time as we can.

MR. BROOKS: No problem and Ms. Berger will be

our last witness.

CHAIRMAN BECHHOEFER: I see Mr. Creech is not going to be with us?

MR. BROOKS: Correct. I haven't yet seen a need for the testimony we were going to have him give, so I'm pretty confident we'll be able to finish, should be able to finish by the lunch break tomorrow unless something controversial happens.

Hard to imagine that happening, huh?

Ms. Berger, can we call you as a witness.

CHAIRMAN BECHHOEFER: Yes. Ms. Berger, do you swear that the testimony you are about to give is the truth, the whole truth, and nothing but the truth, so help you God.

THE WITNESS: I do.

CAROL BERGER,

witness, was called for examination by counsel for the U.S. Nuclear Regulatory Commission and, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BROOKS:

Q Ms. Berger, would you please state your full name for the record?

A Carol Deanne Berger.

Q Ms. Berger, where do you reside?

A I reside in Gaithersburg, Maryland.

Q You can address the Board because no body really cares what I have to say.

Ms. Berger, where are you employed.

A I'm employed at Integrated Environmental Management.

Q Could I pass out a document with is Ms. Berger's professional qualifications and ask that that be bound into the record.

CHAIRMAN BECHHOEFER: Any objection from the staff? Any objection to the document?

MR. DAMBLY: No objection, Your Honor.

CHAIRMAN BECHHOEFER: Okay, then these qualifications will be bound into the record.

[Whereupon the document referred to was bound into the record.]

Carol D. Berger

Professional Qualifications

Ms. Berger has over twenty years experience in nuclear and radiological activities with emphasis in strategic planning, radiation dosimetry, instrumentation, and applied health physics. As a co-founder of **IEM**, Inc., Ms. Berger is actively involved in performance of radiological dose assessments, regulatory interactions, site decommissioning, program evaluations, program development, pathway analyses, risk assessments, dosimetry evaluations, assessment and control of sources of non-ionizing radiations, waste management programs, environmental monitoring programs, and detection and quantification of low-levels of radioactivity.

Education

M.S., Health Physics, San Diego State University, San Diego, California; 1979
M.S., Radiation Physics, San Diego State University, San Diego, California; 1977
B.S., Physics/Chemistry, San Diego State University, San Diego, California; 1972

Certifications

Certified Health Physicist (Comprehensive): American Board of Health Physics, 1983
Re-certified: 1987, 1991, 1995

Experience and Background

1994 - Present — *Founder, Integrated Environmental Management, Inc., Rockville, Maryland.*
Provides high-quality strategic environmental management services to commercial and government clients. As a member of the client's response team, works with clients to promote an understanding of what is required to achieve and/or maintain compliance in the eyes of all pertinent regulatory agencies, individually or jointly; develop an overall strategy for achieving compliance and reduce liabilities in a technically-sound, legally-defensible, and fiscally-conservative business manner; recommend specific solutions that are compatible with the client's operating philosophy; and provide insights into future regulatory issues and their impact as input to the client's long-range business planning and cost forecasting process.

1989 - 1994 — *Senior Technical Consultant, IT Corporation/Nuclear Sciences, Washington, D.C.*
Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Instrumentation; Emergency Response and Preparedness; Site Decommissioning; Radioactive Waste Management; Radiation Risk Assessment; Training; Licensing and Regulatory Negotiations; and Non-ionizing Radiation

1986 - 1989 *Senior Health Physicist, IT Radiological Sciences Laboratory, Knoxville, Tennessee* Performed health physics consulting for government and commercial facilities in Internal and External Dosimetry; Radiation Monitoring; Environmental Monitoring; Applied Health Physics; Instrumentation; Radioactive Waste Management; Training; and Non-ionizing Radiation.

1983 - *1986* *Radiation Dosimetry Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for internal and external dose assessment and programs for ORNL employees, visitors and contractors. Experience included Internal and External Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Site Characterizations; Personnel Management; and Training.

1978 - *1983* *Internal Dose Group Leader, Oak Ridge National Laboratory, Oak Ridge, Tennessee.* Responsible for development of the ORNL Whole Body Counter Facility for detection and quantification of the actinides in-vivo. Experience included: Internal Dose Assessment; Monitoring Program Design and Implementation; Instrumentation Development; Special Studies; Personnel Management; and Training.

1978 - *1986* *Adjunct Faculty, Oak Ridge Associated Universities, Oak Ridge, Tennessee.* Professional training courses and general classes in the following health physics and radiation protection areas: Internal Dose Assessment; In-vivo Monitoring and Bioassay Methodologies; Instrumentation, and Applied Health Physics.

1979 - *1980* *Health Physics and Dosimetry Task Group Member, President's Commission on the Accident at Three Mile Island, Washington, D.C.* Tasks included: Internal Dose Assessment from Whole Body Counting Results; Estimates of Source Term from in-plant Monitoring Systems; Atmospheric Dispersion Modeling and Population Dose Assessment; and Development of Health Physics Sequence of Events.

Professional Society Membership

American Academy of Health Physics (President, 1995; Executive Committee, 1995-1997; Chair of Strategic Planning Committee, 1997)
Health Physics Society
Baltimore-Washington Chapter - Health Physics Society (Treasurer, 1993-1994)
Sigma Xi - Scientific Research Society
American Bar Association, Section of Natural Resources, Energy, and Environmental Law

Publications

Over 30 professional publications; over 40 oral presentations; over 100 technical reports; more than 15 training courses taught.

Other Appointments/Awards

East Tennessee Chapter - Health Physics Society (President, 1986; President-Elect, 1985; Secretary, 1981-1982)

San Diego Chapter - Health Physics Society (Charter member)

American Board of Health Physics, Comprehensive Panel of Examiners, 1989-1993.

ASTM Task Group E-10.04.27 "Transuranic Wound Analysis"; 1986 to present

ANSI Standards Committee (ANSI N13.41) on Multiple Badging; 1986 to 1996 (Chairman, PlanCo-59 Working Group, 1990 to 1996)

ANSI Standards Committee (ANSI N13.39) on Internal Dosimetry Programs; 1994 to present

NCRP Scientific Committee 46-10, "Assessment of Occupational Exposures from Internal Emitters", 1989 to present.

Member of the Health Sciences Advisory Council for the School of Health Sciences, Purdue University, 1995 to 1998.

DOE/IAEA Whole Body Counter Intercalibration Committee (1980-1986)

Consultant to Knoxville Academy of Medicine, Mass Casualty Simulation (1984-1985)

Consultant to the National Cancer Institute to Evaluate Devices and Techniques to Determine Previous Radiation Exposure under Public Law 98-54 (Award for participation presented by Oak Ridge Associated Universities, April, 1988.)

Steering Committee Member, U. S. Department of Energy Task Group on the Education of Future Health Physicists - 1989 to 1991.

Technical reviewer and referee for *Health Physics*, *Nuclear Technology*, and *Radiation Protection Management*

IT Corporation *Distinguished Technical Associate* - June, 1992.

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Presentations and Lectures

"Calibration of a Large Hyperpure Germanium Array for In-Vivo Detection of the Actinides with a Tissue Equivalent Torso Phantom," ORNL Workshop on Calibration of Actinide Lung Counters, Oak Ridge, Tennessee, May 10, 1983.

"Operational Internal Dosimetry," San Diego Chapter, Health Physics Society Annual Meeting, La Jolla, California, November 21, 1983.

"Radiation Protection in the Nuclear Industry," Aquinas Jr. College, Nashville, Tennessee, December 6, 1983.

"HpGE for In-Vivo Detection of the Actinides," ORTEC Workshop on Germanium Detectors, Oak Ridge, Tennessee, April 1, 1985.

"Long-Term Retention of Thallium-202 in a Patient after Thallium-201 Administration," 23rd Annual Meeting of the Southeastern Chapter of the Society of Nuclear Medicine, Charlotte, North Carolina, October 27-30, 1982.

"Two Years of Oak Ridge Involvement in the TMI Incident," Report on the President's Commission Task Group, East Tennessee Chapter, Health Physics Society, March 16, 1981.

"Internal Dosimetry," Y-12 Studio Training Film, June 9, 1981 (Videotape).

"The ORNL Whole Body Counter," ORNL Research Committee, Oak Ridge, Tennessee, October 7, 1981.

"An Alpha-Beta-Gamma Spectrometer as an Aid in Directing Decontamination of Soils," 1981 Winter Meeting, American Nuclear Society, San Francisco, California, December 2, 1981.

"ORNL Participation in Knoxville Academy of Medicine Mass Casualty Simulation," IS&AHP Seminar, ORNL, Oak Ridge, Tennessee, January 18, 1980.

"Health Physics and Dosimetry at Three Mile Island," ORAU Medical and Health Sciences Division Seminar, ORAU, Oak Ridge, Tennessee, April, 1980.

"What's So Good About the ORNL Whole Body Counter?", IS&AHP Seminar, ORNL, Oak Ridge, Tennessee, December, 1980.

"Operational Status of ORNL Whole Body Counter Instrumentation: Comparisons Between a HpGe Array and a Phoswich Detector," LASL/DOE Workshop for Low-Level Transuranic Measurements, Los Alamos, New Mexico, March, 1980.

"Radiation Release and Health Effects Lessons from the TMI Incident: Assessment of Objective Risks for Emergency Preparedness Planning," Kentucky Special Advisory Committee on Nuclear Issues, Northern Kentucky University, Highland Heights, Kentucky, November, 1980.

"A Rapid Method of ^{131}I Detection in Milk," Health Physics Society Annual Meeting, Philadelphia, Pittsburgh, July, 1979.

"^{210}Pb in the Lungs of Smokers," North Carolina Chapter Health Physics Society Annual Meeting, Boone, North Carolina, October 26, 1979.

"Comparison of a HpGe Array and a CsI-NaI Phoswich Detector," Health Physics Society Annual Meeting, Philadelphia, Pittsburgh, July, 1979.

"Quality Assurance at the ORNL Whole Body Counter," Radiation Protection Committee, ORNL, Oak Ridge, Tennessee, August 15,1984.

"Validation of Calibration Factors for Long-Term $_2{}^{41}Am$ Deposition Measurements in Humans," 29th Annual Meeting, HPS, New Orleans, Louisiana, June 5, 1984.

"Health Physics and Dosimetry at Three Mile Island," Comparative Animal Research Laboratory Safety Seminar, CARL, Oak Ridge, Tennessee, March, 1980.

"Operational Internal Dosimetry" - East Tennessee Chapter, HPS Technical Meeting, Pollard Auditorium, Oak Ridge Associated Universities, March, 1986.

"The Hot Particle Issue - Review of Papers Presented at the Annual HPS Meeting" - ETC-HPS Technical Meeting, Pollard Auditorium, Oak Ridge Associated Universities, July, 1987.

Berger, C.D., "Skin Dose - A Hot Issue", presented to the East Tennessee Chapter, Health Physics Society, April 19, 1988, Knoxville, Tennessee.

Berger, C. D., "Americium-241 Release (Sampling, Monitoring and Bioassay)", presented in a special session on the Wright Patterson Air Force Base Americium-241 Contamination Incident at the 1991 Health Physics Society Annual Meeting, Washington, D. C., July 23, 1991.

Berger, C. D., "Reconstruction of Radiation Doses in the Event of Litigation", presented at *Nuclear Materials Licensees Regulation Briefing*, Session 8, "Minimizing the Risk and Maximizing the Defense: Radiological Injury Litigation", The Grand Hotel, Washington, D. C., June 9, 1992.

Berger, C. D., "Risky Business - Renewing our Faith in the Health Risk Assessment Process", IT Corporation Technology Symposium, Scottsdale, Arizona, June 2, 1993.

Berger, C. D., V. P. Gupta, M. L. Howe, C. G. Hudson, P. M. Neeson, K. H. Pryor, W. D. Reece, D. A. Stevenson, D. E. Velkley, and R. C. Yoder, "Criteria for Performing Multiple Dosimetry", Special Session on Effective Dose Equivalent, Health Physics Society Annual Meeting, Atlanta, Georgia, July 12, 1993.

Berger, C. D., "Decommissioning Nuclear Sites and Facilities", Special Lecture, Chemistry 505, Hazardous Waste Management, George Mason University, Fairfax, Virginia, April 20, 1994.

Berger, C. D. "Quality Assurance in Internal Dosimetry Programs", 1994 Health Physics Summer School, University of California, Davis, California, June 24, 1994.

Berger, C. D., and J. P. Reynolds, "Practical, Regulatory and Legal Aspects of Naturally-occurring Radioactive Materials", presented to the Petroleum Landmen's Association of New Orleans, 7th Annual Oil and Gas Seminar, Beaver Creek, Colorado, January 25, 1996.

Berger, C.D., "Performing Radiation Surveys at an Exploration/Production Facility - Determining Compliance with the Intent of Rule 69", presented at the Mid-Continent Oil & Gas Association Oilfield NORM Seminar, Jackson, Mississippi, August 6, 1996.

Berger, C. D., D. E. Bihl, E. M. Brackett, D. R. Fisher, F. E. Gallagher, J. P. Griffin, R. B. Holtzman, W. S. Loring, K. S. Thind, "Draft ANSI N13.39, American National Standard for Design of Internal Dosimetry Programs - Minimum Acceptable Requirements", presented at the 42nd Annual Meeting of the Health Physics Society, San Antonio, Texas, June 30, 1997.

Training Courses (Classes) Given

"Laboratory Assessment of Body Burden," REAC/TS Training Course for Emergency Medical Personnel, 1978-1983, Oak Ridge Associated Universities.

"Radiation Detection Instrumentation," REAC/TS Training Course for Emergency Medical Personnel, 1978-Present, Oak Ridge Associated Universities.

"Whole Body Counting," Five-Week Training Course for Health Physics Personnel, 1979-1986, Oak Ridge Associated Universities.

"Bioassay," Five-Week Training course for Emergency Medical Personnel, 1979-1983, Oak Ridge Associated Universities.

"Internal Dosimetry," REAC/TS Training Course for Emergency Medical Personnel, 1978-1983, Oak Ridge Associated Universities.

"Special Detectors/Instrumentation for Low-Level Counting," Ten Week Training Course for Health Physics Personnel, 1979-1981, Oak Ridge Associated Universities.

"Basic Radiation Protection," REAC/TS Course for Health Physics Technicians, 1978-1982, Oak Ridge Associated Universities.

"NRRPT Review Course-Bioassay/Whole Body Counting," East Tennessee Chapter Health Physics Society, 1979-1986, Oak Ridge, Tennessee.

"ABHP Review Course - Whole Body/Lung Counting," East Tennessee Chapter Health Physics Society, 1979-1984, Oak Ridge, Tennessee.

"In-Vivo Detection of Internally Deposited Radionuclides," TVA Operator Certification Program, 1982, 1983, Sequoia Training Facility, Chattanooga, Tennessee.

"Radiation Monitoring," ORNL Technician Orientation Course, 1981, 1982, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

"Lung Counting," Five-Week Training Course for Health Physics Personnel, 1980,1983, Oak Ridge Associated Universities.

"NRRPT Review Course - Personnel Dosimetry," 1984-1986, Oak Ridge, Tennessee.

"Principles of Whole Body Counting" - Health Physics Society Professional Enrichment Program, Salt Lake City, Utah, July 5, 1987.

"Practical Internal Dosimetry for Operational Health Physicists", presented to health and safety personnel, Calloway Nuclear Plant, Union Electric Corporation, Columbia, Missouri, January 16, 1989.

"Real-Life Whole Body Counting", (IT Corporation Report No. IT/NS-89-111) Professional Enrichment Program, Annual Meeting, Health Physics Society, June 25, 1989, Albuquerque, New Mexico.

"Safety Light Corporation - General Employee Training in Radiation Protection", developed (including videotape) and presented to Safety Light Corporation and USR Industries employees, Bloomsburg, Pennsylvania, June 30, 1988.

"Radiation Worker Training -- Armed Forces Radiobiology Research Institute", developed and presented (including videotape) to the Safety and Health Department, Armed Forces Radiobiology Research Institute, Bethesda, Maryland.

"General Employee Training in Radiation Protection", presented to GE-Lighting, Cleveland, Ohio (with K. Ladrack).

"Radiation Worker Training for General Electric - Lighting Division", presented to GE-Lighting, Cleveland, Ohio (with S. J. Layendecker).

"Site Specific Internal Dose Assessment and Internal Radiation Monitoring", presented to Union Electric Corporation, Callaway Nuclear Plant, January 20-24, 1992, Fulton, Missouri.

"Skin Dose Assessment", presented to the U. S. Nuclear Regulatory Commission, Region I, October 13-14, 1992, King of Prussia, Pennsylvania.

"Skin Dose Assessment", presented to the U. S. Nuclear Regulatory Commission, Region II, December 10-11, 1992, Atlanta, Georgia.

"Skin Dose Assessment", presented to the U. S. Nuclear Regulatory Commission, Region III, April 5-6, 1993, Glen Ellyn, Illinois.

"Internal Dosimetry", Course H-312, presented to the U. S. Nuclear Regulatory Commission, Technical Training Center, June 28-July 2, 1993, Chattanooga, Tennessee (with S. H. Fong)

"Internal Dosimetry for the Applied Health Physicist", presented to Illinois Power, Clinton Nuclear Station, August 3-5, 1993, Clinton, Illinois.

"Internal Dosimetry", Course H-312, presented to the U. S. Nuclear Regulatory Commission, Technical Training Center, March 7-11, 1994, Chattanooga, Tennessee (with S. H. Fong).

"NORMalizing Radiation Protection Programs", presented at the Edison Walthall Hotel, Jackson, Mississippi, October 21, 1994 (with B. A. Kelly and J. P. Reynolds).

"Interactions of Radiation With Matter", Baltimore-Washington Chapter HPS Basic Radiological Health Course, National Institute of Standards and Technology, October 27, 1994.

"Understanding Radiation Protection Programs - Practical Methods for Demonstrating Compliance with State Regulations", presented at Kay-Ray/Sensall, Inc., Mount Prospect, Illinois, May 1, 1995.

"Managing Radiation Protection Programs - Demonstrating Compliance with U. S. Nuclear Regulatory Commission Regulations", presented at Shieldalloy Metallurgical Corporation, Newfield, New Jersey, May 17, 1996.

"Internal Dosimetry", presented to the Radiation Safety Department, USDOE Pantex Plant, Steptember 9-13, 1996, Amarillo, Texas (with S. H. Fong).

"Not Only Unraveling the Thorium Mystery, but Doing Something About It (Or How to Keep Thorium from Becoming a Thorn in your Side)", Professional Enrichment Program, 42nd Annual Meeting of the Health Physics Society, San Antonio, Texas, June 29, 1997.

"Review of Important Internal Dosimetry Concepts", presented at the Baltimore-Washington Chapter HPS Certification Review Course, USNRC Building 2, February 19, 1998.

MR. BROOKS: Do you want us to go a little bit further with this with her background or do you want to take up with the substance in the morning?

JUDGE KELBER: I think we should go to the point where you are ready to get into the substantial material and then we can break.

MR. BROOKS: Fine, sir. There is not objection, I take it to Ms. Berger testifying as an expert, so I don't need to go through her qualifications?

MR. DAMBLY: No objection.

CHAIRMAN BECHHOEFER: Yes, does the staff --

MR. DAMBLY: I said no objection.

CHAIRMAN BECHHOEFER: Oh, I'm sorry, I didn't hear it.

BY MR. BROOKS:

Q Ms. Berger, would you describe the areas of your expertise?

A Primarily instrumentation in internal and external dosimetry.

Q Would you explain what internal and external dosimetry refer to?

A The determination of radiation dose from sources that are either inside of the body, referring to internal dosimetry, or outside the body for external dosimetry.

Q Can you describe your education in the area of

dosimetry?

A Well, I didn't take a class called dosimetry. Well, no, I take that back. I did as a matter of fact. That was primarily a medical physics course where we had done dose assessments from external beams of radiation. It might be cobalt teletherapy, it might be radiotherapy or some other form of either diagnostics or therapy and administration of medical rating new clients as well.

Q Related to your expertise in dosimetry, do you ever have occasion to use what we've referred to here as weighting factors?

A Yes. You always use weighting factors whether you explicitly call them out or not, but every dose assessment takes into account, if you are going to compare it to any kind of a dose limit whatever that limit might be, you always have to take into account the relative risk associated with the radiation of each organ individually.

Q Does your expertise in the area of dosimetry therefore include expertise in weighting factors, the use of weighting factors?

A Yes. Back, and I'm wanting to say it was in the early '80's but, I'm not really sure of the date, the Department of Energy, I worked for a Department of Energy contractor at that time. Had an order that required that you use the ICRP26 Organ Weighting Factors for all dose

assessments, internal, external, uniform and non-uniform exposures. So back at my place of work at that time we did quite a number of external dose assessments using compartment factors.

JUDGE KELBER: You said using compartment factors?

THE WITNESS: Compartment factors.

JUDGE KELBER: That was when?

THE WITNESS: In the '80's. I can't remember if it was pre '85 or post '85. It's somewhere in the '80's.

BY MR. BROOKS:

Q You just mentioned a term compartment factors, can you identify what that means?

A A compartment factor is, there are compartments of the body that contain more than one organ and it's in essence a distribution of the ICRP Weighting Factors based upon where they reside within a particular compartment. For example in the abdominal compartment, maybe only thirty or thirty-five percent of the bone surfaces may be included there and maybe in the thorax you've got another thirty or thirty-five percent. So you are in essence compartmentalizing the weighting factors that the ICRP gave.

Q We'll get to that in some more detail tomorrow, I think.

Can you describe the experience that you've had in your career in using multiple dosimetry and weighting factors.

A We used to put multiple, a number of dosimeters on our. Let me step back for a second. I head of the Radiation Dosimetry Group at Oak Ridge National Laboratory and we did both internal and external dosimetry and we had a number of projects going on at that time. We had used a lot of multiple dosimeters because we did have conditions of non-uniform fields. So we knew that the radiation exposure to these individuals was not uniform from head to toe.

Q You just mentioned a term, non-uniformed fields. What does that mean?

A Meaning that the radiation dose rate is higher in one portion of the body then it is in another portion of the body.

Q Is there a relationship between the existence of non-uniform fields and the need for or use of multiple dosimetry?

A Yes, there is. If I understand the question correctly, if you are radiating only a portion of the body to a much higher level than a other portion of the body, you can't compare the dose to that portion of the body to an effective dose limit. When we were doing multiple

dosimetry, one of the things I was responsible for was comparing the doses for these individuals that are being able to show that the doses for this individuals was below the regulatory dose limit.

Q And is there also a relationship between the existence of non-uniform fields of radiation and the use of weighting factors?

A Is there a relationship, yes.

Q What is that?

A That's the purpose of the weighting factor is to make sure that when you are assessing dose to many and various organs and then you add them all up you don't end up with a higher dose than if you had radiated the body uniformly.

I'm not sure I said that correctly, but.

Q Have you done any teaching in the area that involved the use of weighting factors?

A Yes, I been teaching course in internal and external dosimetry for quite a long time and the ICRP Weighting Factors, which don't distinguish between internal and external, we use those in every single class. We discuss those.

Q Have you been involved in the creation of any standards involved in weighting factors?

A Yes, the NCN 13.41, I was the second chair of

that committee, I was not the first chair.

MR. BROOKS: I guess I'd like to take a break for the day. I think we are about ready to get into --

JUDGE KELBER: Could I please give Ms. Berger a take-home exam.

MR. BROOKS: Absolutely, we'd feel left out if she didn't get one.

MR. DAMBLY: I was going to complain if you didn't give her one.

JUDGE KELBER: Oh, I came prepared. Have ICRP Publications --

MR. BROOKS: Hold on a second, could we give her something to take down the exam with?

JUDGE KELBER: Have ICRP Publications related to Publication 26 been issued in the year since that publication?

THE WITNESS: Meaning has the ICRP revised it's --

JUDGE KELBER: Revised, extended.

Have they prepared any publication which addresses the issue of compartmentalization in some fashion?

And finally, what I have written here is what is the thrust of those publications, but I mean a quick summary of the import of those publications and their

relationship with your dosimetry in non-uniform fields.

Judge Bechhoefer would like to add a codicil. Is there any guidance from the ICRP on who to use the various weighting factors if they address them, compartment factors in non-routine or accident situations.

That's fine. Thank you. Will you break now until tomorrow morning?

CHAIRMAN BECHHOEFER: Yes. Thank you for your -- We'll see you again in the morning and we'll adjourn for the day. 9:00 o'clock tomorrow.

[Whereupon at 5:37 p.m. the hearing was recessed to reconvene at 9:00 o'clock a.m. on Friday, September 18, 1998.]

REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

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were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Official Reporter
Ann Riley & Associates, Ltd.