ORIGINAL

NUCLEAR REGULATORY COMMISSION

In the Matter of: PUBLIC MEETING ON PERSONNEL DOSIMETRY PERFORMANCE TESTING

DATE: May 29, 1980 PAGES: 176 - 275

AT: Washington, D. C.

ALDERSON REPORTING

400 Virginia Ave., S.W. Washington, D. C. 20024

Telephone: (202) 554-2345

ORIGINAL

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

PUBLIC MEETING ON

PERSONNEL DOSIMETRY PERFORMANCE TESTING

- - -

General Services Administration
18th and F Streets, Northwest
Washington, D.C.
Auditorium

Thursday, May 29, 1980

Pursuant to notice a public meeting on Personnel Dosimetry Performance Testing was held by Robert E. Alexander and Nancy A. Dennis of the Nuclear Regulatory Commission in conjunction with the Interagency Policy Committee members at 8:40 a.m.

BEFORE:

ROBERT E. ALEXANDER, NRC.

NANCY A. DENNIS, NRC.

DONALD ROSS, DOE

ELMER EISENHAUER, NBS

MARGARETE ERLICH, HPSSC

LARRY L. LLOYD, STATE OF MONTANA

PHILLIP PLATO, UNIVERSITY OF MICHIGAN

COL. ROBERT WANGEMANN, DEPARTMENT OF ARMY

LUIS F. GARCIA, EPA

SHELDON WEINER, OSHA

DONALD THOMPSON, BRH, FDA

P R O C E E D I N G S

MR. ALEXANDER: Welcome to the second day of the Public Meeting on Personnel Dosimetry Performance Testing. We're glad to have you back this morning. The only topic to be covered is quality assurance and I feel fairly certain that we can finish by noon. Some of the quality assurance discussions have already taken place. Ellery Storm from LASL made his presentation on quality assurance yesterday, as did Manny Jimenez.

Before we adjourned yesterday, I gave you some homework to do, and I wonder if anyone really went to the trouble to think about the elements of a quality assurance program or the criteria for a quality assurance program that the Certification Board should use in making a decision about a certifying laboratory. Anybody? Do you want to do that verbally or in writing?

MR. MELLOR: I might do it verbally anyway. My presentation will cover those elements.

MR. ALEXANDER: Okay, do it that way, and then when you come to that part for the benefit of the transcript as we use it later, identify very carefully that these are the elements that you feel should be included in the regulation, if there has to be one.

Oh yes, Greta. I suppose that of all of us here who are interested in this problem, Greta was the first among us -- would you say that's probably true, Greta?

DR. ERHLICH: Among the people here, probably yes.

Except maybe for Ellery.

MR. ALEXANDER: Well, maybe we'll see it happen.

The session this morning I feel will be primarily you people talking to us. Yesterday, there was a lot of government people talking to you; today, we're going to try to learn as much as we can about quality assurance which has always been a somewhat elusive topic for me. And one of the difficulties that we do have in drafting regulations or regulatory guides is the fact that on a fixed staff like we have at the Regulatory Commissio we just can't have an expert on every topic. And, of course, we don't have an expert on quality assurance for personnel dosimetry processing. We do have a quality assurance engineer whom you may have met yesterday. He was here and spoke for a few moments and can help us in general terms. But as far as the technical details of the quality assurance program for this type of endeavor, we need to find out at this public meeting as much as we can to help us make a good proposal to the Commissioners when we go out with a rule for comment.

So let me encourage you to speak out this morning if you have any qualifications at all in this area or understand it at all to give us the benefit of your views so we can use those views in the development of these proposed regulations.

I believe, Greta, to get all of the government spokesmen out of the way as early as possible, I'll call on you now to give us the benefit of your thinking on the quality assurance aspects

of this effort.

DR. EHRLICH: Actually, what I wanted to say pertains to quality assurance and the standard N13.11. I should like to point out that an element of quality assurance was actually deliberately built into the standard, although some people probably don't realize it.

Now, if a processor plans to cheat on the tests, of course, by treating the test dosimeters differently from the rest of his workload, it's not going to be quite clear whether the quality assurance idea will work. However, if he doesn't cheat, in a very sophisticated manner one can find out whether he cheated or not since we recommend certain methods to test the consistency of his entire work process.

Unfortunately, just as the consensus of the work group was to leave the requirements for angular dependence tests in the standard, which conveniently yesterday I forgot, their consensus was to move the consistency tests into the appendix. Nothing I could do about that.

As you know, the performance criteria are stated in terms of systematic and random uncertainties in the test results. And we recommend that the testing laboratory maintain plots of these quantities; namely, random and systematic uncertainty which we can also call as represented by the standard deviation and the bias; that they maintain plots of these quantities against time, four consecutive tests.

A significant change in the bias or the standard deviation then would -- I should say a significant change that is not made deliberately by the processor would indicate that his process is out of control. Now, to determine what is significant; namely, what changes in the bias and the standard deviation are to be considered significant, we have specifically stated statistical tests that can be performed.

Now, if the NRC or another regulatory is interested in quality assurance testing, I would suggest that they should consider specifying that the testing laboratory perform the recommended consistency tests which are now in the appendix to the standard. And if necessary and feasible, they might want to specify they have performed both on open and on blind performance tests, if cheating should be or could be a difficulty. And that's all I wanted to add.

MR. ALEXANDER: Thank you, Greta. The way our initial thinking is running about the quality assurance program, and using that term quality assurance, is I'm not sure one that you would endorse or condone. But we have in mind that the quality assurance program, as we would use the term in the regulation, would refer to the inhouse program on the day-to-day basis that the processor would use to assure quality. And then the test and ceritifcation program operated by the government we would, I guess, refer to as the outhouse program.

Now, the reason I think that there may be problems about

that is that I know that at Eberline, for example, their quality assurance program, what they call their quality assurance program, consists of an outhouse type testing program. In other words, they send badges to a testing laboratory, just as they would under the program we're contemplating. So it isn't really a day-to-day inhouse type operation that we're thinking about in quality assurance. And since that's true of Eberline it may be true of many other processors, also. We don't know.

But at any rate, at least to start off with until we get our minds changed for us, we're thinking in terms of an inhouse program for quality assurance, and then a test and certification program operated by the government which would involve probably an annual test experience.

Our first prepared speaker from industry, if I can use that term, is Jack Selby from Pacific Northwest Laboratories. Jack, if you're ready we'll have your talk at this time.

MR. SELBY: While we're setting up with the slides, Bob, my feeling is that quality assurance has got to encompass, correctly as you have indicated, both the processor and the testing facility. But I think it also has to go beyond that and start with the user, and I was reflecting that a number of the items that were mentioned yesterday I believe by the gentleman from Duke as part of the quality assurance program, are also identified in ANSI in 13.5 I believe is the correct number. Anyway, the record stand, the old N2.2. Where they're suggesting

that you keep the backup type of records that demonstrate the quality of the program. So I think there is a lot of guidance already in existence. It's just not pulled together in one spot.

What we did is we kind of split the DOE presentation into four pieces and we gave one-quarter of it yesterday, and I wanted to try to give a little bit of an overview leading into the rest of the program.

As Don said yesterday, the Department of Energy and its contractors support the concept of certification as part of the quality assurance program for good dosimetry. The Department of Energy and its contractors and the predecessor have been a part of a number of studies that have gone on for several years. Those studies at least date back to 1961 with some work that was prompted by Les Rogers; later on sometime in 1965 there was a study, a rather large, lengthy study, of both the AEC contractors and licensees that Carl Enrue and Harold Larson of our group were involved in. Later on, not very closely behind that, was the work out of NSF and so on. So, the Department of Energy continues to support this effort.

Don also said that they would no doubt adopt the program when it comes into existence. It's our perception that that's true. As to how it is implemented within the Department of Energy contractors because of flexibility problems that we face is perhaps a little uncertain. In talking with Ed Vallario, it's our impression that when the standard is complete and the regulator

guidance from NRC is complete to the point where it's a fact, I think there will be a technical committee put together within Department of Energy to review the overall position, review what's available, show themselves that the laboratory that's chosen can provide the necessary flexibility in testing that we feel may be needed with the DOE contractors. A little bit later I'll mention why we feel that need for flexibility.

The DOE programs are quite diverse, and the reason they are is that they literally encompass every form of radiation and every energy level of radiation that health physicists today are faced with. The work varies from fusion research to the low-level waste disposal; mixed radiation fields are normally are beta, photon and neutron in many of our facilities. And then we have the accelerator work, highly complex fields involving heavy ions and so on.

So, the nature of the dosimetry problem is complex and by virtue of that, the dosimeters themselves are complex, and usually quite unique to the specific site, and usually unique in terms of interpretation to what we feel is our major problem.

Consequently, the calculations that are performed in evaluations might not be appropriate if we were using strictly a routine source that is identified within the standard iteself. I think Craig Yoder mentioned yesterday that there's a great deal of concern now within several of the major contractors involved in the fast fuels work, the LMF BR and so on, where they're

experiencing the Sodium 24 energies, perhaps a lot more Nitrogen 16 than in the past; some of the other fuels like U-233 with the higher energy photons. These all are causing additional problems in terms of calibration and interpretation, and they certainly may cause problems in terms of test and evaluation of the dosimetry program.

I mentioned some of the early specifics; that is, within the DOE laboratories. The last several years, as a result of the lead lab role that was assigned to Battelle in the health physics area, we have been coordinating a number of studies which again, I feel fall within the quality assurance area for the Department of Energy. When I say coordinate, this is a little different approach than has been done in the past in many of the studies. Currently, many of the major studies involved direct representation from a number of the major contractors within the DOE family in the development of the data, and the reports themselves then come under scrutiny of a committee that has been set up of senior health physicists from various contractors. That committee currently I think is about eight. So hopefully, the results of these studies will be usable to the majority of the DOE contractors and certainly will well represent the current picture.

It was mentioned yesterday that knowledge of your dosimetry -- of the capabilities of this backup information, records and so on is extremely important. And the emphasis in the last couple of years within the DOE family has been to try

to better document the dosimetry programs, and to understand the similarities and the differences between the contractors. This was prompted I think primarily by one of the first studies that I'd like to mention and that is that with the possibility of lowering occupational exposure limits arising from the petitions by Natural Resources Defense Council and others, DOE took a long, hard look at the occupational dose limit impact that could result by lowering the limits to 2.5 rem, 1½ rem and .5 rem, and a report DOE/EV0045 resulted from that particular study.

Another one that is currently going on, the report is about complete, is looking at the basic neutron dosimetry methods at the various DOE laboratories. The report number on that is PNL3213. Again, this is trying to characterize what is the current programs that are available. One of the problems that we're running into is that even though a lot of work has gone into the development of these sophisticated dosimeters, the documentation behind that work is not as strong as we would like to see it. Looking at the study on the occupational records and a survey of the minimum sensitivity, what penetrating level are you measuring your dosimeters, is it one centimeter or 5 centimeter depth, or so on. We're finding that in many instances that maybe is having to be developed; the information is not readily available.

The last one that I would like to mention is the Personnel Dosimetry Calibration Procedures, and this one Craig will be talking on a little bit more when he gives his presentation.

12

As I said, the programs within the DOE family are quite varied in terms of the impact on dosimetry. And therefore, in addition to the studies that have been sponsored by headquarters most of the laboratories have conducted a series of studies within their own organization. Some of these are documented in the open literature, and in other cases they are simply an operational tool and they have not necessarily been readily available. Most of these studies are laboratory-specific; they're designed to meet unique requirements.

Obviously, they're program-oriented, and that program changes. For most contractors, it has changed fairly significantly through the 20 to 30 years that a contractor site has been in operation. I can recall, for example, that in the early sixties after SL-1, one of the major emphases in many of the contractors who had situations where they could have a serious criticality accident was the development of accident dosimetry, both area and also within the dosimeters themselves. Neutron sources have gained a great deal more attention recently, and in some instances -- and I can think of one of our reprocessing plants -- beta dosimetry has been a rather significant problem.

So, each of these programs has been designed to solve a particular problem of the individual contractor and they are not necessarily applicable to other contractors or even to the rest of the industry.

The other thing that I feel is that there is a time

dependency, a time-dependency reflects the attitude, I think, of the industry and, for a while, and later on perhaps, an attitude of the regulatory agencies or the general public. Certainly now, we've reached the point where with the stress for lowering occupational exposure limits, one of the areas that we're all going to have to be concerned with more and more is the improvement of the sensitivity of these dosimeters. If we find ourselves working at lowered limits, perhaps even as low as a half a rem per year eventually, then we cannot afford to have the fluctuation and the scatter that we currently have in the low end, so there's going to be a great deal more pressure to reduce that. That might be by length and the frequency between processings or by improving the technology if possible.

The other area that I think is going to really significantly stress all of us in the next few years is, if the quality factor is changed on neutrons, then an already tough problem will be almost an impossible problem at the levels of protection that we'll be working with.

We feel that quality assurance is more than just quality control of dosimeter calibration and dosimeter processing, and that's certainly an important part of that. But the dosimeter data that results from these programs and from the control that you place on them must accurately reflect the field conditions. Generally, the dosimeters do exactly what the physics suggest that they'll do, and the problem is in being able to develop

the factors that will accurately extrapolate from the measurement in the dosimeters to what the people have been exposed to in the field. This will dictate, I think, further studies for all of us in the future in better identifying the energies that our people are exposed to if we're going to apply the quality beyond the quality of the basic dosimeter and the basic calibration.

As I mentioned, DOE has begun a study of an intercomparison program for use by different DOE laboratories. Craig will be addressing that. We feel a wide choice of calibration sources will be required in order for us to allow the individual laboratories to more closely match the radiation field of the irradiated dosimeters with those observed in the field.

This program may lead to an ongoing DOE certification program parallel to one that would be specified by the NRC regulations, or it could very well be directly using that particular program; again, depending on the satisfaction that the flexibility of the laboratory that is selected, that the flexibility will permit following more closely some of the energy problems that we've been faced with.

For my part of it, without dealing with some of the other, I think that's about all I wanted to say. If there are any questions I'd be happy to answer them.

MR. HILL: Michael Hill from Mason and Hangar. Did you say that those studies that were up there have been completed or are in the process right now? Say, for instance, neutron

dosimetry methods and, for instance, personnel dosimetry calibration procedures?

MR. SELBY: The calibration procedures, as I said, that's a study that's ongoing, it's due to be completed next year. The neutron dosimetry one, the final report is ready for printing now, so the study is complete, has been reviewed by this ad hoc group, whatever you want to call it,this group that was put together at headquarters to review the studies. And the EV0045, that one is out, and that particular document is available through the Document Room or perhaps through headquarters.

MR. HILL: What I was thinking is, for instance, at our facility we have a neutron source which we can get real good producibility but, for instance, because of scattering, wanting to know a correction factor because of the building, the distance away from the source; we're trying to come up with correction factors where really not sure where we can get that type of i ation. Contacting Phil Plato at the University of Michigan, we round out that the National Bureau of Standards practically gave him all the data, and he wasn't sure how they arrived at the actual doses. And then also with the amount of shielding to thermalize the neutrons; how they actually got that.

And I'm thinking that maybe it might be wise to include in this standard that the Nuclear Regulatory Commission presents, maybe having some guidelines on actually calibrating neutron sources or maybe the NBS could come t and calibrate our

neutron source at the facility that we have so ' t we can match what the testing laboratory has. This is a concern of ours for neutron and neutron spectrum.

MR. SELBY: I think that's one of the areas that probably the study that Craig is going to present will at least partially address. Greta, I don't know whether you have any response from NBS or not.

DR. EHRLICH: Yes, I do. First of all, the data that are in the standard and that were used by the pilot testing laboratory were developed at the Bureau of Standards by Charlie Eisenhauer, who has been doing for many years the shielding calculations. And he is in a position to develop data for other geometries as well, and I'm just wondering whether you're familiar with his work or whether you want to get in touch with him. Why don't you give me later the details about your whereabouts and maybe he can get in touch with you.

MR. ALEXANDER: Jack, I have one question before we let you go. You mentioned that the type of DOE participation in the NRC test and certification program would be dependent on the flexibility offered by the testing laboratory. And the question is whether or not the approach that we're considering, the approach recommended by Greta's committee, would offer the necessary flexibility.

Now, for the benefit of everybody, let me review quickly what that approach is. According to that approach, to

use the DOE example, suppose that the people at SLAK were being exposed to what shall we say, high energy electrons, much higher energy than would be provided by strontium yttrium 90 source. The procedure that the committee has recommended is that the people at SLAK, Don Busick, I guess, would submit badges that he is using to monitor these people, these high-energy electrons, to the testing laboratory and the testing laboratory would irradiate those particular badges to their test source for beta particles, and determine for Busick's particular dosimeter a factor of difference, a ratio of correction factor so that the ability to pass the test would be connected in that way to the particular radiationsthat Busick was facing at SLAK.

Now, I don't know whether flexibility is the right term to apply to that or not, but the question is would that approach be acceptable? I guess I'll say, as far as you know. I realize you haven't had a chance to coordinate that answer with all of the DOE laboratories.

MR. SELBY: Right, and let me say I'm not really speaking for DOE right now, either. But my perception in chatting with the various individuals from several of the DOE laboratories and in talking with Ed Vallario at headquarters, I feel that flexibility and what we're talking about here is that unless some studies show that what you're suggesting is really appropriate, we currently would feel that the tests should be based at the energies that we're talking about. So therefore, if somebody

had their dosimeters set up, say, for a 2.4 MeV photon, and that was their principal area of concern, then we certainly would want to test at that level. We're not convinced right now that a so-called correction factor which would allow us to interpret our results for, say, a cesium exposure at .67 or however MeV would provide what we're looking for.

Now, it might be just doing a woolgathering, it might be that these DOE laboratories would participate as much as possible with the program as it is laid out, and then would go ahead and inhouse conduct their own more extensive program that is commensurate with the energy levels that we're talking about. So it's really up in the air. But we do not feel that the specific energies are necessarily totally acceptable as an approach

MR. ALEXANDER: I would say there probably is a good chance it will turn out that way. I think what Jack is saying is that the AEC manual might say that DOE contractors should be certified by the NRC's program, but that that program would not be sufficient necessarily to establish competency for the particular radiations that aren't included in the test and certification program.

MR. SELBY: And as Don said, if I can paraphrase what he said and what I'm saying and what Ed's saying, too, and that is we support the program, we heartily supported Greta's effort, so I didn't want this to be interpreted as being negative towards the program. We may feel we need to go beyond that I think is

what I'm trying to say.

MR. ALEXANDER: Good point.

DR. ROSS: As I mentioned yesterday, this is almost directly comparable to the problem that we had with respirators and respiratory devices, and OSHA's requirement that all such devices must be tested and certified by NIOSH. We accepted their certification as far as it went, and it's not their fault exactly that we use a heck of a lot more air-supplied suits than the rest of the United States does. There weren't enough users of this to warrant their going through all the who struck John to set up approval schedules.

So, we did the next best thing, we thought. We set up a little mini certification of our own, which we have done, and tested over the years a good many suits. So I could visualize that the same sort of situation would exist here. There aren't all that many people who are going to be exposed to muons or something, but if Brookehaven needs a special calibration for muons, so be it. They will have to develop their own.

MR. ALEXANDER: I like the analogy with NIOSH's test certification program for respirators. For example, we have found the one aspect of that program to be entirely lacking, and to supplement it we have a contract with the Los Alamos scientific laboratory to perform the type of test that is not performed by NIOSH. Now, what that is, is to determine the protection factor; that is, the degree of protection actually afforded by the

respiratory protection device. At LASL, they measure the concentration of DOP or sodium chloride inside the mask and the concentration outside in a test chamber while a person is going through physical exercises. They have an anthropometric panel with all kinds of faces, and then they take sort of an average result and determine a protection factor which we in turn use in our regulations.

So I certainly would see nothing wrong with supplementing the NRC program in any way that would be necessary.

DR. ROSS: Bob, one more point. As long as we're talking about the comparability with NIOSH's respirator testing, their approval schedule also requires that the manufacturers have in place a quality assurance program in the manufacture of their respirators. And I can remember full well when it first came out. There was a several-year lag time while the manufacturers developed these QA procedures, but NIOSH had to answer the question, what constitutes a good enough QA program for these respirator manufacturers. And indeed, they turned to Los Alamos Scientific Laboratory, the H5 group there, to develop a QA program that could be used by manufacturers. And you may very well wish to relive some of that history, since you're going to go through virtually exactly the same kind of rationale.

And while I'm mentioning NIOSH, I think that you ought to be aware that NIOSH has a little of piece of paper -- I presume they put it in the Federal Register as well, but they have a little

piece of paper which we have distributed to our contractors for them to comment on. They are just suggesting, they're just raising the issue as a possibility, of cutting out the testing of respirators by NIOSH and relying entirely on the manufacturer's QA program. And I noticed that the ubiquitous Paul Strudler of NIOSH is not here this morning or you could maybe ask about this. See what their rationale is for even thinking about stopping the testing, because if they have found some glitches somewhere, you might want to be sure that the glitch is not built into whatever -- you know, some generic problem of certification laboratories.

MR. ALEXANDER: I talked to Paul about that recently, Don, and I got an answer which I'll try to give the gist of correctly, from Paul's opinion, not a NIOSH position, but Paul Strudler's position. It is that last year, a couple of people were killed wearing NIOSH-certified respirators, and that left some people at NIOSH pretty uncomfortable and rather anxious to get out of the respirator certification business.

Now, we are all hoping that that doesn't happen, and are planning to let NIOSH know that we want them to stay in the certification business. If they do drop out, we'll have to -- that service will have to be replaced. As far as we're concerned, we must have government certification of respirators.

MR. SELBY: Just as an individual operator in the nuclear industry, I do have some private concerns about the makeup of the

two committees that you have identified in your possible regulations. The certifying committee I believe is what you called it, the certifying group. And then your board of appeals. I think yesterday we had one expression of concern, and that is that in the makeup of those two committees, if I understood the gentleman correctly, there's concern that you have at least some representation of people who are active in the field of dosimetry. And I think that is a very genuine concern because I think that Phil will probably tell you, in dealing with the various processors trying to determine why something was failing, that it's a complex problem and it isn't perhaps a black and white decision of certifying or not, rejecting or not. That it may be a qualified, and there may be reasons. And part of it may be that you have a rigid testing scheme and the use of these correction factors may not necessarily be able to bring the individual processor's results into line with what is supposed to be achieved.

So I think that you need some technical backup on both of those two committees. I'd like to have Phil respond to my suggestion.

DR. PLATO: I agree with you 100%, Jack. In fact, in the value impact study document that we have just submitted in draft form to the NRC, we went on about that at great length, and I think when it's available you'll see that we're in total agreement with you.

MR. ALEXANDER: There's a serious problem associated

with having on the Appeals Board a -- the reason I'm focusing on the Appeals Board is that it seems to me that the Appeals Board, from the viewpoint of the problem you're looking at, is more important than the Certification Board. The Certification Board will make a judgment about the quality assurance program and will ask the laboratory if the processor passes, and that's that.

The Appeals Board will have a more difficult job in deciding whether or not a processor's name should be removed from the list of certified processors.

The difficulty in having a person on the Appeals Board, person or persons, who is thoroughly familiar with -- well, let me not put it that way. Who is employed at the time by a dosimetry processor, or who is conducting personnel dosimetry process, would raise a serious question that that person or those persons will be required to vote on whether or not a competitor would keep his certification.

I would personally find that entirely unacceptable, regardless of how much personal confidence I might have in that person. I just don't think that's the way we ought to operate.

DR. ROSS: Are you suggesting an unemployed expert?

(General laughter.)

MR. ALEXANDER: How about a government expert, someone who has in the past operated -- like, for example, myself. I used to operate a personnel dosimetry program at Atomics International. It's a fairly large one, a complex one. And I think

there are people like myself in the government who are sufficiently familiar with personnel dosimetry processing to do a fair job of serving on the Appeals Board. So that's why I am at this time recommending that the Appeals Board consist of people like that, with no more than one representative from any one agency.

Of course, I could have my mind changed for me by a lot of different people, including you.

MR. CAULDWELL: Fred Cauldwell, Yankee Atomics. Bob, I don't see any real problem with it. I would think that it's a consensus of opinion among the processors themselves that they'd like to see somebody from the industry sit on that Board that's reviewing their case. I don't see where they would -- at least in my own mind, I would not have any objection to somebody from my own industry appearing and judging my competency in the area of dosimetry, rather than having an all federal employee panel who I may not be able to swing any weight with or may not know my particular problems, sitting on that Board. I'd much rather be judged by a peer group, or at least partially a peer group, than all federally-employed people.

MR. ALEXANDER: That might turn out to be the consensus among the processors. I suppose we'll probably not find that out until we've published the proposed rule. I would think that our Commission -- I would hope they would be able to comply with such a consensus. You can never predict them.

MR. LLOYD: I can see the desirability of having someone

from industry sitting on the Appeals Board. Also, I see the problem that Bob has brought up about a potential conflict of interest. And just as an alternative that I might suggest would be a consultant or consultants from industry as non-voting members of the Appeals Board, which would allow input but still resolve potential conflict of interest there.

MR. ALEXANDER: Any response to that suggestion, Fred?

MR. CAULDWELL: Definitely. Having a non-voting member of the Appeals Board is like having a guy sitting inside of a bag on the podium with you. He can sit there and he can listen and he can look but he can't say anything and doesn't have any say in what's going to happen to that particular processor. You might as well not even have an individual on the Appeals Board if he can't vote in the decision-making processes of that Board.

MR. ALEXANDER: Would anyone from the commercial processors give us the benefit of -- Bob Wheeler?

MR. WHEELER: I believe, with due respect to Bob, that there's a tremendous difference in operating a commercial service of hundreds of thousands of personnel badged compared to a few thousand. And I'm all in favor of industrial representation and voting representation on the Appeals Board. You may want to set the panel up in the sense that it takes almost unanimous vote to decertify a service in the sense of diluting any bias you might suspect at any time in the future on an individual membership. But I certainly would recommend that you have industrial

representation because I think there's a big difference in a large service which is going to be represented as a certified type processor compared to those of only a couple thousand badges.

MR. ALEXANDER: So you wouldn't particularly worry about one of your competitors sitting in judgment upon whether you stay in business or not?

MR. WHEELER: No, because I think you really are talking about at least a half a dozen members on the Board, and I think it's going to be difficult to handle such a thing like that without unanimous decision on decertification, because that is going to be a very obvious and forceful type decision to decertify anybody, with a tremendous legal impact.

MR. ALEXANDER: Is your position that you wouldn't have any objection to a commercial -- to a competitor on the -- let me finish my question. Is that position contingent on requiring unanimous vote by the Appeals Board before a processor could lose certification.

MR. WHEELER: No, I don't think my comment is contingent on a unanimous decision but I think that's probably the way you'll end up. Very close to unanimous or three-quarters vote or something like this. It's going to have to be a very, very strong vote to decertify somebody. I just see a tremendous legal impact, if somebody is certified and providing services, whether it's commercial service or performed inhouse, and then at some period in time being decertified. I think that has tremendous impact,

legal impact, on what might happen in the meantime through unions, through individual employees, through just implications of what happened between the time that the organization was certified and decertified. So I think it's going to take a tremendous and forceful vote to decertify somebody because I think there is going to be a tremendous legal impact.

MR. ALEXANDER: Thank you very much.

MR. EISENHAUER: In the advance notice of rulemaking you did recognize the existence of the industry committee, the Personnel Dosimetry Overview Committee, and if that committee, in fact, represents the industry then it might be reasonable for them to have an appointed representative to the Appeals Board, representing the entire industry on the Board.

MR. ALEXANDER: Yes, I think that might be a reasonable approach. I'll tell you the stumbling block that may be faced, but I have no way of predicting if this would happen. But it's the sort of thing that's happened before.

The Commissioners, the five NRC Commissioners, have a mandate from the Congress to pass laws and enforce them in this country, which is the same mandate that the Electorate gives the Congress. And they are, of course, just as sensitive about delegation of that authority as the Congress is. Of course, the Congress only delegates authority to regulatory agencies.

That's the potential stumbling block. The Appeals Board will have to be a group that the NRC feels and that those

Commissioners feel comfortable in delegating the authority to overrule the Certification Board, which will be controlled entirely by them, being all NRC employees. That's the biggest problem we face here. I personally have absolutely no objection to complying with your desires in that matter, although I might not completely agree with them. It would be perfectly fine with me but I certainly can do nothing but make a proposal.

Good discussion. Anyone else want to give us the benefit of their thinking on that particular subject before we get back to quality assurance? Fred?

MR. CAULDWELL: On the Personnel Dosimetry Overview Committee in the industry, I've been trying to find out for a year who's on the Committee and I was wondering if somebody can lend me some assistance in that area.

MR. ALEXANDER: The composition of the Overview Committee

MR. CAULDWELL: Yes. I've seen it mentioned, I've heard a few things about it. I'm still trying to find out who is the Committee and where they're from. I'd really appreciate finding out who is on the Committee.

MR. ALEXANDER: Let's see if we can do that from memory. I'll start and then others of you can help me. The Chairman is George Campbell of Lawrence Livermore Laboratory. Or is it now Lawrence Livermore National Laboratory?

DR. ROSS: I wasn't at the office this morning. If they've -- unless they've changed it, it's Lawrence Livermore

Laboratory.

MR. ALEXANDER: Okay. And he's the the Chairman. Lowell Nichols is the Battelle Northwest representative. I believe Bob Wheeler is the industry representative from Landauer. Is Eric Geiger on that?

DR. EHRLICH: He was.

MR. ALEXANDER: I believe Eric Geiger is an industry representative on the committee. Jim Lawrence, is he?

MS. DENNIS: If you'll leave your names, I'll send a list to whoever would like the committee membership.

MR. ALEXANDER: That's Nancy's way of telling me I'm not doing very well.

We'll go on with the quality assurance portion of the program, then, although I was glad to have that discussion. And it's good to have those remarks on this record. It will have a lot of effect, much more than you think.

Is the order important, Jack? Should we have Jack Fix first? I'd like to introduce Jack Fix from Battelle Northwest who will continue with our exploration of the quality assurance problems.

MR. FIX: Thank you, Bob. This morning I'm going to address what quality assurance is to the routine Hanford dosimetry system. At Hanford we processed about 70,000 dosimeters last year. Battelle is resonsible for the technical aspects of the program, and U.S. Testing Company does the routine processing. We have

several contractors at Hanford including Rockwell, United Nuclear Industries, Westinghouse and Battelle, also. In the program, U.S. Testing does the routine processing, Battelle does the checking of the run, has to do our contractual acceptance of the run, and these results are sent to the individual contractors at Hanford which, of course, do their own review. And this morning I'll talk about that.

Yesterday, Ellery described the Los Alamos dosimeter. Ours is nearly the same with some major differences. We have two TLD-600 chips and two TLD-700 chips, and our dosimeter was designed to be specifically sensitive to the plutonium separation work that was going on at Hanford in the late sixties and early seventies. And our dosimeter is specifically designed and our calibration procedures designed also to measure that type of radiation.

Elements of a quality assurance program include dosimeter acceptance, which in our case means the receipt of the chip, the TLD 600 and TLD 700 chips, from Harshaw. We do screening of the chips that have to meet limits that we specify in our contract with them. We do compare new badges with the historical response of the badges that we've received. We also check the fabrication of these chips into the cards, as well as check the fabrication of the dosimeter holders into which these individual cards are placed. And I'll describe that in a later slide.

We also have specific procedures that relate to our

calibration of these dosimeters and is historically related to the work that was done to determine the calibration procedures in the first place and the procedures that are in place to ensure that we have MPS(?) traceability and continue to do this appropriately.

Dosimeter readout I'll describe how we process the run, or in this case, U.S. Testing processed the run, to ensure that during the run we had the machine properly calibrated as well as we can track the run throughout its process.

And dose audits are the bottom line, and at Hanford we have a variety of audits that I'll describe including dosimeters that check the processing throughout the run. We have open audits and blind audits, which I'll describe in a later slide.

Our dosimeter is completely fabricated under Battelle's auspices. We receive the chips from Harshaw and we have our badges fabricated in Seattle at a specific company.

When we receive these chips we check the variability within each batch that we receive. We specify that the badges have to be -- the chips have to be bought badged from Harshaw. We check these so that the resonse is plus or minus 0%. As well as we check the meeting of the response of the new badges that are added to the system with the meanings of chips that we have, historically from previous batches. And these have to match to plus or minus 2%.

All our dosimeters are uniquely labeled after fabrication

for some later testing. We expose these to low-level gamma and thermal neutron exposures, not within the badge but just within the card, to check that the TLD 700 and TLD 600 materials were loaded properly within a check, or within the card. Excuse me. And after labeling, they're exposed and read out and this is reviewed.

Later, after this process is done, they're loaded into the -- after we expose them to low-level gamma and neutron, as I said, we read them out to check that they are properly labeled. Then to check out the badge holders, we take any new holder and put the new -- put a set of cards inside it and expose it to low-level thermals, and this checks that the badge holder has been fabricated properly. We have cadmium on one of our TLD 600's and no cadmium on the other, and that's the most critical part of the -- well, all parts are critical, but that's one that's easily confused. The tin and the cadmium being very nearly identical, we have to make sure that they're fabricated appropriately.

Our calibration is based on historical measurements that were taken at Hanford to measure the energy spectra of the type radiation that we receive, including beta, photon and neutron. In our case, our badge measures both slow and fast neutrons, and there are certain suctions and there are calculation algorithms that go into that. In the design of these badges, generally to achieve something, you're giving up something else, and it's generally universally true with all these dosimeters They have

their strong points and their weak points.

We have NBS traceable instrumentation that allows us to calibrate our dosimeter. For photon monitoring, we have direct monitoring of the beam throughout its irradiation on both the calibration dosimeters and the dosimeters that we use to check the run throughout its process. And for each dosimeter that's irradiated, we have a log of the dosimeter number, the geometry, the exposure rate, the time of exposure, et cetera, for each dosimeter that these logs certainly have to identify.

During readout, we have several computer interrogated parameters that we monitor, but for the dosimeters themselves we look at the calibration dosimeters, as well as we have a set of check dosimeters that accompany the regular dosimeters throughout the run, and these include a blank dosimeter with essentially no exposure and one-hour check dosimeters. And by contract, U.S. Testing has to include each of these at least every 50th dosimeter in the run. And usually it's more frequent than that. The results of these dosimeters are computer interpreted and have to fall within a set limit or the run is stopped automatically by the computer and an alarm sounds.

We also have a series of open and blind audits which I'll talk about in my last slide, which accompany the run also.

We have several means of being able to check out the consistency of a given run, as well as we have a contractual -- it's contractually stated as to what has to be done to accept a

given run. And these are based on statistical analyses of the results historically, at the beginning of this particular type of dosimeter processing system at Hanford back in the early seventies. We do at the calibration, check dosimeters that are unfamiliar with the system and look at these for consistencies and to see if there is any apparent problem. During a run, for check dosimeters we have a dosimeter every 50th one at least. So if we're processing 5000 dosimeters we have at least 100 of these.

We also have open and blind audits. Open audit to us means the dosimeter which is known to the processor to be of an audit batch, but he doesn't know the dose level. A blind audit is one in which he has no idea what is done. This process at Hanford involves each of the contractors at Hanford having a certain set of people who are fictitious who do have a dosimeter, and these people receive those dosimeters routinely, they send them in to the calibration laboratory separate from the routine run, and these are exposed to different levels which are determined by Battelle. And these are submitted just as would be for an ordinary person. And these constitute the means to accept the run; the open and blind audits.

And this is what is involved in the DOE contractual acceptance of the run.

After we accept the run, we send the results to the other contractors at Hanford, and these people in turn have some clever techniques of checking us and they also check the run.

That's the end of my talk.

MR. CAULDWELL: Jack, if you don't mind I'd like to get a little specific with you on one particular part of the subject. You said had computer interrogation of the audit TLD's. Do I understand that you have a mini-computer of some kind attached right to your TLD system that's sensitive to a serial number or something like that?

MR. FIX: Yes. We have computer interrogation of the check dosimeters, not the audit dosimeters. But of the check dosimeters, which are run at least every 50th in the run, we have computer, we have an LSI-11 mini-processor that controls the entire thing, and this computer not only checks the dosimeter results but it checks light source readings, the temperature of the heater before and after the run, several electrical circuits within the computer, the photomultiplier, et cetera.

DR. PLATO: You said that you screen the chips as they come from your supplier. Do you have -- could you give us an estimate of how many you have to reject from your plus or minus 10%?

MR. FIX: Very few. We specify that first of all, they have to be all of one batch. So when we buy a set of dosimeters they have to be of the same batch. And when we receive those, then we check them for variability, and we don't find very many from a single batch that vary from that mean.

DR. PLATO: Outside of that 10%.

MR. FIX: Yes.

DR. PLATO: What about your check of the badge itself? Does that ever turn up any flawed badges?

MR. FIX: Yes. Definitely. If you do not check your system, you're going to have a failure rate. I would say any manual process that's not checked, you have at least 1% failure rate for any component of the system.

MR. POLAND: Al Poland, Public Service, Indiana. Just a few more questions on specifics of your program. You just mentioned that you checked or you require all dosimeters to be of the same batch when you purchase them. Do you have a requirement that the new batch that you purchase match the old batch that you got maybe a few years ago? Do you provide dosimeters from the previous batch for the contractor to match those with? So that you have batch to batch consistency.

MR. FIX: Yes. We fabricate the entire system ourselves, and when I was talking about matching new chips with the historical chips, that's what I was talking about. We have retained parts of the historical batches that we use in inter-comparing with any new batches.

MR. POLAND: You mentioned that you do an audit dosimeter every 50th dosimeter. Are you talking about every 50th chip or every 50th badge in that case? In other words, it would be about every --

MR. FIX: Every 50th badge.

MR. POLAND: Okay, so it's approximately every 200 TLD readings then, right? If you've got four chips per badge.

MR. FIX: For multi-purpose dosimeters, each one has four chips, so it would be every 200th chip. We check many other parameters during a run, also, including heater, temperature, light source, et cetera. And contractually, it's every 50th dosimeter.

MR. POLAND: Do you have separate acceptance tests for your 600 and 700 dosimeters in your badge? You mentioned that you, in your pre-acceptance testing I guess you probably irradiate all the badges probably to gamma, I guess, and then test for variability, plus or minus 10%. Do you have different criteria on the 600 chips as opposed to the 700 chips?

MR. FIX: Yes, we do. It's photon response initially, but yes, we do have -- it's different but it's similar. As far as we -- when we get our chips, we get batches of individual chips. Before they're fabricated into the dosimeter, we have individual chips and we do tests on those batches of individual chips; maybe 10% of the sample. If we were going to receive 5000 dosimeters, we'd maybe do tests on 500 of them.

And then, once those meet our criteria, then they're fabricated in the dosimeter card, and then we do a further test on that card to make sure the 600's and 700's are loaded in their appropriate places. And then, we put them into our dosimeter holder. The cards go into the holder which has the filters.

And we do tests of the holders to make sure that the filters that are in the holders are of the appropriate element and are in the appropriate place.

MR. POLAND: One final question. On your audit dosimeters, I guess during your regular runs, could you tell briefly what you do if you have audit dosimeters that didn't pass the check, and you've already completed 50 badges or whatever?

MR. FIX: Well hopefully, that never happens. But that's a very difficult situation when you know that something has gone wrong in the run and you have to go back and determine what happened and where it happened.

Each of our dosimeters that goes through the system is serially labelled. And by examining it -- that's one reason there's a check dosimeter every 50th; so that helps in pinpointing where there may be any problems. But one can examine through the output of the run with a serial listing, you can pinpoint where the problem has occurred, and by examining the response of the audit and check dosimeters thereafter, as well as light source readings, you can perhaps determine bias in the system. That generally doesn't happen.

MR. POLAND: Do you feel there's a need to plot the glow curves, to maintain a record of glow curves, so that possibly you could do a paper check on previous dosimeter readouts?

MR. FIX: Well, I think if you have a system -- interpreting the glow curves, that would be very nice. We use

glow curves to set up our entire processing so that we know that we're emptying the drafts. When you're doing large processing as we do, you want to keep the individual readout as short as possible, but you want to be sure you don't make the 600's. But as far as retaining individual glow curves, I think it would be better to digitize the information and have it computer checked. I don't think just having it on the storage scope and looking at it does anything in itself. I think it's very valuable to digitize the information and to have some method to interpret it.

MR. HILL: You did say that all 600 and 700 chips are exposed to low doses for gamma. What about for neutrons? Do you have -- like the 600's, all of them, and they have to fall within a certain percentage range, also?

MR. FIX: Yes. And we have much more difficulty matching 600's, as you would expect. Usually, we do match 700's very easily, but 600's may take us months. To match a new batch with the response of our historical. And those are exposed to low-level neutrons.

MR. ALEXANDER: Jack, do you make any use of any of the statistical formulas that are used in quality assurance to determine how many or what percentage of your badges to include in the audit program?

MR. FIX: I'm not sure if I understand your question. We use statistical methodology to determine what our acceptance

criteria is, based on the response of dosimeters that are in the system. We use statistical methodology.

MR. ALEXANDER: But you mentioned a couple of numbers where decisions were made, like 1 in 50, and there was another number you used. And I wondered whether those were selected arbitrarily or if some mathematical formula used in quality assurance was employed.

MR. FIX: With reference to the plus or minus 10% for an individual badge, or plus or minus 2% between means? Those were not statistically derived. They were attempts to be able to add dosimeters to the system and not add too much variability to the system.

MR. ALEXANDER: Okay, thank you. There are -- I guess we're all vaguely aware of statistical criteria or formulas that are used in sampling, to determine sample sizes. And I don't know whether such criteria have a role in personnel dosimetry quality assurance or not. I wish I did know.

I'll call for a 10-minute break at this time.

(A short recess was taken.)

MR. ALEXANDER: The next speaker this morning is Dr. Craig Yoder from Battelle Northwest, who will talk to us I believe about the intercomparison study of dosimeter calibration which is considered to be part of the quality assurance program there.

DR. YODER: Let me introduce what I'm going to say by a brief description of what I'm involved in at Battelle, and sort of what our philosophy has been on calibrations and personnel dosimetry systems.

There are many facets that go into a dosimetry program, and I think in the course of today and yesterday we've seen that it involves an administrative process; Jack Fix just recently described some of the pre-dosimeter process where we screen chips, some of the auditing procedures and indicated that there are various administrative reviews and perhaps maybe some technical reviews of how we accomplish assignment of occupational doses.

An interesting or at least a very major part of this is calibration of the dosimetry. We at Battelle, in terms of our routine program provided in the check and calibration dosimeters, will calibrate approximately 12,000 dosimeters a year in addition to many, many instruments, probably averaging between 70 and 80 instruments a day that are calibrated.

My basic function is providing some technical support and perhaps information to this routine program of calibrating instruments and dosimeters. We have been pursuing in several different areas research aimed at perhaps providing some additional information as to how calibrations may be performed or at least may be somewhat standardized. This is a very technical area that lends itself to a lot of procedures and standardized types of things, and we want to make sure that if they are standardized,

they do have some flexibility to adapt to what will be some new radiation environments in the future, and also, lend itself to improvements in the technology itself.

It's somewhat elementary here, the first statement. But the purpose of the calibration is to somewhat correlate the dosimeter response to a measurement of absorbed dose that a person may receive. This is what Phil Plato somewhat described yesterday; that the dosimeter response is indeed some physical characteristic like light output or something. But what we're really trying to do is create a radiation environment that we can perceive or measure what the dose is an individual will receive. And once we have made this measurement, or at least ascertained what the dose might be for a well-controlled or well-characterized radiation field, then we will irradiate a dosimeter and compare that dosimeter's response to what we perceive the absorbed dose to be.

Well, in conjunction with this, the calibration provides this element of quality assurance in that we have some documented evidence that our assignments are made on some scientific principles rather than perhaps judgment or some things like that.

Our calibrations are quite extensively recorded. We also are in the process of computerizing a great deal of the information that we process. We are trying to implement or computerize the control of our X-ray system and to make real time corrections for voltage fluctuations, perhaps variations in the ampere output, make real time corrections of pressure and

temperature and also make sure that the calibration dosimeters are well identified and will continue to be identified throughout the whole system, trying to avoid maybe some clerical errors or such as that.

Some of the objectives we're trying to achieve, and I think it's been alluded to several times, is that one is basically interested in what's going on out in the field. Those are the doses you're required to measure, and these are the ones that we're trying to calibrate to. And as I mentioned, one of the facets of calibration is trying to determine what the dose to an individual might be in that radiation field. And this has led to a variety of our research; one example being our interest in C_x values; that is, if you have a well-characterized field, what is indeed the value that will relate to absorbed dose?

We also are interested in providing some consistent radiation fields. Now, this may seem somewhat elementary, but it's very important because some change in your system may show up in various avenues at various stages of a dosimetry review or audit or run, and you want to really be sure that the change is maybe due to a breakdown in your technical system and not really a major change in the radiation environment of your workers. That is, is the dose really something that someone is receiving and not something that has been created due to a technical change or indeed maybe an error in the calibration laboratory. So reproducibility is something we have been very keen on, and it

gets to be somewhat of a problem for some of the new types of radiations that we are going to be experiencing at Hanford. Jack Selby indicated that we will be experiencing some high energy photon fields.

Well, there has been a great deal of high energy photon worked on in the medical applications, particularly in radiotherapy, but we're beginning to see a need for a different approach to high energy photon dosimetry for health physics purposes. Basically because the sources are different, and we're also having, in addition to maybe the high energy sources, we have low energy sources combined, and the effects on the dosimeter can be somewhat interesting.

One of the projects that we are currently investigating for the Department of Energy is to try provide some technical guidelines for personnel dosimetry calibrations. Now, this study is looking at several features that we think are important. One is calibration variability, and I'll discuss this later. That is, each of the DOE contractors has its own need. What are the variabilities between them? How might these be examined so that we know that there might be a comparable level of quality dosimetry at each of the contractors, but still account for the different needs of the contractors themselves?

Another area is calibration procedures. Now, some of these I think are very or must be site-specific, but there are certain approaches that I think are logical and I think the standard

or at least the proposed standard, will indeed affect how one might calibrate, particularly if one is passing a test. You're going to have to calibrate, or at least have some kind of correction factor, to those environments.

The third area, and this is the intercomparison area; that is, you may have some calibration procedures, but there is no guarantee that these are actually employed. And perhaps the procedures in themselves identify all of the things that need to be identified. The intercomparison program, we think, is a good avenue to identify intangible features. And I'll discuss this in a little bit.

The calibration variability I think has somewhat been alluded to and is a basic function of radiation sources. Now, at Battelle we maintain a really wide variety of sources. We have approximately 25 X-ray techniques that we can use, either filtered or K fluorescence types. We have several isotope sources, we have several neutron sources and we have an accelerator and we have access to some other facilities that may have even more unique radiations.

We're looking at these, trying to understand what is happening when we're doing the calibration. What is happening to the dosimeter when it's being exposed, and indeed, if we calibrate perhaps one or two sources, what might we miss? Indeed, the radiation environment or something else. I think this is something that we want to be much concerned about. I think the C_x values

are pointing this out; that while for cesium and cobalt it may be very -- not introduce a major error if one assumes that roentgen values equal the absorbed dose; that is, one to one, at low energy photons, this may produce a sizeable error in that it might be more than one to one; perhaps one and a half to one or so.

Another area is exposure geometry. This is very interesting, and I think a lot of us may have experienced this in the pilot study. That is, your calibration geometry may be quite a bit different than the test laboratory's geometry. And most important would be neutron calibrations where scatter and particularly if have an Albedo neutron dosimeter the phantoms and setups it may be quite imperative that you duplicate or at least come very close to duplicating what is being done in the testing laboratory.

Even the source design itself is a very important thing. If you have a source that may not be suitable as a point source but use it that way, you will introduce some errors due to the antistophe of the source. In fact, one can only receive a calibration on the output of the neutron or a californium source; it doesn't necessarily mean you know what the fluence may be at a certain point away from that source.

Another indication that we studied is scatter. Now, scatter is a very important extraneous element that tends to take a well-characterized beam that you may be able to know the dose of and change it, so that you may not know the dose as well as you

would like. Scatter is a major problem in neutron types of irradiations, particularly with, again, the Albedo dosimeter. Room return can be a problem; this is one area that we are at least initiating investigations in, and we are working with NBS and some of the laboratories to examine this factor. Everyone, unfortunately, has a different room, so calibrations unfortunately will have some degree of variability. And I think this will have to be addressed. I don't know the exact nature of the outcome at this time.

Scatter, and another area is the use of tissue equivalent phantoms. This hasn't really been discussed in great detail as yet, but tissue equivalent phantoms are -- there are a wide variety of such phantoms. I think in one study by White in England, he's probably identified maybe 50 or 60-odd different tissue equivalent types of materials. And indeed, a very common one is the water phantom or perhaps a block of lucite or polyethylene maybe in some cases or perhaps the Alderson-Rando(?) phantom.

But these phantoms, just being of different materials, will have different scatter purposes. We have found that not to be a major problem for photons but it may indeed be a major problem for neutron calibrations.

Another area is the positioning of a badge or dosimeter on a phantom. We found this to be somewhat crucial. If you place it in the center of the phantom or perhaps on the edge. This can maybe be standardized in one lab, but in a multiple or large

process, you may want to do several dosimeters at a time and you need to know what effect you may have by having a position error, or a position-dependent factor.

The last area is the adaptations area where one is trying to extend one's capability; that is, to new areas of health physics or dosimetry that we see coming.

At Hanford we are seeing the development of high energy photons. We also are having a very large accelerator trying to duplicate the irradiation environments of a fusion reactor. We really don't know what to expect from this type of accelerator. We know it will be unique and it will be of energies and perhaps types of radiation that we have not really gained a lot of experience with, so therefore, we will be trying to work with perhaps some other contractors who have had maybe some of the experiences that we anticipate.

Our calibration procedures -- we get hit from two angles on this. Battelle has its own quality assurance department, and they come around and, as a researcher I feel -- or as a scientist -- they come around as a thorn in my side looking at my procedures, but then again, as an administrator I see it as a nice way to cover my trail.

Here we have a need for uniformity of approach, and that is, are we going to calibrate things day to day, or year to year, and if we make a change do we have it well documented so that the next guy who comes along after I'm dead and gone will know

what we did and will know what happens when he effects a change, or at least what was going on.

In addition, procedures provide you with technical base for your decisions. That is, if you find that there is an improvement, you haven't documented that indeed the improvement is worthwhile. Many times people make changes and I think these need to be very well investigated so that it is known to be an improvement and that the change is not going to produce an unbiased or somewhat of an effect like that.

As an example, the C_x values, we feel that there is quite a bit of need to document the selection of the values, and perhaps supporting evidence or whatnot so that, as Greta indicated, when better values come along we can indeed identify these as being better values and perhaps we'll not be subjected to some criticism for arbitrarily changing things. We've got it down in place beforehand.

The intercomparisons -- as I mentioned, we can have all the procedures in the world and we don't know that they're going to be implemented correctly. Well, intercomparison is a way that at least helps you have some feel that you're implementing things right. As an example, we maintain a variety of intercomparison standards such as ionization chambers, that we will have calibrated at NBS for an X-ray beam. We will also have this calibrated by a private calibration laboratory. And then with our own free iron ion chamber, which is the primary standard,

we'll calibrate the chamber ourselves. So here we have three different calibrations of the same instrument, and we can check with our own methods to see that indeed we are carrying out our own primary calibrations in a fashion that is agreeable with some of the other laboratories.

This is most important because we do have a lot of X-ray techniques that we must calibrate ourselves. That is, there is no calibration that can be attained at other laboratories that provides some traceability. This is particularly important right now in K fluorescence X-rays, but maybe we'll have a change in the future.

Another thing that it identifies intangible factors. Many times, things come up and we really don't know why they're there and an intercomparison helps you to at least identify that there's something going on, so let's look at it and go ahead and find out what's going on.

And the other thing is it also provides an avenue for technical discussion. That is, it forces you to react to other people in the industry. And I think this is something that's really needed if we're going to continue to develop and improve the system.

To summarize, here are some influences I've seen of the dosimetry standard we're looking at. That is, it does influence the calibration procedures and your approach or your method. You are going to be looking at calibrating, or at least being able

to measure the doses resulting from a variety of sources. Now, these may not be suitable to your immediate need, but you will have to be able to provide the dosimetry; that is, can you at least, if your condition is this, can you calibrate and perform a dosimetry for these? And I think the sources we have now are easily enough done so that if you can't probably do a very good job on some of them, perhaps you really ought to look at your process I think. The cesium sources and things can be quite easily calibrated.

But the standard also emphasizes the technial approach, I think. Thatis, these are the sources and this is what you do, maybe a tissue-equivalent phantom, this is the thing like this. But there are other elements of a dosimetry program that you want to attack or at least address, and these stem from the administrative features. Phil mentioned the clerical errors and things. Well, here we have this and how are we going to improve that? That these don't occur, or perhaps can we alter the situation so that if a test has failed or something we can at least identify the reason and perhaps adjust our actions in accordance with that.

The other thing is the adaptability or the flexibility and we may be able to provide factors that will relate our calibrations to the testing laboratory. Sometimes these factors introduce other problems. It's been mentioned that perhaps if you use a different beta source you can just get a conversion ratio that will relate to Strontium 90. Well, this is very fine,

but if you're going to be testing for low-energy X-rays, sometimes your beta source calibration can influence how you're going to interpret to low-energy X-ray dose, particularly at the shallow depths and things where we have a variety of influencing effects going on.

The overall focus, I think, is that it's a very good approach and I think it does do a job in trying to identify or at least indicate the overall performance of the system. I think what may be needed is some method of distinguishing the types of errors that may occur and perhaps allowing some to be understandable. And we're looking at them in that light. Perhaps administative things, because each person has his own way of approaching the problem. You know, I may want to set up with a manager and a boss and put myself as boss, but here again, someone else may want to put me as the lab technician, which may not be so bad. I may get out of the limelight.

That's my presentation and I'll be willing to address any questions.

MR. ALEXANDER: Ellery, do you have anything you'd like to add to the DOE discussion this morning?

MR. STORM: No.

MR. ALEXANDER: All right. I believe that concludes, then, the quality assurance presentation of the DOE contractors. Moving now to the Department of Defense, we have with us I believe Phillip Jackson from Lexington of the Blue Grass Army Depot.

I don't know your rank or if you have one, Phillip, but I'll call you Mr. Jackson.

MR. JACKSON: Thank you. Maybe I'd better explain my position. You don't know whether I'm ranked or unranked. But I'm a civilian employee of the Department of the Army. I might also explain a little bit about my background, why I'm up here instead of one of my colleagues who probably ought to be up here. That is because of the title of the address this morning on the quality assurance aspects of dosimetry. And I am Chief of Quality Assurance Division at the Lexington Blue Grass Depot Activity, for which I both have responsibility for the dosimetry program, or the dosimetry lab, and also the Army Calibration Lab for the area of radiation standards.

I'm very pleased to have the opportunity to represent the U.S. Army and Department of Defense at this meeting, and to discuss with you some of the quality aspects utilized by Lexington Blue Grass Depot Activity in providing personnel dosimetry to civilian and military personnel of the U.S. Army.

To give you a better picture of where we fit in the Army structure, this slide shows the organization as it exists today. Over the years there have been many name changes. The original organization at the beginning of the Army Photodosimetry Service, was the U.S. Army Signal Corps which was located at Fort Monmouth with the Lexington Signal Depot, which was located at Lexington, providing the service under the general guidance of

the Office of the Chief Signal Officer in Washington, D.C. Mr. Alexander mentioned that Greta Ehrlich had probably more experience in this area than anyone in the room, and I would not dispute that. I know we started the Army Dosimetry Service in the early 1950's and she was a great source of information and assistance at that time. And any success that we've had in this program I'm sure is primarily due to their efforts there at the National Bureau of Standards.

This chart shows the guidance channels that we have in the Army's system. Of course, the primary responsibility for the Army personnel exposure to ionizing radiation is the responsibility of the Office of the Surgeon General at the Department of the Army level.

Through them, the program has been assigned to DARCOM, which I showed in the slide where they fit into the organization. In DARCOM, the primary responsibility for the administration of the dosimetry program is the Quality Assurance Directorate, with technical guidance from the Safety Office and the Office of the Surgeon at DARCOM level. Our administrative channel is through DESCOM which is located at the Kenny(?) Army Depot in Chambersburg, Pennsylvania, to Lexington where the actual service is performed.

As I mentioned, we do get our technical guidance directly from the Office of the Surgeon and from DARCOM Safety.

Our mission statement, as given or published, is

provides photodosimetry services to all armies worldwide. And as you can see, it's pretty limited; it says photodosimetry. And as you may gather, we're the first processor up here who has talked about photodosimetry, because everybody else talked TLD. Well, the Army system right now is still using the film badge. And there are several reasons for this, some of which we like but we may not be able to contend with it forever. We keep losing film makers.

My talk today will cover two areas relating to the Army dosimetry program, and the first subject is a brief background of this program to better help you understand our involvement at Lexington and the part that we play in the overall dosimetry program.

The first film badge operation in the Army originated at the Signal Labs in Fort Monmouth in the early 1950's. As the Lab began processing their own badges, other Army elements requested that the Signal Labs also process film for their personnel who were working with sources of ionizing radiation.

In early 1954, the Signal Corps assigned responsibility for providing the film badge service to the Lexington Signal Depot. From 1958 to 1977, Sacramento Army Depot provided a portion of this Army service. However, Lexington is now the only source of this service for the Army.

This program has been in operation at Lexington now for about 26 years. There have been many improvements in

equipment, film, procedures, techniques over the years. Many of these will be mentioned in my discussion of the quality controls associated with the dosimetry program at Lexington.

For purposes of this discussion, I've broken the quality control elements down into five areas that you see listed here. Some of these have been covered by other persons but I'll still go through my prepared presentation. There may be something a little different that we do.

First, in the area of calibration our films are purchased from the manufacturer in approximately a six-months batch with the contract specifying that all the films for that group be of the same emulsion or batch number. Each new film emulsion is calibrated by selecting samples of film and exposing them to doses of radiation, which is measured by NBS traceable calibrated R-meters, Shonka chambers or sources. Standards and equipment are calibrated periodically by the Nucleonics Primary Reference Lab which is also located at Lexington, and which is the highest level lab in the Army calibration system.

Cobalt 60, Cesium 137, Radium 226, natural uranium, Strontium-Y-90 and the various NBS standard X-ray techniques are available for use. Unmoderated plutonium beryllium neutrons are used for neutron film calibration. We have always performed the calibration in free air. However, we do not foresee any problems with converting to the phantom calibrations if the proposed standard is adopted.

In the area of dose controls. A customer's film shipment is selected from consecutive films from one box. A minimum of two additional films from the same box are selected and retained at the laboratory to serve as quality control checks. One of the quality control films is exposed to a dose of radiation, which produces a good response in the low-range film component of the film packet, while the other quality control film is exposed to a dose which produces a mid-range response on the high-range component.

The exposures of the quality control films are made at the mid-point of the wearing period for the films which they control. When personnel films are returned for processing, the quality controls films are placed with them and are processed in the same processing rack. The data obtained from the quality control films is then used to adjust the calibration data to compensation for minor variation of the film batch sensitivies and film-developing procedures.

In processing controls, the processing machine which is utilized in the dosimetry program automatically times the stay in each processing sequence to assure uniformity. Processing chemicals are changed after approximately 4000 films have been processed and new chemicals are shot for processing unused excess film to stabilize the chemical before personnel films are processed. The chemicals are held at a constant temperature plus or minus .1 degree F. by water circulation system. Neutron films

are not processed until the chemicals are aged by processing a minimum of 1000 beta gamma film.

Evaluation Controls. Our experience has indicated that personnel films cannnot be accurately evaluated by machine methods alone because most exposures occur at various angles where the badge has been partly shielded. We have found that the only satisfactory method of evaluation is to have experienced technicians visually analyze the exposure geometries involved and apply human judgment along with machine-measured density readings to make the best dose determination.

Unique or questionable exposures and high-level exposures are reviewed by a qualified physicist.

One of the most important aspects of the quality program for dosimetry is the audit of the technical and procedural operations. Audits of the dosimetry operations are performed on an unannounced basis by elements of the Quality Assurance Division, who check for compliance with applicable regulations and standard operating procedures. Other audits are performed by such agencies as Office of the Inspector General, the Army Environment Hygiene Agency and DARCOM Field Safety Office.

In addition to the procedural audits, periodic checks are made on the accuracy of the dosimetry program by exposing test film to known doses of radiation and sending them through the normal processing and evaluation channels.

Results are compared and analyzed to determine the reason

for variations. One quality check that we do not recommend but have not been able to avoid completely is the test by the customer of the service. Many persons apparently do not believe inthe effectiveness of the film badge and are determined to test to see how it works. This usually results in reported over-exposures and in investigation by the Office of the Surgeon General. We prefer to leave the testing to those qualified in the field of dosimetry.

This concludes my presentation. I have two very capable persons with me who I would like to introduce. Mr. Joe King and Mr. Edward Abney, both of whom have been associated with the Army dosimetry program for many years. We will be glad to answer any questions now or to discuss any facet of our program privately anytime during this meeting. I'll take care of the general questions, they can take care of the technical questions.

MS. DENNIS: Nancy Dennis, NRC. My question has to do with the number of badges or the number of films per box. You said there are two films held back, and I was wondering that's per how many others?

MR. JACKSON: That's for each customer. If he gets five films, we still make two dose controls that go with those five films.

MS. DENNIS: So if he gets five or 5000, then you have two.

MR. JACKSON: Right. I said two per box. Of course,

I think there are only 150 films in a box, so if a customer gets more than 150 films at one wearing period, then naturally we would hold film from each box that he's provided.

We have a special reason for this. I'd rather not go into it. It concerns the quality control of the film produced by manufacturers.

MR. ALEXANDER: Mr. Jackson, the film that you process, are they entirely from the Army or do you do processing for other services or other branches of the federal government?

MR. JACKSON: Our charter says that we provide service for the Army and DLA, Defense Logistics Agency. We've tried to provide it to other federal agencies and we had complaints from our commercial competitors, so we are restricted strictly to the Department of the Army.

MR. ALEXANDER: I suppose that some of the Army operations are licensed operations and some are exempt from licensing. Is that true? Maybe Col. Wangemann would --

COL. WANGEMANN: Yes, that's correct.

MR. JACKSON: That's true.

MR. ALEXANDER: For your licensed operations, then, if the Commission goes ahead with a mandatory test and certification program, then your dosimetry service would become a certified service, I presume.

MR. JACKSON: I'm sure we would do that. We've been encouraged to participate in all the tests, back when the

National Sanitation Foundation ran their tests, we participated in both of these tests and I'm sure our guidance from higher level would be go to with the program as certified.

MR. ALEXANDER: Thank you very much. We appreciate your preparing that talk and sharing with us the elements of your quality assurance program.

We'll move now into the area of the commercial processors We had looked forward to having Mr. Nells Johnson from Eberline with us this morning, but I haven't seen him. Or Rosemarie ?

Then we'll only have one presentation from a commercial processor, that will be Bob Wheeler from Landauer.

MR. WHEELER: We wish to thank the Nuclear Regulatory Commission for inviting us to express our views on the quality control and quality assurance measures that should be adopted by all processors if performance consistent with the test criteria standards is to be expected as typical of the regular service.

First, however, we want to confirm our continued support for the prompt and timely achievements of the objective of certification of personnel dosimetry processors.

As shown by the University of Michigan, all intervals of the certification test standard are passable. However, before some measurable impact of this program can be expected, these standards of precision must be assured on a continuing basis. Therefore, each processor must have a program to assure the integrity of his badge configuration, identification of the

dosimeter, calibrations, dosimeter processing, dose interpretation, reporting routine and recordkeeping policy.

Each of these key functions require quality control and points of audit that can be defined to assume their effectiveness. A documented quality control and quality assurance program is a prerequisite to a consistent performance. While quality control is concerned with monitoring day-to-day operations and unit control, quality assurance must be responsible for the adequacy of the quality control program and the overall performance level of the processor. As a result, quality assurance responsibility must have a line directly to top management and cannot be a function of operations.

In order to meet the performance standards of the certification test, a technically competent badge configuration must be used. Following these periodic examinations, it must be assured the same badge configuration is used in the routine service and that a no less competent design is substituted or used in the service.

The objective of the processor of personnel dosimeters is the reporting of correct exposures for the correct individuals. In all instances, a reasonably effective dosimeter identification format must be maintained. There are a few options for dosimeter identification available for all dosimeter types. Certain practices should not be considered acceptable.

For example, the procedure of using X-ray identification

through marking personnel monitored film clearly presents the problem of identification retrieval in the event of a higher exposure when high optical densities will be measured, making the decoding of the X-ray imprint nearly impossible, and at a time when errorless performance is most critical.

The other side of the question is calibration standards. Certainly this calibration requirement must have been met in order to initially pass the certification tests. Since these tests are only a snapshot in time, maintenance of this benchmark must be assured. While this requirement will be met in part with periodic testing, the chambers used for source calibrations must be regularly recalibrated by the National Bureau of Standards.

We further recommend that the dosimeters used by the processor actually be exposed by the Bureau and evaluated by the processor to identify and define areas of ambiguity. Records of these calibrations can be objective audit criteria.

The critical phase of the processor's objective is the actual processing of the dosimeter and the acquisition of some quantified value that can be directly related to dose. In order that this objective be maintained, the prerequisite of NBS traceability is essential.

Taking film as an example, no personnel film should ever be processed without pre-exposed calibration film being present in the solutions at the same time, the optical densities of both being determined and recorded in some sequential manner.

This normalization to processing variables can be applied to other dosimeter types as well.

In the case of TLD, for example, we expose all dosimeters to a standard source each time the TLD is evaluated, and then re-evaluated. This permits adjustments of the initial value to account for individual variations in dosimeter response. Since film cannot be re-exposed, complete response characteristics must be obtained and recorded for each manufacturer's film lot or emulsion run.

We find it extremely important in our QA/QC program to insert in each group of personnel dosimeters, dosimeters that are pre-exposed to values unknown to operations personnel. Before the results of that batch are released to the customer, the results of those QA dosimeters must fall within predetermined limits. If not, the reason for that variance must determined and personnel exposure adjusted accordingly.

Certain artifacts can be expected in both film and TLD. For that matter, in any dosimeter, and they can induce errors into the dose interpretation. The QC program must include the provision for identifying these artifacts and minimize their effect. Procedures must exist where the processor will identify these artifacts and compensate for them or describe their description in an acceptable manner.

The final work centers compare the documented exposures for reporting to the wearer of the dosimeter, and then long-term

retention of this date and, in the case of film, long-term retention of the processed film. Procedures must provide for final verification of these results to the data generated in the evaluation process. The document storage facilities must not only protect the document being stored, but provide for positive identification for eventual retrieval.

Finally, it is recommended that processor QC/QA programs include continuous exposure evaluation formats, replicatin the testing standards to be adopted. Records of these results are an important quantification of the program. It is further recommended that when individual processors's claimed dose performance levels are lower or higher than the test criteria parameters, these limits be included as part of their inhouse performance test and subject to art.

While these comments are not intended as a specific outline of a final QC/QA program, we believe all points are critical to assure continuous and stable dosimetry performance in the spirit and form of the proposed regulation. I've intendedly kept this presentation short, hoping that we can have some further discussion on specifics of QA/QC programs. Obviously, we have a very detailed, indepth inhouse program ourselves and I'd be happy to discuss any phase of this which may be of interest to the Committee.

MR. LLOYD: One of the questions I've had and no one has alluded to it, particularly in film processing this morning,

what kind of quality assurance program do you have on the film processor itself? That is, in the developing. Are you running anything so that you can monitor excursions during the developing period?

MR. WHEELER: You're talking about in the solutions?

MR. LLOYD: True. If you have a processor using sensitometry to monitor this,and if you are, how often is this being done?

MR. WHEELER: We do use a batch process system, first of all, as opposed to an automated developing system. Let me tell you a few details that are important to this sort of procedure

First, before any film is processed, a set of pre-exposed calibration film are processed first thing in the morning. These are exposed to known levels, they're processed in the baths that are prepared the night before. Before any film is permitted to be processed, these pre-exposed calibration film are then processed read and compared to what the known doses are.

Secondly, the process itself, what we call a batch or a process, consists of a couple thousand film. In this batch, there are 2 sets of pre-exposed calibration film varying in dose range from a couple hundred mr to 500 roentgens, and I believe there is something on the order of 8 to 10 -- I don't remember exactly -- film in each set for each film emulsion or film lot manufactured by Eastman Kodak. For our particular facility, we may have three emulsion runs simultaneously in the sense that we will

have one large active run or emulsion run; there would be film that can be expected, that are late film from up to six months in the past. At some period in time we would now introduce a new emulsion so we can't have the three emulsions being processed at one time for each emulsion lot. It is handled and computed separately and calibration film are included for each particular emulsion they're in the process of at that time.

With TLD, as I mentioned, we include not only pre-exposed TLD's in every cassette, and a cassette runs 52 TLD chips. There are two blanks, two exposed dosimeters, two in the beginning, two in the end. Each dosimeter is then re-exposed to a standard source and reread, and this adjusts for individual variations in chip-to-chip readings. There are sensitivity changes that you might expect with time.

We found that over the course of years, just relying on batches from Harshaw was inadequate; that there were some batch variations. With use, you find that the chips do change in sensitivity for many reasons, from heating histories, radiation histories, just chipping of the chips themselves that can't be detected, wearing of the edges. So we improved our accuracy by better than a factor of two by this recalibration process.

Any other questions?

DR. PLATO: If you did not make the correct batch corrections or lot corrections from lot to lot from Kodak, do you have a feeling of what sort of variations you would be faced with?

MR. WHEELER: We make two sorts of corrections. First of all, for actual sensitivity corrections; and secondly, each emulsion run has its own calibration characteristic formula. And this is relative to the energy sensitivity of the emulsion.

From batch to batch, run to run, there -- first, I think I have to say that Eastman Kodak does a fantastic job on reproducibility. We've compared not only Eastman Kodak but film that were made in Europe and film made in Japan, and we just selected American-made Eastman Kodak film as being superior. Superior in these sense of the entire emulsion run. The way I understand it, what emulsion is -- it's difficult to see this happen because it's obviously very dark, so even though you may have a tour of Eastman Kodak facilities you really don't see anything.

But apparently, the emulsion is coated on a very large role of plastic, which may be a couple thousand feet long and maybe about 60 inches wide. And the uniformity is extremely uniform throughout this sheet. From emulsion run to emulsion run, now they are pouring the chemicals together, and I hope nobody from Eastman Kodak is here because I'm sure this is a very crude explanation of how this is performed. But they mix this in a big bucket and then pour it into the machine. From batch to batch you can expect different amounts of silver in there, which is going to change the energy sensitivity, and also, the thickness and the amount of silver will change the dose sensitivity.

We do not find much difference in energy sensitivity

changes. The errors that we find are probably covered in just errors in measurement of our exposures. The equations come out to be different each time, but when you look at them all you see that there's not really much difference; that they really are very reproducible.

As dose sensitivity follows, plus or minus 10% would probably be wide as a limit on the dose sensitivity variation. The optical density per unit dose is probably within plus or minus 10%, or very close to that.

MS. DENNIS: I'd be interested in hearing a discussion of any special quality control or assurance measures that you use with accident dosimetry, or if you know that there's a suspected high exposure accident, et cetera.

MR. WHEELER: Usually we don't. Are you speaking of in a test or in an actual case?

MS. DENNIS: In an actual case.

MR. WHEELER: I'm just trying to think of an actual example. Usually, it comes as a surprise to everybody. We find, and we process many, many thousands film a day and many thousands of TLD's a day, we may have a half a dozen or a dozen dosimeters per day that are extremely high exposures. Normally, what happens is the case where a nurse distributing badges leaves the box of badges in the cobalt therapy room while she's doing something else and forgets to take it out. Very seldom, following investigation, as anybody here probably knows, is there a true exposure to a

person which exceeds a few hundred r. But we do have a number of dosimeters that exceed this every day, and that obviously requires some sort of investigation or identification by the customer.

If we are told in advance, and this is usually what we would classify as a rush or an emergency film -- we really handle it the same way as any other film except it goes ahead of everything else. It's just processed immediately. If we know something is coming in at the airport and we have a delivery service waiting to pick it up, we just have qualified, our best qualified experienced people there ready to process and evaluate it. Very likely somebody suspected what the dose was, and we might bracket that dosimeter with pre-exposed dosimeters on both sides of it. In fact, we definitely would do this. This is our objective in inserting pre-exposed dosimeters in the process, as I mentioned, from a couple hundred mr up to 500 r; is that hopefully we're bracketing any eventual exposure which occurs. And if somebody were to call up, some organization, and suspect a dose, for example, over 100 r we would probably then expose dosimeters of that same emulsion or same TLD's to exposures of 150, 200 r and then back down to 75 r, 50 r and so on.

Typically, what happens is that people grossly err in what their estimate is and what the exposure is; fortunately, their estimates are usually on the high side and we find many times that emergency film, when they're processed, or emergency TLD's when they're processed, end up with exposure of 150 mr or

200 mr, fortunately. And obviously, once in a while we're surprised, but everybody is surprised.

MR. ALEXANDER: Bob, let me catch you as you pass the microphone. In your opinion, with TLD's which is the preferable procedure for obtaining adequacy and consistency? To calibrate each chip or to go through a screening process to eliminate those that can be within plus or minus 10% or some criterion like that?

MR. WHEELER: We're obviously doing what is preferred; to calibrate every chip each time, and to really underscore that is the fact that when we started doing this, there was no way to pass this additional cost on to the customer, but we did it anyway. And obviously, it doubles your handling. More than doubles it because you now have to not only evaluate it, but you have to expose it and then evaluate it again. And then use that data as an adjustment factor which has to be related -- well, if you can imagine, we have a number of TLD readers. The problem that we have is that a set of dosimeters read on one reader does not have to go back to that particular reader again. You just don't want to be constrained that much. So we take the dosimeters off of one reader after they're read, expose them, and then those dosimeter sets are available to go back and be reread on any particular reader, which means that the individual tip calibration has to be related again also to the calibration dosimeters to adjust for reader variation, and then, to be readjusted again for dosimeter variation. But this is probably easier, and I'm

not sure if it's cheaper, than trying to take care of lots and calibrating lots and maintaining that information. Because the same wearer does not receive, again, the same dosimeters, so it would be a tremendous bookkeeping problem to identify who is getting which TLD and from what lot that particular chip came from.

We receive dosimeters from Harshaw on a monthly basis, a few thousand a month, on a continuing basis. So the lot problem, audit problem, is very difficult and very complex. So maybe we took what we feel is the best approach but it also may turn out for us to be the least expensive in the long run.

MR. ALEXANDER: Do you introduce an appreciable potential error in making sure that you associate the right calibration factor with the right TLD chip when it comes back from your customer?

MR. WHEELER: We would like to have a system where the chip itself is identified. We just don't know how to do that yet.

MR. ALEXANDER: I guess that means the answer is yes.

MR. WHEELER: We would like to advance further in that direction. We would like to have something -- as film, where you would have some positive identification in the sense of a binary hole sequence; a punched hole in the film, which is really a positive type thing.

We would like to advance a little bit further in TLD, where now everything is kept in sequence and maintains identity. I can't think of a time when we've lost identity of a dosimeter.

But you do have a small area of ambiguity with TLD, which has to be controlled and assured that you not lose the identity. So you need covers for your cassettes and things like this to be certain that when a TLD is placed in a certain position in a holder, it's not going to come out of that holder. I'm not sure if that was exactly the question you asked.

MR. ALEXANDER: Yes, that's exactly right. Have you kept track of or published or do you have any data you can share which indicates the -- in the process of determining calibration factors for each chip, something that shows the variability among chips in their response to irradiation?

MR. WHEELER: When we decided to do this, we found that over a number of lots we had a standard deviation of something on the order of plus or minus 17% in the dosimeter itself, which we felt was intolerable. You just cannot start off before the person even receives the badge with a 17% error.

By individual chip calibration, we reduced that to something like 6% or 7%. Apparently, Harshaw claims to have plus or minus 2% of the instrument. It's actually probably a little bit better than plus or minus 2% reproducibility. However, by the time the dosimeter is actually picked up by the reader, which is a backing system, automatic system, and then positioned in the heating chamber and then the facing and reflection of the light, you probably end up with a total of maybe plus or minus 6%, and we feel this is reasonable.

MR. ALEXANDER: Phil, you found a little wider variability than that in your site visit program, didn't you?

MR. WHEELER: Let me point out, though, this is the chip itself. This is --

MR. ALEXANDER: I understand. But I believe you had mentioned, instead of 17%, up to plus or minus 25% variability in the chips.

DR. PLATO: No, I'm not exactly sure what you're referring to.

MR. ALEXANDER: Well, you had told us that in talking with processors around the country, many of them felt that you could have as much as a plus or minus 25% error built into the chips themselves if you used them without screening.

DR. PLATO: Oh, yes, okay.

MR. ALEXANDER: And if I understood Bob Wheeler's response to my question just a moment ago, he found 17%.

MR. WHEELER: I said standard deviation.

MR. ALEXANDER: OH, that was the standard deviation. I see, okay. So those are not incompatible then.

MR. SELBY: We heard from Lexington Signal Depot that apparently there's at least a minimum of two control dosimeters or control film per 150 users, I guess you might say. And more control films if the number of users is less than that 150; it might be two per 100 or something. I was wondering if Bob has any experience from his standpoint as to the need, because I think

that's one of the quality assurance aspects. The control dosimeter that go along with the dosimeters to the user -- how many he feels there ought to be.

MR. WHEELER: The way I interpreted the Army's procedure was that this is assuring that the film received by Eastman Kodak was in good shape. We used to use the Dentofilm packets, and we took three film out of each box of 150; one somewhere in the beginning, somewhere at the end and somewhere in the middle. We used them a little bit differently. We processed those before the film were sent out.

Now, we buy our film in bulk and package it ourselves, and the film when it comes off the packaging machine is in a very, very long strip. It's 8 mm film and each one is a separate tab. To make certain that the film is packaged properly by us, and also at the same time, assure that the film is of adequate quality from Eastman Kodak, we remove -- and I'm not sure exactly the procedure, but it's something on the order of three film every 100th film, and we process that before that film is assigned to an individual.

Then there's an extremely detailed procedure, a very complex procedure, of what action is taken if a defective film is found. It depends on the frequency. Typically, if you find one defective film in those three, the 100 film before and the 100 film after are tossed away. It just turns out that that's more cost effective than taking additional samples of those 200 film.

The film that are used in the process when the film are developed are taken from that same emulsion and are stored and then exposed, and then when the film are returned, film from that same emulsion run, Eastman Kodak's emulsion run, are inserted into the developing process. Is that really what you were asking, Jack?

MR. SELBY: I guess -- yes, that's partly it. But I was also interested -- I assume that you also will use control dosimeters to try to determine the transportation problems, and I was wondering if you had any experience in that area?

MR. WHEELER: Oh, yes. Every -- just for your general information, we do not give the customer an option of whether or not he receives the control dosimeter along with his film; there is no charge for that film and it's just included. And that film is manufactured in sequence with the film that he receives; it just happens to be done that way because the film are assigned by the computer. So when a particular customer's account comes up for shipping, the first film assigned by the computer will be a control film, and a label is applied automatically that it's a control film. Then following that will be all the participant films.

This, then, is shipped in the same container to the customer for use during that period, and hopefully, he returns it when he returns the bulk of his other film. Obviously, in many instances the customer does many things with that control film.

He may stick it in a badge and wear it, or he may scotch tape it on the wall or use it as an area monitor or expose it, or it can be exposed in transit. However, as one film in the calibration set that's included in the process, it's an inhouse unexposed film. So if no control film is returned, or if the control film is exposed for any purpose at all, we still have identification of what the base density is for evaluation.

We then go through a process of subtraction of the dose on the control film. It's not arbitrary, and if the subtraction amount is greater than 50 mr and all or a certain fraction of the participant film is greater than 50 mr, that amount of the control film is subtracted. However, the amount subtracted is also recorded, so that we don't have the case of 500 mr being subtracted and nobody knows it was subtracted. Obviously, if there was a high exposure of the control film, that probably is as important to know by the customer as a personnel film being exposed because he's going to find out or assure how that got exposed. It may have been in transit or it may have occurred in his facility.

MR. HILL: You said that you receive maybe several thousand badges or a few thousand new chips per month. With so many new batches of chips coming in per month, how do you eliminate certain badges from your system? Is it like on a timely basis of once every year, or if they don't meet certain standard deviation, or when do you decide to eliminate certain chips or badges from your system?

MR. WHEELER: It seems that people tend to lose dosimeters very rapidly. The attrition on dosimeters is about 30 months or something like that. However, the dosimeters are examined by the person that takes the dosimeter out of the holder and places it in the little cassette that will be used for evaluation. So this person will visually examine the dosimeter for cracks or chips or whatever, and then if there are any noted, that person will put them aside and -- we don't know what we're going to do with those but we've got a big supply of them right now. We could probably sell those very cheap to somebody if someone would like to buy them. There's an attrition in that sense.

Also, if the dosimeter is found to under-respond or over-respond by a factor of more than -- a factor of two or less than 50% of what the average is on the second exposure process, then that dosimeter will also be put aside and not used anymore. By this individual calibration, you can tolerate much wider swings, obviously, in sensitivity. However, you don't want to have something that's so insensitive that you have very large errors because of the insensitivity. That happens very seldom, though.

And sometimes you have an over-response because of the way it was used by the customer and some amount of dirt or some foreign material was affixed to the dosimeter and now that's burning or glowing every time the dosimeter is read. Which obviously will cause a rejection of that dosimeter and it's taken

out of use.

MR. STORM: I'm sorry, Bob, I'm not familiar with your badge. Do you just use a single chip in your TLD badge?

MR. WHEELER: We have provision for up to four chips. The normal configuration is two; one shielded and one window area of a smaller, lower absorption.

MR. ALEXANDER: Bob, you offer I believe a polycarbonate membrane for fast neutron dosimetry?

MR. WHEELER: We offer two. One's a polycarbonate and one is a CR-39 which is a relatively new type material. CR-39 is a material that's similar to what's used in contact lenses and is a proton recoil-sensitive device,where the polycarbonate is a carbon and oxygen recoil, a more heavier ion detector. That has a higher energy threshold and the CR-39 has a much lower neutron energy threshold, about 100 KeV.

MR. ALEXANDER: Have you checked those materials for -- those membranes for variability, such as you found in the TLD chips Variability in response to neutrons.

MR. WHEELER: We have checked. Again, when you really find out what's going on is when you process a million dosimeters or so, and we haven't processed a million of those yet. We don't think there is much sensitivity change in either the polycarbonate or CR-39 of the dosimeter itself. Both are etched in a situation where the -- well, one is etched at a higher temperature of greater than 60 degrees C. and we know that process is temperature

dependent and also time dependent. So we see variations in the sensitivity but it appears to be due to the processing variables.

So here again, just like in film, there are pre-exposed dosimeters in every process to account for all those variables that you really cannot calculate in advance.

MR. LLOYD: The question I had is what instruction and how often is given to the customer relating the use of the control badge? As we inspect, we see exactly what you've mentioned. Some of the control badges are used properly, some of them are taped to the inside of the booth, some to the outside of the booth, some are used by a number of different individuals during the month as an extra badge, some are used during the holding process. They're used for essentially everything. We tried to instruct them in the field and the general response is that they didn't know what that extra badge is for.

MR. WHEELER: A new customer receives an information bulletin which includes a number of instructions. It almost assumes that he has never worked with radiation before and this is the first time he's worn a badge.

We know, and probably as you are pointing out, that most people don't read things, or if they read things, they don't know what they've read. When we find that a control badge is misused, we have a note that is included with the report that says that. We also have -- and I don't remember exactly what it looks like anymore. We have, whether it's an individual sheet that re-

explains the use of the control badge or if it's a smaller brochure, it's either one or the other. When we find severe misuse; for example, when you see a filter pattern on the control film you know somebody put this in a badge holder, and that's not what it's intended for. We would then send him this note, which is separate from the report.

The regular note that I'm talking about is just a coded identification along with that particular exposure form, which says something to the effect that the control film was misused or exposed or whatever happened in that particular case. If it's obviously that he misused it, then we include this little phrase printed on a little form that explains again to him how to use the control badge.

I believe, I'm not certain -- doesn't the back of the report have the use of the control badge printed on the back of the report form? Because it's so common, like you're pointing out, we did put it on the back of the report form. But as you know, many people do not read things.

MR. ALEXANDER: Thank you very much, Bob, I appreciate your sharing Landauer experience with us. We heard yesterday from one inhouse processor on quality control, Manny Jimenez from Duke Power, and we have an additional speaker from Yankee Atomics who will tell us about their quality assurance program. Russ Mellor from Yankee Atomic.

MR. MELLOR: Thank you. Yankee Atomic appreciates the opportunity to explain what we feel are the essential elements of a viable quality assurance program from the point of view of a medium size, inhouse processor. Our dosimetry program processes approximately 5000 to 6000 pieces of dosimetry per quarter.

In starting off, it might be redundant, although useful, to talk about what is quality assurance, and we were given a nice definition yesterday; that it is a planned, systematic and documented series of actions necessary to provide adequate confidence in theresults produced by a measurement system or service.

That's all well and good. It basically means that we're going to go through quite a bit of work in order to determine what the adequate confidence in the results will be.

One facet of quality assurance which was alluded to yesterday is quality control is sort of unnecessary. We believe it is actually firmly necessary to establish what quality control means. And in our case, we don't apply a regulatory definition to it; we utilize the application of simple, reasonable tests which are based on a common sense analysis of the measurement system or service, and the results of which are utilized to verify the quality of data generated by the system or service.

It's not uncommon to see the idea of common sense playing a second-degree role. Many of the things that you see are wrong are usually wrong because you have a gut level feeling, a

common sense approach, that they're not correct. Although the tests will be simple and reasonable, the documentation of the tests and the documentation of their adequacy for quality assurance purposes may not be simple; it may be involved.

Yankee Atomic Environmental Laboratory, which is in control of the dosimetry processing for the Yankee organization, originally developed a set of key elements in the implementation of a viable quality assurance program. It is not necessary to take any of this down; we do have handout copies if you desire to have them.

The first of these is selection of key personnel, and we proceed on down through facility design, awareness of exposure parameters, selection of analytical techniques, analytical equipment, training and selection of analytical staff, establishment of the chain of custody, and establishment of the quality control criteria.

The majority of these criteria were adapted to the measurement of thermoluminescent dosimetry from our working in environmental radiation measurements. The criteria were first established in 1977 when the Laboratory first started operation.

Selection of key personnel I think is rightfully deserving of the position of number one. In this case, I think that quality begets quality; I don't think that in the overview of the standard that we're talking about today, if you have quality personnel you are necessarily guaranteed that you will

pass any such standard. However, I think you can make the assumption that if you don't have quality personnel you are liable to fail.

And these personnel have got to be knowledgeable about the dosimetry needs of their users, and aware of the complex interactions required in functional dosimetry programs. And it must be realized that these people are responsible for delineation of the entire program. Bob Wheeler has really gone into great detail in his answers to questions on the intricacies that are necessary in order to provide adequate dosimetry programs to users.

Something that many people tend to ignore when they're talking about quality is the facility design, and it is our interpretation that the facility design has a direct bearing on the quality of the results, and it must indeed be large enough to accommodate your planned quantity of dosimetry processing. And each separate area of processing must be adequate and must have adequate space, proper lighting and adequate lighting, heating and ventilation control and temperature control. Obviously, temperature control being extremely important, not only from the point of view of dosimeters but from the point of view of instrumentation.

A lot has been discussed in the last two days on awareness of exposure parameters, and the basic opinion that I think is coming out is that adequate health physics cannot be

performed without adequate knowledge of the type of radiation to be measured; not only the type, but the energy spectrum for each type, and the expected exposure levels. So it's necessary in planning a dosimetry program and implementing and carrying it out to be aware of all of these criteria.

Selection of analytical techniques is another key issue. A processor who processes a significant number of dosimeters must have a balanced blend of quality and quantity. It sounds rather harsh to say quantity, but you have to produce your dosimetry results in a timely manner, and that means that your dosimetry processing scheme must be fairly sophisticated and perform on a very routine basis.

You must utilize well known and well documented techniques, and in order to do that you must have a working knowledge of the techniques and of the measurement system being considered. You must have an understanding of all the technique uncertainties. Each technique has its own individual areas of uncertainty.

And if you come across the need to utilize or come across two techniques which could be utilized, then a comparison of expected accuracy and precision for the two anticipated techniques must be performed, either from literature surveys or from inhouse experience, in order to determine which technique is the most viable. One word of caution here: when you're looking at literature predictions of accuracy and precision, you must take them with not necessarily a grain of salt but realize that

these were under the best of conditions; those techniques being reported by people in the literature. They are the most familiar people with those techniques and they will most likely do the best job.

Selection of analytical equipment -- that's partially governed by the choice of the analytical methodology, but there are several points to remember when you're looking at analytical equipment. One, is it suitable for measuring the required quantity? Is it reliable? Is it reproducible, and that's not necessarily the same thing as reliability. You can have an instrument that is reproducible only when it works. What are the operating parameters that are involved in the instrumentation? What maintenance is required? What is the availability of that equipment?

It's often wise to obtain a list of users, present users, of the equipment if you're establishing new equipment and get their input on what is involved with that equipment. Is it good equipment, is it bad equipment, what experiences have they had? And, is the equipment user-oriented? Nothing more devastating than to have a technician who cannot utilize an instrument to its full capacity because it's not user-oriented.

Selection and training of analytical staff is important. The degree of experience is necessarily dependent on your program needs, but the initial training should really consist of technique familiarization and that should include theoretical considerations

even for people on the technician level. They should at least be involved with the theoretical considerations for their work duties.

The processing of routine matrices, the processing of replicate irradiated unknowns and the processing of submitted dosimetry; all of these should be carried forth in the initial training. And retraining should be accomplished at an appropriate frequency depending on your program needs and the individuals' needs. I must stress the individual's needs. Some people need more frequent retraining than other people.

One must establish a chain of custody, and in this sense we talk about chain of custody as a knowledge of the dosimetr location at all times when it comes under your purview, not when it comes under the purview of the user. And you must establish the normal flow of the dosimeters for the measurement process, establish a system for issuing and receiving dosimeters, and establish a method of notifying the contractee of any dosimeters not returned.

This should help to minimize a number of blunders that occur by lost dosimetry or lost dosimetry data, which definitely lead to irretrievable results.

Once these parameters have been attended to and established, one has to establish a quality control criteria. To what are we going to be responsible -- to what level are we going to be responsible for the measurement? It's not proper to just

establish all the controls and then not place any criteria on them as to what level you'll be working to. And in order to do that, you must recognize the key parameters of accuracy and precision, and in this term, accuracy here represents the term of bias as represented in the standard. How accurate or precise do we want to be? Do we want to make a pure guess as to how accurate we need to be, or do we want to base it on an educated estimate, or should we look at the capabilities of our system, and that's the system in total, the total dosimetry system, and make an estimate based on the measurement of systematic and related uncertainties? The normal procedure is to lie somewhere in between items 2 and 3.

Well, when you finally get down to choosing an operating criteria, what do you do? You can choose a criteria from another facility, and I think you can -- if you made a poll of anyone out there who has a facility, you'll find that everyone has a different criteria; there is no set criteria. So you could utilize existing criteria from another facility, or you could do the evaluation of the current measurement process and modify an existing criteria from somewhere else to meet your needs.

Those are all the preliminary steps; now we get down to the things that maintain your dosimetry program, and that's maintaining satisfactory performance within established criteria.

You must determine the major uncertainties for the measurement process, if you have not already done so. You have to

maintain those uncertainties below their estimated upper boundaries You have to establish checks to insure the quality of data, and these are the day-to-day workings of a viable quality control program.

We can list some of the elements that go into a successfu quality assurance program, and the first of these is listed in what we consider to be the order of their necessary importance.

One, you should really establish an emphasis on quality among all staff members. You, as a processor, or your capabilities as a processor are only as good as the weakest member of your department or of your staff. Not necessarily in their abilities but at least in their philosophy towards quality.

You must establish and maintain a thorough procedures manual dealing with all aspects of the measurement process. You should utilize well-known or proven methodologies, and if you develop those methodologies inhouse, all facets of the methods must be tested, verified and documented.

You should establish and maintain a viable training program which will include initial training and subsequent retraining.

Your analytical staff must be thoroughly familiar with the dosimetry measurement systems being utilized and be able to recognize and correct inadequate performance. This is important if nothing else, if you don't recognize inadequate performance you'll always go on feeling that you're doing a superb job.

You should maintain a calibration schedule and calibration documentation. You should perform instrumentation calibration checks, utilizing well-characterized dosimeters and radiation sources, the measurement of which truly reflects the operation of the system under consideration.

You should perform standard measurements during each series of exposure determinations. Quality control charts or tables should be utilized as appropriate for recording instrumentation status, checks and not only that but the criteria for acceptability should be readily apparent on those forms.

As we've mentioned before, you must establish a chain of custody system for the tracking of dosimeters throughout the issuing or processing cycle.

You should establish a recordkeeping system which will lend itself to ease of use and data retrievability, and it should be capable of checking the validity of key data inputs from the analytical calculations. And it is our hindsight that whenever you try to do a measurement in a quality manner, normally 40% to 50% of your workload is in the recordkeeping area, of one form or another.

You should document and validate all aspects of the computer programs; verify percentage of all calculations; maintain a complete instrument history on the instrumentation utilized in the laboratory; and insist upon data review by individuals knowledgeable in the dosimetry measurement process.

For quality control dosimetry, you should expedite data review, not only before reporting that dosimetry result, but also after the known data is available. To allow incorrect data unchallenged is really a travesty on the system that you've already set up.

And you must perform appropriate actions based upon the acceptance or rejection of the quality control data when compared to the established criteria.

In implementing this procedure -- or rather, these elements -- the Yankee organization has determined some potential sources of error or uncertainty in thermoluminescent dosimetry systems, and these errors may be peculiar to the system that we're using, the Harshaw system. We have noticed that there is a potential for incorrect phosphor position or type. For example, the lithium 6 fluoride present or not present in the correct configuration for neutron monitoring, and that's been pointed out dramatically before.

Improperly supplied attenuators for neutron monitoring; the presence of tin instead of cadmium. Variations in response of individual thermoluminescent phosphors outside of manufacturer specifications. The lack of reproducible response of individual TL phosphors outside of manufacturer specifications. Individual TL response factors, because of items 3 and 4, really should be utilized and determined. Determined and utilized.

There's also a loss of thermoluminescent sensitivity

with the increasing number of readouts. What should be done about this I leave up to the individual processor. One must know the fade characteristics of the dosimetry system that you're utilizing, and you should account for those fade characteristics. You must be aware that you can have loss of thermoluminescent data due to mechanical malfunction of the dosimeter itself or of the equipment. And another potential source of error is the utilization of poorly characterized radiation sources for measurement system calibrations. And a lack of knowledge of radiation environment in which the dosimeter will be utilized. That's another key item; the inability to know the radiation environment in which you will be utilizing the dosimeter severely hampers your ability to correctly predict the absorbed dose.

Finally, after all of these items are in place, one must process some form of quality control dosimetry, and we have basically broken out quality control dosimetry into five sections. That is, the intralaboratory process check, which is a known level, normally prepared or irradiated inhouse. And the agreement with some established criteria is immediately known. However, there is certainly no systematic bias. You cannot determine if you have a systematic bias with this methodology.

A replicate irradiation program can be an excellent indicator of precision for truly replicate irradiations, and it is our preference that it be controlled by our contractees.

However, we do like to get notification of all results,

and that includes those results that are acceptable as well as unacceptable. And the category into which the standard falls, an interlaboratory comparison, and that assures us an independent third party objectivity. Agreement with the criteria either established by ourselves or by the committee is not immediately known, so there is a time lag here, and processing of dosimetry in the interim may or may not be questionable should you pass or fail. It is, however, a good measure of system bias.

The Yankee organization would prefer to see a national program. However, I don't think informal programs should be discouraged. Whenever possible, you should be utilizing other people to check your dosimetry.

The use of control dosimeters has been questioned at length for film. Certainly, they have the same approach in thermoluminescent dosimetry. And they should be processed to reflect the intransit storage dose evaluation during the issue period, and a viable percentage must be utilized. And they should be processed with easy exposure processing.

It's also possible that in order to insure that there is not a change in fade characteristics, you might want to include some portion of the controls as irradiated controls.

System background checks are also important. They give you a check of well-characterized background level and they give you an indication of the maintenance of stability of your system.

Those are all the remarks that I have. However, Yankee

will be commenting on this formally in written format before the end of June. Any questions?

MS. DENNIS: I have a general observation that I'd like to make, and I'd like, for the sake of the record, to ask those people who are here who have spoken already to make some sort of a statement about training of personnel. There are those who believe that that is a significant portion of any quality control program, and unless I was not listening attentively or otherwise occupied, I think this was only just brought up in this very last discussion. And I'd very much like to hear about technician training, what you feel are basic minimum requirements from other people in the room, please.

MR. MELLOR: I want to make one more comment on staffing. I think we all realize that in the radiation measurement field quality personnel are becoming harder and harder to find and locate, and therefore, you might be forced into bringing onto your staff some people who, although they may be quality people, may not be trained in the arts of radiation dosimetry. And I think training is going to be an important part of your approach to quality.

DR. PLATO: Russ, I'd like to ask a question. You, in your presentation, referred not only to training but to retraining of personnel. Could you elaborate a little bit on what you have in mind as far as retraining frequency, degree?

MR. MELLOR: I think retraining is partially a function

of the ability of the people that you have originally trained. If you have extremely competent individuals, the retraining is an ongoing process for them anyway. And this partially gets back to the idea of instilling quality, the idea of quality, amongst all of your workers anyway.

As far as retraining, I think you have to set a very nominal degree and frequency of retraining that you can increase because of the needs of the individual. I hope that explains it in more detail.

I didn't have any specific comments. I think that's system-oriented, the training of individuals. However, the Yankee organization does not frown on sending people to areas in which they can obtain theoretical training, and that's not -- that's an extremely important area of training. Not just to be able to push the buttons and be able to tear the computer paper properly, but rather to be able to theoretically understand what is happening with your dosimetry system. Otherwise, you can allow inadequate performance to slide by. Certainly, even a quality assurance individual in a facility doesn't see all data that is produced. However, technicians do, or should.

MS. DENNIS: Do you have minimum qualifications established for your technicians?

MR. MELLOR: We prefer to utilize people with a minimum of an associate's degree for technicians. The reason we set the minimum at the associate degree level is because people who have

further degrees tend to become rapidly dissatisfied with the day to day operation of a unit, or the day to day responsibilities of performing routine measurements. And dissatisfaction leads to error more often than not.

MR. POLAND: One area that hasn't been discussed thus far, and I think it exists in the industry, is I guess the so-called use of satellite TLD systems, so to speak. And I would think in an organization such as Yankee in which they send their dosimeters to maybe a services lab such as yours, that the individual plants might need some sort of an onsite readout system to handle the real time exposure control requirements. For instance, if a pocket dosimeter goes offscale or something like that. So they can get a readout real quickly.

I'm wondering whether -- if someone has such a system; for instance, a manual system, that they can read the dosimeter out quickly and get a valid result; is the certification requirements going to be extended to this type of a system? Generally, how would people handle this type of a thing? I believe it exists, in talking with various HP's.

MR. CAULDWELL: Basically, we do have an onsite system per se, if you want to call it that. We operate out of a central corporate office in the middle of Massachusetts, roughly, and cover most of New England. It's a fairly nice, small operating area and we're within two and a half to three hours of any one of our operating plants.

The way we generally work things is, if we have an offscale pocket dosimeter or something like that, we run a courier service between our plants and the main processing lab, with telephone communications being established prior to that dosimeter leaving the plant so we can anticipate its arrival. Normally in this way we can process any dosimeter results within three and a half to four hours after an incident occurs.

In addition, during major outages at our plant we have a mobile processing facility that is basically just an extension of the lab itself. We load our gear into the mobile processing van and all our procedures and computer tie links and data links and everything else, and just travel right up to the plant and we can sit right on the plant site. Or, in case of a Three Mile Island type incident, unhopefully, we can move to almost anyplace where there's a telephone and set up work and start processing via our normal procedures and the normal way we do business.

So we really don't make any differentiation between "onsite" processing and "offsite" processing; it's all the same to our system.

MR. WHEELER: Since that point was brought up, we also have a system which is placed at the user's facility and particular nuclear stations where the station reads the dosimeter out on our TLD reader and the calculations are performed by telecommunications back at our computers in Glenwood. But we also provide a quality control/quality assurance for this type of system as

well. It's a little bit different than our own inhouse system in that here -- and I think I'm going to be blamed for missing lunch but I'll make it short -- we idividually calibrate each dosimeter card that is used at the station and record its specific sensitivity, and we also supply pre-exposed dosimeter cards to known values, as well as what we call a quality assurance dosimeter which must be read out each time any size badge or quantity of personnel dosimeters are read. And this quality assurance dosimeter -- the exposure is not known to the customer. It's known only to us. And when he receives the report by return phone call, he will receive the results of the personnel dosimeters as well as the result of the QA dosimeter card, and that QA dosimeter card must fall within specified parameters of accuracy; otherwise, certain other procedures must be pursued to determine the reason for the error, if it falls outside of a certain percentage. I don't remember exactly what that is.

MS. DENNIS: Mr. Wheeler, could you speak about technician training and qualification while you're at the microphone?

MR. WHEELER: Yes. I was thinking about this. I don't believe we really have established any specific entry qualifications. We do need certain manual dexterity in certain functions. It's almost entirely on the job training, which is certainly necessary. After an employee has been with the company two to three weeks, he is taken on a very detailed tour of the entire facility so he also gains insight into the purpose, why we're

doing this, the importance of dosimeter data, so he doesn't feel that he is just pushing a button and getting a number. He has to really be taught to relate this number to an individual, that a person wore this particular badge and this exposure is important to that person.

The employee is then trained in many as jobs as possible, so that we don't have the situation of an employee being extremely bored at a very repetitive job. So he may be switching from a TLD system to a film system or vice versa, and we intend to actually have even interdepartmental training, which we really haven't fully implemented yet on a full scale.

But this is important, not only operation-wise, but in maintaining some level of interest in the employee of doing variable work and recognizing his importance, which really what it does is improve the accuracy. The more interest he has in the job he's doing, it provides better performance in the work that he does.

MS. DENNIS: Is the representative from Canada still here? Yes. Since you have a government-operated program, could you speak to the training that you require there, or minimum qualifications?

MR. GROGAN: We again don't have minimum qualifications except very basic high school education sort of thing. Most of our training also is on the job training.

MR. ALEXANDER: I would like to thank my colleagues from

the other government agencies for attending this public meeting and assisting with your comments. And I would like to thank all of the participants for contributing to our public record on this rulemaking action. We need you very much and we appreciate your help.

With that, I'll close the meeting.

(Whereupon, at 12:05 p.m., the public meeting in the above-entitled matter was closed.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

---

in the matter of: PUBLIC MEETING ON PERSONNEL DOSIMETRY PERFORMANCE TESTING

Date of Proceeding: May 29, 1980

Docket Number: _____

Place of Proceeding: Washington, D. C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Suzanne Babineau

Official Reporter (Typed)

Suzanne Babineau

Official Reporter (Signature)