NUCLEAR REGULATORY COMMISSION

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

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

PUBLIC MEETING ON

PERSONNEL DOSIMETRY PERFORMANCE TESTING

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

Wednesday, May 28, 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 9:40 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

NRC
Personnel
Dosimetry
3-28-80
Babineau/
Burrell
Tape 1

P R O C E E D I N G S

(8:30 a.m.)

WELCOME AND INTRODUCTION BY R. E. ALEXANDER, NRC

MR. ALEXANDER: Good morning, ladies and gentlemen. We would like to welcome you to Washington, D. C. and to this public meeting on the subject of Personnel Dosimetry Performance Testing.

I am Bob Alexander, the Chief of the Occupational Health Standards Branch at the Nuclear Regulatory Commission.

We met in this room a little over three years ago when we thought we thought we were about ready to go to rule-making on this subject. I wonder how many of you were here for that public meeting. Not very many. That is a surprising thing. I guess the others learned from that experience that there was no use to come back to the second one.

The Washington, D. C. area is populated by a very politically sophisticated group of people, and you will need a topic for discussion with your waiter at lunch, so I thought I would give you this announcement that I picked up in the Washington Post this morning, a report from Great Britain that Ronald Reagan has decided to select J. R. Ewing, wealthy Texas oil man, as his running mate. With Mr. Ewing's qualifications for advancing his own achievements, it really won't make much difference how old Ronald Reagan is.

I wonder how many of you know who J. R. Ewing is. Not many.

(Laughter.)

J. R. Ewing is the bad guy on the TV program, "Dallas," that comes on, I think, on Friday night. He would make a great vice president.

Well, we are glad you could come. We have a fairly tight schedule. The agenda has been handed out, and we will follow it fairly closely. We will have a lunch break at 11:30 for an hour and a half and meet back promptly at 1:00, and then we will meet again at 8:30 in the morning. I will try to run a fairly tight ship here as far as time is concerned to make sure we get completely through the program and have adequate time to discuss the advance notice of rulemaking before we adjourn tomorrow.

The NRC staff feels that we have laid an appropriate groundwork for a regulatory test and certification program and that it is now approximately time to publish proposed regulations in the Federal Register for public comment.

The remarks I will be making this morning about the proposed regulations which I think is the topic you will be most interested in, you will have to recognize as being very preliminary in nature, not yet having the approval of the Commission or even NRC management or even the other offices, or even the Office of Standards Development.

These are strictly preliminary thoughts of ours who are doing the groundwork in developing these regulations, but I thought that if I would tell you where we stand right now, and even recognizing that changes may be extensive, it would help give you a feeling of at least the ideas that you will be confronted with either to support or try to overcome when a rule is published for public comment.

The issue as we see it, and when I say "we," remember I am just talking about Bob Alexander and his staff, the issue as we see it is that the NRC has not established in its regulations requirements of any kind regarding the competence of personnel dosimetry processes to determine the external dose of workers exposed to radiation in NRC-licensed activities.

Evidence exists which indicates that a great deal of improvement is needed on the part of some processors who do not perform these dosimetry services with a high level of technical competence.

Thus, the question arises as to whether the Commission should establish a regulatory program intended to ensure an acceptable degree of technical competence on the part of processors who measure the external radiation dose to individual workers in licensed activities.

That is in brief the issue that we intend to bring before our Commission. The staff has made a careful study of this problem and is now recommending that the Commission establish in

its regulat _ a test and certification program for personnel dosimetry processors.

In accordance with proposed regulations to be recommended by the staff, NRC licensees would be required to comply with certain of the Commission's regulations; namely, those requiring the measurement and recording of occupa_ onal radiation doses, by obtaining dosimetry results from processors certified by the NRC as being competent for this type of technical measurement.

The proposed regulations will now be discussed in considerable detail.

The following actions have been taken or planned in preparation for this regulatory program. The Health Physics Society Standards Committee has developed a consensus performance standard for personnel dosimetry. This standard was published as a draft by ANSI, ANSI No. 1311.

A public meeting was held to explore various alternatives for using this standard. There was a general consensus that a regulatory program should be adopted but that the standard should first be tested for suitability.

The suitability of the draft standard for a regulatory program was tested by the University of Michigan under contract with the NRC. M st of the processors in this country participated in this pilot study. The results of the study verified the need for improvement by some processors and indicated the need

for several changes in the standard.

Let me make an aside on the changes in the standard. I think we would do well to come to grips in this meeting with the position that some people are bound to take, that the standard as a result of the indicated poor performance during the pilot study has been watered down.

Our position is that that would be the wrong way to put it. That leaves the wrong impression and does a disservice to the standard. From my view the people on the working group who were charged with coming up with this standard several years ago under the leadership of Dr. Ehrlich from National Bureau of Standards faced a very difficult situation in trying to reconcile in an appropriate manner two very difficult end concepts about which very little was known. One was what degree of accuracy and consistency is really needed in this type of measurement for personnel protection purposes. And the answer to that question still isn't available and probably won't ever be.

The other difficulty was coming up with something that would be practical, that not everyone could pass easily, so that there would be no challenge to conduct an appropriate program, but also not so difficult that no one could pass and virtually paralyze the nuclear industry with a regulation.

So from my view they were virtually taking a shot in the dark. The standard that they came up with might have been one

that was much too easy or it might have been one that was much too difficult or with a very low probability. It might have been one that was just right.

As it turned out in our view, the standard has been indicated to be too stringent. So adjustments have been required to bring it into line as best they can with the two needs that I mentioned before and with the state of technology in the dosimetry industry.

So the standard was modified by the Health Physics Society Standards Committee. Using the complicated criteria of the draft standard, 35 percent of the final radiation category tests were passed, indicating either poor performance or an overly stringent standard. Using simple dosimeter -- -- to accuracy criteria, 73 percent of the dosimeters tested were within plus or minus 30 percent of the true dose and 86 percent were within plus or minus 50 percent, indicating a rather high degree of competence on the part of most of the processors.

Thus, the standard was revealed to be overly stringent. Using the criteria of the modified standard, 62 percent of the final radiation category tests were passed.

So I feel that that is getting very close to what is needed. The staff now has sufficient confidence in the standard to recommend it for reference in the proposed rule. However, the major changes may require additional testing prior to issuance of the rule in effective form. This testing will be conducted

in parallel with the public comment procedure. The staff does not anticipate additional major changes in the standard. If such changes are made, an additional public comment period will be recommended.

Several other governmental agencies, federal and state, plan to use this test and certification program. To facilitate their participation the Policy Committee on Personnel Dosimetry Performance Testing was formed early in the program's development stages. This committee is chaired by NBS and includes as members NRC, OSHA, EPA, DOD, DOE, BRH and the Conference of State Radiation Control Program Directors.

The members of this committee for the most part are seated on the stage this morning, and I will be introducing them to you in just a moment. An overview committee was formed by the industry to monitor the progress of and comment on the program's development.

To encourage and provide for voluntary improvements well before enactment of the new regulations an effort is being made to identify specific causes of poor performance in the pilot study. This effort involves visits by University of Michigan personnel to each participant's site for direct investigation and consultation. Phil Plato will speak in more detail to that program in a moment.

A comprehensive value impact statement of the various alternatives for federal corrective action is under preparation.

This statement will make use of the studies performed for this purpose by the University of Michigan personnel. The information-gathering process included a series of meetings with processors at the University of Michigan.

The advance notice of rulemaking was published to obtain public comment regarding operation of a testing laboratory. The public comment period, as you know, has been extended so that the comments made at this public meeting can be included and so that many of you who would wish to make your comments after this meeting in the light of what you hear at this meeting.

The comment period has been extended to I guess June the 27th, is that right? Something like that.

Incidentally, an aside remark on the public comments: I think most of our citizens who look at our proposed rules or our regulatory guides and see something they like feel that a public comment is not useful or necessary, and I believe that that is not right. If you see something that you particularly like that we are doing, you should comment to that effect to us in writing because what you see that you particularly like could very well disappear if we get a half a dozen negative comments.

The further in preparation for the rules, we are holding this public meeting today. The staff believes that these actions have provided a technically sound and well thought out basis for the proposed rules.

Now for the most important features of the new

regulations as conceive them today. There are fifteen points, quite a bit to take notes on. The transcript of this meeting will be available in just a few days after the meeting is concluded. We have a court reporter here today who will record and transcribe everything that is said.

All right, the first point: Personnel dosimetry results will be acceptable to the Commission only if developed by a dosimetry processor who is certified for this purpose in accordance with the new regulations.

A certification board would be established for the purpose of certifying and recertifying qualified processors.

Processors would be certified in one or more specified radiation categories -- gamma, beta, neutron, et cetera.

Certifications would remain effective for one year. The recertification process would take place during the certification year. Failure in the recertification process would not affect the previous certification. Recertification could be issued only during the final four months preceding certification termination.

The certification board would award certified status on the basis of, A, passing a performance test, and, B, approval of the processor's quality assurance program.

To become certified a processor would have to agree to permit onsite inspections of the quality assurance program by the NRC staff.

Performance tests would be conducted by private laboratory under contract to the NRC. Under an interagency agreement with the NRC the NBS would evaluate and approve technical aspects of the testing laboratory's operation.

The testing laboratory would charge a fee for the testing service as necessary to provide for a self-sustaining operation.

The performance standard used by the certification board would be ANSI 1311, which will be incorporated into the regulation by reference.

An appeals board would be established to examine extenuating circumstances that might be associated with the failure of a process to achieve or retain certified status. Decisions of the appeals board would be final.

Processors making an appeal in accordance with the regulations would remain certified until the decision of the appeals board would be issued.

The certification board would publish a list of certified processors by radiation category each month in the Federal Register. Omission from the list would indicate termination of certified status.

The regulations would establish time constraints for the testing laboratory, certification board, appeals board, and the processors as necessary to ensure that a processor during the recertification process would have time for retesting and/or

appeal prior to being removed from the list.

The certification board would consist of NRC staff members designated one each by the various principal NRC offices.

Appointments would be for a period of three years and would be approved by the NRC's Executive Director for Operations. The chairman would be selected by him from among the designees.

There would be no restrictions on reappointment.

The appeals board would consist of representatives, one each, from the following federal agencies: NBS, NRC, DOL, EPA, HEW -- that is the Bureau of Radiological Health -- DOE and DOD. The chairman would be the NBS representative. All appointments would be subject to confirmation by the Commission. There would be no restrictions on reappointments.

These features will of course be dealt with in more detail when we publish the proposed rule for public comment.

As a matter of interest, there is a precedent for the NRC using a test and certification program in its occupational health protection program. That precedent exists for the certification of respirators which are used by workers to protect from airborne radioactivity.

In 20.103 of 10 CFR, Part 20 there is a requirement that any respirator for which the licensee makes allowance in determining the worker's exposure, must be tested and certified by NIOSH.

Now there is the case of a federal agency; namely, NRC,

using the certification program of another federal agency. And we anticipate that use of our program will be made by other federal and state agencies, and that is one of the main reasons we have tried to keep them involved from the beginning of this program.

The NRC staff, although the NIOSH test and certification program is not perfect, considers it to be a very successful, practical and workable way of assuring that these devices are safe.

Other test and certification programs that the staff has already started working on, in addition to the respiratory protection program and the personnel dosimetry program, include bioassay laboratories and the certification of Health Physics Survey instruments.

At this point I would like to introduce to you the representatives of the other agencies whom we have been working with on this project. To my immediate left is Don Ross from the Department of Energy, who apparently is representing Ed Volario.

It remains to be seen how well Mr. Volario will be represented.

Next to Dr. Ross is Elmer Eisenhauer, of the National Bureau of Standards, who is the chairman of the policy committee.

Next to Elmer is Greta Ehrlich, who also works at the National Bureau of Standards but is here today in her capacity as

chairman of the Health Physics Society Standards Committee Working Group that developed ANSI 13.11.

Next is Larry Lloyd, who represents the Conference of Radiation and Control -- I never can get this right -- the Conference of Radiation Control Program Directors. Larry is the one who has to travel to our meetings the most, and also represents a much wider constituency than any of the rest of us do, but Larry does a very good job.

Next to Larry is Nancy Dennis of my staff who really does all of the work on this project these days.

Next to her is Phil Plato from the University of Michigan who has been a great source of strength to us in the program, has conducted the pilot study in a very competent, professional, successful manner.

Next, representing really the Department of Defense, although he is in the Army, is Colonel Bob Wangemann.

Then my friend and yours, Luis Garcia of EPA.

Sheldon Weiner of OSHA will be joining us later. Those of you who may be wondering why David Lee isn't here, who we are used to dealing with in radiation protection matters from OSHA, David has left OSHA and gone to work as a safety engineer for the Post Office. Sheldon Weiner is now the radiation man in OSHA. He can be reached on the same telephone number that David Lee was using.

Finally, from the Bureau of Radiological Health, Dr.

Donald Thompson.

I would like to give each of these distinguished, starting with Dr. Thompson, an opportunity to make a few brief remarks to you. Dr. Thompson.

DR. THOMPSON: Thank you. Most of you probably know the Bureau of Radiological Health does not have any regulatory authority in the use of personnel dosimeters. However, because of its public health responsibility, the Bureau of Radiological Health has maintained continuing interest in the reliability of personnel monitoring.

In 1961 the Bureau, better known as the Division of Radiological Health, contracted with the University of Pittsburgh for research on the accuracy and sensitivity of film monitors. In 1963 the Bureau provided technical and financial assistance for a performance survey conducted by the National Sanitation Foundation.

The Bureau also funded the 1973 NBS Public Health Survey of commercial processors and in 1975 contracted with NBS for the development of a new personnel monitoring standard.

That standard as later modified by the Health Physics Society became in 1978 ANSI draft standard, which was employed by the University of Michigan for the pilot test project.

In addition to the general public health responsibility the Bureau currently has a responsibility for monitoring some 5000 occupation-exposed individuals. These are employees of the

Public Health Service, the Coast Guard, the Bureau of Prisons, and several other agencies.

To support this function, the Bureau developed an automated recordkeeping system which is available to interested organizations.

The Bureau has been a member of the interagency policy committee on personnel monitoring since its inception. It was the cosponsor of the 1976 public meeting of the meeting of the personnel monitoring control program.

At that meeting (inaudible) implementation of voluntary compliance programs among those processors and exposed personnel not subject to authority of the Nuclear Regulatory Commission or the Department of Energy.

It is still the Bureau's intention to participate in the establishment of a comprehensive nationwide program with uniform criteria for personnel monitoring performance. We strongly support proposed certification of personnel dosimetry processors and urge that it become effective by the summer of 1981.

Among the many important considerations related to this program the proposed testing laboratory and the appeals process deserve special attention. We support the concept of a single laboratory, initially funded by NRC, but eventually self-supporting fees charged for services rendered.

The laboratory will be monitoring technical by NBS and

completely independent of existing processors.

We also strongly favor a single uniform appeal system available to all personnel dosimetry processors. This can be accomplished with an interagency sponsorship with a demonstration by a single agency such as the NRC.

The Bureau recognizes that NRC licensees and DOE contractors can be covered by the proposed certification program quite simply by the stroke of a pen. Many other processors in agreement states and in institutions such as medical care facilities not directly covered by NRC and DOE would need special attention to ensure their participation in the uniform nationwide program.

The Bureau will actively participate with appropriate rules and individual processors to encourage their adherence to certification programs.

MR. ALEXANDER: Mr. Garcia?

MR. GARCIA: The EPA, you know, is not a regulatory agency in this matter. So EPA at present does not have an official policy position on the subject matter of this hearing. I intend to recommend that EPA strongly support the efforts to meet the objectives of this program, namely; to standardize personnel dosimetry and to provide a means for the quality assurance of such services.

I don't know exactly to what extent this would be represented by such matters that are in the jurisdiction of EPA,

such as in the formulating of new radiation protection guides for occupational exposure that EPA hopes to put out for public comment before the end of this summer. And at this moment I don't know to what extent the efforts to support this program here will be reflected in those proposals of EPA.

MR. ALEXANDER: Thank you. Colonel Wangemann.

COL. WANGEMANN: The Department of Defense as of today does not have an official position on the subject matter of this meeting either. However, we have actively participated in the interagency policy committee since its beginning. We fully support the objectives of the committee in advising the NRC in this area of personnel dosimetry.

We believe that adequate personnel dosimetry is really the heart of every radiation protection program. Without it we just can't practice proper health physics. With it we can do what our profession is dedicated towards, and that is managing an effective radiation program for our workers.

Therefore, as one of the radiation protection professionals within the DOD, I support the objectives of this program to provide certification standards for dosimetry processors and to provide for quality assurance programs by the individual processors.

I believe that the basic tenets of the HPSSC standard, as will be discussed today, and expect that the DOD will adopt them as they become further down the road, and I certainly intend to

recommend that too.

MR. ALEXANDER: Thank you. The next member of the policy committee is Larry Lloyd representing the states.

MR. LLOYD: Thank you, Bob. As Bob mentioned, I represent the Conference of Radiation Control Program Directors. For those of you who are not familiar with the conference, the conference was formed in 1968 for the purpose of assembling and disseminating information pertaining to radiation protection.

The conference membership is comprised of voting members from the 50 states, the Virgin Islands and Puerto Rico, and associates but nonvoting members from also programs within the 50 states and the territories.

Essentially all of the states have radiation control regulations which very strongly parallel those contained in the federal 10 CFR 20. Requirements for personnel dosimetry are essentially the same as in 10 CFR 20.

We have seen problems in the past years with the assessment of dose utilizing the existing personnel dosimetry services.

Speaking from the State of Montana we have had objection from users of the personnel dosimeters in the past that we had a requirement which was not realistic because even when it was known that significant doses had been delivered, we were not seeing them on the personnel dosimeters.

In fact, we have had some radiologists go as far as

to expose, purposely expose personnel dosimeters, to an approximated dose of around 200 millirem, and these were still reported as minimal, zero or what have you. And it is very hard for a regulatory agency to justify a requirement for its regulated people to utilize services which have been shown to really be quite inactive. For this reason in 1973 we brought this problem up at the Conference of Radiation Control Program Directors meeting in Portland, Oregon.

A workshop was held at that time regarding the personnel dosimetry problem as we saw it. The executive board of the conference saw fit to establish a task force following the conference meeting. And as the task force progressed, we had several members from the conference, and we obtained liaison personnel from other interested federal agencies, essentially those that you see represented here today.

In the past seven years there has been considerable work by these other agencies and strong support from the Conference of Radiation Control Program Directors to obtain a testing laboratory and a mechanism of certification of personnel dosimetry vendors.

The conference has since 1973 strongly supported the concept of testing and certification. The conference supports the concept of the single testing laboratory. We feel it would be extremely difficult to both monitor and financially support multiple testing laboratories. We strongly support the concept

of the proposed hearings and appeals board, and we also foresee that the testing and certification be eventually funded by fees which would be charged to the participating personnel dosimetry laboratories.

MR. ALEXANDER: Thank you, Larry. Let me now call on Dr. Donald Ross from the Department of Energy.

DR. ROSS: If this meeting had been held just a few months later, it could have been the 20th anniversary of the first time that the regulatory people in the person of that western rancher, Les Rogers, first brought up the subject of a personnel dosimetry certification laboratory.

We supported this program down the line then as we do now. As you all undoubtedly know already, the Department of Energy's government-owned facilities are exempt from the NRC but it has always been our intention that when a program is set up for the certification of personnel dosimetry processors that we will make the same requirement of our contractors as the NRC does with their processors.

We have only one caveat or one thing that we want to be sure of, and that is that all of the technical data on which the standard is developed has a complete, a full peer review so that we can be certain from the beginning that we have got the best standard that we possibly can.

MR. ALEXANDER: And finally our chairman, Elmer Eisenhauer, from the National Bureau of Standards.

MR. EISENHAUER: As you probably know, NBS is not a regulatory agency, and we therefore have no implementation plans for this standard.

Our role is to develop and maintain the national standards for measurement and also to provide means and methods for making measurements made in the field consistent with those national standards.

We recently did a study for a congressional committee on the need for intermediate laboratories for calibrations and measurement quality assurance throughout the country. The conclusion of our study was that there is a need for a number of intermediate laboratories in order to provide traceability to the national standard.

For that reason we are very interested in and support the concept of a testing laboratory for personnel dosimetry because it is an intermediate laboratory of the type that we feel is needed.

Another conclusion of the study that we did was that there is a need for coordination of measurements in the country. And this is not a new idea because a number of other people have done studies, including some additional congressional committees, and have concluded that there is a need for coordination among the federal and state agencies.

If the standard on personnel dosimetry is to be implemented, it should be done uniformly throughout the country.

And that is the primary purpose of the Interagency Policy Committee And for that reason we support the idea of the policy committee and intend to continue our participation in it.

We look forward to continued cooperation in this project as a model for achieving traceability and uniformity in measurements throughout the country.

Thank you.

MR. ALEXANDER: A touch of finality to your statement. I would like now to ask you for any questions that you might like to ask of any of us that are here for the government. You might want to hold your questions for Phil Plato until after he makes his talk. But I would like to ask you during the entire meeting to use the microphones in the aisles for making statements or asking questions and to please give your name and affiliation. You give the affiliation the first time and from then on just your name.

We are going to be privileged to have a question, or more likely a statement, by Mr. Sol Harris.

MR. HARRIS: I need no introduction. Sol Harris, Edison Electric Institute. I just had a general question for the panel. Is there a similar group working on the performance standards for personnel dosimetry for the consumer? We understand since Three Mile Island that around nuclear power plants the public is being encouraged to buy or obtain in some manner personnel dosimetry for their home.

Tape 2
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MR. ALEXANDER: I will try to deal with that one unless some more qualified person wants to. I checked into that recently, Sol, and found that there probably is not a suitable standard at this time for that purpose. And so if such an effort is to be inaugurated seriously, it would have to start with a standards development effort. To my knowledge, no such effort has been started.

Well, it looks like we haven't made any of them very mad yet, so we will proceed into the next -- oh, we do have an angry --

MR. HILL: No, it is not necessarily. I would like to --

MR. ALEXANDER: Could you give your name?

MR. HILL: Okay, Michael Hill, with the DOE contractor. And I would like to address my question to Mr. Ross.

Would the DOE contractors be accountable to the NRC review board or would DOE set up its own review board and would we accountable to them?

DR. ROSS: That is easy to answer because we haven't really even considered that part of it yet. My guess is, purely guess, that we would use the same review board that the NRC has.

MR. ALEXANDER: Don, does the DOE use the NIOSH certification program for respiratory protection devices?

DR. ROSS: Absolutely. We have a little adjunct to that, however, because we use a lot of supplied air suits for

which there are no NIOSH approval schedules. And so we have a group of people out at Los Alamos who will test, who will set up test schedules and test respiratory protective devices for which there are no approval schedules, but we wouldn't touch with a ten-foot pole a respirator that can be and should be tested by NIOSH. So we use NIOSH's just as you do.

MR. ALEXANDER: Has that caused any problems for your agency that you know of, using a testing certification program established and operated by another agency?

DR. ROSS: Not in the slightest. I just wish they would set up an approval schedule for supplied air suits so we could get out of the testing entirely.

MR. ALEXANDER: Well, perhaps we can find some way to bring pressure on them.

I would like now to call on Dr. Philip Plato of the University of Michigan, whom most of you know, possibly as a result of the pilot study that he conducted for the Nuclear Regulatory Commission.

We have extended the contract of the University of Michigan to include two additional action items. One involves what we are calling a Site Visits Program, and the other involves a Value Impact Study that they are performing to assist us in the development of a Comprehensive Value Impact Statement for this proposed regulation.

Dr. Plato, if you would, come to the roster.

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PRESENTATIO.. OF DR. P. A. PLATO, UNIVERSITY OF MICHIGAN

DR. PLATO: Thank you, Bob. Good morning.

As most of you know, but maybe not all of you, so I will take just 60 seconds maybe to back up just a few months and try and tell you at least the way I see things going and where we come from.

We finished the two-year pilot study looking at the original draft of this standard around last September or so, submitted, it was a final report and a procedures manual that came out of that effort.

After the final report was submitted, the working group of the Health Physics Society that prepared the original draft of the standard met and revised the standard, in some cases considerably, which Dr. Ehrlich will talk about in a little while.

That was done, or began in October. Around the end of last year then we went back and looked at all of the data that had been generated during the pilot study in the eyes of the revised standard as much as we could. You can't do it exactly, but you can come pretty close, especially the change in the statistical method that determines whether a processor passes or fails.

All of the test results from the pilot study were in a computer, and it was easy enough just to change the pass-fail

formula and run the computer program again and see how things came out.

So we played around with those numbers, and that took us up until maybe January or so of this year, and we wrote what we called a supplementary report to our final report, which in effect the main idea of the supplementary report was to ask how would the pilot study results have gone had the revised version been used. And I will mention that in a few minutes.

We are now, at the University of Michigan, we are now charged with two more tasks for the NRC, as Bob just mentioned. One is a Site Visit Program.

During the pilot study we were able to visit a relatively small number of processors which in part was very good for us, because even though we have been testing processors we are not a processor ourselves. And it is very easy to become arrogant and simpleminded about what should be done until you get to know some of the real day-to-day problems that processors have. And so it was a great help to us to be able to visit the working shops of a number of processors, although it was a very small number during the pilot study.

We are going to make an attempt this summer to visit any of the remaining processors that will be kind enough to invite us. Those of you that are processors we will be bugging you pretty soon about trying to arrange that sort of schedule.

The purpose of the site visits are not only to help

educate us so we can do the things that we do better, but to be of any assistance that we can to the processors to discuss the standard, some of the intricacies maybe of the testing method, of the procedures that we followed, that the future testing lab or laboratories will follow, in some small measure maybe to check on or cross-check between radiation sources. During the testing program we had a certain number of radiation sources as specified in the standard. A number of processors have their own sources, in some cases just small check sources, and these site visits give us an opportunity to do a little cross-check on the sources and just in general be of whatever assistance we might to the processors.

So the site visits we hope to have completed, or intend to have completed by the end of this summer.

The second effort that we are currently involved in is this Value Impact Study. The NRC is required to produce a value impact statement on this whole business of dosimetry testing, and that statement is to include various alternatives for everything, and for each alternative what are the advantages and what are the disadvantages, and finally, what are recommendations for each of these various alternatives.

To help us with -- our task in this was actually technically not to write the value impact statement but to supply enough information to the NRC to permit them to write the value impact statement.

So in doing this value impact study on our end, one of the things that we tried that we thought would be very helpful, and it turned out to be a good assumption, is we invited processors to come to the University of Michigan at Ann Arbor to sit down for a one-day meeting and go over a number of these points. What for you as a processor would be the value of this alternative and that alternative? What would be the impact? And what would be your recommendation?

We divided the processors into three groups according to as we saw specific needs of the groups. We had talked to the commercial processors on one day, what we called private inhouse processors on a separate day, which included power reactors, hospitals, universities, people of that sort. And we talked to government-affiliated processors on a separate day, the national laboratories, the prime DOE contractors, the military and so on.

Those meetings were very helpful to us. We have prepared now a draft of a report to the NRC on this value impact study just last week as a matter of fact, and I personally hope that as soon as this report is found acceptable to the NRC and the typos and so on are corrected, I would like very much to send a copy to the individual processors to show you what some of our thinking on that, which I think you will see reflected a lot of the comments that we have heard from you.

A lot of the alternatives that we looked at in our

report are probably not worth discussing, at least right now. If you have questions, I would be glad to talk about it. They concerned a lot of the nitty-gritty details of all of this, alternatives for how many testing labs should there be, who should oversee the testing labs, what sort of frequency of testing would be most desirable and so on, a lot of the actual working details.

But there was one alternative that I thought that, just finishing up my little presentation here, that I would try to share with you. And that is, as we saw it at least, we needed to discuss the alternative of not having a testing program at all. You come to a crossroads in this effort, and you ask yourself, which we found very entertaining, you ask yourself what do you expect to get out of a testing program and with equal importance what don't you expect.

What is this program going to do for you and what is it never going to do for you? And when you look at one versus the other, is the whole effort really worth it? And if you don't have that clear in your mind, it seems to me that you are stumbling into the future blindly and perhaps expecting more out of something than you are really going to obtain.

So in this report we tried to rake over the coals the various advantages of a testing program and the various disadvantages, and there are a number of minor points which I won't bring up now. But there are a few major points that I

thought I would share with you, in part to let you know how our thinking went, following those meetings, and in part maybe to stimulate some thought and discussion here.

In the pro column; that is, what are the advantages at least as -- or what are the arguments, not advantages, these are not advantages but these are arguments for and against a testing program. So what are the arguments for a testing program, at least as we can see?

One argument can be summed up, I guess, as the results of the pilot study. As Mr. Alexander mentioned, when the original draft of the standard was prepared the committee that wrote the standard really didn't have a good idea of how, once you make up a statistical formula to determine pass-fail, just how will this work? Is this formula so trivial that even the most incompetent of processors could stumble through it, or is it so stringent that even the most competent of processors cannot handle it?

Well, as Mr. Alexander mentioned, the results of the original formula that was used during the pilot study were not very encouraging. During the pilot study, for those of you that are not familiar with it, we administered two tests, two identical tests to each participating processor. We had something like 59 processors participating, which as near as we could determine, covered something like 90 percent of all personnel dosimetry in the U. S. So we think the pilot study was

well represented in terms of personnel dosimetry.

We administered two identical tests to each processor. We tried to give each processor three months between those two tests to take whatever corrective action they thought was necessary. The results of the first test showed that of all of the categories that were tested, of all of the individual tests that were performed, only 23 percent were passed; that is, three-quarters of the tests administered were failed. For test two, the pass rate went up from 23 percent to 35 percent. And this represents some improvement, but it is a little difficult to think of a mandatory testing program where there is evidence to suggest that two-thirds of all of the tests that will be taken will be failed. This does not seem to be the way to head off into the future.

Running through the same data, through the revised standard, the passing rates for these two identical tests were 48 percent and 62 percent.

So at the end of the pilot study, using the revised statistical formula, you can still view the results as showing that approximately a third of the tests were not passed, even after two tries. And this can be fairly compelling evidence to suggest that there must be some need out there for a performance testing program. The state of the art is not what it could be. That was one reason.

A second reason in favor of a testing program that we

identified is that when you look at the reasons for these relatively high failure rates, which I am going to discuss a little later today, when you look at these reasons, it turns out that they are probably not very difficult to correct.

And in doing so, if a processor does make these corrections, we feel that the corrections will probably rub off on the individual users of the processor's service. That I might add in the end comes down to a hope and not a certainty.

The third item that we could identify in favor of a testing program is that of credibility for the processor. We gathered from a number of conversations that processors are hammered at from a number of different directions to demonstrate in some hopefully nationally recognized fashion that in fact they can do acceptable work.

Many processors are very conscientious, have all sorts of internal quality control programs, self-checking programs and so on, but these programs are by and large self-designed and in some cases self-administered, and there would certainly be a recognized credibility of having passed a nationally recognized peer review testing program.

These in our opinion are the three major reasons in favor of a testing program.

Well, against that: why shouldn't there be a testing program? One is, at least in our opinion, and this I realize is open to debate, but at least in our opinion we could not recognize

a major health hazard in the state of the art of dosimetry as it is today. And at a time of rising costs for everything, at a time of rising bureaucratic regulations, there is certainly a tendency to keep both in check. And we feel this is a compelling argument against the testing program.

The other argument that we have against the testing program is a serious one, and that is that even if a processor is able to pass a testing program there are no guarantees that the users of their service, that their service itself, that the quality of the service has either been documented or improved. That is, just because a processor can pass a testing program does not necessarily guarantee that the users of their service are any better off for it, that the whole thing could deteriorate into sort of a game between a processor and the testing lab.

Well, we looked at these alternatives, these pros and cons, and a number of others. There are quite a number of minor things, not the least of which I suppose is cost to the processor which ultimately filters down to the users. And we decided that given the right design, the right operation, a nationally recognized testing program would in fact serve a useful purpose, that when one weighs the advantages against the disadvantages, the costs against the benefits, that in fact it would serve a useful purpose. And that is how we concluded our report.

MR. ALEXANDER: Would anyone like to ask questions of Phil Plato or make any statements of either agreement or

disagreement with the University of Michigan conclusions?

I want to warn you that we have three people here today considerably contaminated by volcanic ash, and one of them, Dr. Craig Yoder, is going to talk to us now.

DR. YODER: Phil, I guess I have a sort of specific question in regards to the reevaluation of your pilot study with the revised standard, and that is that there are some revisions in the standard, did your reevaluation consider all of these or only the statistical analysis? In particular, did you look at new C_x values and their impact?

DR. PLATO: No. What we were interested in mainly was the statistical model to determine pass and fail. And what we were trying to do was to go back and squeeze just as much information out of the data already at hand without generating anymore new data that we could. We did not, at the time, as a matter of fact, that we did this reevaluation, I was not aware that that were any other C_x values available.

DR. YODER: One other point, sort of in addition, maybe more general, related to your value impact: were you able to ascertain any estimate of the impact of actually using a C_x concept where you are taking exposure to dose and the impact on the actual assignment of occupational doses in general? Was that discussed, or do you have any feel for what that impact may be in changing over the current process?

DR. PLATO: I am not sure I understand your question.

DR. YODER: Well, if one used the C_x values that are proposed, or now, what effect does that have on what is currently being used to assign doses, or what is the impact? Will we see a noticeable change in the reported occupational values or will we not -- is sort of my question.

DR. PLATO: We addressed that point qualitatively, not quantitatively, since we did not have the -- I didn't feel we had the time or the resources to examine it from an individual processor point of view and say how do you come up with dose equivalent now, and depending on what C_x values; that is, the C_x values are conversion factors; they let you go from exposure, roentgens in air to dose equivalent at any specified depth in tissue.

This is a very important number, because it is easy to measure roentgens and seemingly difficult to measure dose equivalent. So a lot hinges on these values. And the question is, which I think is an excellent one, and one we as I say tried to address qualitatively, depending on how a processor historically has gone from exposure in air, however that was measured, to dose equivalent, now when a standard comes along and there are, let's say, nationally recognized methods of going from exposure to dose equivalent. In my view it is entirely possible that this will represent a rather drastic change in the way a processor assigns dose.

Now whether the change will be up or down nationally

or up or down for an individual processor we did not pursue it in that detail. But I agree with you that I can certainly see that in some cases it may be -- I wouldn't be surprised at all if in some cases you would see a 50 percent change in the assigned, in the paper dose given to someone due to a change in the method of going from exposure in air to dose equivalent, regardless of what conversion factors you use.

I think it could be a very dramatic change and lead to quite a few problems in terms of trying to explain to, especially a radiation worker, why all of a sudden your assigned dose is considerably different than it has been.

MR. ALEXANDER: Let's ask Dr. Yoder a question, Phil.

Craig, you have been investigating this problem of converting the R dose to rems at two different depths, 7 millirems per square centimeter and 1000 millirems per square centimeter. And you are aware that the government is considering putting some additional emphasis through this personnel dosimetry standards effort into getting everyone to make those conversions.

Now, the question is with regard to the degree of protection afforded to a worker, is it appropriate to convert that dose to a rad or rem dose at a specified depth? Is there an advantage to the worker in doing that or is there a disadvantage? Because after all, worker protection is what we are after here.

DR. YODER: Well, I think basically what we are looking at is indeed the absorbed dose in an individual, and that is the

ultimate term we are trying to get. And from that we will have some indication of biological or quality factor when we go to rem.

I think that is the ultimate objective, and I think that is what we would base our protection values on. I see a purpose for the values. I am just curious in my question, and I think I agree with Phil very much, that the conversion from a measurement made in air -- that is very easily done and very well documented -- is difficult, and may be very specific in that we do the thing that we think is going to be most amenable to the actual radiation field condition that the worker is receiving.

But I think from health protection, I do think we want to go to absorbed dose or at least a rem value at some depth at which we are comfortable with. I don't know that one centimeter or skin depth is any more beneficial than say something else, but that is a matter of opinion.

MR. ALEXANDER: Thank you. There may be others who wish to comment on that. The problem I have in mind is that I believe there will be a price to pay in going to these conversion factors, particularly for medical workers exposed to low energy photons, and it may well be that there will be from the moment that this new standard goes into effect that there may be a dramatic increase in the recorded dose among medical workers and there will be a price to pay.

So the question is, is it worth it? Is that the sort

of thing we ought to do? Should we avoid doing it right just to avoid that price?

Does anyone else want to comment on that?

All right. We will all remain noncommittal on that difficult point.

Any other questions for Dr. Plato?

All right, I think we will take a ten-minute break now and reconvene at five minutes till ten.

(A brief recess was taken.)

I suppose that many of you have chosen not to hear what is going on today, but apparently someone has also chosen not to see. These glasses were found at the registration desk. Well, apparently the person is too embarrassed to admit that he lost them. I will see you privately at lunchtime and return these glasses.

We are going to hear next from the chairman of the Health Physics Society Standards Committee Working Group that developed ANSI 13.11, Margarete Ehrlich of the National Bureau of Standards.

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PRESENTATION OF MARGARETE EHRLICH, NATIONAL BUREAU OF STANDARDS

DR. EHRLICH: I asked the ladies to give you a sheet. Did everyone get a table? There are still some coming in from the other door. The reason for this is that my first slide, which has the same thing on it as what you see, won't be very

visible from where you are.

I was asked to talk about the changes that we made since the draft in the standard, since the first draft standard was published. Now the first thing I am going to address are the changes in the sources and the category, and this is the one that I think you are not going to see, and this is why I gave you a handout. And instead of letting you look at this you look at your own.

We are going to talk specifically about the changes in the photon and the neutron sources that are now recommended to be used for the tests. Now before we had three test categories covering the photons with energies from an average of 15 KeV up to Cobalt 60 energies.

We now have two test categories in the protection range and two test categories in the accident range instead of having the test and the accident ranges combined in the two old categories, and we are covering a smaller range of energies as well. We are going down, we specify certain NBS spread strontal techniques with energies predominantly above 20 KeV rather than 15 KeV, and that is for our low energies, or K fluorescence x-rays, again with energies larger or equal to 20 KeV. And for the high energy we specify cesium instead of cobalt.

Now the reasons for the changes, first of all, I will address myself to the division between the accident and the

protection range. The reason there is that the regulatory agencies may wish to exempt certain processes from covering the accident range while we feel and have pointed out in the appendix that in general it would be recommended that whoever wants to be offering services in the protection range for photons should also be capable of monitoring an accident. But some of the users may feel this will not be necessary for them and some of the processors who cover only such users therefore might be exemptable.

As far as changing the lower limit from 15 to 20 KeV is concerned, it was found in the pilot study that relatively few processors are called upon to monitor below 20 KeV. This is why we made the change.

Now as far as going to cesium from Cobalt 60 is concerned the open window areas of the dosimeters are likely to show the scale of electrons from the cobalt, and depending on the geometry of th irradiation, the amount of response in the open window area will be different.

Now if you go to a lower energy you will avoid this, and the reason why we felt it ought to be avoided is because it will make it easier for the testing laboratory to specify the dose equivalent level and the processors will not confuse the secondary electrons from the cobalt with beta radiation that the testing laboratory might have a mixed.

In other words, we were trying to simplify the dose

equivalent assignment by this.

Now as far as the beta particles are concerned, we didn't make any change. We still have Strontium 90, but I might mention here, and this applies to all the other categories as well, that we specify that for all types of radiation the testing laboratory should be prepared to furnish factors relating the response of a processor's dosimeter to the radiation he uses for his calibration to the response to the radiation used in the test.

Of course, this, we had a lot of comments here about the beta particle source not being the one that the processors are using or the users most request, and therefore, this will be mainly beneficial in this respect.

Now as far as the neutron sources are concerned, before we had two test categories, the one for point fission source of 252 Cf, and the other one a mixture of this same point fission source with high energy photons.

We now have again two categories, but the two categories are different. We have again the one-point fission source of Californium 252 either by itself or admixed with photons, and the other one, a heavy water moderated californium source, again either by itself or with additional photon admixtures.

As you can imagine, the reason for the change was that the group felt that it would be useful to introduce the processor

to spectra that are closer to those present in power reactor environments.

Now as far as the changes in the evaluation of the test results go, on the ordinant you see a quantity here that is the relative difference between the assigned dose equivalent and the reported dose equivalent, which for short we call the performance quotient because indeed it is related to the performance.

Now in a baseline study that was performed before we came up with our first criteria in the draft standard, it was found, and of course it is quite natural that a thing like this occurs, that if you plot this performance quotient as a function of something that is proportional to the dose equivalent, and to see this down here for three ranges, for the range from 10 millirem to 100 millirem, from 100 to 300, and above 300 millirem -- and by the way, these three plots here are on the same ordinant scale -- it is expectable that the performance is getting poorer the closer one is to the limit of detectability with a particular dosimeter system.

But since we wanted to use statistical performance criteria base, that are only holding really for normal distributions, we wanted to be sure that the data are statistically equivalent over the range of values in a given category, which as you can see here they were not, and therefore, in our original version we split the range of dose equivalents

used for the test in any one category into three intervals, one below 100 millirem, one between 100 and 300 millirem, and one above 300 millirem.

Now as a result of the pilot study it was found that really this wasn't necessary because the way we specify in our standard the random selection of the irradiation levels you have very few points below 100 millirem. And even the few that you have will not be on the average lower than 80 millirem, and for doses of this level the distribution is still fairly close to normal, and therefore the statistical tests are not appreciably affected, even if one uses only one range per category. And this is what we are currently doing.

That means that we, instead of using three intervals, each interval populated with 10 dosimeter results, we now require only 15 dosimeters for any one category at most, because -- I shouldn't say at most, 15 dosimeters, period, per category. And in this way it was possible to reduce 235, the number of dosimeters required for participation in all categories, from a number that was greater than 200 before.

Now regarding the performance criterion itself, I introduced the performance quotient before. Now let's look at it a little more closely. If a processor is completely correct in his evaluation, then the H' is going to be equal to the H and the P is going to be 0. Now in general of course this will not be the case and you will find that you have a statistical

distribution of the P values, which as we were talking about is not far from normal.

Now on the average thing, the P bar, the average value, if there is a -- well, let us say on the average the P bar value would be around 0, if there were no systematic error, but in general we can't assume that there is no systematic error, and we set for a large dosimeter sample, large number of sample, we can say that the average of these P values will approach what we call the bias of the systematic error.

Just for the sake of convenience, we use the absolute values so that we always have a positive bias. Now this bias thing would be the distance between your P equal 0 and your P bar.

Now in addition, we want to take into account the random error as given by the estimate of the -- or as characterized, I should say, by the estimate of the standard deviation what we call S here.

Now we then have a choice as to what statistic we want, in how closely we want to monitor the outlyers in any one category if we set as our performance criterion the sum of the bias and two estimates of the standard deviation and require it to be smaller than a certain tolerance level, L. Then we know that on the average, again assuming that we work with a normal distribution, 95 percent of the results will then lie

within this value L.

Now this is what we did before. Well, when we found that the state of the art was relatively poor we didn't change the L value because it was really recommended by the national and international organizations based on protection criteria. But we decided to try just for the beginning to see how a criterion having only one standard deviation, B plus S, recommended to be smaller than the value of L, would fare, which means that we are now requiring that about 68 percent of the results are within the L.

And as Phil Plato told you, this really increased the level of passing considerably.

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It doesn't mean that in the future one might not try to go to a more stringent criteria of 2S or 3S, even, "3S" meaning 99-and-a-half percent or something, 99.9 percent.

Now, with regards to the value of the "L," we didn't really change this for the maximum permissible levels, because this is where we had rather strong recommendations, based on health physics criteria, biological criteria, if you wish. Now, before, however, we had, as I was saying before, B plus 2S, smaller than L, where L was a function of the dose equivalent, going along with the general recommendations of the NCRP-ICRP, which are that while safe for dose equivalents of the order of the maximum permissible, .5 or .3 are recommended for the L, it is perfectly feasible to go up to a factor of 2, 3, or 4 at very low dose levels from a biological standpoint, from a health physics protection standpoint. And, therefore, we had this black curve here holding for all but the high-energy photons, with .5 for the maximum permissible, and then flaring out to values of about 2 for the 80 millirem and up, the lowest that actually play a role in our standard, while for the high-energy photons we had a value of .3 and then flared out to something comparable to about 0.8 or .9 for -- maybe .7, I don't know -- .8 for 80 millirem.

Currently, as I was saying, we really went to something stricter as far as the L is concerned, while we are using B plus S smaller than L, our L now is constant all the way down to the

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lowest levels. For all protection categories we have a value of .5 over the entire range. And for the accident categories we have a value of .3.

Now, the justification for this deviation from the general NCRP-ICRP recommendations is really twofold, let us say. First of all, one can expect better performance on tests that are carried out under laboratory conditions as compared to tests in the field. And actually Phil Plato, if I recall, told us once that if one put in some random numbers at the low level one could still pass; and that, of course, we don't want to happen. But even more important is the fact that there is a need for testing the performance at the more stringent limits that are set by the NCRP for pregnant women, and this would not have been taken into account with our flaring L values. The result is quite beneficial and welcome, since it simplifies the test; but this wouldn't have been the reason for this change.

Now, finally, the bone of contention here: the conversion factors between exposure and dose equivalent. Now, the previous factors that we used were based mainly on ICRP recommendations which were very much outdated, but we didn't have anything that was generally accepted that was any better. Now, I think that they served a good purpose, namely, to have the processors realize that equating exposure and absorbed dose or the dose equivalent is just not good enough at the low photon energies for protection purposes.

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Now, the present factors, the ones that are now in the draft standard, which you haven't even seen, represent some improvement over the former ones, but I am pretty sure that they are not the ones that will stand as the final ones. We hope that they soon will be replaced by some even better ones. The difficulty, of course, is that the international and national recommendations several years -- will come out several years from now, and we are just -- we just had to make it on our own and accept the best available data for the time being.

And that's really all that I find necessary here to mention as far as substantive changes in the standard are concerned.

MR. ALEXANDER: Would anyone like to comment on the changes that have been made in the standard, or question Dr. Ehrlich on any aspect of these changes?

Yes, sir? Would you please give your name and affiliation.

MR. CAULDWELL: Fred Cauldwell, from Yankee Atomic Electric.

With regard to the C sub x values that Margo was talking about, I presume that these are just based upon use with the phantom source configuration we're talking about for the standard. Obviously, that will change in the spatial equilibrium environments where you have a person being exposed from all directions by a radiation source. These are strictly factors

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that are applied for use with the standard, I take it.

Do I make myself clear?

DR. EHRLICH: Yes, I think you made yourself clear.

I think you made yourself clear. From the data that I have seen, there is some difference, of course, particularly depending on the type of -- with the type of dosimeter that you use, on the direction of the radiation. But we have not considered using factors for 4 pi irradiation at all. Maybe you might let us know whether this is a mistake. We thought that for environmental monitoring we certainly would go for -- to 4 pi conversion factors. But for personnel monitoring, one can either only consider one particular direction of incidence or some sort of an average which will have to be computed differently -- or measured, I would say, not computed, measured for each type of dosimeter, because it will depend on the dosimter geometry how much the dosimeter will see from the sides. Or, of course, if the radiation comes from the back, the thing is going to be completely out of control. And for this reason we decided to set these conversion factors for the test only, just as you said, with one perpendicular incident.

MR. CAULDWELL: Again Fred Cauldwell from Yankee Atomic.

Bob, my real question on this was that I got the general drift this morning, in the first part of the meeting, that the standard is going to be -- or the regulations are going

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to be meant as something that we're going to have to use for providing exposure records to our personnel. In some cases, we undertake quite extensive studies in some radiation environments for providing dose estimations to our employees. And we're an in-house processor and we can tailor our services sometimes very explicitly in this area. And I'm trying to emphasize keeping away from getting stuck with what the standard says I've got to do to perform to the standard and having to apply it to my own personnel that we're providing dosimetry for.

DR. EHRLICH: Could I add to this also

MR. ALEXANDER: Yes. Before Greta answers, I would just like to say that we hope to see some coupling between the performers, between the processor's performance on the -- in the field and his performance on the tests.

DR. EHRLICH: We recommend, in an appendix to the standard, that the processor be in a -- that the testing laboratory be in a position to test the annealer dependence of the response of individual processor's dosimeters. This will go a far way to eliminate the difficulty that you were talking about.

MR. ALEXANDER: Let's see, Greta, the -- just a moment, one moment is all -- the -- at about what energy does C sub x become essentially one?

DR. EHRLICH: Oh, somewhere between 100 and 150 --

MR. ALEXANDER: Hundred to --

DR. EHRLICH: -- KeV.

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MR. ALEXANDER: -- a hundred and fifty --

DR. EHRLICH: KeV.

MR. ALEXANDER: -- KeV.

DR. EHRLICH: Yes.

MR. ALEXANDER: Now, Mr. Cauldwell, I would have supposed -- until you raised the particular question you did -- that at power reactors you'd have no problem about the C sub x values, it would, in general, just be one, in other words, that the component of low-energy photons below 150 KeV would be such a negligible contributor to the dose of your workers that you wouldn't have to be concerned with it in your dosimetry program.

MR. CAULDWELL: I would say generally speaking that's true. But we do extensive amount of work inside of steam generators during major overhauls and we can have extensive amounts of low-energy type of activity located in those generators, which, in effect, puts a cloud of radiation per se around the individual while working in the generator. Our dosimetry has extreme difficulty telling whether this is "beta radiation," if you want to call it that, or low-energy gamma in some respects. We try monitoring under 300 millirems, to be in compliance with the Form Five requirements, and at the same time we've tried responding to the standard under a thousand millirems with the same dosimetry; we've had extreme difficulty doing this, working with the old cobalts and the strontium beta, or yttrium beta would be even more precise.

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We find that as we get to know our dosimetry system better we may want to apply specific correction factors based on the types of radioactivity that we're going to be encountering within a specific work environment. And we don't want to be bound into having to use particular correction factors that are established by the standard for providing dose equivalent results to our employees. We think that's a step in the wrong direction.

MR. ALEXANDER: I think that clears up your position.

Mr. Harris.

DR. HARRIS: Saul Harris, from Edison Electric Institute.

I want to ask, Greta, whether or not would your comment about need for more stringent tests for monitoring pregnant women relate to -- do you foresee a separate system or different dosimeters, would the monitoring of pregnant women be done with standard badges and TLDs and so on? Or what's implied in that?

DR. EHRLICH: No, certainly not. But I want, we wanted to be able to say that we test to low enough doses with sufficient stringency to take care of the more stringent regulations' limits for pregnant women.

Does that make it clear?

DR. HARRIS: You mean .5 in nine months?

DR. EHRLICH: Yes. Yes.

MR. ALEXANDER: Yes, sir?

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MR. ROBERTS: My name is Jim Roberts, from Pennsylvania Power & Light Company. And I guess my question is directed to both Dr. Ehrlich and Dr. Plato.

The main justification for this certification that has been proposed today is the results of the University of Michigan study. I would like to know what kind of implication exceeding these tolerance levels that were set by the NCRP and ICRP would have. For instance, three-quarters of the participants in the first round of this study failed. Now, what kind of implication would that failure have as far as over- -- under-reporting doses to the NRC, for instance? Would it be significant? Would it be something that we should be concerned about?

DR. EHRLICH: This should be answered by the NRC, right?

MR. ROBERTS: Okay.

MR. ALEXANDER: You're very vulnerable in this forum, Greta.

Well, I'll tell you, I was standing here very comfortably contemplating other matters, thinking that Greta was, or Phil Plato was, going to answer this question. And so I'm afraid I'm going to have to ask you to repeat it in simple terms suitable for a regulator.

(Laughter)

MR. ROBERTS: Okay. According to Dr. Plato's study, three-quarters of the participants in his study failed the first

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round of the test. And I imagine they failed by exceeding the tolerance levels that were set by NCRP and ICRP and used in this study. Okay, by failing these tests, did anybody look at the severity of the failure, the amount by which the tests were failed, and determine whether really is it significant in reporting doses to the NRC? I mean, does it -- one of the reasons that was proposed why not to certify dosimetry is that it really doesn't appear to be a safety consideration, you know, with state-of-the-art dosimetry.

MR. ALEXANDER: Okay. Okay, I have the question now and have my answer for you.

I don't agree at all with the University of Michigan position that there are no health and safety implications. As a matter of fact, the statement wasn't that there are no health implications but that there, I believe, are not serious implications. Now, that might be argued, that there are not serious ones, but there definitely are health and safety implications. The data that we -- that were received as a result of the pilot study and data that became available as a result of two earlier studies of dosimetry processor performance indicated, very rarely, thank goodness, but there are instances of errors of a factor of 10 or larger; in fact, there are even errors infinitely large. I remember one of the earlier studies, a dose of 800 millirem neutron exposure was recorded and reported as zero.

So I -- regulatory programs are not developed for, in

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general, as a general statement, regulatory programs are not developed for the best performers in the country. I don't think laws, in the criminal area, are passed for the most -- based on the most honest people in the country. And the answer to your question is that one of the things that made us look with a great deal of interest at the value of a test and certification program was the fact that a significant number of the errors are quite large, in excess of a factor of two; and those of us in the regulatory business simply don't feel that we have done a good enough job of assuring that the dose is measured correctly in this country.

MR. ROBERTS: That holds true for gamma measurements? You were saying that gross errors were made in the neutron measurements. Like, we propose to use a neutron badge supplied by an outside vendor and we'll do our own gamma TLD dosimetry processing. And those kind of errors exist for gamma dosimetry processing also, that magnitude of errors?

MR. ALEXANDER: The maximum errors I've seen for photons were considerably smaller than those I've seen for neutrons, but still a factor of two or more is not -- would not be considered rare.

MR. ROBERTS: Okay. Thank you.

MR. ALEXANDER: We want to -- to see a good job done of controlling the lifetime exposure of the workers in our licensed activities. And a factor of two can make quite a

JO-11

difference in the risk associated with exposure to ionizing radiation.

DR. PLATO: I'd like to comment to that, since, apparently, we disagree. In the supplementary reports that we prepared, which is NUREG CR 1304, in the appendix, which is longer than the report itself, what we tried to do was to show the performance of processors in a -- I mean, there are one bar graph after another that shows processor performance relative to what it would take to pass. So we created a little index, which I won't explain, but with a -- when that ratio is less than one the processor passes, and anything greater than one, he fails. We just ratioed this, this delivered -- or the P bar plus 2S, we ratioed that to the tolerance limit L. When that ratio is less than one the processor passes, and when it's greater than one he fails.

Well, the -- when it gets much less than one he passes with ease, and then as it gets higher than one by a factor of two or three you begin to get a feel for -- that this number of processors just barely failed or, in fact, that they failed by a factor of two or three or four. And we discuss that at length. And when you look at those graphs, a fairly large number of processors were within a factor of, say, two or three. So one way of looking at the results is, even though that there's still a fairly high failure rate, this was the first time that processors in the U.S. were subjected to this kind of -- these,

JO-12

these reference sources and testing and so on, and that perhaps given a little opportunity they could get themselves over the border and would pass.

Now, there were some processors, as Bob mentioned, that were way off. They were some that were five orders of magnitude off. We didn't have a scale of graphs large enough to get those data on. And, in fact, some of those --a lot of those, which I was going to talk about later, came from photons. We were -- you can find some scare statistics in here where we were giving some dosimeters up to 800 rads of photons and processors were reporting zero. But that's not -- now, now that's a health problem, true, but it's -- we saw that in a very small number of processors. And the processors that were in that category, by and large, were very small processors, were catering to a very small number of people; and, by and large, they were catering to people who were not really being exposed to much in the way of radiation. They're catering to doctors and dentists, whose people, you know, set up a patient and then get out of the room before the beam is turned on. And this is what led us to say that, in general, there are probably not major health problems here. And I hedged it. It's not -- you can't say there are no health problems, but -- then another way of looking at the data, as someone mentioned a little earlier, we -- we -- instead of looking at the statistics that were -- the statistical model that was given in the standard, we just looked

JO-13

at each and every one of the dosimeters that we irradiated during the pilot study, of which there were something like 23,000 individual dosimeters. And we asked, also in this supplementary report, a very simple-minded question: that is, of all of these dosimeters, how many were within, say, plus or minus 10 percent of the delivered dose, and how many were in plus or minus 30 percent, plus or minus 50 percent? The 50 percent, you have seen that number kicked around a lot, but not in this context; in other words, all of the -- of all the dosimeters a processor submits, how many came within plus or minus 50 percent of the correct value, and if you had to quote a number the answer was about 80 percent of them were within plus or minus 50 percent of the correct value. And of the 20 percent that were not, when you really look at it, it turns out that it's a small number of processors that are out in that region.

I think that a real answer to your question is in that supplementary report. There is quite a bit of data analysis.

MR. ROBERTS: What's the number again?

DR. PLATO: About 80 percent of the --

MR. ROBERTS: No, of the report.

DR. PLATO: Oh, the NUREG number is CR-1304.

MS. DENNIS: I'd just like to mention, I brought extra copies of all three of the reports. They're back in the very back of this room. So if you're needing to borrow a report or look at something during the meeting, you're welcome to go back

JO-14

and get one.

MR. ALEXANDER: I believe that if I were sitting in the audience and asked to make an unbiased evaluation of the -- of Mr. Alexander's comments and Dr. Plato's, I would conclude that Mr. Alexander is absolutely right.

(Laughter)

MR. FIX: My name is Jack Fix. I'm with Potomac Quest.

Could you tell if there's been a story -- a study to indicate how representative these calibration sources or radiation fields are with what's experienced in the field, for field fabrication facilities or nuclear power plants, et cetera?

DR. EHRLICH: We decided at the beginning not to have necessarily realistic sources. The only concession to the field needs that we made was in the realm of the neutrons. The others are simply available calibration sources that can be well calibrated and well controlled in the laboratory.

MR. FIX: Have you looked at consistency in strontium 90 yttrium sources for calibration?

DR. EHRLICH: I didn't understand you.

MR. FIX: The encapsulation around strontium 90 yttrium -- what effect that has on the radiation field, the spectrum?

DR. EHRLICH: As I was mentioning, we specify in the standard -- or I shouldn't say in the standard, we recommend, I think, I'm not sure now if it's in the standard or in the

JO-15

appendix, that the testing laboratory be prepared to determine factors that give the relationship between the response of a processor's badges to strontium 90 as used by the testing laboratory and the source that he may be using for his calibration.

MR. FIX: Do you think the different designs in the dosimeters will have an effect on that? For example, do you know what depth dose or nonpenetrating depth is used for the different dosimeters?

DR. EHRLICH: That's what I just said. For the processor's dosimeters. The processor can submit dosimeters to the testing laboratory and the testing laboratory will be prepared to establish the ratio of the response of these dosimeters to the same doses or dose equivalents for the different types of radiation.

Does this not answer your question? You don't seem satisfied.

MR. FIX: No, I would have to think about it for a moment. I would think that there's a variability in the dosimeter designs as far as what depths are used to measure both penetrating and nonpenetrating, in the design of the filters, et cetera.

DR. EHRLICH: Very true.

MR. FIX: And this would have a big impact on the dose interpreted, depending on the spectrum of radiation incident on

JO-16

the badge.

DR. EHRLICH: The Battelle Northwest experience in this field was that on the average at least around Battelle Northwest you come close with the beta radiation environment from strontium 90 rather than from plutonium -- uh, sorry, uranium I wanted to say.

MR. FIX: Yes, we had a uranium-slanted calibration and it's calibrated also to a strontium 90 source as ten mils of aluminum encapsulation. There is a number of assumptions that are used in that calibration. And it assumes that the field spectrum and the laboratory spectrum are very nearly correct -- and that's not the case for both the uranium slab and strontium 90 at the same time.

MR. ALEXANDER: Well, Mr. Fix, it's good to see that inhalation of volcanic ash doesn't affect one's ability to ask interesting questions.

Mr. Harris.

DR. HARRIS: Saul Harris, Edison Electric Institute.

This is probably a question for the regulators, both the state and federal and anywhere else. But what you're essentially saying, Bob, as a regulator, is that the film badge accuracy really sets the accuracy for the standards for permissible exposure, that if you set five rem per year or three rem per quarter, you're setting five plus or minus something and three plus or minus something as possibly monitored by film badges, or

JO-17

TLDs. Is that essentially what you said earlier?

MR. ALEXANDER: No.

DR. HARRIS: Why not?

MR. ALEXANDER: I didn't think to.

DR. HARRIS: Okay. Well, then, are you essentially saying that the five rem per year is the maximum range plus or minus of some number below that that film badges or TLD or personnel monitoring have to meet? In other words, if the personnel monitoring devices are statistically wrong inherently by a certain number and you're setting 5.000 per year for occupational exposure or 3.00 per quarter for occupational exposure, then you really need a lower number for the target.

MR. ALEXANDER: I think I see your question. I'm willing to try to answer that, if --

DR. HARRIS: Maybe this is not the appropriate time in this discussion, but it sort of has to be answered. In other words, if a personnel monitoring company reports an employee got 3.001 mr in a quarter, that's still within the statistical variation of the monitoring device but it's exceeding your occupational standard.

MR. ALEXANDER: I don't think we'd cite in that case.

(Laughter)

DR. HARRIS: Well, you know, it sort of came up -- any comments from the audience?

(Laughter)

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MR. ALEXANDER: Some disagreement.

Well, let me answer your question, if I might interrupt it. The -- I think what you're asking me is, if I think that the dosimetry processors or dosimetry systems should be able to come within plus or minus 30 percent, then I'm really saying that I'm -- that I think that the dose limit should be three and a half rems per year, not five rems per year. And the answer is no.

DR. HARRIS: Three plus or minus 30 percent.

MR. ALEXANDER: Yeah. Well, no, it's five plus or minus 30 percent.

DR. HARRIS: Okay, five.

MR. ALEXANDER: With the minus 30 percent giving me the 3.5 that I think, okay, that it should be 3.5 -- and the answer is no, this, the information that we have indicates that, at least, in many cases these results are normally distributed and the probability of getting 6.5 is equal to probability of getting 3.5 and that that's the way it will turn out, and that the most -- if the dosimeter indicates that a person got five rems in a year, that the most likely number is five, even though it might have been somewhere between 6.5 and 3.5.

I thought that was a very good answer.

(Laughter)

DR. EHRLICH: May I add something? I understand that most companies set administrative levels that are within the

JO-19

five and the three, so that they are on the safe side. Isn't this correct? I know that Battelle Northwest does.

MR. ALEXANDER: Well, I think that's probably usually done but for a different reason, at least, among our licensees.

Dr. Yoder, from Battelle.

DR. YODER: Craig Yoder, Battelle Northwest. My questions sort of relate to the change from cobalt 60 to cesium 137, and, I guess, primarily from my own or from the own experiences we're having at Battelle, that we are seeing, indeed, higher energy radiation environments, that perhaps cobalt 60, although not being identical, would maybe suit our needs somewhat better. In particular, we're looking at nitrogen 16 radiation environments, which are very, very high-energy photons, sodium 24 environments, which are again a high-energy component in some accelerator activities. And I feel that perhaps there might be a need for a high energy source, basically because the design of the dosimeter is critical in measuring those, those radiations.

DR. EHRLICH: If you design the dosimeters suitably you'll find that there is very little difference in the response to the various energies above 1 MeV, or above six or seven hundred KeV.

You don't find this to be the case? We ought to talk about that maybe.

Later on, I am sure, we can add some more sources.

DR. YODER: Sure. No, we found it to be --

JO-20

DR. EHRLICH: But for the beginning we didn't consider it.

DR. YODER: -- slightly different. It holds well up to one or one-and-a-half MeV, but when we start getting around three to eight we really find some problems. We're really underestimating, with the current design or some of the methods, the actual dose, or we could underestimate, because of the build-up spectrum, the range it takes, or the depth it takes, to get electronic equilibrium when you calibrate to one source or another.

MR. ALEXANDER: Craig, isn't it true that in a test and certification program if, for example, at Battelle, if you chose to use cobalt 60 for your calibration source, that there would be absolutely nothing wrong with determining for your dosimeter a factor of difference between cesium 137 and cobalt 60 and then to use that when you would participate in a test?

DR. YODER: No, if you want to approach your system, that is, provide a set of factors that you would only use for the test and a different set for your program, I think the objective, or, at least, some of the comments I've heard, is that you would like the two to be somewhat congruent. And basically what we in the field are trying to do is to establish the credibility; that is, if we are going to have to calibrate for some specific radiation fields, what credibility can we lend ourselves. If, indeed, the standard is something that can help

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this credibility. What other alternatives might we have. Or can we add some other sources that may help extend this credibility. These are just some comments.

MR. ALEXANDER: I'm not sure I understood what you just said. Was that answer yes or no? I mean, do you think it's okay to use calibration factors for --

DR. YODER: No, I --

MR. ALEXANDER: -- the purpose of passing the test?

DR. YODER: I don't feel that that's the optimum situation. I think in some cases one is just demonstrating that, indeed, if my radiation environment was such that it was equivalent to the standard source, that I could decalibrate and perform dosimetry correctly. However, my actual radiation environment may be quite different and passing this test does not really, indeed, indicate that I can do the appropriate stuff for what I am experiencing. And I think this is one of the questions that this meeting is trying to answer.

MR. ALEXANDER: I guess it's a practical matter. If we want to discuss this for just a moment. It would seem to me that there has to be a limit on the number of sources of radiation that a testing laboratory can offer. And so for beta radiation perhaps the testing laboratory should just offer radiations in the source called for by the standard. And if the certification program insisted then that people go about taking this test the way you just described and then working it into their

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operational system, we could have a situation, for example, where a person is using a uranium slab and all his workers are exposed to uranium in a fuel fabrication plant, so he's doing a bang-up job of dosimetry, then we come along with a standard and force him to switch to strontium 90, so that now he can pass the test easily but he's no longer doing a good job of measuring the workers' dose. And that the way, the best way, to avoid that is to openly suggest that people develop calibration factors. As a matter of fact, the -- as I -- we can -- Greta can verify this for me, if she will, but it's my understanding that the standards committee felt that an acceptable compromise for the situation would be for the testing laboratory to possess a full stable of sources but to only use in its testing program those called for in the standard; then for any processor who wanted to stick with his calibration source, for the obvious reasons we just mentioned, that the testing laboratories, for a fee, would determine for his dosimeter the calibration factor for that type of radiation, so that he would not have to make any change in his dosimetry field operations.

Don't you think that's a reasonable approach, practical?

DR. YODER: That does have a lot of practicality. That, I think, would be welcome in many cases.

My only comment is that, you know, back to the high-energy problem, is that it is a different region, that even

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though it may not, you know, cobalt 60 or maybe TLV X-rays, or whatever, may not actually duplicate my own calibrations, it does give an indication whether I can, indeed, calibrate and perform high-energy dosimetry. That's the crux of the matter, I think: how well can you perform the dosimetry in the energy region or categories that you are experiencing. And the standard has selected those calibration sources that are currently readily available and have been well documented; and I think that's good. But I am saying there are situations where we might need some special help or, at least, some special assistance.

MR. ALEXANDER: All right. I believe Mr. Selby had --

DR. EHRLICH: This is exactly what I said.

DR. YODER: Yeah.

DR. EHRLICH: Yeah.

MR. SELBY: Jack Selby, Battelle. I'm not sure who I should be directing this to, maybe to Phil.

I believe that a part of this study, that there were some blind tests performed. I know that we have provided -- been involved in considerable blind testing. There is a very decidable difference in the results of passing or failing: a lot less pass when you do it in a blind test, which might suggest that by providing factors to go to a uniform set of standards, may give you the wrong view as to the quality of the dosimetry being provided to the users. You may be able to provide a factor that you can pass -- and I believe there were one or two

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instances where the second round, by applying the factors, the people passed nearly all or all of the test -- and I feel that the blind testing aspects of this demonstrate that we've still got some rather serious problems even if we do go to this particular standard.

MR. ALEXANDER: Well, I certainly agree. The regulations that we're going to propose to the Commission will contain a provision that certified processors also have good quality assurance programs, in accordance with performance criteria, not specific things. And hopefully, that would go a long way toward answering the problem you brought up -- or, at least, go part way.

DR. PLATO: Well, may I respond to that also?

MR. ALEXANDER: Certainly.

DR. PLATO: Phil Plato. Yes, during the pilot study we were required to blind test some processors. And we picked the easiest ones, which are the large commercial processors. It's very easy to sneak badges in to those people. It's very difficult to sneak badges in to someone who only processes two or three hundred, such as a power reactor, and they know each one of their two or three hundred employees intimately. And yes, the results of the blind test, even for those processors, were not as good during the pilot study as were the results for those processors in the so-called open portion of the pilot study. And I suspect that part of the reason for that difference was that the -- that when the processors knew they were being tested

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according to the rules of the standard, they attempted to apply the correction factors necessary for those radiation sources.

Which leads to a very difficult question, because if you operate a mandatory testing program on a blind testing basis, even for those processors that you can physically blind test, which there aren't many, but even if you blind test those processors, the only way they're going to pass is if they treat their regular customers, their regular users, exactly the way the standard requires them to treat the testing lab. And then you get to the problem that's already been raised: does this represent a step backwards in radiation dosimetry.

And then a very practical problem is, the vast majority of the processors in the U.S. I don't really have the foggiest idea how you would blind test.

MR. ALEXANDER: Mr. Fix.

MR. FIX: A possibility that I was thinking of, that would help those of us who have field conditions that are significantly different than the sources used in the testing program, would be to allow us to submit a set of calibration dosimeters to the testing lab in addition to our dosimeters to be tested. This would allow us to calibrate our system to the source geometries and the radiation fields that you are using in the testing laboratory.

MR. ALEXANDER: Someone raised his hand back there. He's changed his mind.

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Well, thank you for a good discussion of the standard. I'd like to close that discussion with a question for our state representative.

We received a letter, from -- I don't believe I remember who it was signed by, Larry, somebody for the Conference of State Radiation Control Program Directors; we received this letter several months ago, encouraging that the standard not be changed as a result of the pilot study. And I'm wondering if you could comment for us on the position today regarding the adjustments that have been made to the standard.

MR. LLOYD: Yes, I believe that the, very possibly the letter that you are referring to came from the state of Louisiana and was signed by the radiation program director, Bill Sabelle. I spoke with Bill Sabelle about his letter, which I think was a very good and supportive letter, and I did not read the letter, as you did, Bob. The reference that Mr. Sabelle made in that particular letter in meaning was not to water down the standard, really, not to weaken the standard as such, however, the Conference recognizes that the original standard was one which was untested, and we recognized that through the pilot study that there have been various flaws which have been identified and changes need to be made such that this standard will meet the needs from the health physics standpoint and also from the standpoint of practicality. And from the Conference standpoint, we feel that the amendments to the proposed standard are going a

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long way to meet this need.

So, again, from the states' standpoint, I don't think that, if we're speaking of the same letter, that Mr. Sabelle meant that there should not be a change in the standard. It meant that it should not be watered down to the point that the testing was meaningless.

MR. ALEXANDER: Thank you. In the Federal Register notice regarding this public meeting, we invited those who would like to make brief prepared statements to let us know and we'd provide time for that. And we'll turn to that portion of the program now.

We have three people who have indicated to us that they would like to speak. And we're going to allow 15 minutes for these statements.

Is Mr. Anthony La Mastra, from Bethlehem Steel, present?

We'll call on Mr. La Mastra at this time.

STATEMENT OF ANTHONY LA MASTRA, BETHLEHEM STEEL

MR. LA MASTRA: My name is Anthony La Mastra. I'm the senior radiation control engineer from Bethlehem Steel Corporation, Bethlehem, Pennsylvania.

Bethlehem Steel wishes to make the following oral presentation for consideration by the U.S. Nuclear Regulatory Commission in its preliminary rule-making process relative to a compulsory personnel dosimetry performance testing and

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certification program. This oral presentation represents a condensation of our written comments, which will be submitted prior to the deadline of June 27, 1980.

Number one. As we understand it, the purpose in the proposed ANSI standard which would be adopted by the, or potentially adopted by the, proposed rule-making, states that it provides a procedure for testing routine personnel dosimetry performance under controlled conditions. We believe that good routine personnel dosimetry mandates that each processor identify the energy range of the radiation to which each badge has been exposed. This permits a more accurate estimation of personnel dose. If processors have developed systems of dosimetry which are based on the good health physics practice of knowing the energy range of the radiation, it is both poor health physics and unfair to demand that the energy range not be identified to the processor. The proposed ANSI standard should be changed to ensure that a processor be informed of the energy range of the radiation exposure for which each badge is to be evaluated.

Number two. If one of the purposes of the proposed compulsory testing program is to upgrade the accuracy of personnel dosimetry, as stated in the Federal Register notice, then we suggest that the program begin with a two-year initial phase during which each testing is compulsory but during which there are no negative consequences of failure to meet the requirements of the regulation. During this initial phase, the processor

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would be expected to take the necessary action to achieve compliance with the requirements of the regulation.

Number three. It is estimated that Bethlehem Steel Corporation presently spends about 200 man-hours a year, at about $15 a man-hour, or $3,000, plus $3,000 per year for system maintenance, which totals $6,000 per year, to provide personnel monitoring. Under the proposed ANSI standard, we would have to add an additional initial 500 man-hours to calibrate all dosimeters, plus an additional 50 man-hours per year to participate in the testing program. This first-year cost, of almost $8,300 in personnel time plus approximately $3,000 in testing fees and about a thousand in additional maintenance costs, adds up to a total first-year cost of $12,000. Recurring annual costs are estimated to be about $5,000. The above estimates assume that the proposed ANSI standard will be changed to permit notifying the processor of the energy range of the radiation exposure for each badge; if this is not done, we will have to purchase new badges at an initial cost of $6,000 and incur an additional manpower cost of $15,000, thus our first-year costs would rise to $25,000 with recurring annual costs of about $8,000. This amounts to a doubling of our personnel monitoring costs when these expenses are evaluated over a five-year period. This is a very significant cost increase for our program, especially when evaluated in the light of very neglibible increases in benefits to our employees. It must also be kept in

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mind that these added costs would be on top of the large expenditures already required for Bethlehem Steel to comply with the magnitude of regulations already in effect.

Four. Accident dose categories should be optional rather than mandatory. With our style of TLD, the absorption of an accident dose requires discarding the dosimeter after its use.

Five. The proposed ANSI standard should not penalize a processor for high dose estimates. We suggest that P sub i be redefined so as to permit as much as a 100 percent overestimate and not result in a penalty.

Number six. The doses which would be delivered to badges during certification testing are well above the doses we normally encounter. Our highest annual cumulative exposures are less than one rem. And 95 percent of our annual exposures are less than 100 millirem. Therefore, a separate program would be required on our part to adequately estimate the dose at these higher ranges. While bare TLD may have a linear dose response, we have found that TLD in our specific badge does not. Thus, we are asked to accurately estimate doses which are foreign to our program. These increased doses may also leave a residual dose on our routine dosimeters which would result in erroneous exposure evaluation.

Seven. We do not see a need for certification testing to be performed more frequently than once every two years for

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any one category.

Number eight. If a processor passes a certification test, he should not be required to be retested for five years. This would help reduce unnecessary costs.

Finally, the ramifications of failure to pass the certification test should be established and distributed for public comment well in advance of their publication in final form in the Federal Register. We feel the details should, at least, be set forth along with the details of the proposed ANSI standard in a notice of proposed rule-making.

Thank you.

MR. ALEXANDER: Thank you.

I should mention, for the benefit of those of you who don't know it, that in the NRC's standards development process those who comment formally on proposed rules or on draft regulatory guides receive a copy of the analysis of comments that the staff performs. Analysis of comments -- we're required to deal with every comment you make, specifically, to make a decision regarding either its rejection or its acceptance, and to provide a written rationale for each one. Sometimes the reading of those can be quite interesting. So it's our policy now to send a copy of the analysis of comments to every formal commenter.

Is Dr. Kathleen Duffy with us now?

We'll have to call on her later.

Dr. Rosalee Battelle?

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I am -- all of the people in the audience are male -- I'm doing this -- except my own employ -- I'm doing this to keep from being charged as a sexist.

Mr. Jack Fix, from Battelle -- did you want to make a --

MR. FIX: I'm under the impression that we're scheduled later in the progrram.

MR. ALEXANDER: Yes. I suppose there is some confusion there. We had expected a presentation from you on the subject of quality control. But we also had the idea that you might want to make a prepared statement otherwise.

MR. FIX: No. I don't have any.

MR. ALEXANDER: No. All right.

Phil, can you cover your causes in 15 minutes?

DR. PLATO: Yes.

MR. ALEXANDER: Good. The next point on the program is a discussion by Phil Plato from the University of Michigan on the causes of the category test failures during the pilot study.

Now I should be frank with you in this regard that one of the primary purposes that we have in conducting this entire meeting is to encourage dosimetry processors to go ahead right away with the changes in their process that would enable them to conform with the standard, rather than waiting until such time as a mandatory program is established in the NRC regulations. There are two principal advantages f r this. One is probably a better job of dosimetry during the intervening period, which will

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probably be about 18 months. And second is that if that, to the extent that is done, that when we embark on the mandatory program everybody will be all set and we can minimize the travail.

Phil Plato.

PRESENTATION OF DR. PHIL PLATO, UNIVERSITY OF MICHIGAN, ON CAUSES OF FAILURE IN THE PILOT STUDY

DR. PLATO: Thank you again, Bob.

In looking at the results of the pilot study, we could identify four reasons that, at least, in our opinion, accounted for the rather large failure rate during the pilot study. And I would like to very briefly discuss these.

The first is the so-called calibration factors, which have already been kicked around quite a bit this morning. That is, the standard required us, as the testing laboratory, to use a very specific set of radiation sources -- cobalt 60 for gamma rays, very particular X-ray spectra, a very well defined beta particle spectrum, and a neutron source. Most processors, of course, are not calibrated to all of these sources. They had calibration factors that they have been using for years that differed from the calibration factors that would have been necessary to pass the standard. And maybe we don't need to go into too many more details now about this, but obviously this business of the response of the dosimeter is very important. No dosimeter -- at least, to my knowledge -- no personnel dosimeter measures dose equivalent directly. It measures odd

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things like optical density of film or light output from a TLD or little holes or scratches in neutron films. And one has to generate the conversion factors that let you go from that kind of a response, a read-out, to dose equivalent. And the calibration factors that had been used historically in many cases differed considerably from those that would have been necessary to have passed the standard.

In some cases processors, I think, made a heroic effort to try to generate the factors, and in some cases succeeded; and in some cases processors did not make any effort at all and just wanted to see how their existing dosimeter would hold up to the sources required for the testing program and in many cases found out they wouldn't hold up at all.

One other thing concerning calibration factors that we've been discussing this morning that we might consider, and that is, it is a relatively simple job to generate calibration factors for one particular source. That is, if a processor feels that uranium is a better beta reference source for their needs than is strontium 90, true, it is relatively easy for the testing lab or the processor, or anyone, to take some of the dosimeters from that processor, expose the dosimeters to known doses from uranium, known doses to strontium 90, and you have given the processor enough information to know how to jump between strontium and uranium. In many cases, though, I suspect it turns out to be a much more complicated affair when you require a

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dosimeter to respond to an entire set of sources, as opposed to just one source. That is, the way the standard is written now, which was just criticized by Mr. La Mastra, is that the testing lab does not divulge the type of radiation to the processor; so that means the testing lab does not tell the processor that these dosimeters were exposed to beta particles; the processor must figure that out for himself. And that means that he must not only have a calibration factor for beta particles, for the beta source that was used in the testing program, but his dosimeter must be smart enough to identify -- to separate beta particles from, say, low-energy photons. And I suspect that the problem of generating calibration factors is compounded when you blend all of the calibration factors needed to pass the standard together.

So calibration factors, the proper use of calibration factors, I think, certainly was a major problem in the pilot study -- not that it's a fault of the standard or necessarily a fault of the processor, because I think it's just, it's more of a fact of life. In fact, this was probably the overwhelming problem.

A second problem that we can identify is, in shorthand notice I wrote down, dosimeter variability. Film seems to be fairly constant from batch to batch. And I guess since Kodak is the only supplier of film, perhaps this helps somewhat. But processors that use thermoluminescent phosphors have, can have,

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considerable problem in variability among the phosphors from one phosphor to another. Most dosimeters have more than one chip, one phosphor, in the badge, and there can be differences there and so on. If you take a large number of these chips, or these phosphors, and look at the bias among a large number, the bias tends to hover around zero; that is, as many over-respond in general as under-respond. And so if the standard tested only for bias, this would probably not cause a problem. But the standard, at least as it was done during the pilot study, as Dr. Ehrlich pointed out, tested not only for bias but for two standard deviations. You blend the bias term with two standard deviations. Well, if you have a number of chips that are not responding the same, that have a fair amount of difference from one chip to another, two or even one standard deviation can be enough to cause this statistical formula to fail a processor.

So dosimeter variability, the proper screening of these chips, the proper selection of these chips, in my opinion, at least, has led to a fair amount of failures, not because of the bias component of the formula, but because of the standard deviation component of the formula.

A third reason that we can identify is clerical errors, which maybe I'm just naive but it really kind of surprised me to see this. We ran into a number of cases where the reported doses were off, for instance, by a factor of ten, and we as the testing lab wrote this up and we sent a report to each

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processor showing for each of their dosimeters the delivered dose and their reported dose and that the P value, that Dr. Ehrlich mentioned, and P bars and all the statistical stuff that went along with it. And in many cases the processors would look at that and discover that, in fact, they were, in one badge out of perhaps a set of 40 dosimeters that were tested for one category, one dosimeter was off by a factor of ten, and on investigation discovered that the raw data that went into that dose estimate from the processor's end was, in fact, correct and somewhere along the line someone just slipped a decimal point. The question then arises, is this dosimetry or is this -- is this something other than dosimetry, is this a -- should a clerical problem be penalized right along with such dosimetry type problems as a lack of proper calibration factors?

Transposed numbers were another good example. The processor truly believed that the dose should be 36 but somehow it got written down as 63, and with the statistical formula that looks at not only bias but either one or two standard deviations in many cases an error that large, which is -- there is a factor of two right there, the example I just made up, in many cases that's a fatal error. So we ran across many what I would say clerical errors on the processor's part.

When the problem -- when the clerical errors, or any errors, are made by the testing lab's part, it's -- you know, you swallow your pride and you own up to it and you void the

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dosimeter. But when the error is made on the other end, why, it's not quite that simple.

The last thing that we could identify as a -- as one of the major problems, the calibrations for accident doses. And we have already heard a few comments this morning about that. Many processors maintain that, in fact, they can see no way that their users are going to receive high accident doses. Now, according to the standard, an accident dose is a dose greater than ten rads. And many processors maintain that that's not going to happen to their people and that, therefore, they are not calibrated for high doses and they have no need to.

Now, during the pilot study the accident doses were, as Dr. Ehrlich mentioned were, blended in with the protection doses in two of the radiation categories. That is, the standard as it was used during the pilot study did not give the processor a choice. If you were going to be -- if you elected to be tested in gamma rays, then you had to be tested from 30 millirems up to 800 rads. That was the way the original version was written.

In the revised version, we broke out the accident doses, as Dr. Ehrlich mentioned, and made them a separate category. So, at least, according to the current draft of the standard, a processor can choose whether they want to be, or need to be, tested for accident doses versus protection doses.

I rather suspect that if some processors had had their way during the pilot study and had not been required to be tested

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for accident doses, at least their passing rate would have been much larger.

The question is, then, why can't a processor pass a high dose? And one answer is the linearity, as was mentioned, the linearity of their system. You have calibration points up to 100 millirems, maybe one rem or so; with many TLD materials you can extend that calibration curve up quite a ways, but with -- but in some cases you just cannot. So some processors just simply did not have calibration data for very high doses.

Another that existed that we noticed with these calibration values, and I think that's what led to a lot of the zeros that we saw for accident doses, as I mentioned earlier, when we give five, six, seven, eight hundred rads to a dosimeter and a processor would report back zero, and this happened, we saw this for both film and TLDs, and in trying to follow this up, to ask, to pick up the phone and call the processor and ask why, why do you see this, and one reason is, apparently, that for many processors when a very high dose shows up, a very black film or an enormous amount of light coming out with the TLD reader, their regular on-line procedures alarm and the dosimeter must be taken off-line and handled special, as a special case; and for some processors, at least, or some of the time -- we really did not play detective and follow this all the way down the line, but from glimpses that I got when some processors took these dosimeters off-line, in some cases, they perhaps just never

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got around to doing it, and so when a report came back to us with no result, their computer interprets no information at all as a zero. And I think this is consistent at least with things like film, where, obviously, if a piece of film is so black you can't see through it and the densitometer is having trouble passing a beam of light through it, obviously, there is something other than zero there. And I think it's a reasonable explanation when a zero comes back to the testing lab, it's very reasonable to understand, at least, what happens in terms of this piece of film is set aside and one day we've got to evaluate it and that time never comes and somehow a zero gets reported.

So, in any case, I'm not excusing anything, I'm just trying to enumerate the major reasons that we saw, which were the calibration factors, the dosimeter variability, clerical errors -- which are probably quite significant in terms of their numbers and their severity, a clerical error can be absolutely devastating if it's a factor of ten -- and the accident dose calibrations; these are what we saw as the four major problems, on the processor's end, there were one or two on our end, too.

MR. ALEXANDER: Thank you, Phil.

We'll adjourn now for lunch and reconvene at one o'clock. There is a sheet, for those of you who are not familiar with this area, that the GSA provides that gives local restaurant locations.

Where can these be obtained, Nancy?

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MS. DENNIS: They're back with Kathy. If you haven't received them, they're at the registration desk.

MR. ALEXANDER: At the registration desk you can get copies of these.

Mr. Cauldwell?

MR. CAULDWELL: Will the room be locked, Bob?

MR. ALEXANDER: Pardon?

MR. CAULDWELL: Will the room be locked?

MR. ALEXANDER: I don't think so. I don't think so. Martinis are allowed in the course of these public meetings, but we encourage restraint.

Let's go.

MR. CAULDWELL: Bob, I'd been originally scheduled, I think, for a Lessons Learned section, and I do have a prepared statement I'd like to give after lunch, if that's possible.

MR. ALEXANDER: All right, fine.

MR. CAULDWELL: All right. I think it'd be more appropriate in the prepared statement section than in the Lessons Learned.

MR. ALEXANDER: Okay, we'll take that right after -- we'll take that at one o'clock.

MR. CAULDWELL: All right.

(Whereupon, at 11:30 a.m., the meeting was recessed, to reconvene at 1:00 p.m. this same day.)

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AFTERNOON SESSION

(1:05 p.m.)

MR. ALEXANDER: A lot of people have asked me during our lunch break if we could wind up the meeting today. And I think that those people aren't, they aren't enjoying the meeting as much as I am.

(Laughter)

(Pause)

What we'd like to get into now is a discussion, as open and frank and lively as possible, on the Lessons Learned as a result of the pilot study. Now, we in the government have the impression that the pilot study itself was a worthwhile effort in that some processors in the course of the pilot study identified areas that they would like to improve, or, at least, change, in order to comply with the standard or perhaps in order to do a better job. It may very well be that some of the changes that were made in the process, processes as a result of all this were very practical in nature and innovative and would be something that other processors would want to do, perhaps an idea that everybody didn't have. So what I'd like to do is encourage all of you who participated in the pilot study or who were interested in it otherwise and did learn something from it to share that with others. I realize that may be a theoretical, highly theoretical, request, to ask some of you to share good ideas with your competitors, but it's all in the interest of

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safety, so perhaps we can do that to a certain extent at least.

Fred Cauldwell, of Yankee Atomic, we told him, happened to tell him, in advance about this part of the program, and he said he would be glad to prepare a statement relating their experience there at Yankee Atomic. And I call on Fred at this time to make his statement.

And we will consider this, Fred, as a prepared statement and you will qualify for a copy of the staff's analysis of comments.

Incidentally, everybody can have a copy of the staff's analysis of comments, either by getting it out of the public document room or calling Nancy or me. It's just that if you make a voluntary statement like this for the record, we send it -- we go to the trouble to send it to you and you don't have to ask for it.

Fred Cauldwell.

MR. CAULDWELL: Bob, would you like me to come on up there and speak from the podium.

MR. ALEXANDER: Sure.

STATEMENT OF FRED CAULDWELL, YANKEE ATOMIC

MR. CAULDWELL: Good afternoon. Yankee Atomic started participating in the test program on a willing basis, might be the best way; we walked into it very innocently with our dosimetry program. And we've run into a number of interesting facts about the dosimetry that we use. I'll be specific with the

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type of dosimetry: we use Harshaw TLDs, configured in a BGN one type case which contains 300 milligrams of plastic and aluminum filtration plus cadmium stripping within the case for thermal Albedo type neutrons. We use G7 TLD cards and NG 67 TLD cards. Both of the cards conta. lithium 7 fluoride. The NG 67 card contains lithium 6 fluoride, hopefully -- and I'll use that word, "hopefully."

We had an initial problem in the testing program that showed up, that Phil and I happened to see, where one of our neutron badges had absolutely no response whatsoever. We went looking, and I said, "Phil, did you really deliver the dose?" and he said, "Yes," and came back and looked at our badge -- still no response. And we shot it again -- and still no response. It turns out that the badge didn't have any lithium 6 fluoride in it. That knocked us out of our neutron categories for both phases of the testing program. Matter of fact, we were by a factor of, oh, almost a hundred off on our neutron exposures as a result of that. So we flunked neutrons right off the bat.

MR. ALEXANDER: Did you find out how that happened to happen?

MR. CAULDWELL: Well, we asked Harshaw, and they said, "Yeah, we might have a QA problem once in a while." The week before we came down here, we started on testing every one of our G7 and NG 67 badges for the thermal neutron response. So far we have tested 600 badges. We have found ten badges that either

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do not have lithium 6 fluoride in them or, what is even worse, that they've got it in the wrong position within the badge. In three cases we had the lithium 6 fluoride in the G7 card, which is intended for beta, gamma monitoring; and in two out of those three cases it's in the open window position of the badge, therefore if we have neutrons and betas on our dosimetry we have an excessive beta dose and no neutrons.

In some cases on our NG 67 cards, I think we've got four specifics in that area, that the lithium 6 fluoride happens to be in the gamma background position of that card, if you want to call it that; thus, our calculational models do not detect any neutrons, that we use computer programs for deriving all our data.

That's, like I said, ten badges out of 500 that we've tested so far. It seems to be random errors; we haven't been able to discern any noticeable trend as to where the errors are occurring or why the manufacturing errors occur.

That was one of our Lessons Learned. We are now in the process of going through Yankee's supply of over 10,000 dosimeters and individually testing each and every dosimeter for thermal neutron response.

Fortunately, neutrons for the Yankee system amount to less than 2 percent of our total exposure. And we do not see where we have a major problem as far as personnel monitoring goes. Most of our people do not exceed 300 millirem per quarter

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for neutron monitoring anyway. We're very fortunate in that area; we could be in a real problem if it was.

Outside of that, I will get into, mostly, our prepared statement. It's questions that I've got of the standard. And we'll run through things and then I'll ask for questions from the floor when I get done.

Item one. Adoption of ANSI N13.11 as modified in October of 1979.

Yankee Nuclear Services Division concurs that the most recently modified version of ANSI N13.11 is a good basis for establishing a standard method for testing personnel dosimetry processors. We, however, have observed many inconsistencies, both technical and practical, as to how the standard was applied during the initial testing program. These areas of inconsistency must be resolved prior to implementing the standard as a NRC regulatory requirement.

Item: deep dose determination. Yankee Nuclear Services Division uses TLDs, for whole body personnel monitoring, which are under an absorber of approximately 300 milligrams per square centimeter. The dosimetry is configured in this manner to maintain compliance with instructions for completion of NRC Form-5's, which require this depth configuration for those personnel not provided with eye protection of at least 700 milligrams per square centimeter.

The photon component of the neutron source --

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unmoderated californium 252 -- was only defined for the depth dose of 1,000 milligrams per square centimeter. This posed an over-response problem of approximately 4 percent, as our dosimetry -- under 300 milligrams -- was responding to low-energy photons, or X-rays, not capable of penetrating 1,000 milligrams.

The yttrium 90 beta source, in addition, produced an indicated depth dose equivalent to 25 percent of the delivered beta dose in the dosimetry.

The above three problems led to developing empirical equations for quantitizing delivered deep doses. These equations, however, are highly dependent upon the precise definition of each source and configuration. If any parameter changed, such as distance for neutron and gamma exposure, response precision suffered dramatically.

Shallow dose determination. The yttrium 90 source used for the standard does not adequately test a beta dosimeter because the 2.26 MeV maximum beta particles are not significantly attenuated by a beta window on most dosimeters. In addition, betas in this energy range are not common to the environment encountered at nuclear power stations. Our major problem with the yttrium 90 source is with, as mentioned above, penetration of yttrium 90 betas through the deep dose absorber, of 300 milligrams, of the TLD. This presented many problems with trying to obtain statistically reliable beta data for developing an

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equation to remove this penetrating component.

Neutron dose determination. The neutron spectrum of the unmoderated californium 252 used by the standard was so unlike the spectra of our dosimetry users that initially reported results were out of range by at least an order of magnitude. With assistance from the University of Michigan, we again developed an empirical equation for responding to the standard. It was noted during this testing that one of our neutron dosimeters was completely unresponsive to neutrons. This is what I just mentioned at the beginning of the program. We found, in addition, as previously mentioned, an over-response to the photon component of californium 252.

We are pleased to have learned that the new standard will include moderated californium 252 as a neutron source. This should improve our ability to provide reliable results for neutron doses. However, we state again that the photon component of this source will still present problems to dosimetry processors.

Mixed field determination. When the gamma and beta exposures were mixed in testing for Category VI, we found that our problems had been compounded. No provision had been included in the standard to account for photoelectron production in air which gave an indicator response approximately 10 percent higher than that of the gamma and beta components by themselves.

As can be seen by the above discussion, Yankee Nuclear

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Services Division found many problems associated with trying to respond to the standard in a professional manner. Some problems were of an in-house nature and are being addressed. But the vast majority of problems seem to be associated with either the lack of proper definition of the sources used -- and choices of sources -- or with inconsistencies within the regulatory and standards requirements. We request that these areas be evaluated and corrected prior to implementation of any testing standard.

Item two. Frquency of certification.

After having participated in the pilot study, Yankee Nuclear Services Division believes that yearly testing is probably the most viable testing frequency. The yearly testing, we presume, would be performed in a manner similar to the schedule established by the University of Michigan. This schedule called for monthly testing for three consecutive months once a year.

This frequency of testing would not have a dramatic impact upon man-hour requirements of a relatively large in-house processor, and if spread over a period of time it would allow the testing to be blended into the processor's routine production requirements.

Item three. Notification to licensee of processor certification.

A timely method of licensee notification of processor

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certification or failure is an integral part of the performance standard. It is suggested that each processor provide to the testing laboratory a listing of NRC licensees serviced by the processor. Notification would be made to the licensee by the Certification and Review Board established in item six below.

It's a long one, gang.

Testing and certification laboratory.

The testing and certification laboratory should be an independent laboratory outside the confines of the federal government, preferably operated by a university. The laboratory would be established and initially financed under contract to the appropriate federal agency, with testing fees making the laboratory self-sustaining after the first few years of operation. The laboratory would, of course, be certified by NBS.

The above recommended testing laboratory would have several distinct advantages to alternatives presented in the Federal Register. First, the laboratory could act as part of a dosimetry processor's quality control program by allowing the processor access to irradiation sources outside of the normal testing cycle. Second, if a dosimeter processor has an unusual situation, similar to Three Mile Island's beta problem, the testing laboratory could assist in providing irradiations outside the testing program. Third, the laboratory, as a totally uninterested party, would have a seat on the Certification and Review Board evaluating those processors who fail a testing

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category.

Fee schedules used by the testing laboratory should be based upon a processor's volume of work and number of categories tested. This arrangement will allow processors to be charged fees that are commensurate with their operating budgets.

Item five. Laboratory surveillance by NBS.

Yankee Nuclear Services Division concurs that monitoring of the testing laboratory by NBS is an absolute necessity. This will ensure unbiased exposure technique and lend credibility to the testing program. NBS should be totally involved with the areas of: source selection; source, dosimeter, phantom configuration; exposure delivery procedures; and definition of delivered exposures.

Item six. Loss of certification and appeal.

Of all the areas involved with processor certification, this is probably the most highly sensitive area of the program. We recommend establishment of a Certification and Review Board. This body would be composed of individuals involved with each facet of the regulatory processes. Specifically, a member would be drawn from each of the following areas: Nuclear Regulatory Commission; National Bureau of Standards; a national laboratory; a dosimetry processor; and the testing laboratory. The board would be responsible for resolving differences of opinion between any parties involved in the certification program. The board would also be empowered to render judgment as to removing

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a processor's certification following the administrative program established by the new regulations.

The administration of the certification program should address, at a minimum, the following items:

One. A requirement for processors to define under which categories their dosimeters will be tested and that they have notified their users of the useful range -- both energies and type of radiation -- of this dosimetry.

Two. Not removing the processor's certification -- excuse me, not removing the certification of a processor for the first year of participation in the test program. This will allow processors to evaluate their dosimetry and adjust to meeting the requirements of the program.

Three. Establishment of a graded certification procedure, such as Pass-Probation-Fail program, for each category in which the processor is being tested. Each grade would be based on the performance index, P, established in the standard. Those processors who fall outside the Pass grade would automatically be placed on probation; the processor would then be given a time period within which he must be retested. The processor would also be required to report to the Certification and Review Board his findings with regard to this failure. If the processor passes the retest his certification would be reinstated. If the processor fails the retest his certification would be removed.

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Four. Consideration for processors and users when the processor fails a particular category. This area can raise some legally sensitive issues which must be addressed by the regulation. Some of these issues are:

A. Can a user obtain dosimetry from another certified supplier in time to comply with the users' stipulated exchange period?

B. Are the exposure results since the last testing cycle to be considered valid?

C. What can or is to be done about dosimetry presently issued? Is this dosimetry to be processed by the uncertified processor?

And D. What legal recourse might be taken by employees of a licensee with respect to the licensee's using a processor who fails the certification?

Item seven. Angularity response.

The performance standard as presently written includes requirements for performing angularity testing of processors dosimetry. However, no criteria are placed on this testing. There are many factors in addition to angularity response that affect the response of dosimetry, and to only check one of these is both misleading to the processors and users.

Yankee Nuclear Services believes that a processor should perform checks, such as angularity response, and make this data available to its services users. But to include a

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study of angularity response with no criteria or apparent intent in a performance standard is inappropriate. We request this section be removed from the standard.

Item eight. Purpose of the performance standard.

Yankee Nuclear Services Division has noted that many processors feel the performance standard will require them to change the calculational models presently used for reporting exposures. We strongly believe that the performance standard should be used as a basis for standardizing and evaluating a dosimetry processor's performance under a well defined set of conditions. The standard should, however, specify calculational models used by a processor for performing to the standard need not be those applied by a processor to the dosimetry supplied to its users. This is particularly important with respect to beta and neutron dosimetry.

Item nine. Average dose.

According to ICRU Report 25, the estimation of internal organ doses should be made by assuming that radionuclide distribution within the organ is uniform, thereby calculating an average dose to the organ. This assumption is made due to the practical limitations in determining the distribution within the organ by using routine whole body counting systems. In the same report it is recommended that skin doses should be estimated at a depth of .007 centimeters in tissue. This depth corresponds to the epidermis. It is assumed that at this tissue depth the

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maximum dose to the dermis would exist under most irradiation conditions.

One major omission in the recommendation for skin dose estimation is the practical limitations involved in measuring doses at .007 centimeters in tissue. To date, there is no dosimetry system capable of directly measuring the dose at a .007 centimeter tissue depth over a wide range of particulate radiation. Many facilities attempt to determine a "beta" correction factor for their dosimetry system by using a high-energy beta source, which may or may not be representative of an actual field condition. If, indeed, the correction factor was applicable to one field condition, it is unlikely that it would be -- apply to another, due to the changes in the components of the radiation field, such as comptom electrons, low-energy X-rays, gamma rays, beta particles, and conversion electrons.

In order to surmount this problem, consideration should be given to the measurement of an average skin dose. In this case, it is advantageous to use dosimetry corresponding to the accepted thickness of the dermis, of approximately 150 milligrams per centimeter squared. Values generated by this dosimeter would be representative of the average skin dose independent of the energy of the directly or indirectly ionizing radiations. This concept will greatly reduce the existing practical problems associated with beta dosimetry.

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The measurement of average skin dose is more consistent with the ICRU approach and may have strong physiological justification. This concept has major implications in the field of radiation dosimetry and if incorporated can greatly improve and simplify dosimetry provided to the radiation workers.

And that's Yankee's prepared comment. Are there any questions that I can answer?

Thank you, Bob. We appreciate the opportunity to talk.

MR. ALEXANDER: I have one question, about one of your recommendations. When you were talking about an appeals board, or -- or perhaps a review board, either one, you suggested that the test lab -- that it should have a representative from the testing laboratory on the board. Now, it would seem to me that the type of questions to arise before an appeals board would be, would have -- be adversary in nature, where the processor who has reported the wrong dose to a badge is saying that, no, he got the right dose to the badge, that the testing laboratory gave the wrong dose to the badge. And so --

MR. CAULDWELL: That's possible, yes.

MR. ALEXANDER: -- it wouldn't seem right to me to have a representative of the test lab in a position to vote, because he's very likely to be biased and to vote for his own way rather than to be open-minded in reviewing the processor's case.

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MR. CAULDWELL: I think that if the testing laboratory is performing their business in the fashion that I foresee that they should be performing their business, the testing laboratory would have documentations of actual delivered dose to any particular dosimeter. Witness the way Phil did it with Michigan: that he spread his dosimetry, not just dosing our TLDs but dosing five or six other people's in the gamma categories at the same time. If recording dose rate instrumentation was used along with each of those exposures and the location of the dosimetry and its particular dosing thing provided, I don't see where I could knock whether he delivered the proper dose to a particular TLD of mine or not. I'd be -- I wouldn't have any -- it would be a moot point I wouldn't be able to argue with him on.

And we, I think in the whole testing program we only had two pieces of dosimetry that were voided because of improper delivered dose; and those were only voided after Phil had discussed, or somebody else maybe, a problem and I'd actually passed based on those dosimeters. And when I ordered the dosimeters I failed one of my categories. So I really can't argue the point either way with you.

I would say there's a lot of personal integrity that's going to have to be involved in both areas. I think having a certification review board that is totally composed of people who are outside the area of practical dosimetry is not a good idea. There are an awful lot of aspects to practical dosimetry

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that are gut-level feelings that you have to work with in how you handle your dosimetry system, that you have to have a little bit of sympathy on the certification review board to. And I'm anticipating that maybe the testing laboratory will be established also to help you, not only to test you but also to help you.

MR. ALEXANDER: I see what you're looking for. You're looking for an advocate on the --

MR. CAULDWELL: Well, you've got to have somebody to help you out somewhere along the line.

(Laughter)

MR. ALEXANDER: Anyone have any questions for --

MR. CAULDWELL: By the way, I've got copies of my comment down here on the table. They're unpublished and untitled, but you're welcome to have a copy. We've got about 20 copies we brought down from Yankee with us.

Thank you very much.

MR. ALEXANDER: Greta, did you have -- did you want to -- if you feel like challenging him on any of his suggestions, why, I wish you'd do so for the benefit of the record, which will become part of the legislative history of this whole rule-making proceeding.

DR. EHRLICH: I thought that the procedure was that we will have a chance to comment in writing. Isn't that what you have in mind? To these prepared statements.

MR. ALEXANDER: Well, it depends on what you mean by "we." The staff will --

DR. EHRLICH: Oh. Oh, I see.

MR. ALEXANDER: -- is forced to do that. So we will certainly comment on each one. I mean, we'll make a decision on each one.

But what I'd like for you to do, of course, is to say something to help us stick with our position and not have to cave to him.

(Laughter)

DR. EHRLICH: Well, as far as the choice of the depths for shallow and deep is concerned, it would be very interesting, in fact, to have more experience and more comments in the -- from United States interested people on this, because this is a problem that is being internationally discussed now and it would be very nice to have an input from the United States to this discussion. There is a good chance that one is going to go with something like an average dose equivalent. I don't know, I haven't heard the 150 mentioned. Of course, the 300 milligrams per square centimeter is something that we considered adding for the lens of the eye. This -- the meeting that I may or may not have mentioned -- which I haven't mentioned publicly here, that is going to take place in -- under URATUM (phonetic) and PTB auspices this fall, and also ICRU auspices I think, probably will lead to some international decision on what quantity would

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be most useful to the interested communities both in Europe and in the United States and what depths would be chosen.

Somehow it's -- we don't have the time, it seems, here in the United States at the moment to wait until internationally this decision will be taken. But I foresee that we will go through a long process of changes and trial and further changes of different depths and different quantities before we will have arrived at a point where we feel at ease.

Now, it would be very nice if we could have more comments in this direction. Dr. Ralph Thomas of the University of California, Berkeley, probably will be a contributor to this conference this fall in Europe. I probably will be there, too. And I think that maybe if you approach either him or me we could take to the European community some suggestions from the U.S. community.

Let's see. What else was there? This was the main thing that I had in mind at the moment.

MR. ALEXANDER: Well, if you think of something later, just let me know and we'll call on you.

DR. EHRLICH: Let me see. I'll have to look at these points again.

MR. ALEXANDER: Oh, yes, you wanted to remark?

MR. CAULDWELL: I think so, Bob. Fred Cauldwell, from Yankee Atomic, again.

Our major concern is that during the standard, you know,

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responding to the standard that we expect to see within the upcoming year, I would presume, that all dosimetry is designed for monitoring 300 milligrams, in compliance with lens of eye and gonadal doses, et cetera. And the standard is requiring us to monitor at a thousand milligrams. Well, we can calculationally get around it, but our statistics suffer dramatically on the dosimetry every time we start making a mathematical change to the directly indicated dose on the TLD. And what we're really interested in is that if we do have to start monitoring a thousand and providing routine type badges for the testing program, that we're talking -- you know, we're a relatively large in-house user of around 10,000 pieces of dosimetry, we're talking at -- if we monitored the thousand that we normally -- like we're required to for the testing program, and we went and monitored the thousand for our people, it'll cost us some $50- or $60,000 just to change our case design, at least; that's just presuming we can modify our present cases and not buy all new ones.

If we stay with our 300 milligrams, which we would prefer to do, we'd be all set.

If we went to a thousand and we got inspected by the NRC at one of our plants, we would wind up with a citation because we don't provide eye protection for all our personnel at the plants and we'd be in violation of NRC Form-5 requirements.

We're caught between the horse and the cart and they're

JO-62

both squeezing us to death -- and the horse is about ready to do a number on us. I really don't know what we're going to do. And what I'm really looking for is some guidance in this area as to, one, we'll be in compliance with the standard when it goes into effect, two, we'll be out of compliance with NRC Form-5 requirements, we've got to change one or the other, or give us the latitude to play games with our calculational models.

MR. ALEXANDER: Believe me, we're under complete control.

MR. CAULDWELL: Thank you.

(Laughter)

I hope so.

MR. ALEXANDER: We'll change Form 5 to --

MR. CAULDWELL: That would be most appreciated. That will take a burden off of myself and our plants, and that would be great. Thank you.

MR. ALEXANDER: Okay. Thank you very much for a good statement.

Greta?

DR. EHRLICH: Could I add a little more?

Of course, you are always welcome to use the factors. And the testing laboratory is going to help you, if we have anything to say, to establish these factors -- for the different depths, for the different energies. Same holds for the yttrium, which is high in energy. We mentioned that this morning.

JO-63

With regard to the angular dependence tests, they are not mentioned at all in the standard. They are recommended in the appendix. And that's why there are no teeth in them: because they are not in the standard at all.

MR. CAULDWELL: I don't have a copy of the revised final version.

DR. EHRLICH: You don't have to have a copy of the revised one. I was just told by one of the people in the audience that one of Phil Plato's NUREG documents in the back of the room has the published draft standard in it. And the published draft standard did not have the angular dependence in the standard, as far as I know. Or did it?

DR. PLATO: Well, in the standard, in the old and the revised version, it is required, angular dependence measurements are required, in the body.

DR. EHRLICH: All right. It's no more. It is no more. It's no more.

DR. PLATO: It is in the body, isn't it?

DR. EHRLICH: No.

DR. PLATO: The last I saw, it was.

Did you take it out?

The standard, as I recall, requires that an angular response study be done.

DR. EHRLICH: Yeah, but it doesn't tell you where or how.

JO-64

DR. PLATO: No. But it requires that it be done.

DR. EHRLICH: Oh, it requires that it is done.

MR. CAULDWELL: It requires an angularity dependence test, but it doesn't give you any criteria for it. I have no real good idea why.

DR. EHRLICH: It only requires -- it only -- I, I know why, but I was not for it and neither were many of the other people on the group but we were outvoted. There are some people who feel that, at least, the testing laboratory should be prepared to do this test and do it. And this is why we have it in. But we were not prepared to say that there will be recommendations -- that there will be test criteria set for it.

The argument was -- and I wish we had, I had the man here who is so strongly for this -- the argument is that you can have a great deal of difficulty without knowing that you have this difficulty if you are not familiar with the angular dependence of your particular badge and, therefore, the testing laboratory should do this service to the processor, of providing him with the angular dependence of his -- the response of his badge. That's all.

MR. CAULDWELL: I can see this might be a long afternoon getting up and down.

Our basic contention on angularity dependence is that if we work in a four-part geometry, which most of the radiation exposures are received in, or something very close to that, that

JO-65

angularity dependence becomes really a moot subject when you talk about C sub x values; it disappears because C sub x takes into account, if you do your source phantom badge configurations process properly, assuming that the badge is not on a fan and is continuously revolving in every different direction going and being irradiated by a mono-directional source, you wind up with a C sub x correction factor that takes into account angularity dependence. At least, that's my understanding of the subject. Therefore, the angularity becomes a moot subject. So I'll --

DR. EHRLICH: As far as the criteria is concerned --

MR. CAULDWELL: Right.

DR. EHRLICH: -- yes, indeed. But the C sub x is the C sub x that applies to perpendicular lengths.

MR. CAULDWELL: Right.

DR. EHRLICH: We agree.

MR. CAUDLWELL: Right. It's a very complicated subject when you're getting into the nitty-gritty, if you want to call it that, of precise radiation dose delivery. We have the same problem when we're trying to evaluate it for neutrons, where we believe that straight neutron irradiations on a phantom are fine and dandy but they don't truly represent a neutron environment per se, that more probably that maybe your -- if you're wearing Albedo badges, they're mounted on a fan and then having the fan doing a rotational routine, so that it'd be as if the person were working in a neutron cloud, if you want to call it that, and from

JO-66

what we see, we have quite a bit of scattered neutron problems that are at a power station, and that would be more appropriate to have a "inversion factor," or a correction factor, based upon that type of dose. It's very, very difficult to arrange that type of configuration and come up with appropriate correction factors for dosimetry purposes; and for a testing standard it is impossible, from our point of view. And that's why we don't, you know, really see any point in having angularity dependence tests. If you establish your program based upon the ultimate, if you want to call it that, and calculational dose delivery, you should be in good shape. But it's an awful lot of work on the part of the processor and something that's outside of what you might call normal dosimetry. Most processors will not be willing to spend the money to go into that kind of testing. And we're fortunate within the Yankee system, where we've not necessarily had that money available but we can convince people to spend that kind of money to do the kind of testing we need. So --

DR. EHRLICH: I fully agree with you. But you have to keep in mind that Health Physics Society standards and ANSI standards are consensus standards. And this was the consensus of the group, to do it this way.

MR. ALEXANDER: I believe Jack Selby wants to raise a question or make a statement.

Oh, he's backed out. We're losing a lot of comments

from people that subsequently back out.

DR. YODER: Such is the stimulus for comments, huh?

I guess I'm somewhat confused about the statement on C sub x values. From our own investigations, all C sub x does is provide the method for taking an in-air measurement and relating what it does under broad beam conditions when it scatters and interacts with a phantom. The way these are measured is that one is measuring a cumulative value in air, and really one is not strictly interested in the direction, however, if one actually wanted to put a phantom in the field with a four-ply geometry, one would weight the various C sub x values by the depths in tissues and things like that, but you would still have to have that factor, that accounts for the build-up and scatter and attenuation and what all, other competing processes that you have. So I think you're going to have to have this, regardless of the direction of the field. It's -- if it enters the back or it enters the front, it's still building up in the same physical process.

And that's my comment.

DR. EHRLICH: May I ask a question in connection with this?

Did you want to imply that the C sub x value will be the same regardless of the incident?

DR. YODER: Oh, well, in terms of looking at it at the same depth. That is, a centimeter in the back would have the

JO-68

same C sub value if I was looking at a centimeter from the front. Okay. I'm saying and when you weight the whole thing, though, you still have to account for relating to the dose in the body; that's the ultimate goal. And you're going to have to have the factors whether you weigh them, you know, for four-ply or not; you can't ignore them; you can't say that they're going to be one -- they just aren't.

MR. ALEXANDER: I think you wanted to make a comment?

I think I'm going to change the rules of the meeting. Once you raise your hand you're constrained to make your comment, that you can never back out until you say something.

(Laughter)

MR. LA MASTRA: Tony La Mastra, from Bethlehem Steel.

Did I understand Dr. Ehrlich to say that the -- that international groups, or group, a group, was considering the possibility of changing from seven and 1,000 milligrams per square centimeter, and that that might change the standard in the future?

DR. EHRLICH: The international groups are not just considering the difference in -- different depths, but they consider what quantity is best applied or is most applicable to personnel dosimetry reporting. So it goes much -- it's a much broader sort of a field that they are considering. We are talking about whether the dose equivalent index or an average dose equivalent or a shallow and a deep dose equivalent should

JO-69

be considered and then in what depths, if you consider one of these in what depths they will be considered. Say, if you have shallow and deep, then the question is in what depths. But if you take an average, this is a moot point. Or you can have an average to an organ.

I don't know how it's going to go. It may be not just months, it may be years before the ICIU will come out with a recommendation. But we cannot wait that long. We have to go ahead, if we want some sort of a testing program to start.

MR. LA MASTRA: Okay. I guess I have no problem with changing mathematical models, or even changing computer programs. But if badge designs and phantom designs are going to be changed periodically, with relatively -- again, relatively little benefit as far as real health physics , then I have a real problem with spending money just because a group thinks that this particular thing should be changed a hundred, two hundred milligrams per square centimeter. And if a number is decided on, I believe that number should stay.

DR. EHRLICH: For how long? Forever?

MR. LA MASTRA: If there's good reason for choosing it now, why not stay with it forever? Yes. Again, there's not that much of a problem changing a mathematical model, but -- and I don't have a lot of badges, but if periodically, every two, three, five years I have to go out and buy all new badges or redesign my badges, from an industrial point of view, that

JO-70

doesn't make a lot of good sense.

DR. EHRLICH: I agree.

MR. ALEXANDER: Thank you, Mr. La Mastra. I wonder if you wouldn't be a good advocate in those who battle against the SI units.

MR. LA MASTRA: Yes, I would.

(Laughter)

MR. ALEXANDER: We can use your voice.

Well, you're going -- I suppose one of the Lessons Learned at Yankee Atomics certainly would be that before you send a dosimeter in to a testing lab to be irradiated, make sure there's something in there that's sensitive to radiation. Now, that brings me to an appropriate moment for what is probably the closest you'll ever come to hearing an apology by a member of the Nuclear Regulatory Commission staff. The cover letter that we used to send copies of the advance notice of rule-making on the subject out to everybody that we thought would be interested in this subject had a sentence in it which -- which reads as follows: "Some processors expend the necessary effort to screen out the defective TLDs and, as a result, are using dosimeters with variabilities less than 10 percent." I think within a few hours, or perhaps moments, after that was read by Art Lucas of the Harshaw Company, I got a phone call. And it turns out that there's no such thing as a defective TLD -- at least, as long as one is present. He pointed out to me that the

JO-71

-- a TL- -- that there is variability among TLDs but that the fact that you have an outlyer doesn't mean that you would necessarily call it defective, because some processors calibrate each TLD and if you calibrate each TLD and then you use that TLD's calibration to evaluate the dose it's exposed to you get the right answer, so it's really not defective.

So our apologies to Harshaw for suggesting that there might be such a thing as a defective TLD. It's part of the ivory tower complex we live in that so many things that you people do we know nothing about.

I'm sure that's as it should be.

I think we're fortunate today to have Ellery Storm with us from LASL. Ellery was one of the participants in the pilot study that we conducted and has agreed to make a statement to us about the -- what he -- along the lines of what he considers to be in the Lessons Learned category.

Ellery, would you like to use this podium? Or are you going to speak from --

MR. STORM: Well, we did learn something --

MR. ALEXANDER: Fine.

MR. STORM: -- going from the test one to the second test. But what that something was won't be as intelligible unless I present my presentation first, because it describes the badge and the things we learned about it in order to pass the second series of tests.

JO-72

MR. ALEXANDER: Well, would that be on the quality control presentation?

MR. STORM: Yes. The quality control presentation includes a description of the badge which would make what I have to say about our improvements intelligible.

MR. ALEXANDER: I see. So we have a lap-over here. Well, are you prepared now to go ahead with that?

MR. STORM: If the slides are over here. We can check that.

(Pause)

Would that disrupt the program?

MR. ALEXANDER: Not at all. Not at all. I think it'd be very fine to have the whole thing right now.

(Pause)

MR. STORM: In 1978 the Los Alamos Scientific Laboratory converted from the film to the thermoluminescent dosimeter badge. I intend to describe the Los Alamos badge and indicate along the way the quality assurance procedures we follow. And I will conclude by discussing our -- the things we learned in doing the Michigan test.

No one has defined quality assurance so far, so I'll take the liberty of doing so. I'll define the quality assurance as whatever methods or procedures you follow to improve or insure the accuracy of your dose evaluations.

The slide shows the Harshaw TLD card used in the Los

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Alamos badge. The TLD material is lithium fluoride in the form of solid chips which are sandwiched between Teflon sheets and mounted in a card consisting of two aluminum sheets riveted together.

The card is about the size of a film and contains four TLDs. Well, there are three TLD 700's and one TLD 600. The TLD 700 is depleted in lithium 6 and, plus, insensitive to neutrons. The TLD 600, on the other hand, is enriched in lithium 6, so it's sensitive to neutrons by the analph (phonetic) reaction. You also notice there's a Codabar serial number, which can be visually and machine read. And the cutoff corner, the upper right-hand corner, is cut off so that the badge -- the card is oriented properly in the cycolac holder, which is shown in the next slide.

The cycolac holder contains four filter positions. In the first position it's shielded by a copper filter and measures the penetrating dose, which is defined as the dose received at a depth of one centimeter in the body. The TLD 700 chip in position two measures the soft X-ray or beta dose, the nonpenetrating dose, which is defined as the dose received in the body at a depth of seven milligrams per square centimeter. The neutron radiation dose is determined by subtracting the TLD 700 reading in position three from the TLD 600 in position four and multiplying by an appropriate energy-dependent correction factor.

You will notice that there are two types of badges shown there. One is -- we call it a cadmium badge; the other, a

JO-74

non-cadmium badge. The cadmium badge has a pocket of cadmium which absorbs the thermal neutrons. The non-cadmium badge really has -- has no cadmium, it just has plastic absorbing the readings in positions three and four.

The -- as you'll see later, the -- we prefer to use the non-cadmium badge where in the absence of thermal neutrons, because the sensitivity is higher by a factor of five.

The NTA film shown in the slide is used as a backup for the TLDs in areas where significant exposures to neutrons over five MeV in energy are encountered.

The next slide shows our TLD reader. It consists -- as you know, a hot finger activates a solenoid which heats the TLD chips, and the light output, which is proportional to the dose, is measured by a photo-multiplier tube. The reader consists of a logic module, the one on the extreme left, which controls the transport mod' that's shown on the extreme right. The transport mod' -- module loads, reads, and unloads the cards at a rate of one per minute. The pico meter integrates the light output. And the Savin 700 terminal records the data on cassette and provides a hard copy of the readings.

The next slide shows the circular cobalt 60 calibration stand that we use to calibrate the TLDs. Instead, as Bob has just mentioned, instead of applying -- measuring and applying specific correction factors to each TLD, we established an average value and accepted only TLDs that were within plus or

JO-75

minus 15 percent of the average for use in our personnel dosimetry program. Twelve thousand cards were calibrated at 200 milli-R with the cobalt 60 source. This exposure rate was measured by a Victorine thimble chamber calibrated by the National Bureau of Standards.

If all four TLD readings on the card fall within plus or minus 15 percent of the average, it was accepted. If one or more of the chips on the card exceeded the 15 percent, it was rejected and replacements were given. Approximately 8 percent of the cards were returned for replacements. If all four chips on a card fell within plus or minus 2 percent of the overall average, it was considered a standard and it was used to set the sensitivity of the reader.

The sensitivity is adjusted by adjusting the high voltage on the photo-multiplier tube and after such a change it stabilizes within seconds. Standards are exposed to 200 milli-R of cobalt 60 gamma radiation read for every 100 cards that we read.

The next slide shows several anneal procedures described in the literature were investigated and the results of this investigation are shown in the slide. A pre-exposure 80 degree Centigrade anneal for 17 hours was selected. With this anneal a nearly Gaussian single data peak is observed with no significant low temperature peak, resulting in improved reproducibility over the other procedures tested. In addition, less

JO-76

than 1 percent fading was observed over a 120-day period.

Repeated anneals do not appear to affect the sensitivity. Cards subjected to 125 anneals showed no statistically significant differences in sensitivity from cards subjected to five anneals.

If a TLD card is read more than once, an average residual remainder of 3.5 millirem is recorded. In addition to this residual background there is a build-up of .? millirem per day, which we presume is caused by cosmic radiation and radioactivity in the soil and surrounding building materials.

The next slide shows our X-ray unit that we use to measure the TLD badge response. The unit covers an energy range of from 10 to 250 KeV.

And the next slide shows the experimentally determined penetrating and nonpenetrating correction factors as a function of -- the next slide -- no, it's upside down -- well, maybe I could read them -- well, go on with the -- okay, in order to apply the appropriate correction factor, the photon energy must be known. Now, each badges holds a dosimeter card containing four TLDs, and the only information available comes from the light output readings of the TLD chips. Because the chips in positions three and four in the non-cadmium badge are filtered by the same thickness of plastic, they read the same, providing only three readings. From these three readings two distinct ratios can be formed: the two-to-one and two-to-three ratios were

JO-77

the ones that were chosen.

And the next slide shows the two-to-one and two-to-three ratios as a function of photon energy. Above 100 kilovolts for all practical purposes the correction factors and the ratios are one. As you can see, the two-to-three ratio has very little response with photon energy, whereas the response of the two-to-one ratio is very large with energy and permits us to evaluate the photon energy -- or determine the photon energy by this technique.

The next slide shows the two-to-one ratios -- shows -- no, this -- it should show the mixture. These are the correction factors for nonpenetrating, on top, and penetrating, below that, for a mixture of strontium 90 beta rays and cobalt 60 gamma rays. On the left we have all strontium 90 beta rays, and on the extreme right all cobalt 60 gamma rays.

These curves were developed after the first test, the first Michigan test. We failed in five of the 31 intervals. Two of the failures occurred with the mixture of strontium and cobalt. We developed these curves -- the next slide shows the two-to-one and two-to-three ratios, which are fairly distinct, and permits us to not only apply correction factors but we can tell how much of a mixture that we had; whether it was one-third beta or two-thirds beta, we can read off from the differences in these ratios. This was one of the improvements that was made which permitted us to pass the mixture category in the second

test.

The next slide shows the measured response of the cadmium and non-cadmium badge on phantom to nonenergetic neutrons. As you can see, the non-cadmium badge has the larger sensitivity over the range covered. The range is about 50 kilovolts to 14 MeV. And the non-cadmium badge is far more sensitive than the cadmium badge, by this factor of five. And in the first test we used the cadmium badge to evaluate neutrons and failed the two neutron categories. In the second test we used the non-cadmium badge and passed the neutron categories, because of its greater sensitivity. It's just simply a case of the neutron dose being determined by subtracting two readings, one under the TLD 700 and the other on the TLD 600. If that difference is small and you're using large energy-dependent correction factors, you can make very large errors. With the non-cadmium badge the differences between the TLDs in position three and four are much larger and permitted us to obtain accurate evaluations of the neutron dose.

The -- because of the large decrease in sensitivity regardless of whether we had the cadmium or non-cadmium badge, you can see the response varies by three orders of magnitude over the energy range discussed here. So it's necessary to determine a suitable neutron correction factor at each facility where neutron exposures occur. The correction factor at a location is determined by the ratio of the neutron dose delivered

JO-79

as measured by the PNR4 nine-inch sphere to the TLD badge reading itself. A large number of these readings were measured at the Los Alamos plutonium and meson physics facility.

One of the more important aspects of our quality assurance procedures is the critical examination of our monthly personnel exposure listing. The types of radiation received by operating personnel in a given area is usually known by the dosimetry and health physics personnel. After the TLD cards have been computer evaluated, each entry on the monthly exposure listing is visually examined for high or unusual exposures. Exposures which are not consistent with the work being performed in a particular area or exceed certain criteria are investigated by health physics personnel.

One of the criteria is that any exposure in excess of 400 millirem per month must be investigated by a health physicist. A report is written, and it includes a statement as to what corrective measures are being taken to reduce the future exposure.

I think that's pretty much all that's in the prepared statement. The -- as far as improvements in going from test one to test two, the result, as I have indicated, of those curves which permitted us to use the two-to-one and two-to-three ratios to determine mixtures and to determine energies and then apply the appropriate correction factors.

Thank you.

MR. ALEXANDER: Thank you, Ellery. Today is the first

JO-80

time I've ever seen anybody from LASL with a conventional tie on other than a bolo type; I think they must have a real high-class dosimetry operation out there.

(Laughter)

Does anybody have a question for Ellery?

Tell me, is anyone else using that ratio system to determine the correction factor? Will you hold your hand up?

Well, you may be one of the first, then, to have identified that as a useful technique for passing the test, or for -- do you -- I guess I shouldn't embarrass you by asking you if you're using that same technique now to measure the beta dose to people.

MR. STORM: Go ahead and embarrass us. No, we're still working on that.

MR. ALEXANDER: You are working on that?

MR. STORM: Yes. We're looking at the ratios and correction factors in a number of different areas, for both neutrons and betas and gammas as well; we're doing quite a bit of investigative work in that direction. And eventually we'll come up with some numbers which we'll use as correction factors.

MR. ALEXANDER: Very good. So that's a good Lesson Learned.

Yes, sir?

MR. HILL: Michael Hill, from Mason and Hanger Company. I've got a couple of questions. I think, aren't you, Phil, doing

JO-81

some work with the ratio studies on different -- some dosimeters?

DR. PLATO: Well, we've played around with them, yes. But not -- I mean, we're not trying to do it for a -- you know, on a routine basis.

MR. HILL: Yeah. Okay. One thing I was wondering on some of the slides that I've seen, maybe Ellery can answer this: with TLD 600s and 700s from Harshaw, of course, we've had some problems, too, with the 600s not responding to what the neutrons, some of them, but it was, is, have you seen any particular minimal detectable activity as far as down to, like, 50 millirem or 100? I noticed that your testing procedure, you exposed them to, I think, 150 millirem californium 252 dose. And I was wondering, in your study could you see whether or not the minimal detectable activity was like about 50 millirem or was it more? Does it depend on the badge itself? I'm sure that's a factor.

END
TAPE 4

Like, should this be even in a standard? Should you be able to see down to 50 millirem for neutron dose? Or should you be able to see down to 20? Like, for instance, anything less than 50, we are saying that it is minimal detectable activity, and we will report it as zero, if it is less than 50.

Do you have any feel for that? Does anyone?

DR. PLATO: No. If you are asking me, we really didn't look at -- I mean, we didn't have the ability, I guess, to go in to each processor and ask, just how low can you go with each type of radiation.

MR. HILL: Would that come up as a standard, do you think, Mr. Alexander?

MR. ALEXANDER: Excuse me. Go ahead.

MR. HILL: Do you think that that could be part of a standard? I am not saying that I am for it, but seeing down to 20 or 50, or should that be even part of the standard, being able to see that?

MR. ALEXANDER: My opinion on that, which is a fairly new opinion -- I haven't really thought about that very much, but I think I would really hope that the performance standard wouldn't be used to determine the minimum reporting detection limits. It seems to me to be two separate matters.

MR. HILL: Okay.

MR. ALEXANDER: I think it would be unfortunate, for example, if a processor who had satisfied himself he was doing a

good job of reporting down to 20 millirem stopped because the lowest range of the standard is 30. I hope that doesn't happen.

MR. HILL: As far as -- I don't know. Maybe there is one, but I haven't seen one. In fact, maybe Mr. Garcia would like to talk on this. What about, for instance -- we were talking about personnel dosimetry. What about environmental dosimetry? Would there be a testing program probably set up for this?

MR. GARCIA: I don't know of EPA having an -- I don't know of EPA having an equivalent program for the environmental dosimetry. I think several programs have been under way over the years, not only for external dosimetry, but also for, you know, contaminants in water and air and so forth.

MR. EISENHAUER: The people who are in the environmental branch in standards development have requested ANSI to develop a standard that would form the basis of a testing program for environmental TLD's in a fashion similar to the personnel monitoring program, and I believe that that work has started toward development of a standard.

MR. ALEXANDER: I didn't know that.

Another lesson learned that I picked up on from Ellery Storm's talk had to do with a screening that they do at Los Alamos for TLD's. And if I understood it correctly, TLD's that are not within plus or minus 15 percent are not used. Is that correct?

MR. STORM: Yes, that's correct. Each card is exposed

to 20 milli-r of cobalt 60 gamma rays and the reading that we observed on a card on all four chips are compared to the average reading, which was established by taking a large number of these, and if it exceeds the average by plus or minus 15 percent, they are rejected and sent back to Harshaw for replacement.

As I said, about 8 percent of the cards fall outside these limits and have to be replaced. It doesn't mean, of course, that the cards really fail. They are still usable, or could be used with correction factors.

MR. ALEXANDER: Well, I would think that that would be a very good lesson learned that all the processors could profit from. I hope that the standard is stringent enough that a certain amount of screening, a practical amount of screening would be necessary to comply with the standard and to pass the test.

When Art Lucas from Harshaw called me to thank me about the defective word in our letter, I asked him if it was possible to buy from Harshaw pre-screened TLD chips. He said, yes, of course, we will pre-screen them so that our customer has his or her option of doing it in house or having it done by us. I asked him how much it costs to -- how much increase in cost there is to have the TLD pre-screened, and it was substantial.

I believe he said for plus or minus 10 percent chips that it would double the price.

MR. STORM: The cards by themselves alone ought to cost $15 apiece.

MR. ALEXANDER: How much?

MR. STORM: Fifteen.

MR. ALEXANDER: The cards cost $15?

MR. STORM: Fifteen dollars.

MR. ALEXANDER: So you are talking about quite a bit of money.

DR. PLATO: May I ask Ellery a question?

MR. ALEXANDER: Certainly.

DR. PLATO: When you purchase your cards, are there any -- in your purchase agreement, in your purchase agreement, are there any guarantees from your supplier as to the tolerance limits on reproducibility?

MR. STORM: In the sense, yes, that if they do exceed our calibration limit of plus or minus 15 percent, we are committed to send them back, and they return TLD's back to us, the same number. If we have 200 TLD's that fall outside -- TLD cards that fall outside this limit, we return these cards, and then they send us back 200 more for testing.

DR. PLATO: They are not assuring you that all the cards are within 15 percent? They are only saying that if you find any that are not, you can return them?

MR. STORM: If you find them outside that limit, yes, then they will replace them. That is correct. One of the problems we have had recently in reproducing them is, we find that they must follow the same anneal procedures that we do,

because our sensitivity is lower in our anneal procedure than it is if you don't use that anneal procedure.

MR. HILL: Mr. Fix?

MR. FIX: My name is Jack Fix. I am with Battelle. I wanted to ask Ellery a question, and that is, this dosimeter list is very dependent on extensive field support in its neutron interpretation to allow you to have three TLD 700's to essentially act as an energy spectrometer, a crude energy spectrometer, to get these two to one and three to one ratios. I don't know how many dosimeters in the United States have three TLD-700's in their design, and I was going to ask Ellery how essential it was, since he knew what the neutron source was in the testing, how essential it was to have the three TLD 700's with different filtration.

MR. STORM: We can do no spectrometer work with neutrons. I didn't mean to imply that at all. In other words, if we weren't told that it was a Californian source, we could not have come up with the correct values at all. It was only -- We have a Californian source ourselves, and it permitted us to expose our TLD's to that Californian source and come up with correction factors which we felt would be applicable to the geometry that was used by Phil's laboratory.

MR. FIX: Yes. I may have misstated myself. I didn't mean that you were doing neutron spectrometry, but you were able to do essentially the energy spectrum for the beta gamma component, and that allowed you to get your two to one, three to

one ratios --

MR. STORM: That's correct.

MR. FIX: -- to essentially correct your laboratory calibration to what was being used in the standard.

MR. STORM: That's right.

MR. FIX: And you can't make a direct neutron dose interpretation without either a supporting field measurement with your nine-inch, three-inch spear technique, or knowing the calibration source, as you would in the testing.

MR. STORM: That's correct, yes.

MR. FIX: I guess I am making a statement, and that is that someone that doesn't have the dosimeter that Los Alamos has is not going to be able to do the same things without -- as well as they have. They have done some very excellent work, but they needed the three component dosimeter for the beta gamma part, to be able to do parts of that.

MR. STORM: That's correct. In order -- to form these ratios requires three filter positions. We sort of -- the 700 position three sort of has a double duty. It gives us the two to three ratio as well as the three is subtracted from the 300, 600, to get the neutron difference.

MR. ALEXANDER: We have -- Oh, excuse me.

MR. GROGAN: Dave Grogan from Health and Welfare, Canada. Are these comments allowable? I realize I am sort of from outside the group.

MR. ALEXANDER: Anything goes.

MR. GROGAN: Okay. It is going back to the concern about screening of TLD's. We have a rather large program in Canada run by the government, and we have about 150,000 TLD's at the moment currently in service. We have had a great deal of difficulty getting Harshall to guarantee sensitivity reproducibility. We have finally come to the conclusion that we have to individually calibrate all the chips.

I ask the question, if you have to calibrate them to see whether they meet the sensitivity, in a lot of programs, wouldn't it just be easiest to go ahead and use that individual calibration?

We did a prototype study with about 10,000 badges, and we derived a mean. We subsequently did one with about 125,000 badges, and we found that the spread had increased tremendously, and this was the reason for our decision for individual calibration. I don't know whether that is useful or not.

MR. ALEXANDER: Who do you work for?

MR. GROGAN: I am employed by the government of Canada.

MR. ALEXANDER: Does the government of Canada provide a national dosimetry service?

MR. GROGAN: Yes.

MR. ALEXANDER: Would you like to recommend a service like that to this group?

(General laughter.)

MR. GROGAN: It gets rid of a lot of problems.

MR. ALEXANDER: I would like to congratulate you on the way you handled your recent secession movement in your country. We do it much differently here.

(General laughter.)

MR. SHAW: My name is Richard Shaw. I am with Radiation Management Corporation. Since the name of Harshall Company has been mentioned several times, I would like to use this opportunity to just mention sort of in response to Mr. Fix' question, there is a system designed and manufactured by Panasonic Japan. The system uses two differents phosporouses, lithium borate and calcium sulfate. It has four elements. There are many different capabilities.

Dr. Plato and Radiation Management and with Panasonic, we worked very closely together. By using this particular system, we were able to differentiate beta gamma and even detect Californian 252. When Mr. Alexander mentioned about a ratio, I was a little bit -- I didn't pay as much attention to your comment. We are using this ratio method also, between or among several elements. We find it is a very effective method to detect radiation in a mixed field.

Actually, Dr. Plato developed a logarithm which was rather useful.

DR. ALEXANDER: Did you start that as a result of

participation in the pilot study?

MR. SHAW: In a way, yes. We were very interested in the potential capability of this particular Panasonic system at the time that you started this pilot study, so we actually combined the two things together.

MR. ALEXANDER: Thank you very much. Does anyone else want to raise a question or make a statement at this time?

We have a representative from the Duke Power Company with us, I believe, today, who wants to share with us some of their experience with the pilot study and some of the lessons they may have learned. Mr. Manny Jimenez, I would like to call on you now. You can feel freem to use this rostrum here, or the microphone in the aisle. Do you have any slides or anything like that?

MR. JIMENEZ: No.

MR. ALEXANDER: Fine. Well, whichever. If you would be comfortable here, come right on up.

(Pause.)

MR. JIMENEZ: My talk concerns really elements of personnel dosimetry quality assurance programs, I will discuss some of these.

We at Duke Power Company have always been interested in the accuracy and quality of our in-house personnel dosimetry service, and have been having for the past three years a program in this area. We believe that these programs, quality

assurance programs, can provide adequate confidence in the accuracy of results in order to assure regulatory agencies and radiation workers that the results are reasonably valid.

Well-documented quality assurance programs can adequately assure the health and safety of radiation workers, as well as provide some legal protection for the company. Therefore, we think it is very important that a great deal of care and professional attention be given to the design and implementation of these programs.

To help me discuss the elements which make up such a program, I have chosen to divide my talk into three sections and discuss each individually. The first one is operating procedures and records. The second one is the actual operation and maintenance of the dosimetry laboratory. The third is dosimetry performance testing and evaluation. Let me begin with the operating procedures and records.

We think that central to all quality assurance programs is a set of written procedures, and also records, which describe in detail and document all the activities involved in performing the entire operation. Written procedures should provide systematic instruction in the following things: A, storage, handling, shipping, and receipt of personnel badges; B, operation, calibration, and maintenance of all the instruments; C, calibration of radiation sources; and D, production, evaluation, and reporting of dosimetry data.

We think that these procedures should be prepared, reviewed, and approved by those persons who are knowledgable and familiar with principles and good practices concerning these activities. Procedures should also be reviewed and revised as appropriate, and new procedures written and implemented to continually upgrade the program.

Just as important as procedures are your records which document all phases of the operation. For dosimetry programs, records which should be kept include dosimeter inventory lists, badge issue logs, results of instrument calibration and maintenance checks, results of source calibrations, documentation of computer programs, dosimetry reports, and results of dosimetry performance tests, if there is one.

Okay. The second phase I would call the operation and maintenance of the dosimetry laboratory. The proper operation and maintenance of the dosimetry laboratory is just as important as is the documentation of your procedures and records. This means that all laboratory personnel should be intimately familiar with all the procedures and methods and should exercise care and pay special attention to details when performing all the activities.

To ensure that individuals responsible for the operation know and can carry out their responsibilities, they need to be fully trained and for some of the less routine activities, we think that periodic retraining may be necessary to maintain proficiency in this task.

Keeping in mind the differences in the operation of laboratories can exist, depending on type of dosimetry system, computer capabilities, calibration facilities, and number of dosimeters processed, most of the laboratory activities can be grouped as follows.

First, radiation source calibration and maintenance. Radiation sources that are used to calibrate and verify the response of your instruments should be calibrated and leak tested periodically, and we recommend at least once a year. When practicable, source calibration should be traceable to the National Bureau of Standards.

The second activity, dosimeter reader calibration, dosimeter read-out devices should be initially calibrated and then response checked prior to reading all personnel dosimeters. Calibrations should also be performed after any maintenance work is done on the systems. We think that variations in calibration of greater than plus or minus 5 percent should be investigated.

The frequency at which the response checks should be performed may vary depending on the length of the monitoring period, size of the processor and type of the dosimetry system, and purpose for which it is used.

The third activity involves one that we have already discussed, and that is dosimeter response check. We think at least when using POD dosimeters, the radiation response of new dosimeters should be tested before they are used in the field.

POD dosimeters should also be retested preferably yearly, but at least once every two years. Obviously, dosimeters which fail to meet the performance criteria, whichever you have established, should be discarded.

The fourth operation involved is badge handling preparation and shipment. Sufficient time should be allowed before the beginning of the monitoring period for the preparation, packaging, and shipment of badges. Badge preparation for shipment may involve, depending on the system, loading and package the badges. Control badges should also be included in all badge shipments.

The last major activity that I am going to discuss is badge receipt and evaluation. The badge receipt and evaluation process should be performed as soon as practicable after the badges arrive at the dosimetry laboratory. This process involves checking badges for contamination, unloading and reading the badges, and preparing the personnel dosimetry reports.

When practicable, computer programs may be used to speed up some of these -- some phases of badge preparation and evaluation.

The last one, the last part of my talk involves dosimetry performance testing and evaluation. When a national dosimetry performance testing program is implemented, if and when it is implemented, participation in this program will become an integral part of all dosimetry quality assurance programs. In

conjunction with the rest of the quality assurance program, this testing program can be used by a process to further document the adequacy of this personnel dosimetry program, provided, of course, that he successfully passes the performance tests.

Furthermore, we believe that processor participation under a voluntary program -- and I emphasize this -- would be most useful in promoting his credibility. In fact, we think that a voluntary testing program would probably now be very successful because of the interest processors, especially in nuclear power utilities, now have in documenting the quality of their systems.

The dosimetry testing program could be used as a reasonable measure of the adequacy of the personnel dosimetry program, if test dosimeters receive the same care and attention as that given to personnel monitoring. This means that test dosimeters should not be pre-selected with tighter performance criteria than that of those normally used in the field. Handling and evaluation of test badges should be performed by individuals who handle personnel dosimeters routinely and not by your in-house experts.

Finally, when practicable, test dosimeters should be analyzed using the same dose equations and conversion factors as those routinely used. However, the processor should have the option of using special factors to meet the test if he can adequately document that the sources used for the test do not reasonably simulate the radiation exposure conditions of his

workers, and that he utilizes in his processing laboratory.

In conclusion, then, personnel dosimetry quality assurance programs should be established to provide adequate confidence in the results. If properly documented and carried out, he can assure that the results are reasonably valid.

As the last item I want to emphasize, participation in any established national testing program should be voluntary and not mandatory.

Thank you.

MR. ALEXANDER: Thank you?

Does anyone have a question for Manny? Yes?

MR. HILL: I noticed -- This is Mike Hill from Mason and Hanger Company. You said something about checking dosimeters for contamination. I have heard this brought up once or twice before. If you've got several thousand personnel, how would you check them quickly, if you want to say quickly, for contamination? What methods?

MR. JIMENEZ: What we do, now, the stations, before they ship them, we are an in-house processor, and we have one operating station. What the plants do, they usually check them, whatever -- they probably use a GM counter of some sort just to quickly scan, and then when we get them in the lab, we don't have that many dosimeters. You know, we don't have thousands of dosimeters. We may have a couple of thousand. It is not a very large task to go through and just quickly scan

them for some contamination. We have never found anything on them, but just as a routine measure we do it.

MR. HILL: But it is not an automatic process. You just pick them up?

MR. JIMENEZ: Yes. The way we have them in shipment, we clip them to cardboards, and they are about 20 to a cardboard, and then we just go through them very quickly. It is not a very intricate check. It is just a very cursory check.

MR. ALEXANDER: Manny, are you aware that in the mid-sixties a voluntary program was inaugurated and tried for several years. The participation was less than 10 percent of the processors, and for that reason, it was, at least from a national viewpoint, was not considered to be successful. So I am surprised to find Duke Power recommending that we try that again.

On what basis do you think if we tried it again that it might be successful?

MR. JIMENEZ: I think that now, more than ever, we are really pressed to show and document our programs, and I think that if somebody participates on a voluntary basis, their credibility would be very much enhanced, and from our standpoint, if there was a program, we would probably participate, and we would actively try to pass and achieve these performance criteria.

I think the evidence -- Well, I will not go into that.

MR. LLOYD: Speaking from the standpoint of a state regulator, we found that voluntary participation is unacceptable.

The voluntary participation, as Bob Alexander mentioned, was very sparse. The National Sanitation Foundation in years past launched a very gallant effort to attempt to upgrade the quality of perosnnel dosimetry, and this was in the mid-1960's, and for those of you who would like to look at the records of the National Sanitation Foundation would find that only a half a dozen processors, commercial processors, ever attempted it, and some of them -- I could be corrected -- I think, only attempted their test maybe one time, and I don't think that as a regulator we would ever revert back to voluntary testing.

It is unfortunate that we have to go to a mandatory system, but voluntary testing has been well proven not to be functional.

MR. ALEXANDER: Manny, not everyone is going to agree with you in a forum like this. You should wear my shoes for a while, where nobody agrees with you.

(General laughter.)

MR. ALEXANDER: Thank you very much for the trouble you went to to prepare that review of the Duke quality assurance program for us. That was very interesting.

Yes?

MR. GORDON: My name is Len Gordon. I am a member of the staff of the Nuclear Regulatory Commission. My title there is quality assurance engineer.

I would just like to make a comment as a form of an

observation rather than a question.

After hearing the two speeches by Mr. Ellery and Mr. Jimenez -- Mr. Storm, Ellery Storm -- it is refreshing to know that at least somewhere in the industry they can make a distinction between when we ask them what is your quality assurance program, that they don't go on and describe their testing program, but also document what we call our programmatic controls, which you did, you know, quite adequately, talking about what you do to assure one's confidence that the tests in this case are performed to increase one's confidence that it will be adequate, things like you explained for your test control, your documentation control, your calibration control. All this is something that I think, if it is going to be a creditable program, we are going to have to insist that the processors have a well organized, systematic program where we get involved with training of personnel, getting documented programs as far as making sure that the people are well trained before they engage in any activity, that the packages, like you say, are packaged properly before they are shipped, and also, everybody is giving a definition of what their quality assurance is.

We at NRC also have our own definition, which pretty much falls in line with what you said. It says that quality assurance is all those planned and systematic activities that will increase one's confidence that an item will perform satisfactorily in service use. And then it goes on to confuse

the thing a little further by having a little subscript to say that quality control is part of quality assurance.

So, both you gentlemen are correct, except that my -- what I tried to construe here is that when we talk about a quality assurance program, we are not just talking about your test results. We are talking about, you know, all these programmatic controls that have to be added to the program to assure that what you are doing, you know, it adds confidence that the results will be proper.

Thank you.

MR. ALEXANDER: Anyone else? Fred?

MR. CAULDWELL: Fred Caldwell, Yankee Atomic.

Something that might be of interest to Manny and someone else who was talking about contamination control on TLD's, we have processed in the neighborhood of 6,000 to 7,000 pieces of dosimetry per quarter at Yankee coming in from three different power stations at the present time. We do see lowgrade contamination on a routine basis on our badges coming in, in the neighborhood of 500 to 2,000, 10,000 becocuries on the badges, depending on what is going on at the plant at that particular time.

We did have a particularly bad incident about two years ago, where we read a TLD that had an indication of 22 rem of exposure on the badge. We were not doing contamination surveys on the badge at the time, and the plant that we were processing

dosimetry for accused us of contaminating the badge or sending them a badge that was previously contaminated. Since we had not surveyed the badges when they routinely came in from the field, and we routinely send the same badges and cases back out to another facility, we didn't have a real leg to stand on other than the fact that the contaminations that we did find on the badge under jelly analysis with Yankee's environmental lab and some other routines like that indicated very low levels of short-lived activity, and the plant told us that when the badge had originally been shipped to them, it had in the neighborhood of half a curie of contamination on it, but we couldn't prove otherwise.

We wound up in a very sticky situation with the plant as a result. So, now, every badge that comes into Yankee is surveyed for loose surface contamination. We use RM 14 with an HP210 type survey meter, and we are considering going to solid state detection, maybe a bell-drive type of affair that will actually do gamma counting on the badge rather than just the basic beta counting, and do it with the 210 probe.

There might be something to be well considered if you are providing monitoring for more than one power station, to make sure you do do a thorough contamination survey of your dosimetry. It doesn't take that much extra time. Like, we process 6,000 dosimeters a quarter. We probably invest an extra ten manhours per quarter in doing that survey. So, it really isn't that much

of an effect on us.

MR. ALEXANDER: Thank you very much, Manny.

I don't believe we have heard on the lessons learned session from any of the commercial processors. I see Bob Wheeler in the audience. Perhaps we could twist his arm into making some sort of --

MR. WHEELER: Some sort of what?

(General laughter.)

MR. ALEXANDER: I guess some sort of a statement. Bob Wheeler is from Landauer and Company, and they did participate in, I believe, both of the rounds of testing, and it might be interesting to see what their impressions were.

MR. WHEELER: Let me get my thoughts together very quickly. I think that the first round of testing, what we tried to do was to run all the dosimeter types, and we had four separate sorts of dosimeters that we were testing. One, of course, was film. The second was the TLD. The third I am breaking out as NTA film, because the fourth is then one of our plastic detectors, and what we tried to do in the first test was to run the systems as closely as possible through the regular procedures, through the regular system, and at the same time make adjustments for biases and calibrations from our sources to the sources that were used in the test.

I think that what we did find was that our regular computerized automated systems proved to be a significant

advantage that we could not really use in this sort of test, mainly because we were using different standards in the sense of looking at an absorbed dose on a phantom versus our regular calculations of air dose and free air, and as a result, we had a couple of instances of clerical errors, where the -- an error that would normally not have gotten into our computer system got there only because somebody wrote down the information where it would not have been written down but rather automatically applied to a disc system, and in this case, because it was manual and there were different systems, the errors got through.

We had the opportunity also to evaluate, I think, the effects of errors in the sense of a small dose. In one particular instance, I believe we failed one category in the first round, where a 40 RM exposure was observed by one of our quality control people as being suspected of being a blemish on the film, and crossed off the exposure as being zero, and this caused the entire category to fail.

So, some of these things we put additional emphasis on. I will be talking more later today or tomorrow on quality control, quality assurance. However, one thing we have implemented, that I was not going to include, is that we have set up a continuing program where film and TOD's are inserted every day into the system, and then a comparison made once a month against a simulated test program.

So, we have tightened our restrictions, where many of

the categories are pass, fail at .5 or .3. We have reduced those categories to something on the order of .2 to .25, only because in the summary report it doesn't help us at all to find that, well, everything passed or everything failed. What you are trying to do is see trends away from the standard or towards the standard or better.

So, in that sense, administratively, we try to use a little bit tighter limits, so that we can watch them on a -- I said a monthly report, but actually the data is available almost daily, and we can watch trends based on the standard. This actually gives us a tremendous amount of information now on how we expect to perform routinely when the standards are finally -- and the whole program is finally implemented.

I think that is really all I can comment on right now.

MR. ALEXANDER: Thank you very much. I feel I should be forgiven for calling on you without warning. I know from experience that you always have your music with you.

MR. WHEELER: Thanks.

MR. ALEXANDER: I am going to give you a ten-minute break now, provided that everybody agrees to come back. We will try to get out of here by 4:00 o'clock.

(Whereupon, a brief recess was taken.)

MR. ALEXANDER: I let the meeting go on until five minutes after three, and then I found out that after I had declared it was time for a break that the coffee shop closes at three o'clock. And ordinarily I would mention that, except to say that being an NRC employee and being infallible we will have to blame this on Bob Wheeler for being the last speaker.

I am going to change the agenda a little bit. I would like for us to spend about the next 40 minutes on number VIII rather than number VII. In the morning then we will be able to devote the whole morning, if we need it, to the area of quality assurance and then terminate the meeting by noon tomorrow in case any of you need to change your airline reservations or something like that.

I would like to give you a homework assignment in the area of quality assurance. As I mentioned in my little prepared statement earlier this morning, we plan to include now in the regulation for personnel dosimetry performance testing a requirement that certification would be based not only on successful passing of a performance test such as you went through with the pilot study, but also on the maintenance of an adequate quality assurance program. The reason being -- I think I mentioned this morning -- we want to have a close coupling between performance test experience and what you actually do for the users that you service.

We want to avoid -- now of course we just recommend

things to the Commission and they have to vote on whether or not something becomes a regulation. But we want to avoid a lot of detailed requirements in the area of quality assurance. We don't feel that would be productive.

What we would like to include in the regulations, briefly stated, are the criteria that the certification board should go by in making a decision as to whether or not to certify a processor.

Is that very clear? Like if you are serving on the certification board yourself and you read the applicant's, a description of the applicant's quality assurance program, such as we heard from Mr. Jimenez a moment ago, perhaps with more detail on that, and then you are asked to vote on whether or not you think that is an adequate quality assurance program or not.

Okay, the question is before you vote what criteria should you go by? What should you be looking for in that quality assurance program? What should that quality assurance program be able to do to accomplish?

So one of the things that we hope to get out of this meeting, public meeting, is ideas that would help us decide what to recommend to the Commission with regard to these criteria for a quality assurance program. And what I would like for you, seriously, what I would like for you to do is to think about late this afternoon and tonight what you think should be included and to give that to us tomorrow either in writing or

verbally. There will be plenty of opportunity to do it verbally.

Of course the first sentence will read: "I don't think the federal government ought to do a damn thing about quality assurance in personnel dosimetry, but if you have to, here is what I think you should do." That is perfectly acceptable. Almost all recommendations start out that way, and we are certainly used to hearing that.

But I would like to know what your thinking is along that line. If you choose, write down just exactly what you think should not appear in those regulations, given the fact that we don't need them but that we are going to have them anyhow.

Okay, then let's turn now to the advanced notice of rulemaking. We said in the announcement for this meeting that this meeting should be considered as a forum for making oral comments on the alternatives that were mentioned in the advanced notice of rulemaking. And so what we would like to give you an opportunity to do now is to give us the advantage of your comments on that subject. We are prepared to accept comments either oral or in writing, but we do think it would be a good idea to give you an opportunity to say what you think orally. A lot of times you don't get to say what you think in a written communication. You get to say what your boss thinks in your words, and we would like to know what you think.

So maybe perhaps you could be brave and tell us so at the microphone this afternoon.

The advance notice listed and invited public comment on four types or four ways to operate the laboratory. The reason we went about it that way, or the reason we talked about and invited public comment on that particular aspect of it is that other things seemed to be pretty straightforward. There really aren't a lot of ways to run a test and certification program, and the decisions are fairly easy, I think, to make in most cases.

But how to operate the laboratory is not an easy decision. To refresh your memory, the four ways that we have thought of, which certainly may not be all of the ways that are viable, but the four ways we have thought of invited public comment on are what we called an unspecified laboratory. And the way that would work, let me explain. I don't always get to say what I want to say in these advance notices either so this is my chance to explain to you what the bureaucratees in the advance notice really means.

I wonder if Ratsy Dennis talks about me that way when she speaks.

(Laughter.)

She probably does. Can't win.

The unspecified laboratory would, what we would do if we went that route is just stay out of it, not do a thing to help create a testing laboratory or finance it or control it after it is operating, but go ahead with the regulation and say by a

certain date we will only accept personnel monitoring data if they are developed by a certified processor and that the only way a processor can be certified by our certification board is if he can demonstrate that he has passed these tests. Just leave it up to the processor to come up with their own testing laboratory.

With no help or interference from the government. I think there are precedents for that. I can't think of an example right now. Maybe somebody else can. I think that wouldn't be an unheard of way to go about it. I think the main disadvantage is that what would we do if the dates came around and nobody had set up a laboratory. Or what would we do if a laboratory had been operating for three or four years and then they decided to go out of business. It is a littly iffy, a little loose, and based on the comments that I have seen on the advance notice not a popular approach.

The second option would be an NRC-operated laboratory. Now what we mean by that is the NRC would rent a building somewhere and hire some laboratory people and start running a testing laboratory.

Of course this would add to the federal workforce and payroll and would, I guess, tend to spread at least the initial cost around to all the taxpayers, most of whom aren't involved at all in the things required of personnel dosimetry. And it would involve us in an operation of a type that we are not geared

up to do. We have nothing like that in our agency now. But it is a viable option.

The third option that we listed is an NRC-contracted laboratory. According to this option, we would contract for the testing laboratory service just as we contracted with the University of Michigan for the pilot study.

That incidentally is the favored option of the NRC staff at this time.

The fourth option is a federal government-operated laboratory, but operated by an agency other than the NRC. This option would probably involve a federal agency accustomed to operating laboratories, perhaps even accustomed to operating testing laboratories. NIOSH would be probably the best example of a government agency very accustomed to operating testing laboratories and doing test and certification.

There are a lot of advantages to that. Probably the main disadvantage is there might be a difficulty for an agency like NIOSH to staff up for an operation like this. We have explored this quite a bit with Nick Blaskovich of NIOSH, and I think the main problem that they have right now is they don't have people on board who are dosimeters and are used to working with radiation sources.

So staffing would be a problem, although it certainly wouldn't be an insurmountable problem. The staff size for the testing laboratory is really quite small. We have some experience

with that. We think probably 90 percent of the processors -- well, that is not the way to say it. We think about 90 percent of the dosimeters that are being processed in this country are being processed by participants in the pilot study. So the size of the operation wouldn't be much bigger than the size of the pilot study, and that was conducted by, well, less than, certainly less than five people, even including a person for administrative activities -- Phil Plato, Glenn Hudson and Sandy and, what, her husband? Yes.

So this is a fairly small operation. Phil has estimated other than the capital cost about 160 thousand 1979 dollars for the operation.

All right. Now let's have some discussion about this, particularly if there is anybody that has another idea, another way they think the laboratory should be operated. We would like to hear about that. Or if you just want to be negative, just give reasons why none of these options will work, we would like to hear from you.

Craig Yoder.

DR. YODER: Craig Yoder for Battelle Northwest. I guess several points. To develop a laboratory, particularly one for testing, and it should be sophisticated, I feel just to confine it to performing tests is somewhat a waste of talent. I think it perhaps should be available for maybe some other services, such as maybe dosimeter development or to serve as a

calibration facility for a small dosimeter processor who may be wan ing to design a new badge but is unable to fork out the capital dollars to procure the sources and everything to test and evaluate a new design.

I think a laboratory along the lines of a testing lab should also be able to provide this type of a function. I have thought about this, and of course the idea crops up of conflict of interest for the testing lab; helping in the design evaluation and also doing testing may be a problem for you. I don't know.

Secondly, and this, I guess maybe out of professional courtesy, I will direct to Elmer Eisenhauer, and a few weeks ago at NBS they held a conference on traceability of ionizing radiations, at which time Elmer presented a schematic of a series of secondary standards laboratories that NBS has approached, or has developed. And I would think also I would like to see perhaps that concept be adapted or at least maybe the testing lab adapted to that kind of a concept to join the two. And maybe you would have a secondary standards lab serving the federal community, such as DOE or somebody that would be a secondary standards lab for serving federal customers and then perhaps an alternative lab serving the private community.

I don't know, maybe Elmer may have a comment or two on that.

DR. EISENHAUER: In the study that I mentioned this

morning we did look at the possibility of setting up a system of intermediate, and just call them standards laboratories, that would do calibrations and hopefully some kind of measurement quality assurance and any other services that would be needed. And we did divide it into three sectors for political reasons and to avoid conflict of interest.

They are the federal sector, the state sector, and the private sector. I don't know if you are proposing that there would be a testing laboratory for personnel dosimetry in each one of those sectors. Is that what you are suggesting?

DR. YODER: I guess my question is: could one of those secondary standards lab serve as a testing laboratory?

DR. EISENHAUER: I think if you were to select one of them you would run into the conflict of interest problem. You would have a person who is being regulated, for example, by a state, testing the state dosimetry services, or the use of those services. If you sit down and think about it, you can imagine situations where you would get into that kind of a problem.

I don't know if --

DR. YODER: Well, one of the other impetus for this is that perhaps with the calibration and standard services that could help defray some of the cost of testing that may have come up and perhaps help assure that there will always be a lab available for performing the certification. You know, that was one of the things that Bob just alluded to. What happens if

a lab, vanish, in the future, where you left. And I think also from my own technical viewpoint that it may become rather mundane or something, and that to keep a testing laboratory that will be, I think, recognized in terms of standards and, you know, certified by NBS, or at least approved or looked at or reviewed by NBS is going to take some technical talent that I think will have to be challenged. And just to perform a routine test may not always keep the technical talent where it is needed.

DR. EISENHAUER: That is very true, but to add calibration services to personnel dosimetry testing, for example, I don't think would solve any problems, because calibration services traditionally are not economically viable, unless you have some very strong incentives, like if you had some additional regulations that require periodic calibration.

MR. ALEXANDER: Phil, can you comment on the idea that this routine operation of the testing lab might prove to be stultifying to the staff?

DR. PLATO: Could be what?

MR. ALEXANDER: Stultifying. Or he used the word "mundane," I think.

DR. PLATO: No, I am not sure I can add anything.

MR. ALEXANDER: Addition?

DR. PLATO: I am not sure I can add anything.

MR. ALEXANDER: You mean you agree that it does get boring and so forth if you have to 23 thousand irradiations

in a two-year period?

DR. PLATO: Well, certainly. There is a lot of production line work to something like this; and, yes, from our experience, as having done it for -- well, we spent seven months, it took us seven months close to seven days a week to get ready for it, for the first irradiations, and then we spent twelve solid months irradiating these dosimeters.

Personally, I was glad to see the last one go. Things settled down though. As hectic as this was to get started, looking back on it, certainly the last six months of the irradiations were nowhere near as hectic as the first six months. So gradually things settled down, and there is plenty of room for offshoot, spinoff type projects, and people want special work done and certainly the facilities are there, and I certainly subscribe to the fact that it would be a real shame to set up such a laboratory and use it only to irradiate personnel dosimeters. That would just be a waste of personnel and physical resources.

So I would hope whatever evolves evolves in a better fashion than that.

MR. ALEXANDER: Well, one way to handle the laboratory is contract, if we are allowed to do it that way, perhaps might be to allow the laboratory under contract to do anything they want to that is self-sustaining, but with the exception of, and then we might specifically list the prohibited

activities that could create a conflict of interest situation, things that would help the processor being tested where we would have the test lab actually helping him to pass the test, whereas his competitors might not be getting that help.

DR. PLATO: One comment on cost that I was thinking of when you were talking, that our estimate of cost, of how much it would cost to administer a test, you are right, excludes buildings and some really major items like that. But another thing that we had not considered was that the testing lab would be required to do things such as angular dependent studies and would be required to have on board and use any irradiation source that anyone required.

I think that you have to be a little careful when you start casually dumping requirements like that on a testing lab, especially as they are getting started. This is not going to be a five-person operation. This is going to start to get to be an enormous operation.

MR. ALEXANDER: We had felt that the contracted laboratory should, that the contract should be awarded as the result of an open bidding process, and with the normal government's contractor selection procedures. One of the disadvantages, at least from the viewpoint of some people of taking that approach, is that the national laboratories are not allowed to compete, so that when you take that approach you automatically eliminate a number of people who are highly

qualified to operate a testing laboratory and who might be willing to do so.

Mr. Selby from Battelle.

MR. SELBY: Bob, in response to your four categories, again I would like to see things left as flexible as possible. Now there has been some indication that there are segments within the industry that would very much like to do it themselves; in other words, similar to your item one.

Now whether or not that has really been developed to the point where they would be in a position to develop a laboratory and man it, I don't know. But certainly if that were to be the case, they would have more than one motive or they couldn't afford to put the capital dollars into that program and use that laboratory strictly for the certification, let's say, of the nuclear utilities, of the processors serving the nuclear utilities.

They are going to have an intent to do more things. And so a lot depends on these restrictions that you were to place on this.

I think there is precedent that says that laboratories can function in more than one fashion and still be credible. And I think that right now that the testing for HEPA filters is done by two DOE laboratories, and they certainly don't restrict their activities to only the testing of HEPA filters. They provide technical expertise within the DOE contractor family.

I know at least in one laboratory case they are providing outside of DOE to private firms. And yet they are providing the certification, if you will, for the HEPA filters, and they have been doing that for many years.

I think the strong consideration that should be given to this is that we have a highly flexible laboratory and one which we can all be justifiably proud and we not spend a lot of extra taxpayer dollars needlessly duplicating laboratory capabilities that perhaps you have already helped develop at the University of Michigan or that you might have in the DOE family or the Department of Defense or perhaps even in FMEA, as you have a rather sizeable laboratory complex within the FMEA.

So I think that a lot of consideration has to be given before you go out and ask for bids and before you place certain restrictions on what the laboratory can and cannot do.

MR. ALEXANDER: Thank you. Yes, sir?

MR. SHAW: Richard Shaw from Radiation Management. I have a question about the funding of this laboratory. According to this advance notice of rulemaking the funding will be provided by the testing fee. My question is: has NRC considered other source of funding? And if the answer is yes, any reason for rejection?

I think it plays a rather -- -- of what other choice are you going to make.

MR. ALEXANDER: Well, the only other source of funding we have considered is just the usual congressional funding of all of the things in the country that Congress funds. We would have to make our case through the NRC's budget process, which is incredibly difficult, and then go to the Office of Management and Budget and somehow convince them that all of the taxpayers should pay for that and then go to the Congress and try to convince the oversight subcommittees and Appropriations Committee that the public should pay for it.

Most of us on the staff feel, and I think these people too from the agencies, that we would get a resounding "no" from all of these people, that everybody would just say let the processors pay for it and pass the cost on to their users and not spread it out over the whole nation. So that is the thinking so far that has gone into this.

MR. SHAW: One other thing is if this testing laboratory is solely sponsored by all the processors, would that present somewhat counter interests?

MR. ALEXANDER: If it was what?

MR. SHAW: If this testing laboratory is solely sponsored or funded by all the processors in the way of testing fee, would that present somewhat a conflict of interest?

MR. ALEXANDER: I don't know of any. Perhaps you have thought of something along that line? Do any of you have a remark on that comment?

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You must have gone completely over our heads.

Yes, sir?

MR. ROBERTS: Jim Roberts from Pennsylvania Power & Light Company. I would like to make a comment on the necessity of this rulemaking, since I don't have much time and I won't be here tomorrow. There seems to be from the tone of this meeting a foregone conclusion that we are going to have the certification requirement for personnel dosimetry processors.

I think that in today's society with the limited resources that we have it behooves us as professionals to examine the allocation of those resources, and I don't think, in my opinion, an adequate case has been presented for requiring us to have our personnel dosimetry program certified. And as it has been indicated by a lot of the participants in this meeting, it is going to incur a substantial cost.

I think that you need to take a good hard look at the real necessity of this, and maybe you are doing it with this value impact assessment study that Dr. Plato is doing. I don't know.

I was thinking of two reasons why perhaps it isn't justified. First of all, the occupational dose standards that have been set were based on risk estimates that were derived from very inaccurate dosimetry methods. And the dosimetry methods that we use today currently in the industry are much more accurate than those dosimetry estimates that were used to

develop the risks that were used to develop the standards that we have to comply with.

Second of all, I would like to know, and anybody can comment on this whole statement, but the standards that were set, weren't they conservatively enough to account for state of the art dosimetry underestimating a dose?

I think those two factors really have to be looked at critically to determine whether or not we really do need a more sophisticated and refined method of personnel dosimetry.

If anybody has any comments I would certainly like to hear from you.

MR. ALEXANDER: Those are good points. As far as the program that the NRC is contemplating is concerned, the final decision will be made by the five commissioners who have been authorized by the Congress to make laws.

That is true of all the regulatory agencies. The Congress doesn't have time to attend to all of the lawmaking that apparently needs to be done, and so regulatory agencies and commissions like ours are given that authority. And one of the things that will be looked at the hardest by our five commissioners before they vote will be that very problem you just raised. How much does it cost and how much good is it going to do?

That is the purpose of the value impact statement. Sometimes the commissioners make a good call, and sometimes they

don't. We will just have to wait and see.

Now the staff people working on this at the NRC, people like myself and Nancy Dennis, I believe it is necessary, as long as the cost isn't too much. And so we will be trying to present to them an unbiased picture of something that we really want to happen, which is usually the case when we are doing staff work.

We are not supposed to slant our papers, but I am afraid we usually do. We are supposed to make a recommendation of the various alternatives, and it is sort of hard to work for a couple of years or more on a staff paper with a recommendation without making the staff paper support the recommendation.

That is the way it is going to happen. And then what the other agencies do about it I can't predict, although they all have shown a great deal interest in it. We expect them to use the program.

But I share your concern, and I hope that a good decision is made.

Does anybody else want to comment on that? I mean on this statement of his.

As to the dose, I believe that that is really a matter of opinion. There are a lot of people who feel that the dose limits are too high and should be reduced in order to reduce the risk to a level more commensurate with the safer industries.

Now some of the people who hold those views have their

heads screwed on pretty tight, and it is easy to sympathize with that view. If you use a new -- -- report -- -- depend on risk factors and calculate how many people out of a hundred would die of radiation-induced cancer if they were exposed at five rem per year for a fifty-year working period, the answer is seven; whereas, a person working in mining or quarrying, one of the most dangerous industries in the country, the answer is three.

So with numbers like that that are being bandied about, there are a lot of people who feel that the dose limits are too high. There are others who feel like they are too low, particularly for photons, that the dose effect response is quadratic, not linear, and that the dose limit should be raised. Others think that we had better just hold on to what we have and leave it at five rem per year.

So I think to that last question you raised you are going to get a different answer from every knowledgeable person you talk to. I think it would be very difficult for us to make a decision on that basis, although I suppose I would have to admit that that is a consideration that should be included in the staff paper we submit to the Commission.

Anybody have a better answer than that for him? I suppose most any answer would be better than that one.

Here comes a better answer.

MR. POLAND: I am Al Poland, Public Service of Indiana. You are talking about costs. One of the comments I

had on the rulemaking was that I felt that it needed to address what would happen if you were to suddenly lose your certification. And I feel that in terms of cost, from a public utility standpoint, we are going to have a tremendous cost in terms of lost manhours or just manhours expended in trying to resolve your problems, getting your certification reinstated. And also, if you cannot put your workers to work because you don't have a valid dosimetry system, they may be sitting around on their hands for several weeks not doing any work.

And so I think that is another factor in the cost that maybe hasn't been addressed before.

MR. ALEXANDER: Well, I think it probably hasn't. I haven't seen that particular cost addressed yet.

MR. POLAND: Well, okay. That is really the point I wanted to make on the cost. And Fred talked about it briefly in his presentation this morning on the invalid dosimetry results, how long would this tie up our program. And I guess that is a matter of how quickly you can get it reinstated, as far as certification goes. And have we got to throw out all the dosimetry results we have gotten for the last three months or four months and apply correction factors to everything or what?

I think these questions really need to be resolved.

MR. ALEXANDER: The way the regulations are drafted now, if a processor were unfortunately to lose certification and if our licensee unknowingly had one or two, three months of data

acquired by a processor who had lost certification, we would go ahead and accept those data as complying with our regulations in Part 20.

However, the licensee would be in noncompliance with respect to the regulation to acquire the data from a certified processor.

(Laughter.)

If you don't do it that way, you are going to have a gap in the worker's exposure history that has to be avoided.

We just have a few minutes left, I think, if I am going to get you out by four o'clock, as I promised. So I will use that time giving you a very rough idea of what the written comments we have received on this subject so far say.

Now let me explain that. The way we normally handle a public comment analysis is to wait until the public comment period is closed to do a careful study, and since the comment period doesn't close until toward the end of June we haven't done a careful study yet.

However, Nancy Dennis has read just about all of the comments that have been received. I think we have received 18. And so she is going to give you at least a rough idea about what people are saying.

Nancy.

MS. DENNIS: What I have done is just enumerated some of the things which I see appearing in many of the comment letters

collectively. Most of the letters in general, and I should mention that I have read about 14 of the 18. Things were kind of hectic last week. I have had many calls from processors who participated in the pilot study, who had planned to attend the meeting today or who had planned to get the transcript in time to be able to read the procedures of the meeting, and at that time change or alter their comments, and still get the comments in before June 27th at the end of the comment period.

In general, I think I can say that all of the letters have been overwhelming in support of some sort of a testing program. And from there on they seem to deviate. Many of the comments from the letters have suggested that changes be made in the standard, which Dr. Ehrlich has already conceded to or mentioned as changes that would be incorporated in the revised standard.

So I don't think I need to dwell on that. There were a number of letters regarding the fact that the sources used within the, or the sources specified as protesting against with the standard, they felt that considerable work was necessary as far as being able to generate the appropriate calibration factors and that in fact the testing laboratory should be helping along in that particular aspect, as well as offering a large stable of sources.

A couple of processors wrote in that they thought it was a great advertising potential that they could be certified

and that they are very much in favor of that, whatever it is that comes along.

Most of the comments as far as the frequency of the testing is concerned are in agreement with the idea that they should be tested somewhere around once a year, although there was at least one comment letter that suggested that there be more than one test a year, in fact quarterly.

There have been a number of varying comments as to what should be the makeup of the appeals board for a certification program.

I think the overall writing complaint or area of concern in the letters that I have reviewed so far has been in the area of beta dosimetry, and they have even suggested that a number of other sources be used and given their reasons for that.

There were several letters which included comments that we have already heard today in regards to Form 5, NRC Form 5, and that that appeared to be inconsistent with the guidelines that were being recommended in the standard.

There are at least four comment letters that I am aware of which deal with the range of photons and the idea that the range to which the processor or the person the laboratory is being tested should be identified. And the reason for that is that their specific area, for example, one specific operator may in fact only be dealing with low energy photons and therefore

don't feel that they should be required to test in other higher areas. They simply don't feel they have a need.

Of course, some people have written in that they don't think the standard should be changed at all, that it was stringent and they thought that was excellent, it should remain that way.

Then there were a couple of letters to conclude which spoke about the need for a quality assurance program as well as the development of the certification program, that it simply would not be enough if there were a certification program enacted without a quality assurance program. That is not by any means a complete list of all the ideas that have been presented. Some are in great detail and others are very brief.

MR. ALEXANDER: Nancy, has anybody said that we ought to forget this whole thing?

MS. DENNIS: Not to my recollection.

MR. ALEXANDER: So far that comment hasn't been made?

Back to these glasses, I have tried them on and they do nothing for me. There is no gold or silver in the frames that I can have recovered, and I am sure they must have cost $50 or 60. So I hope that the person who wears them will decide to come get them. I am going to lay them here on the table and after everybody is gone you can slip up here and get them and nobody will know that you are the one who lost them.

We will see you at 8:30 in the morning.

(Whereupon, at 4:05 p.m., the meeting was adjourned, to be reconvened at 8:30 a.m. of the following day.)

end T. 6
Burrell

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

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in the matter of: **PUBLIC MEETING ON PERSONNEL DOSIMENTRY PERFORMANCE TESTING**

Date of Proceeding: **May 28, 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)

Fred Caldwell - Yankee Atomic Presentations 5/28/80

Item 1: Adoption of ANSI N13.11 as Modified October, 1979:

Yankee Nuclear Services Division concurs that the most recently modified version of ANSI N13.11 is a good basis for establishing a standard method for testing personnel dosimetry processors. We, however, have observed many inconsistancies, both technical and practical, as to how the standard was applied during the initial testing program. These areas of inconsistancy must be resolved prior to implementing the standard as a NRC regulatory requirement.

Deep Dose Determination

Yankee Nuclear Services Division uses TLDs, for whole body personnel monitoring, which are under an absorber of approximately 300mg-cm^{-2}. The dosimetry is configured in this manner to maintain compliance with instructions for completion of NRC Form-5 which requires this depth configuration for those personnel not provided with eye protection of at least 700mg-cm^{-2}. When the badges were exposed against the standards for a deep dose (1000mg-cm^{-2}), electronic equilibrium would not have been established within the badge, thus, leading to an underresponse of the TLD. This underresponse, however, appears to have been offset by photoelectron production and compton scattering in the air and from the collimator of the irradiator.

The photon component of the neutron source (unmoderated ^{252}Cf) was only defined for a depth of 1000mg-cm^{-2}. This posed an overresponse problem (~4%) as our dosimetry (300mg-cm^{-2}) was responding to low energy photons (X-Rays) not capable of penetraing 1000mg-cm^{-2}.

The ^{90}Y beta source, in addition, produced an indicated deep dose equivalent to 25% of the delivered beta dose in the dosimetry.

The above three problems led to developing empirical equations for quantitizing delivered deep doses. These equations however, are highly dependent upon the precise definition of each source and configuration. If any parameter changed, such as distance r neutron and gamma exposure, response precision suffered dramatically.

Shallow Dose Determination

The ^{90}Y source used for the standard does not adequately test a beta dosimeter because the 2.26 MeV (max.) beta particles are not significantly attenuated by beta windows on most dosimeters. In addition, betas in this energy range are not common to the environment encountered at nuclear power stations. Our major problem with the ^{90}Y source is with, as mentioned above, penetration ^{90}Y betas through the deep dose absorber (300mg-cm^{-2}) of the TLD. This presented many problems with trying to obtain statistically reliable beta data for developing an equation to remove this penetrating component.

By trying to use production TLDs and cases, in keeping with the spirit of the standard, we found it extremely hard to keep within $\pm$ 15 to 20% of delivered dose.

Neutron Dose Determination

The neutron spectrum the of unmoderated ^{252}Cf source used by the standard was so unlike the spectra of our dosimetry users that initally reported results were out of range by at least one order of magnitude. With assistance from the Univerisity of Michigan we again developed an empirical equation for responding to the standard. It was noted during this testing that one of the neutron dosimeters was completely unresponsive to neutrons. We found, in addition as previously mentioned, an overresponse to the photon component of the ^{252}Cf.

We are pleased to have learned that the new standard will include moderated ^{252}Cf as a neutron source. This should improve our ability to provide reliable results for neutron doses. However, we state again, that the photon component of this source will still present problems to dosimetry processors.

Mixed Field Dose Determination

When the gamma and beta exposures were mixed in testing for Category VI, we found that our problems had been compounded. No provision had been included in the standard to account for photoelectron production in air which gave an indicated response approximately 10% higher than the sums of the gamma and beta components.

Summary

As can be seen by the above discussions, Yankee Nuclear Services Division found many problems associated with trying to respond

to the standard in a professional manner. Some problems were of an "in-house" nature and are being addressed. But, the vast majority of problems seem to be associated with either lack of proper definition of the sources used (and choice of sources) or with inconsistancies within the regulatory and standards requirements. We request that these areas be evaluated and corrected prior to implementation of any testing standard.

Item 2: Frequency of Certification:

After having participated in the pilot study of the standard, Yankee Nuclear Service Division believes that yearly testing is probably the most viable testing frequency. The yearly testing, we presume, would be performed in a manner similar to the schedule established by the University of Michigan. This schedule called for monthly testing for three consecutive months once a year.

This frequency of testing would not have a dramatic impact upon man-hour requirements of a processor and is spread over a period of time that would allow the testing to be blended into the processor's routine production requirements.

Item 3: Notification to Licensees of Processor Certification:

A timely method of licensee notification of processor certification or failure is an integral part of the performance standard. It is suggested that each processor provide to the testing laboratory a listing of NRC licensees serviced by the processor. Notification would be made to the licensee by the Certification and Review Board established in Item 6.

Item 4: Testing and Certification Laboratory:

The testing and certification laboratory should be an independent laboratory outside the confines of the federal government, preferably operated by a university. The laboratory should be established and initially financed under contract to the appropriate federal agency with testing fees making the laboratory self-sustaining after the first few years of operation. The laboratory would, of course, be certified by NBS.

This above recommended testing laboratory would have several distinct advantages to alternatives presented in the Federal Register. First, the laboratory could act as part of a dosimetry processor's quality control program by allowing the processor access to irradiation services outside of the normal testing cycle. Second, if a dosimetry processor has an unusual situation (similar to Three Mile Island's - Strontium Beta problem) the testing laboratory could assist in providing irradiations outside of the testing program. Third, the laboratory, as a totally uninterested party, would have a seat on the Certification and Review Board evaluating those processors who fail a testing category.

Fee schedules used by the testing laboratory should be based on a processor's volume of work and number of categories tested. This arrangement will allow processors to be charged fees that are commensurate with their operating budgets.

Item 5: Laboratory Surveillance by NBS:

Yankee Nuclear Services Division concurs that monitoring of the testing laboratory by NBS is an absolute necessity. This will ensure unbiased exposure technique and lend credibility to any

testing program. NBS should be totally involved with the areas of; 1) source selection, 2) source, dosimeter, phantom configuration, 3) exposure delivery procedures, and 4) definition of delivered exposures.

Item 6: Loss of Certification and Appeal:

Of all of the areas involved with processor certification this is probably the most highly sensitive area of the program. We recommend establishment of a Certification and Review Board. This body would be composed of individuals involved with each facet of the regulatory processes. Specifically, a member would be drawn from each of the following areas: 1) NRC (or other governing federal agency), (2) NBS, 3) a National Laboratory, 4) a dosimetry processor and 5) the testing laboratory. The board would be responsible for resolving differences of opinion between any parties involved in the certification program. The board would also be empowered to render judgement as to removing a processors certification following the administrative program established by the new regulations.

The administration of the certification program should address, at a minimum, the following items:

1) A requirement for processors to define under which categories their dosimetry will be tested and that they have notified their users of the useful range (energy and type of radiation) of this dosimetry.
2) Not removing the certification of a processor for their first year of participation in the testing program. This will allow processors to evaluate their dosimetry and adjust to meeting the requirements of the program.

3) Establishment of a graded certification procedure such as a Pass - Probation - Fail system for each category in which the processor is being tested. Each grade would be based on the performance index (P) established in the standard. Those processors who fall outside of the PASS grade would automatically be placed on PROBATION. The processor would then be given a time period within which he must be retested. The processor would also be required to report to the Certification and Review Board, his findings, with regard to the failure. If the processor passes the retest, his certification could be reinstated. If the processor fails the retest, his certification would be removed.

4) Consideration for processors and users when the processor fails a particular category. This area can raise some legally sensitive issues which must be addressed by the regulation. Some of these issues are:

   a) Can a user obtain dosimetry from another certified supplier in time to comply with the users stipulated exchange period,

   b) Are the exposure results, since the last testing cycle, to be considered valid,

   c) What can or is to be done about dosimetry presently issued. Is this dosimetry to be processed by the uncertified processor.

   d) What legal recourse might be taken by employees of a licensee with respect to the licensee using a processor who fails certification.

Item 7: Angularity Response:

The performance standard, as presently written, includes requirements for performing angularity testing of processors dosimetry. However, no criteria are placed on this testing. There are many factors, in addition to angularity response, that affect the response of dosimetry and to only check one of these is misleading to both processors and users.

Yankee Nuclear Services believes that a processor should perform checks, such as angularity response, and make this data available to its services users. But, to include a study of angularity response with no criteria or apparent intent in a performance standard is inappropriate. We request that this section be removed from the standard.

Item 8: Purpose of the Performance Standard:

Yankee Nuclear Services Division has noted that many processors feel that the performance standard will require them to change the calculational models presently used for reporting exposures. We strongly believe that the performance standard should be used as a base for standardizing and evaluating a dosimetry processors performance under a well defined set of conditions. The standard should, however, specify that calculational models used by a processor for performing to the standard need not be those applied by a processor to the dosimetry supplied to its users. This is particularly important with regard to beta and neutron dosimetry.

Item 9: Average Dose:

According to ICRU Report 25, the estimation of internal organ doses should be made by assuming that the radionuclide distribution within the organ is uniform thereby calculating an average dose to the organ. This assumption is made due to the practical limitations in determining the distribution within the organ by using routine whole body counting systems. In this same report, it is recommended that skin doses should be estimated at a depth of .007 cm in tissue. This depth corresponds to the epidermis. It is assumed that at this tissue depth, the maximum dose to the dermis would exist under most irradiation conditions.

One major omission in the recommendation for skin dose estimation is the practical limitations involved in measuring the dose at .007 cm in tissue. To date, there is no dosimetry system capable of measuring the dose at a .007 cm tissue depth over a wide range of particulate radiation. Many facilites attempt to determine a "beta" correction factor for their dosimetry system by using a high energy beta source, which may or may not be representative of an actual field condition. If indeed the correction factor was applicable to one field condition, then it is unlikely that it would apply to another due to the changes in the components of the radiation field (comptom electrons, low energy x-rays/ gamma rays, beta particles, and conversion electrons).

In order to surmount this problem, consideration should be given to the measurement of the average skin dose. In this case, it is advantageous to use dosimetry corresponding to the accepted thickness of the dermis (150mg-cm^{-2}). Values generated by this dosimeter

would be representative of the average skin dose independent of the energy of the directly or indirectly ionizing radiation. This concept greatly reduces the existing practical problems associated with "beta" dosimetry.

The measurement of average skin dose, is more consistent with the ICRU approach, and may have strong physiological justification. This concept has major implications in the field of radiation dosimetry and if incorporated, can greatly improve and simplify dosimetry provided to radiation workers.

Table 1

Test Categories, Test Irradiation Ranges, and Tolerance Levels

Test Category[1]	Test Irradiation Range	Tolerance Level, L, for $H_{I,d}$	Tolerance Level, L, for $H_{I,s}$
I. Accidents, low-energy photons (NBS technique MFI [7])	10 to 500 rad	0.3	no test
II. Accidents, high-energy photons (^{137}Cs gamma radiation)	10 to 500 rad	0.3	no test
III. Low-energy photons (NBS techniques LG, LI, LK, MFC, MFG, MFI, HFD [7][2] or K-fluorescence radiation of energy $\geq$ 20 keV [8][3])	0.03 to 10 rem	0.5	0.5
IV. High-energy photons (^{137}Cs gamma radiation)	0.03 to 10 rem	0.5	no test
V. Beta particles (^{90}Sr - ^{90}Y)	0.15 to 10 rem	no test	0.5
VI. Photon mixtures (any combination of categories III and IV)	0.05 to 5 rem	0.5	0.5
VII. Mixtures, photons and beta particles (any combination of categories IV and V)	0.20 to 5 rem	0.5	0.5
VIII. Mixtures, neutrons and photons (^{252}Cf, bare, either alone or combined with category IV)	0.15 to 5 rem	0.5	no test
IX. Mixtures, neutrons and photons (^{252}Cf, moderated by 15 cm of D_2O, either alone or combined with category IV)	0.15 to 5 rem	0.5	no test

Notes:

(1) All test categories except the first two which are specifically marked "Accidents" apply to protection dosimetry.

(2) One of the specified techniques shall be selected at random for each test.

(3) If requested as an alternate to NBS techniques, K-fluorescence radiation shall be selected at random from at least 5 choices.

Draft for Discussion
Gitlin/Thompson with BRH
May 22, 1980

Because of its public health responsibilities, the Bureau of Radiological Health has maintained a continuing interest in the reliability of personnel monitoring. In 1961 the Bureau, then known as the Division of Radiological Health, contracted with the University of Pittsburgh for research on the accuracy and sensitivity of film monitors. In 1963 the Bureau provided technical and financial assistance for a performance survey conducted by the National Sanitation Foundation. The Bureau also funded the 1973 NBS/Battelle survey of commercial processors, and in 1975 contracted with NBS for the development of a new personnel monitoring standard. That standard, as later modified by the Health Physics Society, became the 1978 ANSI draft standard, employed by the University of Michigan for the pilot test project completed in September 1979.

In addition to its general public health responsibilities, the Bureau currently has the responsibility for monitoring some 5000 occupationally exposed individuals. These are employees of the Public Health Service, the Coast Guard, the Bureau of Prisons, and several other agencies. To support this function the Bureau has developed an automated record keeping system which is available to interested organizations.

The Bureau has been a member of the Interagency Policy Committee on Personnel Monitoring since its inception and was a co-sponsor of the 1976 public meeting on the need for a personnel monitoring control program. At that meeting the Bureau offered to promote the implementation of a voluntary compliance program among those processors and exposed personnel not subject to the authority of the Nuclear Regulatory Commission or the Department of Energy. It is still the Bureau's

intention to participate in the establishment of a comprehensive nationwide program with uniform criteria for personnel monitoring performance. We strongly support the proposed certification of personnel dosimetry processors and urge that it become effective by July 1, 1981.

Among the many important considerations related to this program, the proposed certification laboratory and the appeals process deserve special attention. We support the concept of a single laboratory, initially funded by NRC, but eventually is self-supporting from fees charged for services rendered. The laboratory would be monitored technically by NBS and would be completely independent of existing processors. We also strongly favor a single uniform appeals system available to all personnel dosimetry processors. This can be accomplished through interagency sponsorship with administration by a single agency such as the NRC.

The Bureau recognizes that NRC licensees and DOE contractors can be covered by the proposed certification program quite simply by the stroke of a pen. The many other processors in Agreement States and in institutions such as medical care facilities, not directly covered by NRC and DOE, will need special attention to assure their participation in the uniform nationwide program. The Bureau will actively participate with appropriate groups and individual processors to encourage their adherence to the certification program.

University of California
LOS ALAMOS SCIENTIFIC LABORATORY
Post Office Box 1663 Los Alamos, New Mexico 87545

In reply refer to
Mail stop: 697

June 16, 1980

Ms. Nancy Dennis
USNRC
MS: NL-5650
Washington, DC 20555

Dear Nancy,

As requested in our phone conversation on June 9, 1980, I am enclosing the figures accompanying the talk I gave at the public meeting on Certification of Personnel Dosimetry Processors in Washington, DC, on May 28, 1980.

Sincerely,

Ellery Storm

Ellery Storm
H-1 Dosimetry & Personnel Section

ES:jl

Enc. a/s

CY: ISD-5 (2), w/o enc.
File

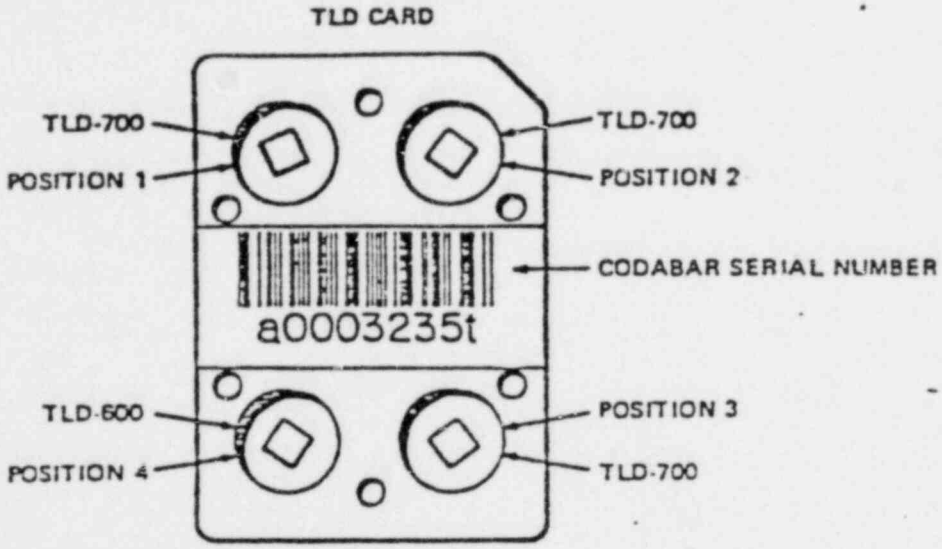


Fig. 1. TLD card showing the four LiF chips and Codabar label.

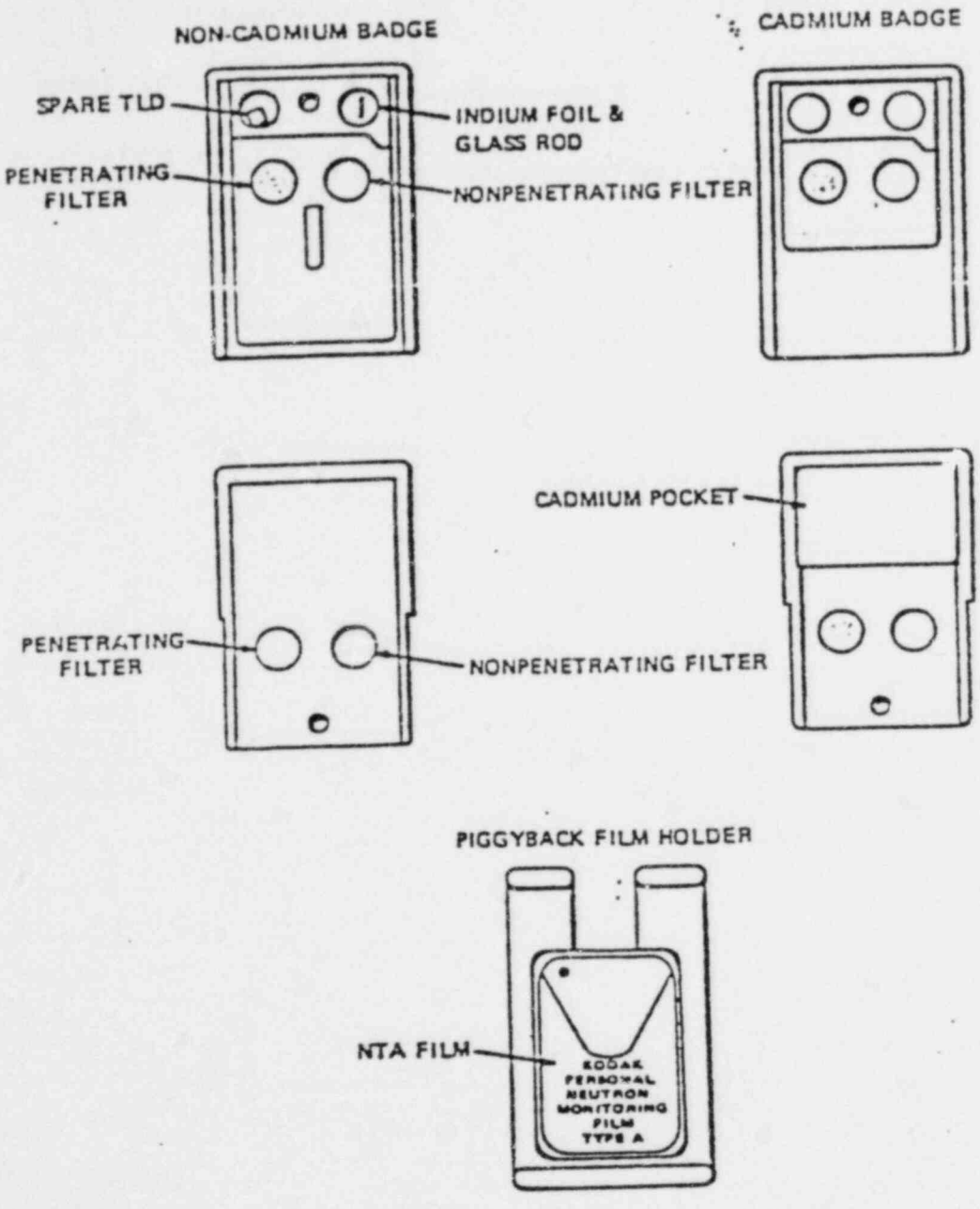


Fig. 2. The cadmium and noncadmium neutron badges.

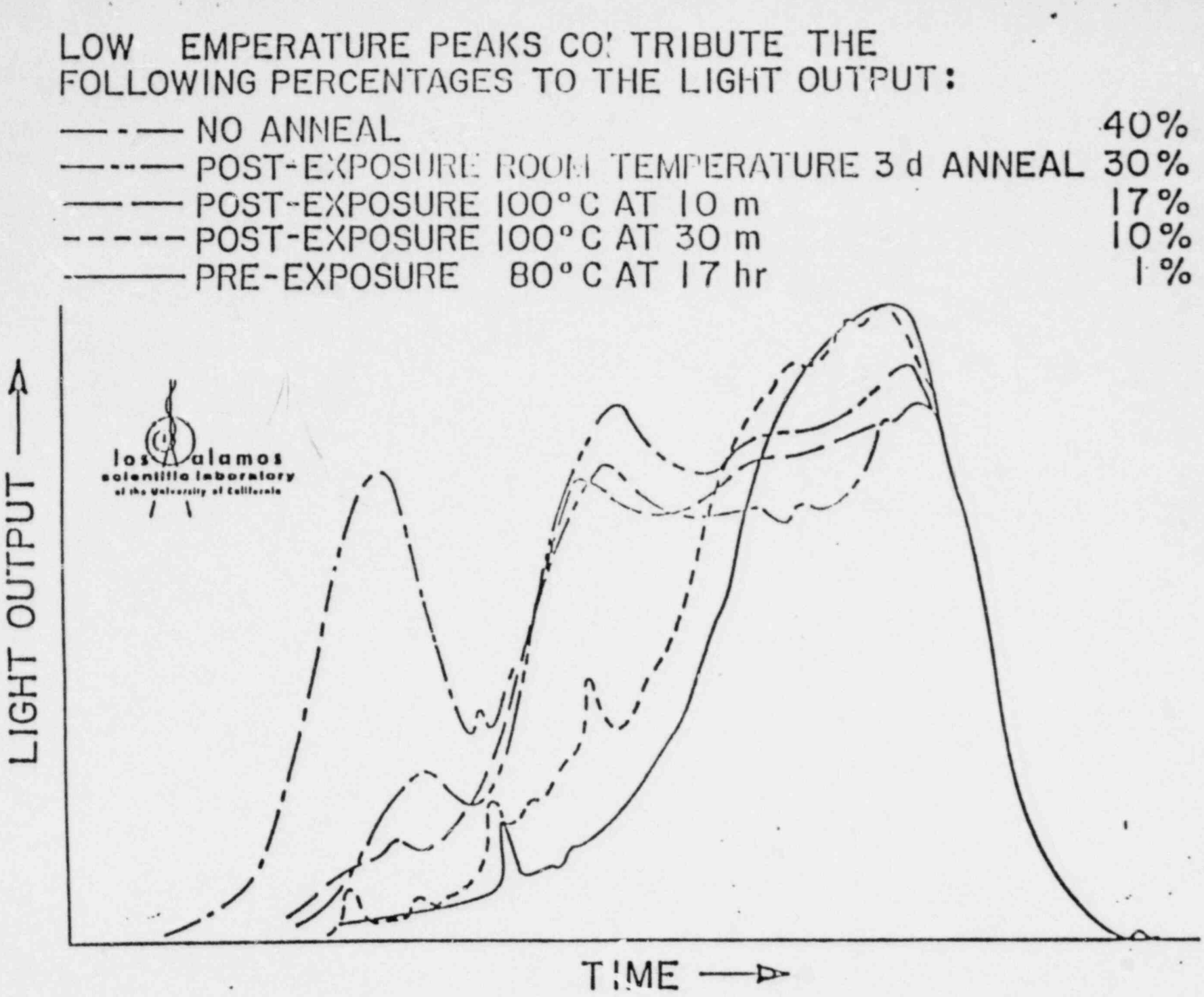
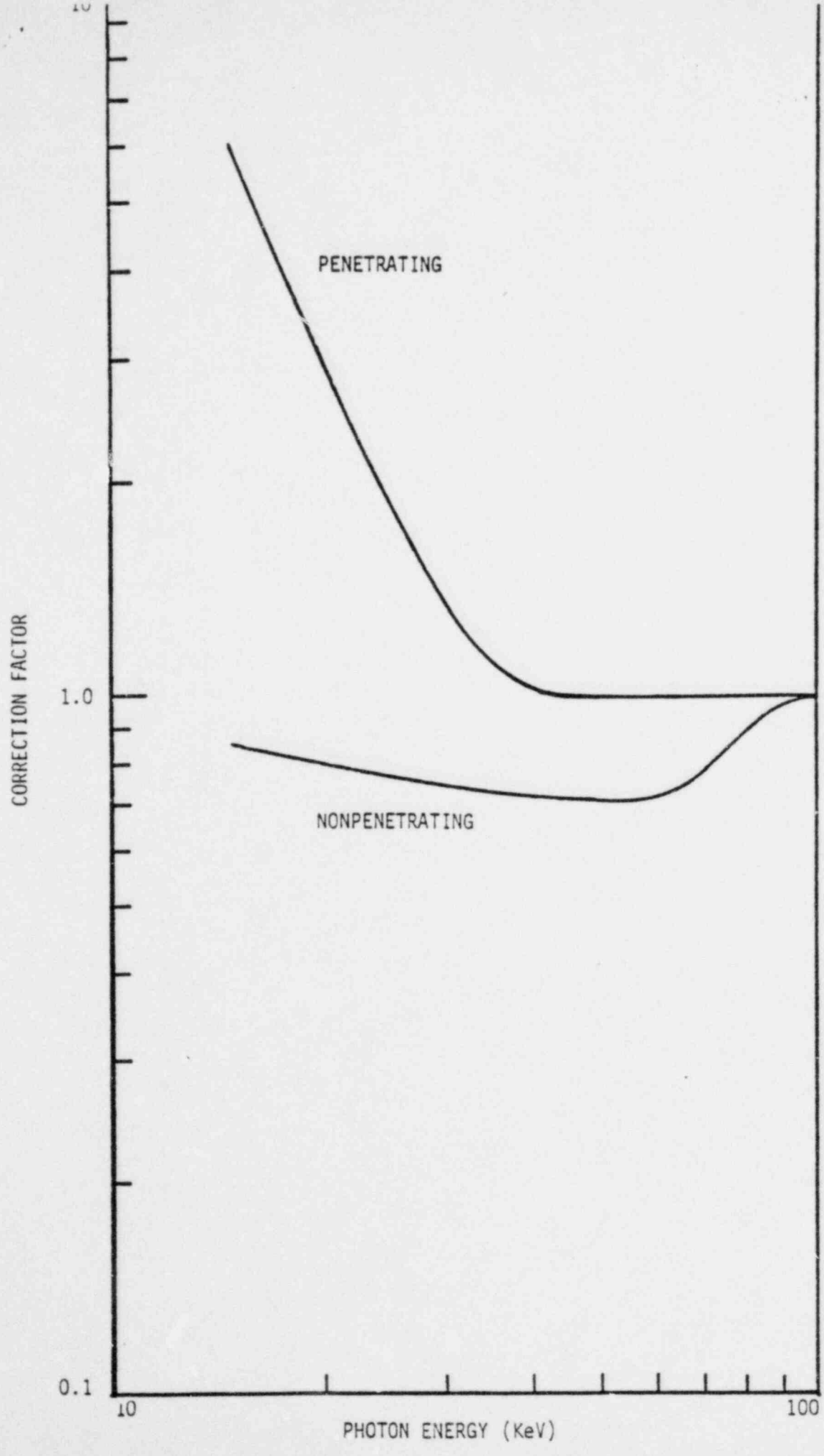
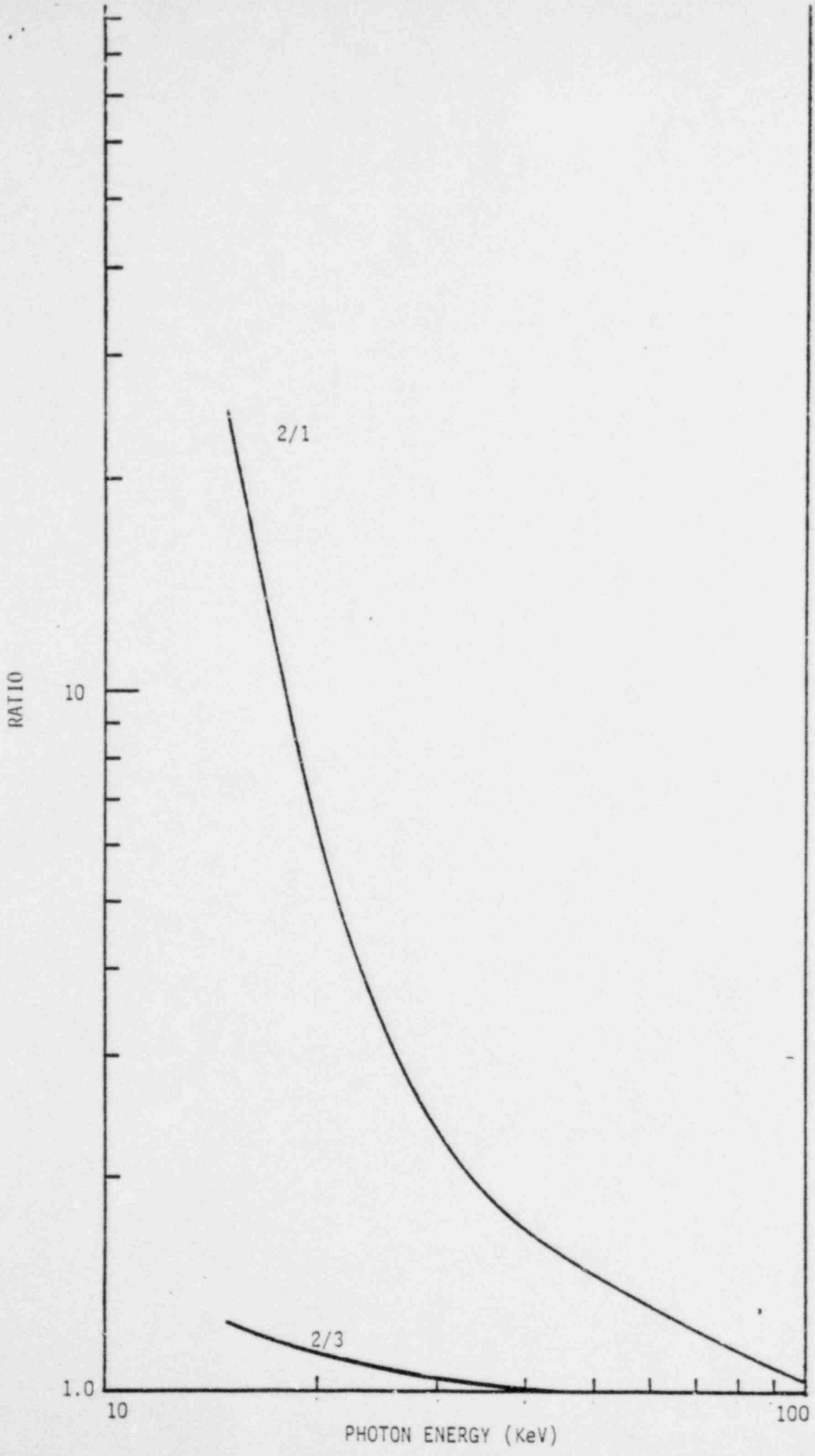
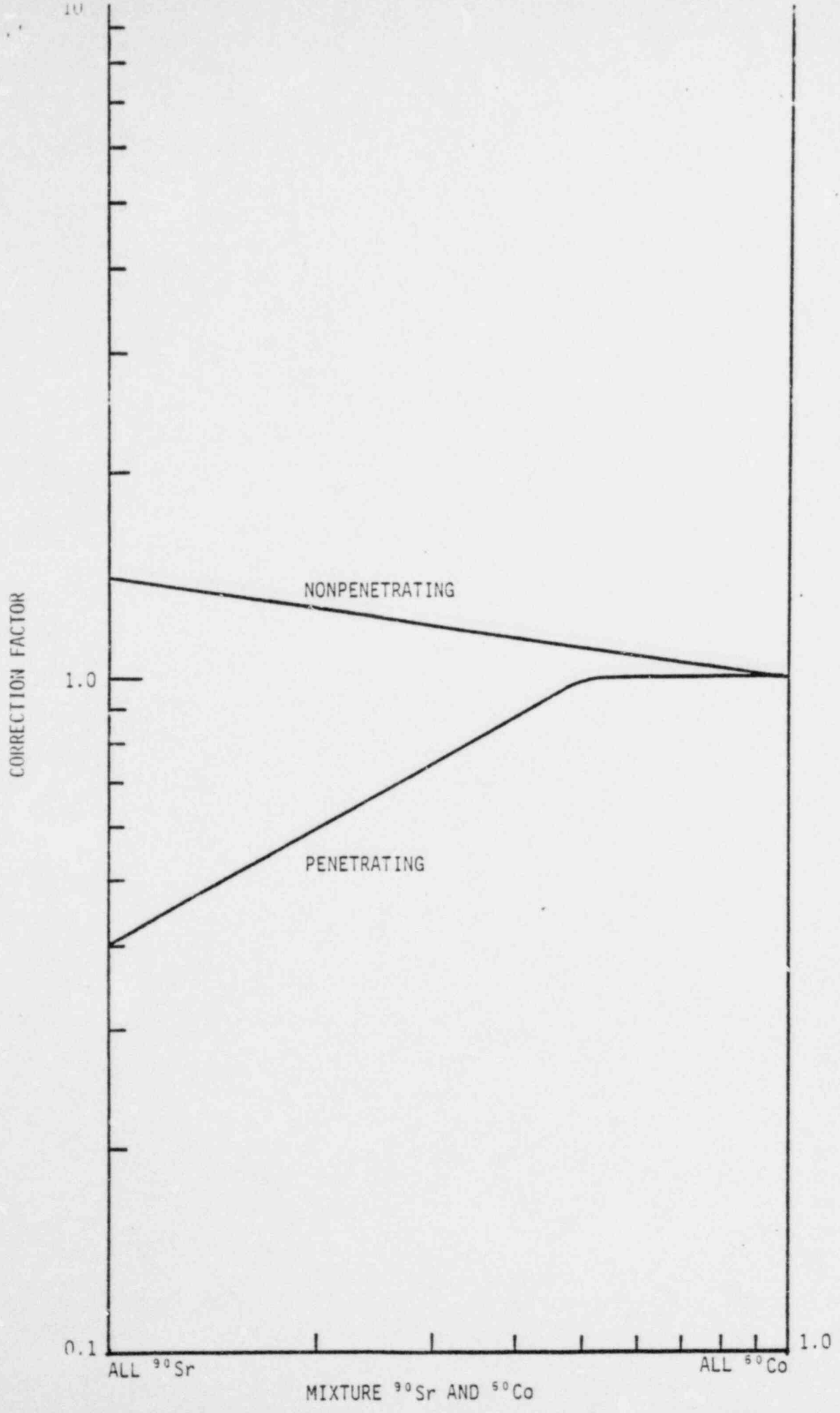
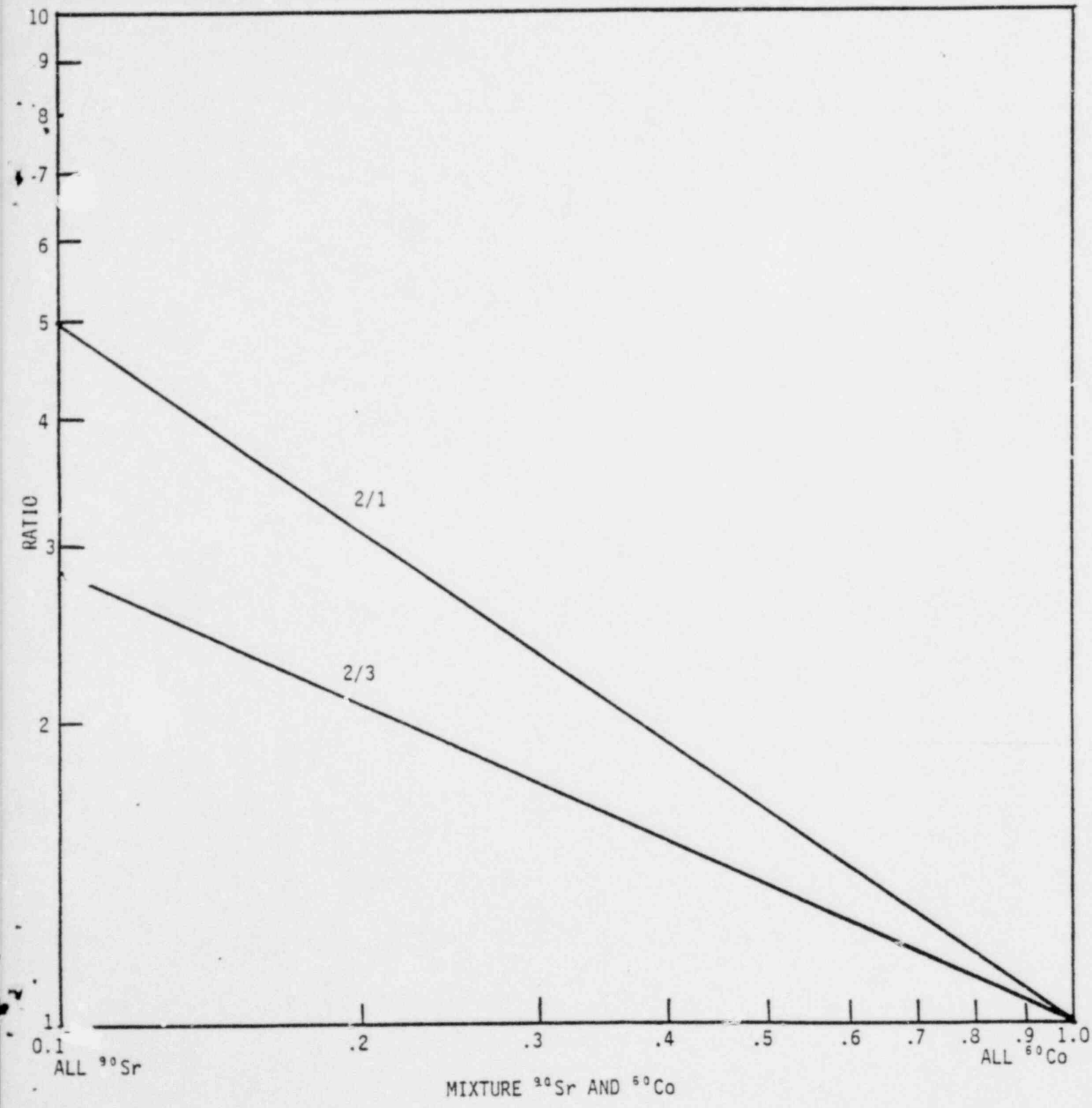


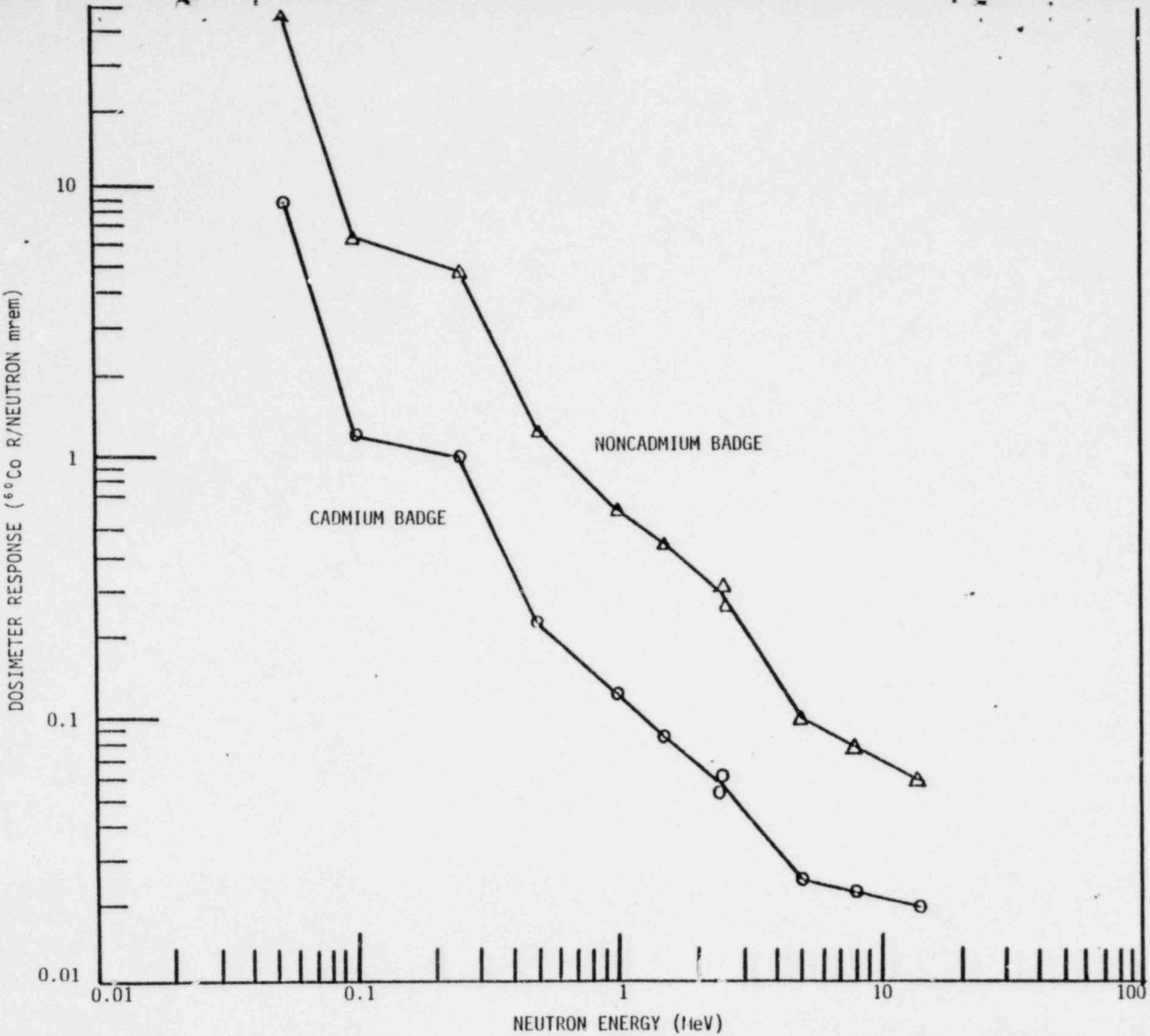
FIGURE 8 COMPARISON OF GLOW CURVES OBTAINED WITH DIFFERENT ANNEALS


CORRECTION FACTOR
1.0
0.1
PENETRATING
NONPENETRATING
10
100
PHOTON ENERGY (KeV)


2/1
2/3
RATIO
10
1.0
10
100
PHOTON ENERGY (KeV)


10
1.0
0.1
CORRECTION FACTOR
NONPENETRATING
PENETRATING
ALL ^{90}Sr
ALL ^{60}Co
1.0
MIXTURE ^{90}Sr AND ^{60}Co


10
9
8
7
6
5
4
3
2
1
RATIO
2/1
2/3
0.1
ALL ^{90}Sr
.2
.3
.4
.5
.6
.7
.8
.9
1.0
ALL ^{60}Co
MIXTURE ^{90}Sr AND ^{60}Co


DOSIMETER RESPONSE (⁶⁰Co R/NEUTRON mrem)
10
1
0.1
0.01
NONCADMIUM BADGE
CADMIUM BADGE
0.01
0.1
1
10
100
NEUTRON ENERGY (MeV)

ELEMENTS OF PERSONNEL DOSIMETRY QUALITY ASSURANCE PROGRAMS

By Manuel A. Jimenez
Associate Health Physicist
Duke Power Company
Charlotte, North Carolina 28242

For

Public Meeting on Personnel Dosimetry Performance Testing
Washington, D.C.
May 2829

We at Duke Power Company have always been interested in the accuracy and quality of our inhouse personnel dosimetry service and have maintained a quality assurance program in the area. We believe utility in-house personnel dosimetry processors have a need for quality assurance programs that can provide adequate confidence in the accuracy of results in order to assure regulatory agencies and radiation workers that the results are valid. Planned, well-documented dosimetry quality assurance programs can adequately ensure the health and safety of radiation workers, as well as, provide legal protection. Therefore, it is important that careful consideration and professional attention be given to the design and implementation of quality assurance programs involving the measurement and documentation of personnel radiation doses.

To facilitate the discussion on the elements which form a personnel dosimetry quality assurance program, let me arbitrarily divide such a program into three major areas and discuss each one individually keeping in mind that all three are necessary for a successful program. These are:

1. Operating Procedures and Records
2. The Operation and Maintenance of the Dosimetry Laboratory
3. Dosimetry Performance Testing and Evaluation

1. <u>Operating Procedures and Records</u>

Central to all dosimetry quality assurance programs is a set of written procedures and records which describe and document all the activities involved in performing the entire operation. Written procedures should provide systematic instructions on the:

a. storage, handling, shipping and receipt of personnel badges,
b. operation, calibration and maintenance of all instruments,
c. calibration of radiation sources, and
d. reduction, evaluation and reporting of dosimetry data.

These procedures should be prepared, reviewed and approved by individuals who are knowledgeable and familiar with principles and good practices concerning these activities. Procedures should be periodically reviewed and revised as necessary and new procedures prepared and implemented to continually upgrade the program.

No quality assurance program is complete without records which document all phases of the operation. For dosimetry programs, records which should be kept include:

a. dosimeter inventory lists,
b. badge issuance logs,
c. results of instrument calibration and maintenance checks,
d. results of source calibrations,
e. documentation of computer programs,
f. dosimetry reports, and
g. results of dosimetry performance tests.

2. The Operation and Maintenance of the Dosimetry Laboratory

The proper operation and maintenance of the dosimetry laboratory is just as important to the overall success of the quality assurance program as is the documentation of procedures and records. This means that laboratory personnel should be intimately familiar with all of the procedures and methods and should exercise care and pay special attention to details when performing all laboratory activities. To ensure that individuals responsible for the operation know and understand their responsibilities, they should be fully trained in all aspects of the program. For some of the less routine procedures, periodic retraining may be necessary to maintain proficiency in these tasks.

Keeping in mind that differences in the operation of dosimetry laboratories can exist depending on the type of dosimetry system, computer capabilities, calibration facilities and number of dosimeters, most of the laboratory activities can be grouped as follows:

a. Radiation Source Calibration and Maintenance

Radiation sources used to calibrate and verify the response of dosimeter readout devices and to periodically test dosimeters should be calibrated and leak tested at least once a year. When practicable, source calibrations should be traceable to the National Bureau of Standards.

b. Dosimeter Reader Calibration

Dosimeter readout devices should be initially calibrated and then response checked prior to reading personnel dosimeters. Calibrations should also be performed after any maintenance work is done on the systems. Variations in calibration greater than ±5% should be investigated. The frequency at which the response checks should be performed may vary depending on the length of the monitoring period, size of the processor and type of dosimetry system and purpose for which it is used.

c. Dosimeter Response Checks

When using TLD dosimeters, the radiation response of new dosimeters should be tested before they are used in the field. TLD dosimeters should also be retested, preferably yearly, but at least once every

two years. Dosimeters which fail to meet the established performance criteria either during the initial or during any subsequent tests should be discarded.

d. Badge Handling, Preparation and Shipment

Sufficient time should be allowed before the beginning of the monitoring period for the preparation, packaging and shipment of badges. Badge preparation for shipment may involve, depending on the system, loading and packaging the badges. Control badges should also be included in all badge shipments.

e. Badge Receipt and Evaluation

The badge receipt and evaluation process should be performed as soon as practicable after the badges arrive at the dosimetry laboratory. This process involves checking badges for contamination, unloading and reading the badges and preparing the personnel dosimetry reports. When practicable, computer programs may be used to speed up some phases of badge preparation and evaluation.

3. Dosimetry Performance Testing and Evaluation

When a national dosimetry performance testing program is implemented, participation in this program will become an integral part of all dosimetry quality assurance programs. In conjunction with the rest of the quality assurance program, such a testing program can be used by a processor to further document the adequacy of his personnel dosimetry program provided, of course, that he successfully passes the performance tests. Furthermore, we believe that processor participation under a voluntary program would be most useful in promoting his credibility. In fact, a voluntary testing program would probably now be very successful because of the interest processors (especially nuclear power utilities) have in documenting the quality of their systems.

A dosimetry testing program could be used as a reasonable measure of the adequacy of a personnel dosimetry program if test dosimeters receive the same care and attention as that of those used for personnel monitoring. This means that test dosimeters should not be pre-selected with tighter performance criteria than that of those normally used in the field. Handling and evaluation of test badges should be performed by individuals who handle personnel dosimeters routinely and not by the facility's dosimetry experts. Finally, when practicable, test dosimeters should be analyzed using the same dose equations and conversion factors as those routinely used. However, the processor should have the option of using special factors to meet the test if he can adequately document that the sources used for the test do not reasonably simulate the radiation exposure conditions of his workers and that he utilizes in his processing laboratory.

In conclusion, personnel dosimetry quality assurance programs should be established to provide adequate confidence in the results. If properly documented and carried out, it can assure that the results are valid. Also, participation in any established national testing program should be voluntary.