Res & Tech

SITE VISITS TO EIGHT MAJOR DOSIMETRY PROCESSORS

conducted by

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for

The U.S. Nuclear Regulatory Commission
Office of Standards Development
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OBJECTIVE

The NRC-sponsored pilot study of the HPSSC Standard requires that each of the 59 participating processors submit dosimeters for two tests using the radiation sources and statistical procedures outlined in the Standard. To date, we have received the results for Test #1 for all but about three of the processors. We have also received the results for Test #2 from about half of the processors.

The results to date are not encouraging. Only 23% of the categories tested in Test #1 were passed. Although this pass rate increased to 31% for Test #2, it is generally felt that the increase is not significant for a future mandatory test program.

The objective of this report is to discuss the reasons why most processors have not passed the Standard most of the time. To accomplish this objective, we visited 8 of the 59 participating processors. Each site visit included a detailed discussion of the processor's results for Tests #1 and #2, a review of the sources and procedures used by the processor, and a few spot calibrations of the processor's photon sources using the University of Michigan's electrometer and NBS-calibrated ionization.

PROCESSORS VISITED

We visited the following processors during April and May, 1979:

Eberline Instrument Corporation
P.O. Box 2108
Airport Road
Santa Fe, New Mexico 87501

ICN Pharmaceuticals
26201 Miles Road
Cleveland, OH 44128

R. S. Landaurer, Jr. and Company
Glenwood Science Park
Glenwood, IL 60425

Radiation Detection Company
162 Wolfe Road
Sunnyvale, CA 94088

Searle Analytic
2000 Nuclear Drive
Des Plaines, IL 60018

Teledyne Isotopes
501 Van Buren Avenue
Westwood, NJ 07675

United States Testing Company, Inc.
2800 George Washington Way
Richland, WA 99352

Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

CONCLUSIONS

Although these 8 processors represent a good cross section of the 59 participating processors, we hesitate to draw strong conclusions from such a small sampling. We are especially concerned that these relatively large processors have a more sophisticated calibration and quality control program than does the average processor. A thorough examination of the reasons for poor performance in the pilot study should involve similar site visits to more of the processors than time permitted.

Although each of the eight processors had somewhat unique methods for handling their dosimeters, we found several common problems among most of these processors. These common problems with the HPSSC Standard are as follows:

1. Sources

Most processors own only a few radiation sources. Some own only one, usually cesium-137. Thus, the processors must generate correction factors so their sources can be used to simulate cobalt-60, strontium-90, and the various X-ray techniques used in the pilot study. Some processors have been very successful in generating such correction factors and others have not.

Some processors have connections with outside laboratories to which they send dosimeters for testing and to generate the necessary correction factors. This is an economical arrangement to obtain access to a variety of sources and experts.

We measured the exposure rate of the photon sources used by most of the processors we visited. Their calibration and ours generally agreed to within 1%. This agreement is excellent, especially considering that most processors rely on Victoreen Condenser R-Chambers for calibration.

We conclude that it is difficult, but not impossible, for a processor to pass the Standard with a minimum of radiation sources.

2. Dosimeter Variability

3. Clerical Errors

Before and during our site visits, we encountered many clerical errors made by the processors. For example, a TLD reader might display 1720 mR, but the technician records 172 mR. With this one dosimeter in error by a factor of 10, the processor will fail the interval. Since all intervals within a category must be passed, the processor fails the category.

We conclude that clerical errors are an important source of problems for many processors and possibly account for about 10% of the categories failed.

4. Processor Effort

The HPSSC Standard requires the use of radiation sources and procedures that are different by many of the processors. In order to pass the Standard, a processor must read, understand, and follow the procedures of the Standard. Many processors have not made a conserted effort to calibrate for the sources and procedures used in the pilot study, even after their results for Test #1 showed they could not pass the Standard with their regular procedures. Most processors have the competence to adjust to the Standard, but have chosen not to do so. The primary reason for their choice appears to be that their procedures have served their needs for the past 10 to 20 years. Other performance standards have come and gone during that time, and perhaps this Standard will also disappear.

Related to this problem is the plethora of standards that already exist from, or are that are being developed by the National Sanitation Foundation, The American National Standards Institute, The Health Physics Society, and The International Standards Organization. Most processors have the technical competence to pass almost any standard. They are simply not eager to attempt to pass all the standards.

We conclude that, with more effort by the processors than has been given to this pilot study, most processors could eventually pass the HPSSC Standard. The required effort could be stimulated by a national concensus to make the HPSSC Standard the one-and-only test to be passed.

5. Dosimeter Design

Most of the dosimeters we have reviewed are engineered well enough to meet the accuracy requirements of the HPSSC Standard. Some dosimeters have trouble distinguishing low-energy X rays from mixtures of beta plus gamma. Some dosimeters have trouble detecting the neutrons from californium-252. It might be that some dosimeters may never be able to pass some portions of the Standard, regardless of correction factors generated.

All of the irradiation procedures developed for Test #1 (e.g., X ray techniques, gamma plus beta for Category 7 instead of X ray plus beta, etc.) were also used for Test #2. If we had varied our irradiation procedures for Test #2, as is permitted by the Standard, badge design problems would undoubtedly become very important.

We conclude that most, if not all, dosimeters are designed well enough to handle to radiation sources and procedures required by the Standard. In general, the competence of the people employed by a processor is far more important than the design of their dosimeter.

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Department of Environmental
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Mr. Robert Alexander
Office of Standards Development
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Washington, D.C. 20555

Dear Bob:

Enclosed is our report on the sight visits we made to 8 of the 59 processors participating in the pilot study. The report summarizes the major problems we observed that are causing the processors to fail most of the categories of the HPSSC Standard. Please realize that we were only able to spend one day with each processor due to the short time period allowed for this project. We may have overlooked some problems, but we believe the problems discussed are the major ones.

Sincerely,

Phillip Plato

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