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BOARD EX #2

Performance Testing of Personnel Dosimetry Services

Final Report of Test #3

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Testing for consistence is of necessity limited to categories I through V. Categories VI through VIII are not readily amenable to consistency testing because the difference in the evaluation process for different types of radiation makes it difficult to devise a fair test procedure. It is desirable to have consistency evaluations performed on the data for each complete test period in categories I through V, and to provide the processor with the results of this evaluation. When a trend or other sign of lack of consistency is noticed in a processor's test parameters for successive tests, it is important that the reasons for such behavior be determined, since lack of consistency may foreshadow future failure of performance tests.

D3. Choice of Tolerance Level, L

The values chosen for the tolerance level represent a compromise between the recommendations of international authorities in the field of radiation protection and radiation measurements, and the limitations dictated by available measurement techniques. In ICRU Report No. 20 [E20] and NCRP Report No. 57 [E41], a 30% limit is recommended for the uncertainty in the maximum dose equivalent in the vicinity of the maximum permissible levels, while an uncertainty of as much as a factor of three is considered acceptable for maximum dose equivalents smaller by an order of magnitude. In ICRP Report No. 12 [E42], on the other hand, a limit of 50% is recommended in the vicinity of maximum permissible levels under field conditions, when errors caused by unknown irradiation geometry or ambient conditions are taken into account. For dose interpretations at accident levels, a tolerance level of 20% is recommended in NCRP Report 57. In this standard, a fixed irradiation geometry and laboratory ambient conditions are specified for the test irradiations. Because of limitations in measurement technique, the tolerance level is set at 0.5 (50%) for

all but the accident categories and the high-energy photon categories, where it is set at 0.3 (30%). Larger tolerance levels for dose equivalents well below the maximum permissible dose equivalent were considered and in fact had been incorporated in the first version of this standard. Subsequent to the experience gained in the pilot-testing program referred to in the Foreword, this feature was deleted since for the tests specified in this standard (calling for irradiation in relatively straightforward radiation fields under ideal laboratory conditions and evaluation of performance from average errors obtained over a large range of dose equivalents) relaxation of the tolerance levels was found to be unnecessary.

D4. Sources of Uncertainty Not Included in the Performance Evaluation

This standard does not include provisions for testing a supplier's performance under the various possible conditions of practical use of the personnel dosimeters. Among the common sources of uncertainty not included are:

(1) Dependence of dosimeter response on radiation energy for a given type of radiation and geometry of radiation incidence.

(2) Dependence of dosimeter response on angle of radiation incidence for different types of radiation and different radiation energies.

(3) Dependence of response on ambient temperature, including storage temperature before, during, and after irradiations, up to the time of processing or readout.

(4) Dependence of response on ambient humidity, including storage humidity, before, during, and after irradiation, up to the time of processing or readout.

(5) Time intervals between dosimeter issue, irradiation, and processing or readout.

(6) Dependence of response on visible and ultraviolet light prior to, during, and after irradiation, up to the time of processing or readout.

(7) Position of the badge on the human body relative to the point of maximum irradiation on the body surface, and relative to the location of the organs of interest.

(8) A possible bias in the performance on an open test, that is, a test carried out with the knowledge of the processor, introduced by the processor's awareness of being tested.

The extent to which any one of these factors may contribute to a given interpretation of dosimeter response varies widely, depending on dosimeter design, processing and readout techniques. It is suggested that the testing laboratory be in a position to evaluate the supplied dosimeter designs for the influence on interpretation of dosimeter response of any of these and other factors (such as, e.g., in the case of albedo-neutron dosimeters, dose equivalent assignment based on source-to-phantom surface distances as compared to assignment based on the distance between the source and the origin of the bulk of the thermal and/or epithermal neutron albedo). Methods for carrying out some of the required test procedures may be found in the literature [E43].

Because of the magnitude of the potential errors associated with angular dependence of dosimeter response, consideration was given to incorporating into the standard performance requirements related to response characteristics of test dosimeters as a function of angle of radiation incidence for different radiation energies and types of radiation. However, an adequate data base for the angular dependence of the response of the different types of personnel dosimeters irradiated on a phantom was not available. Therefore, it was