RECORD #186

TITLE: Determination of Radiation Exposure From Dosimeters

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NUCLEAR REGULATORY COMMISSION
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FROM: W. Porter Ellis, Senior Enforcement Specialist,
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SUBJECT: DETERMINATION OF RADIATION EXPOSURES FROM DOSIMETERS

In our recent counterpart meeting of the Enforcement Coordinators two questions were raised concerning the validity of radiation doses to personnel as indicated by dosimeters and the evaluation of exposures from direct reading dosimeters versus readings from film or TLD badge. These questions have also been raised during the past year by several of the regional offices as a result of certain frustrations which arose out of trying to prove that an exposure to a badge of an individual did in fact constitute a radiation dose of the same value to the individual.

First it should be said that the obvious purpose of the badge dosimeter is to measure the radiation dose received by the individual who wears it. If a badge dosimeter is used by an individual and that badge dosimeter shows a reading of 3.5 rem for a month or quarter, the nuclear industry and NRC has historically accepted this as proof that the individual received a radiation dose of 3.5 rem if one cannot show that the exposure to the badge most likely occurred when the employee was not wearing it. Although all facts surrounding an exposure should be established, the inspector does not need to establish additional proof that a radiation exposure occurred. However, if there is cause to believe that the individual was not exposed, it is incumbent on the licensee to demonstrate or provide evidence that the exposure to the badge dosimeter did not constitute a valid exposure to its user. Much of the confusion and frustration has come to the inspectors because licensees on some occasions indicated that they did not know whether a dosimeter could have been exposed when it was not being worn on the person of the designated user. It is the responsibility of the licensee (management) to assure that dosimeters are properly controlled to the extent that the radiation doses indicated by the badge dosimeters are reliable. We do not take the position that badge readings are not accepted as valid exposures of personnel if there is no other positive proof to support the finding; rather, in the interest of safety, we must accept the badge dosimeter readings as valid radiation exposures of

personnel unless the licensee can provide reasonable evidence to the contrary.

The second point of concern is the consideration of direct reading dosimeter values versus the film or TLD badge reading in establishing an individual's radiation dose. Generally, the direct reading dosimeter has not been accepted by the nuclear industry or the NRC as the dosimeter of record. It is true that on some occasions when a film or TLD badge was inadvertently exposed while not used by the designated user, the direct reading dosimeter has been used as the best evidence of the individual's exposure. However, there are too many variables involved to use the direct reading dosimeter in lieu of the film or TLD badge dosimeter. The direct reading dosimeter as a general rule is highly energy dependent. Many such dosimeters are made of metal or other material with a high Z number which absorbs many of the low energy photons. Consequently, we frequently find that the film or TLD readings are higher than the direct reading dosimeter for the same exposure to multi-energy photons. The direct reading dosimeters may show a lower radiation exposure than the film or TLD because of the error in numerous readings at the start and end of each work period. On the other hand, the exposures estimated from direct reading dosimeters could also establish error on the high side, dosimeters can drift or discharge when bumped and are not considered reliable even to the extent of their limited range. Therefore, the direct reading dosimeter is a control device, an indicator of the estimated dose. When exposure data is collected for an individual by both direct reading dosimeters and film or TLD dosimeters, the dose as determined from the film or TLD should be accepted as the individual's exposure of record.

Frequently a licensee will explain that the direct reading dosimeter readings were 2.5 rem (the control point) and the film badge or TLD read 3.3 rem or some similar values. The latter reading is the most representative of the individual's exposure to radiation if all other factors were equal. This is frequently the source of failure to make an adequate survey or evaluation of the radiation levels which results in exposure to individuals in excess of the regulatory limits. We cannot accept the licensee's explanation of error in calculation of the estimated dose from direct reading dosimeters as reasons to forgive failure to make proper evaluations of such potential exposures.

Finally, there were questions concerning exposures which resulted from licensed byproduct material and other unlicensed sources of ionizing radiation such as X-ray or radium. If any part of an individuals exposure results from licensed byproduct materials, the NRC has jurisdiction for taking enforcement action for the total exposure. If an individual were to receive 3 rem from X-radiation and 0.3 rem from cobalt-60 for

a total of 3.3 rem in a single quarter, the NRC would issue a citation for a radiation dose of 3.3 rems and indicate that it exceeds the permissible quarterly limit.

Please let me know if you have further questions concerning this matter.

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