18 Using Multiple Badges for Dosimetry

Personnel dosimetry is the way health physicists assess occupational radiation exposures received by workers in radiation fields. There are restrictions inherent to dosimetry systems, such as directional dependence, energy dependence, environmental dependence, variability in response, reproducibility, etc. The behavior of radiation fields plays an important role in dosimetry, because their nonuniformity could be conducive to bad interpretations of dosimeter readings. Single dosimetry is based on the idea that radiation fields are uniform, so that dosimeter location on a worker's body is not an important factor. However, in nuclear power plants, work conditions often involve nonuniform radiation fields, such as steam generator repairs, removal and replacement of pipes, valves and pumps, entry into drywell, control rod drive repairs, dives into cavities or spent fuel pools, etc. In such cases, it may be necessary to issue multiple dosimeters to workers.

There are no simple rules for multibadging because radiation fields and work conditions are job specific. However, in the past[1,2] some criteria have been developed with acceptable results. An ANSI standard is being prepared on this issue[3]. Multibadging is required when all of the following conditions exist[2]:

- Whole body radiation dose gradients exceed 1.5 in the work area (i.e., a significant dose rate gradient within the space occupied by a worker's body).
- General area dose equivalent rates exceed 100 mrem/hr (this includes dose rate measured up to 18 inches from "hot spots" but not contact dose rates.
- It is likely that an integrated whole-body dose equivalent in excess of 300 mrem will be received during the job.
- It is not known to a high degree of certainty, based on past experience or measurements, what portion of the body will receive the highest dose.

It may be possible to establish additional criteria to increase, reduce, or even discontinue multibadging in the ongoing jobs or similar future jobs. Such additional criteria may be based on the ratio of the highest exposure location to the chest location, new survey data, total whole body dose equivalents, or any other important changes in work conditions or radiation fields.

The most common locations for placement of additional dosimeters include the head, chest, gonads, back, arms, and legs, to characterize whole-body dose equivalent (WBDE). In some jobs, such as diving into fuel pools, workers may require as many as twelve dosimeter badges, eight for WBDE and up to four for extremities. (The four dosimeters for the extremities would include two for hands and lower arms and two for feet and lower legs. These members were formerly considered part of the whole body and now are considered as extremities.)

---

[1]Hudson, C.G., 1984, "The Need for Dosimetry Multibadging at Nuclear Power Plants," Radiation Protection Management, Vol. 1, No. 2 (January 1984), pp. 43-49.

[2]Farrell, W.E., Christmas, K.D., and Shelley, M.H., "Multibadging Reductions at the H.B. Robinson Nuclear Plant," Radiation Protection Management, Vol. 4, No. 5 (Sept./Oct. 1987), pp. 31-36.

[3]Health Physics Society Standards Committee Working Group 59.

When using multibadging, the normal dosimeter should be replaced by the set of dosimeters to be used during the multibadging activity. In such a case, the highest value of the set of dosimeters must be taken as the WBDE received during that activity, and that value shall be added to the normal dosimeter value (read at the end of the quarter). Multibadging dosimeters should be read and evaluated immediately after each worker finishes a part of his job and before he starts the next part.

It should be noted that these criteria apply to whole body multibadging only. They do not apply to extremity dosimetry, which is evaluated and handled separately.