Routine Quality Checks of the Personal Dosimetry System at Ringhals

Anna-Kajsa Andersson and Per Drake

Vattenfall AB, Ringhals, S-43022 Väröbacka Sweden

Abstract

At Ringhals we use two parallel dosimetry systems, TLD and electronic dosimeters.

Three quality checks are performed at Ringhals for the determination of the dose to individuals.

1. The response of the TLD system is checked every quarter against the Swedish Radiation Protection Institute. This is complemented with a yearly blind test from the same institute. The electronic dosimeters are calibrated every year.
2. The response of the TLD system is checked each day with calibration dosemeters and all dosemeters, which show more than 5 mSv are calibrated individually.
3. The monthly TLD values are compared with the monthly sum for the electronic dosemeters for every individual within the computer system. If certain differences occur between the two systems then the reason for this is checked and the dosemeter values are corrected.

These procedures and the experience will be explained.

Introduction

The main objective for the Ringhals dosimetry group is to assign the correct dose to each individual. This is performed with individual TL-dosemeters used on a monthly base and electronic dosemeters used for each entry into controlled areas. (Ringhals TLD (Studsvik, Sweden), utilises a combination of two ^{7}LiF pellets (TLD 700 or equivalent) and two $Li_2B_4O_7$ pellets. Ringhals electronic dosemeters are RAD100 (Rados, Turku, Finland.) The dose from the electronic dosemeters is combined with a code for the job-activity and with the time period the dosemeter. The individual monthly doses according to the TLD and summed from the electronic dosemeters should be equal. This paper shows how the dosimetry systems are calibrated and compared with each other.

Calibration

The TLD system is calibrated to give the personal dose equivalent, $H_p(10)$. The calibration procedure assumes that the TLD's are used for a whole month. An accredited laboratory (the Swedish Radiation Protection Institute) performs the calibration irradiation with a Cs-137 source at 2 m with the dosemeters placed on a PMMA slab phantom. This calibration is performed every third month with 30 dosemeters receiving different doses.

The daily calibration is performed with a reference source at Ringhals. This reference source is used on an individual base for all dosemeters with a dose exceeding 5 mSv and with 5 – 20 reference dosemeters each day. Once a year each dosemeter pellet is calibrated and given an individual calibration factor in the computer.

The calibration procedure for the TLD's should produce values in the range 100 % to 105 % (with 95 % standard deviation) of the correct value otherwise the procedure requests that the calibration factors should be changed. The drift in the TLD-system is very low and a change in the calibration factor is normally not needed more than once a year.

The electronic dosemeter system is calibrated with a low-dose-rate and a high-dose-rate Cs-137 source every year. These sources are traceable to national standards and reference calibrations have been performed with electronic dosemeters at the Radiation Protection Institute. The drift in the calibration is very low.

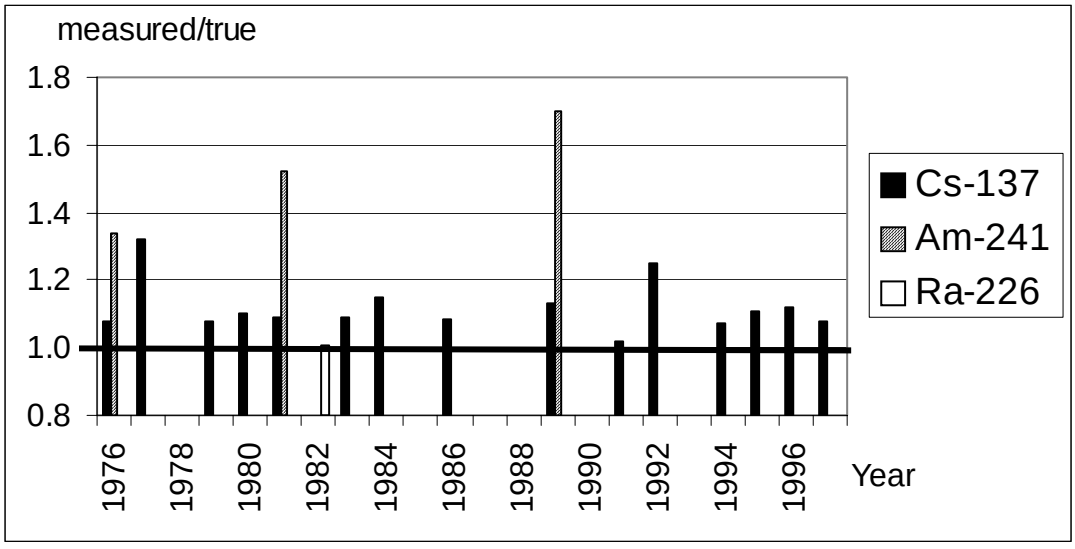
Blind test

The Swedish Radiation Protection Institute (SSI) started blind tests in 1976 of the dosimetry services in the Swedish power stations. (References SSI 76-97). In these blind tests approximately 20 dosemeters are sent to SSI and they irradiate the dosemeters and send them back to the processor for estimation of the dose equivalent using the ordinary readout procedures. The dose equivalent received by the dosemeters is unknown to the processor. When several calibration sources have been used the processor does not know the source-dosemeter combination. The estimated dose equivalent values are compared with the true dose equivalent values. The blind tests are repeated with at most a two-year interval. In most tests Cs-137 (with photon energy 662 keV) was used as irradiation source, and for this energy the processors normally reported values within 10 % of the true value. In one of the blind tests a Ra-226 source was used instead of the Cs-137 source. The largest deviations, for single dosemeters, were in the order of - 20 % to + 42 % for the period 1976 to 1993.

In a few tests Am-241 (with photon energy 60 keV) was used in addition to the ^{137}Cs source. From the 60 keV irradiations all services reported 141 % - 170 % of the correct value.

Figure 1 shows the average of the ratios between the dose equivalent values reported by Ringhals and the true dose equivalent values. The figure includes the results of all blind tests from 1976 to 1997.

Figure 1. Results of blind tests of the TLD system at Ringhals 1976 – 1997. Ratio between the dose equivalent values reported by Ringhals and the true dose equivalent value. The ratios are shown as average of all dosemeters for each calibration source.



Comparison between TLD and electronic dosemeters

After each monthly TLD evaluation the dose according to the TLD is compared with the dose according to the electronic dosemeter. The comparison is performed within the computer system.

When the following criteria for the difference in dosemeter readings are exceeded then the dosimetry group requests from the Health Physics groups to evaluate the reasons for the difference and if needed the individual dose is corrected. The correction is registered and the person is informed about this correction. If a correction is not needed then this is also registered.

Criteria for further research of difference in dosemeter readings

1. *Estimated dose > 0.5 mSv*
2. *Difference in reading > 0.5 mSv*
3. *Electronic dosemeter dose <0.6 x TLD dose or Electronic dosemeter dose > 1.3 x TLD dose*

Experience

Approximately 1 – 2 corrections are performed each month, with an average of 2000 individuals using dosemeters.

The Health Physics group is contacted about 2 – 4 times a month concerning odd doses or large differences between the dosimetry systems.

The main reason for the differences is that the dosemeters have been used for different time periods. A few differences are due to irradiation in the BWR-turbine hall during operation as the electronic dosemeter overresponds to high energy gammas from N-16.

When both TLD and electronic dosemeters have been correctly used then the TLD is considered to show the correct value and only once or twice a year will a higher value be assigned to the TLD.

Conclusions

The combination of two calibrated dosimetry systems and the comparison between the systems on a regular base provides us with a reliable tool for individual dosimetry at Ringhals. The blind tests performed by the authority confirms this.

References

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