Response Evaluation Of Gamma Dose Rate Probes In The Slovenian Early Warning System

Milko J. Križman, Michel Cindro, Dušan Peteh, Barbara Vokal Nemec

michel.cindro@gov.si

MFM 203 produced by AMES

INTRODUCTION

✓In 2006, the SNSA participated in the 3rd international intercomparison campaign for instruments for automatic measurements of external radiation, organized by WG EURADOS, at PTB, Braunschweig, Germany.

✓In the report, published in Radiation Protection Dosimetry in June 2009, the SNSA found that the characteristics of the gauges in the Slovenian early warning network, produced by AMES, are distinctly different from the instruments of other participating countries.

✓Due to historical reasons, calibration of the AMES MFM probes was performed with radionuclide ^{60}Co, unlike the others, calibrated with ^{137}Cs and the results are expressed with the physical quantity H_X (photon dose equivalent) rather than in units of H*(10) (ambient dose equivalent).

Kredarica measuring station

RESULTS OF THE PTB INTERCOMPARISON IN 2006

For the AMES MFM instrument, the intercomparison showed the following disagreements:

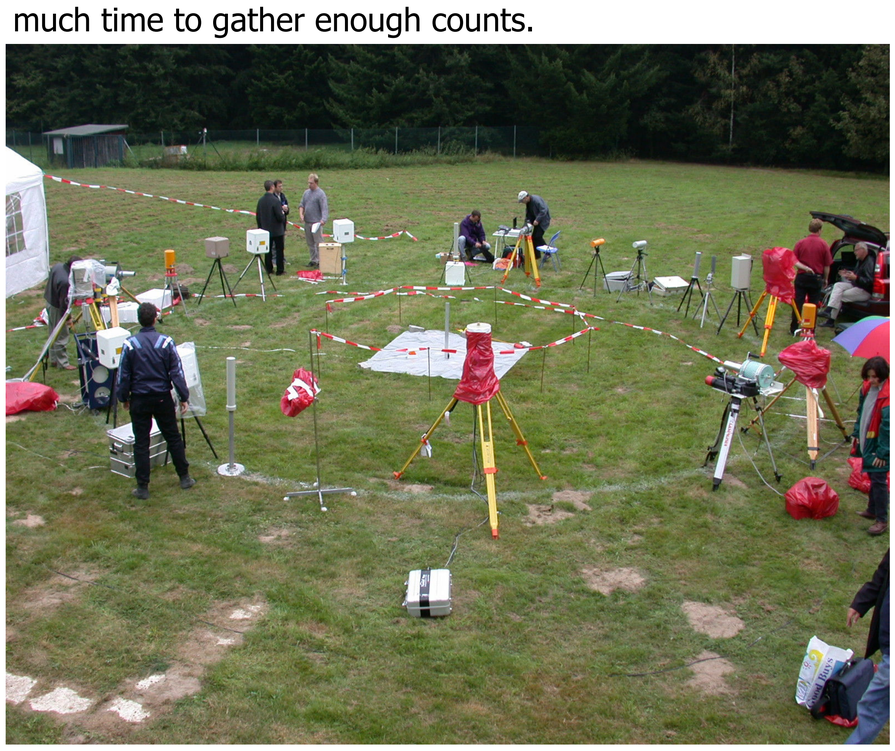
✓The MFM 203 showed extremely low response, 45% less then other instruments.

✓The average ratio of the response values of the instruments and real value of the radiation field H*(10), expressed in the units nSv/h was found to be 0,90 do 0,95 for a great majority of participating instruments while in case of MFM instruments it was only about 0,51.

✓Based on comparative environmental dose rate measurements on the lake, the cosmic component response was found to be overestimated by 6,6%.

✓As regards the terrestrial component, the instrument (calibrated with ^{60}Co) was reporting only 70 % of the real value.

✓Low sensitivity and low counting statistics of the MFM instrument has some important consequences in low artificial radiation fields. The instrument would not be able to immediately detect changes in radiation field in case of the arrival of radioactive clouds since it would take too much time to gather enough counts.



PTB intercompariosn-field measurements

NEW CALIBRATION AND DATA VERIFICATION

In December 2010, some MFM instruments were calibrated at the Jožef Stefan Laboratory for dosimetric standards in a dose field generated by a ^{137}Cs calibration source.

✓Statistical analysis of calibration factors obtained in the ^{137}Cs field showed a very small variance (0,1696 ± 0,0014 nSv/count) for the whole set of instruments.

✓If we compare this value with the previous one based on ^{60}Co calibration (0,1146 ± 0,0010 nSv/count), taking into account numerical correction between the values of physical quantities (H_X and H*(10)) and dead time correction, we obtain the ratio between both calibration factors:

0,1696 / 0,1146 = 1,480

Verification of the newly determined response

✓From recorded results based on calibration with ^{60}Co and the previously used inherent background value we obtain the new net response to the cosmic and terrestrial component.

✓To obtain the "new", (H*(10), ^{137}Cs), data, we multiply the old value with 1,48, so the new value for the intrinsic background is **68 nSv/h**.

✓In order to verify this result we used a dataset based on laboratory analyses of soil samples from four locations (Krško polje, Brinje, Todraž, Murska Sobota), as shown in the table below:

Ratios of measured values of the dose rate and estimated real values for select locations

Location	(H_X, ^{60}Co) / (real value)	(H*(10), ^{137}Cs) / (real value)
Brinje	0,79	1,17
Krško polje	0,75	1,11
Todraž	0,76	1,15
Murska Sobota	0,74	1,10
Average (rounded)	**0,75**	**1,15**

✓So far, existing response of the network, based on [H_X, ^{60}Co] means an essential underestimation of measurement results if compared to real levels in the field; the reported values reached only about 75 % of actual levels.

✓The net response of the sum of cosmic and ground component after recalibration of the network with ^{137}Cs is on average higher than actual value with a factor of 1,15 (range 1,10-1,17).

✓The calibration with ^{137}Cs yields an overestimation of results of natural radioactivity due to the non-linear energy response of GM probes. Nevertheless, this is generally accepted as the best way to calibrate probes since it will yield more accurate results in case of nuclear accident.

CONCLUSIONS

The Slovenian participation at the EURADOS intercomparison was very important. With a new evaluation of the results of the Slovenian early warning network the data – promptly and currently sent by the SNSA to the EURDEP centre in Ispra – will be more realistic and more comparable with the corresponding data from the other European countries.