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CERTIFICATE OF CALIBRATION

9051-KL-9468-14

Date of issue: April 7, 2014 Page 1 of 2

Owner: Laboratories Protecta Ltd., 22 Ivan Vazov Str., 1000 Sofia, Bulgaria
Собственик: Лаборатории Протекта ООД, ул. "Иван Вазов" 22, 1000 София

User: Inspection Body of type A at Laboratories Protecta Ltd., 22 Ivan Vazov Str.,
Ползвател: 1000 Sofia, Bulgaria
Орган за контрол от вид А към Лаборатории Протекта ООД, ул. "Иван Вазов"
22, 1000 София

Measuring instrument: TLD system PROTECTA MTDS, consisting of TLD reader and personal TL dosimeter with TL detectors from CaSO₄:Dy

Manufacturer: Protecta Partnership, Sofia, Bulgaria

Type: Reader PROTECTA VMD-3, dosimeter PROTECTA TLP-3,
detectors PROTECTA MMS-4

Serial number: 10/2007

The results of the calibration have been obtained following the procedures reported in this Certificate and are related only to the date, place and conditions of the calibration.

Date of calibration: March 5 + 6, 2014

Calibrated by:

Ing. Vladimír Sochor

Ing. Tomáš Tesar

Tomáš Tesar



Jiří Šuráň
Head of the Department:

Ing. Jiří Šuráň, MBA

Name

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Name

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Measurement standards used:	Czech national standard of exposure and air kerma ECM 440-5/11-049 The standard is traceable to the primary standards of BIPM – BIPM certificate No. 34 dated 14th September 2012
Calibration procedure:	See bellow
Place of calibration:	CMI-IIR Prague
Ambient conditions:	98.4 kPa, 22.3°C, 32 % r.h
Calibration conditions:	Collimated beam of ¹³⁷ Cs gamma radiation, PMMA slab phantom
Results of calibration:	The calibration coefficient stated bellow is valid for the ¹³⁷ Cs gamma radiation and for personal dose equivalent values in the range of 0.1 to 600 mSv.

The calibration was performed using a group of TL dosimeters irradiated on a PMMA phantom in a collimated beam of ¹³⁷Cs gamma radiation. In total 85 dosimeters in 6 groups were irradiated to different values of personal dose equivalent H_p(10) in a range of 0.07 to 550 mSv. 15 other dosimeters were not irradiated (and used to determine the background value). The dosimeters were then returned to the applicant and evaluated using an applicant's TLD reader.

From each evaluated group of irradiated dosimeters a net average reading R_i was calculated with the background value subtracted, together with the variation coefficient of the R_i. For each group an individual calibration coefficient N_i was calculated using a formula $N_i = H_{ref,i}/R_i$, where H_{ref,i} is the conventionally true value of H_p(10) for the particular group of dosimeters.

The resulting calibration coefficient N was then calculated as a weighted average of N_i, where the inverse value of the individual variation coefficient was used as a weighting factor.

The calibration coefficient value is stated below:

$$N = 2.66.10^{-5} \text{ mSv/u,}$$

where "u" is the unit of a dosimeter reading R. The personal dose equivalent has to be calculated using a formula $H_p(10) [\text{mSv}] = N \cdot R [\text{u}]$. The relative expanded combined uncertainty of the calibration coefficient is 10.4 %. (The conventionally true value has an uncertainty of 3.5%).

The standard uncertainty of measurement has been determined in accordance with EA-4/02 document. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k corresponding to a coverage probability of approximately 95 %, which for normal distribution corresponds to a coverage factor $k = 2$.

End of calibration certificate.



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