QUALITY CONTROL IN PERSONAL MONITORING SERVICE IN TVO NPP, FINLAND

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GENERAL

RADOS TLD System is used for personal monitoring in TVO, Olkiluoto. System includes:

- two Computer controlled Dosacus RE-1 TLD Readers,
- Reference Irradiator, ^{90}Sr
- Oven, Memmert, Tv30u 762245
- Rados Explorer WinTLD version 2.1.4.0,
- TLD Server version 2.1.4.0
- dosimeter card, 4 TLD chips
    - 2 pieces of ^{7}LiF:Mg, Ti (called LiF, commercial name TLD-700)
    - 2 pieces of $Li_2B_4O_7$:Mn, Si (called LiB)
- plastic cover model TVO
- measured quantity: $H_P(10)$ and $H_P(0,07)$
- monitoring is made by monthly basics.

Personal monitoring is operated by Doseco Ltd according to ISO/IEC 17025:2005 [1)] and IEC 1066 standards [2)].

QUALITY CONTROL

Annual calibration, cleaning

Annual calibration is based on irradiations by the secondary standard laboratory (STUK, in Finland). Irradiation qualities are ^{60}Co, ^{137}Cs and ISON300. From these irradiations basic calibration factor Krem, unit mSv/ one pull of ^{90}Sr irradiator, is calculated. The dosimeter system homogeneity and linearity are checked once in a year according to the standard IEC 1066. The readers and the irradiator are cleaned up by manufacturer's authorised personnel yearly.

Annealing

Dosimeters are annealed in the reader. Preheat time is 1,5 s and measuring time 10,5 s. Temperature is 316°C. Annealing is checked by HEHKU 1.5.T software (Fig. 1).

From the report shown in Fig. 2 one can see if the dosimeter is annealed properly. Operator can set parameters to be checked (see Fig. 2). The maximum measured value and the difference between LiF and LiB chips are checked by HEHKU-software. If the value (maximum or difference) is out of the limit the dosimeters are annealed again.

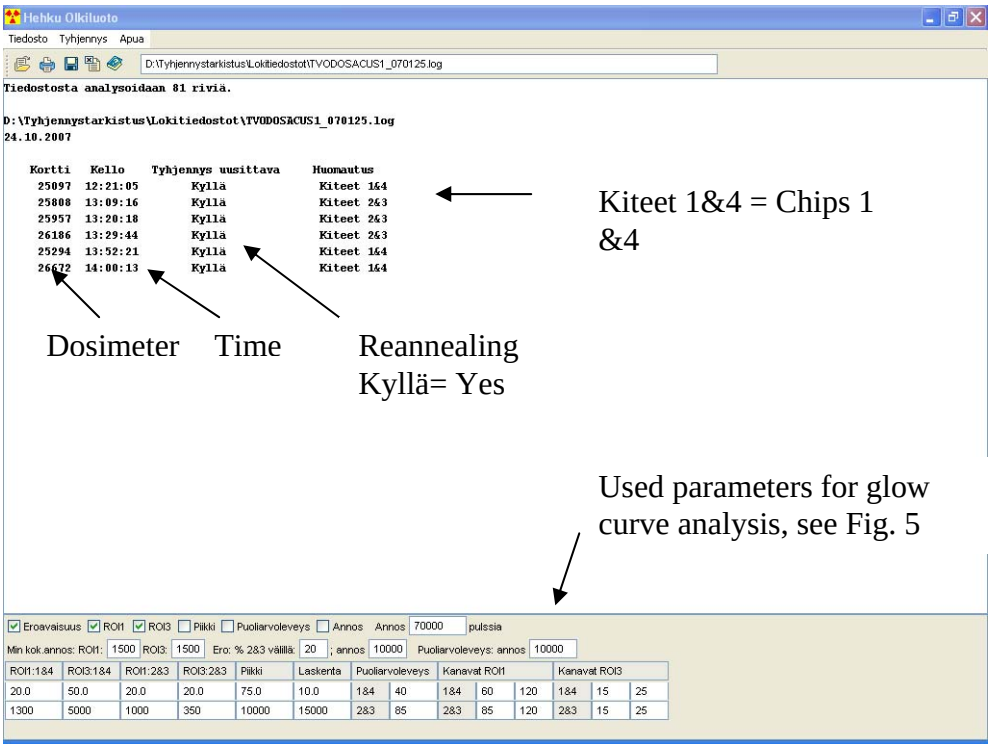

Figure 1. HEHKU-sofware.

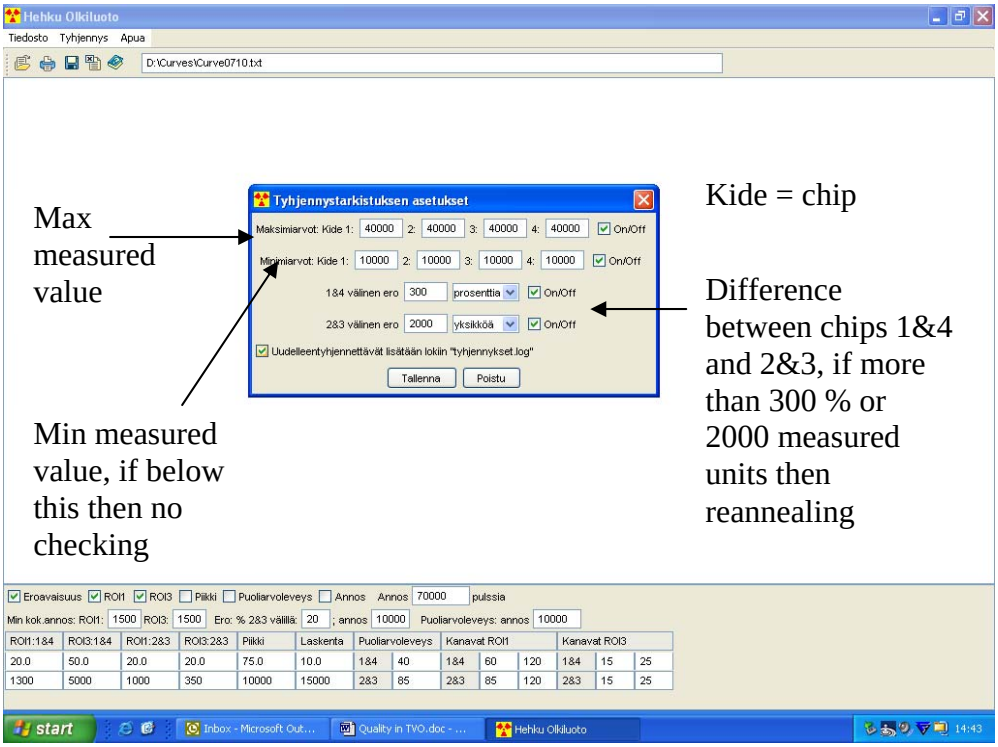

Figure 2. Parameters in annealing.

Reader calibration

Before reading of the used dosimeters, reader sensitivity is checked by ^{90}Sr irradiator by using 40 TLD chips. Measured counts, reference light values and dark current values (Fig. 3) are tabulated. The limit for sensitivity difference is ±2 %.

	LiB	LiF												LiB	LiF
	Tld -reader`s follow-up sheet														
														limit 2%	**limit 2%**
							Ref. light	Ref. light					Dark current		
Date	KReader(A)	KReader(B)	Ref.light				mean	Difference	Dark current				mean	**D Kreader (A)**	**D Kreader (B)**
12.12.2007	5953	20773	71751	71150	71257	71536	**71424**	**-0,7 %**	59	63	95	82	**75**	**-0,76 %**	**0,47 %**
11.12.2007	5908	20871	70706	70725	71565	70802	**70950**	**0,3 %**	88	94	76	90	**87**	**1,80 %**	**1,85 %**
29.11.2007	6016	21265	71260	71082	71441	70782	**71141**	**-0,6 %**	104	72	73	91	**85**	**-0,35 %**	**-0,25 %**
28.11.2007	5995	21212	70276	70707	70816	71160	**70740**	**0,5 %**	92	64	85	82	**81**	**1,45 %**	**-0,22 %**
27.11.2007	6083	21166	70751	71155	71099	71322	**71082**	**-0,2 %**	74	78	87	91	**83**	**-1,76 %**	**-0,82 %**
26.11.2007	5978	20993	70599	70756	71191	71326	**70968**	**0,5 %**	73	81	82	87	**81**	**1,47 %**	**0,40 %**
9.11.2007	6067	21077	71447	71479	71303	71133	**71341**	**-0,2 %**	66	71	82	75	**74**	**0,91 %**	**-0,26 %**
8.11.2007	6123	21022	71081	71331	71436	71073	**71230**	**0,0 %**	104	100	86	98	**97**	**-1,83 %**	**0,83 %**
7.11.2007	6013	21197	71699	71024	70760	71388	**71218**	**-0,3 %**	91	92	80	73	**84**	**-0,35 %**	**0,14 %**
6.11.2007	5992	21227	71290	70549	70722	71320	**70970**	**0,1 %**	105	89	91	95	**95**	**1,90 %**	**0,10 %**
1.11.2007	6108	21248	71229	71182	70588	71135	**71034**	**0,1 %**	74	86	84	82	**82**	**-1,11 %**	**0,35 %**
31.10.2007	6041	21323	71375	70949	71067	70935	**71082**	**0,0 %**	73	85	90	80	**82**	**-1,41 %**	**-0,49 %**
30.10.2007	5957	21218	71248	70850	71172	71178	**71112**	**0,1 %**	92	84	76	73	**81**	**1,16 %**	**-0,43 %**
29.10.2007	6027	21127	70975	70975	71279	71485	**71179**	**-0,5 %**	86	90	84	80	**85**	**0,31 %**	**0,66 %**
24.10.2007	6046	21268	71147	70588	70595	71048	**70845**	**-0,5 %**	66	84	59	77	**72**	**-0,99 %**	**-0,28 %**
23.10.2007	5987	21209	70233	70702	71099	70039	**70518**	**1,0 %**	79	79	69	85	**78**	**1,69 %**	**1,99 %**
5.10.2007	6090	21639	71247	71102	71118	71373	**71210**	**1,5 %**	73	85	93	80	**83**	**-1,03 %**	**-0,47 %**
4.10.2007	6028	21538	72365	72181	71992	72459	**72249**	**0,2 %**	89	84	97	83	**88**	**0,97 %**	**-0,23 %**
3.10.2007	6087	21489	72199	72583	72539	72279	**72400**	**0,3 %**	86	75	68	94	**81**	**-0,83 %**	**-0,20 %**
2.10.2007	6037	21447	72668	72495	72826	72380	**72592**	**-0,3 %**	89	90	93	91	**91**	**0,95 %**	**1,01 %**
1.10.2007	6095	21665	72509	72427	72063	72356	**72339**	**-0,3 %**	77	82	67	109	**84**	**1,25 %**	**-0,55 %**
12.9.2007	6172	21546	72060	71794	72580	72049	**72121**	**1,0 %**	94	78	103	74	**87**	**1,22 %**	**1,85 %**
11.9.2007	6248	21951	72659	73227	72791	72809	**72872**	**0,2 %**	82	78	90	83	**83**	**0,30 %**	**-0,86 %**
29.8.2007	6267	21763	73131	72856	73060	73050	**73024**	**0,1 %**	87	87	80	92	**87**	**1,04 %**	**-0,67 %**
28.8.2007	6333	21618	72898	73232	73155	72989	**73069**	**0,2 %**	63	95	91	84	**83**	**1,66 %**	**0,14 %**
27.8.2007	6440	21648	73049	72913	73443	73505	**73228**	**0,1 %**	103	80	95	68	**87**	**-1,63 %**	**0,83 %**

Figure 3. Data sheet for reader quality measurements.

Reader alarms

The reader checks the dark current value and the reference light value before reading each pellet. In Fig. 4 are shown the used TLD Server alarm parameters [3)].

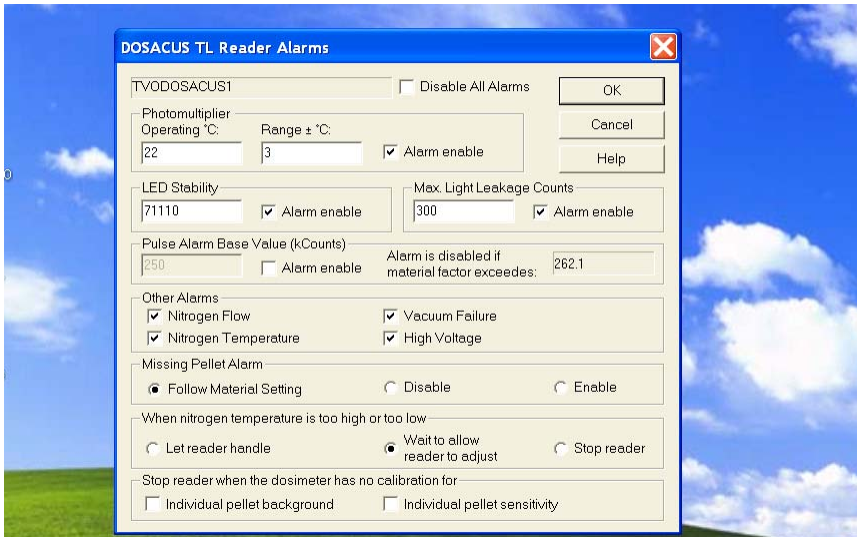

Figure 4. TLD Server parameters

Dose reading

The read out glow curves are checked by HEHKU 1.5 T software (Fig. 5). From the obtained report one can see if there are some abnormal features at glow curve.

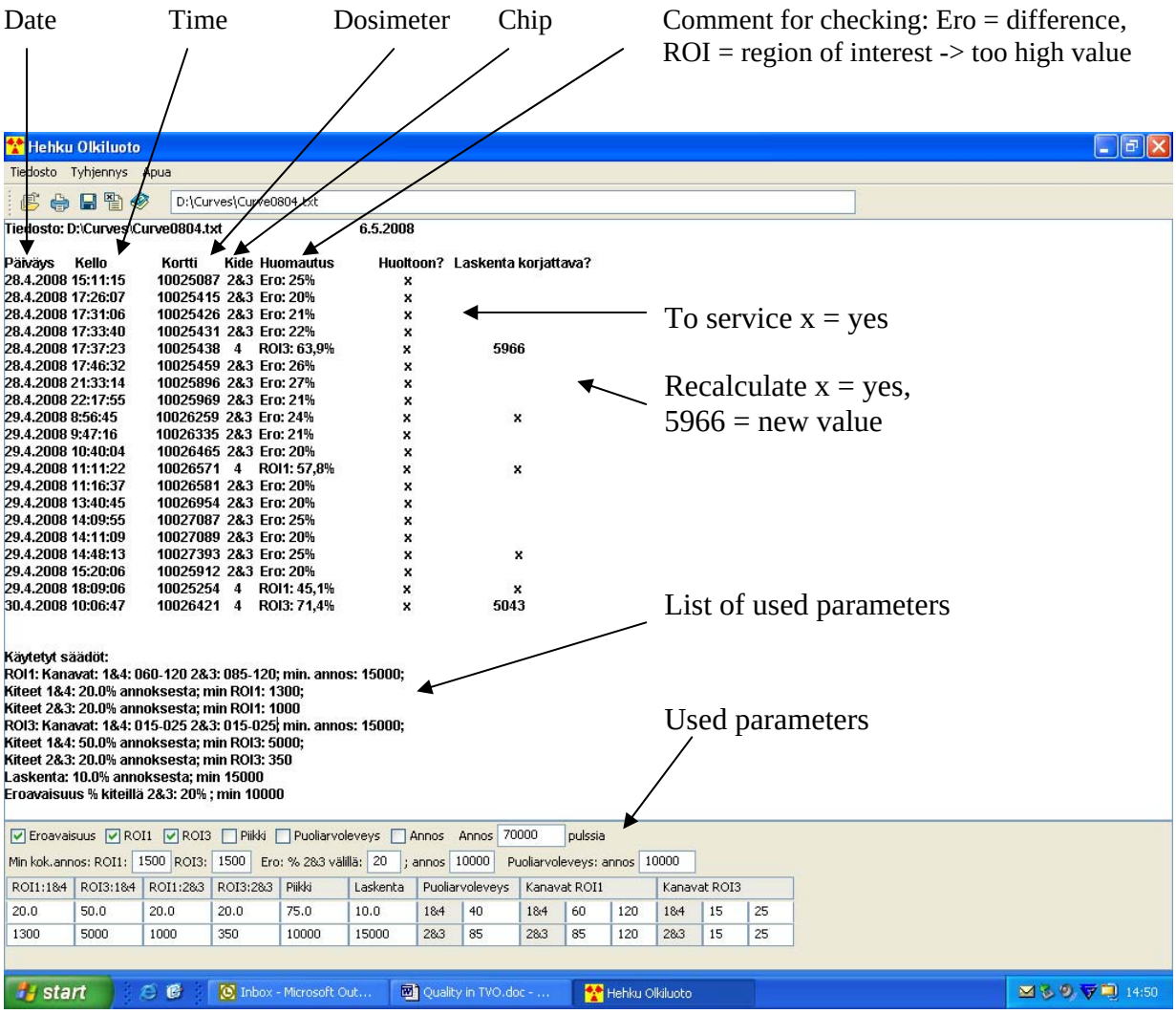

Figure 5. Glow curve analysis

Operator can choose quality checks. In our system two LiF chips for $H_p(10)$ dose are used and the software calculates the difference between these two LiF chips. Operator can set two region of interest (ROI1 and ROI3). Channels 15-25 for ROI3 (beginning of glow curve), channels 60-120 (LiB) and 85-120 (LiF) for ROI1 (end of glow curve) are used. If there are spikes or if the half wide of the glow curve is not normal the software produce a report. In a case of large dose, you can get a report by the software. If there is need for re-calculation of the dose, software gives a new value for that chip.

Annual blind test

Every year about 30 dosimeters are sent to STUK. Measured values are plotted in so-called trumpet curve (Fig. 6) [4)]. Irradiation qualities used can be seen on Fig. 6. The plotted value is a ratio of the measured $H_p(10)$ dose value and the reference dose value. When the TLD system is working properly the ratio should be 1. As can be seen from Fig. 6 the TLD system quality is quite good.

Cleaning of chips

TLD chips can be cleaned by washing in the ultrasonic bath (Elmasonic).

New TLD chips

New TLD chips go through the quality test, where background and sensitivity are measured. In the quality test +30% higher background value compared to used chips average material background is

acceptable. Also ± 30% difference for sensitivity compared to the used chips average sensitivity is acceptable.

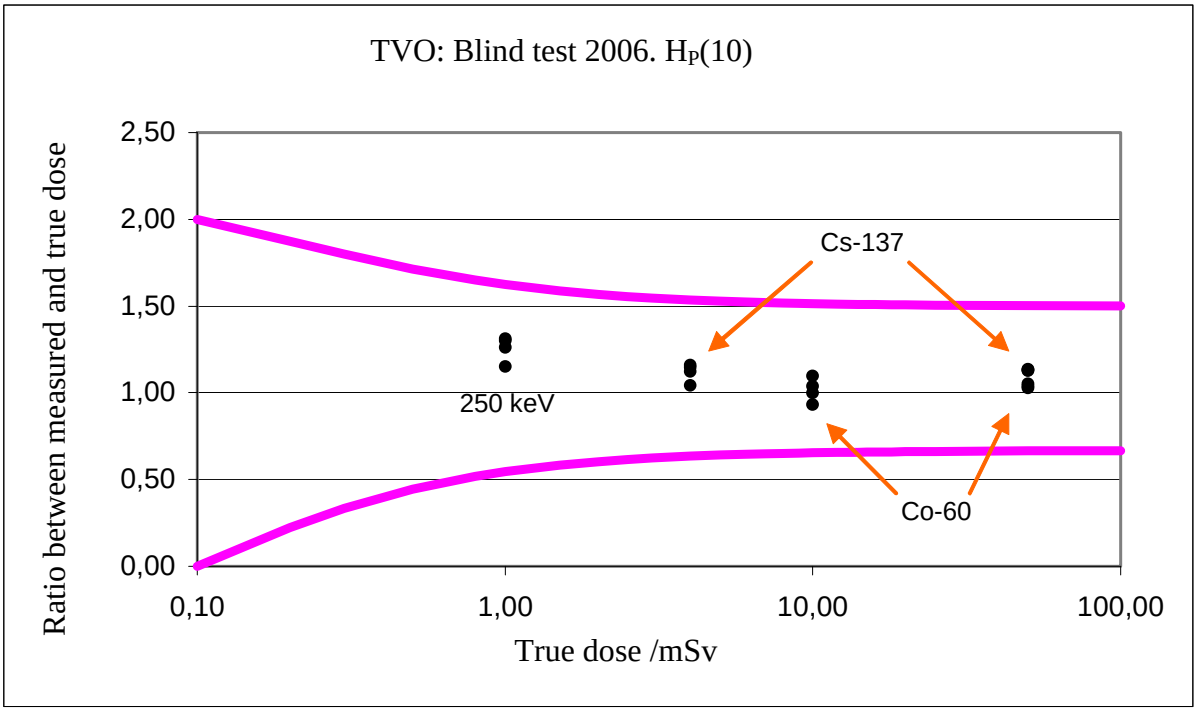

Figure 6. $H_P(10)$ blind test results

CONCLUSIONS

The quality system is very good guideline for personal monitoring service. The documented work instructions, standard oriented personnel, daily tests, annual tests, cleaning and calibrations guarantee a good quality for dose reading.

REFERENCES

1) SFS-EN ISO/IEC 17025:2005. General requirements for the competence of testing and calibration laboratories.
2) International standard IEC 1066:1991. Thermoluminescence dosimetry system for personal and environmental monitoring.
3) WinTLD User`s Manual, version 2.0:1999-2001. Rados Technology Ltd.
4) Technical recommendations for monitoring individuals occupationally exposed to external radiation. Radiation Protection 73. EUR 14852. European Commission; 1994.