Maria Sklodowska-Curie
National Research
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INTERNATIONAL CONFERENCE
ON RADIATION APPLICATIONS
In Physics, Chemistry, Biology,
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SSDL in Poland - experience in performing dosimetry audits

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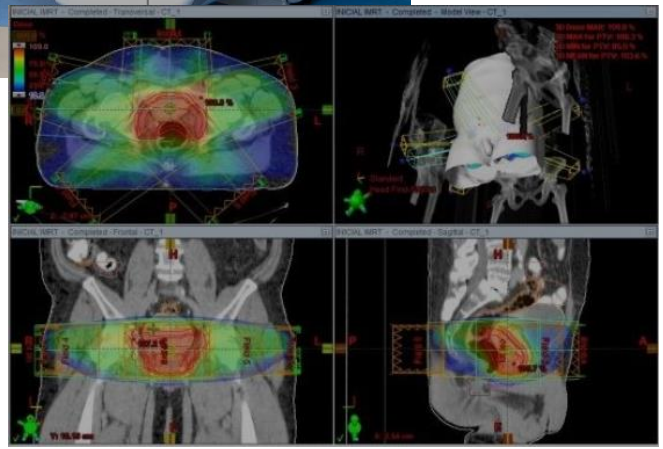
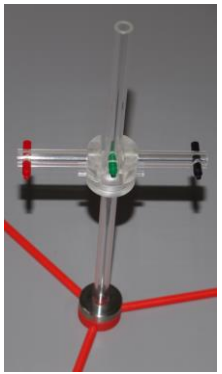
Laboratory accredited by the Polish Centre for Accreditation, accreditation No. AB 1499*

* an actual scope of accreditation No. AB 1499 is available on the PCA website: www.pca.gov.pl

Dosimetry audits in radiotherapy aim to ensure safe radiotherapy for the patient and to improve the quality of radiotherapy. It is an independent external dosimetry audit that is part of the radiotherapy quality assurance process. It makes it possible to check: correctness of beam calibration on the therapy instrument, correctness of geometric reproducibility of planned therapy beams, correctness of data entered into the TPS, precision of calculated dose distributions.



There are four levels of auditing. **Level I** involves checking the calibration of the accelerator for photon and electron beams under reference conditions. This audit indirectly allows checking the competence of the dosimetry teams. In addition, there is **level Ib**, where the purpose of the audit is to check the off-axis dose determination. Here thermoluminescence detectors (TL) or an ionisation chamber are most commonly used. Such audits have been performed in Poland annually since 1991. The measure of the outcome is the delta parameter, which is the percentage difference between the dose declared by the participants in the audit and the dose read out at the Secondary Standards Dosimetry Laboratory (SSDL) taking into account a number of corrections.



$$delta = \frac{D_P - D_{SSDL}}{D_{SSDL}} \cdot 100\ [\%]$$

where:

D_P [cGy] – dose reported by the participant;

D_{SSDL} [cGy] – dose determined by the SSDL as follows:

where:

M [counts] – the TL detector response;

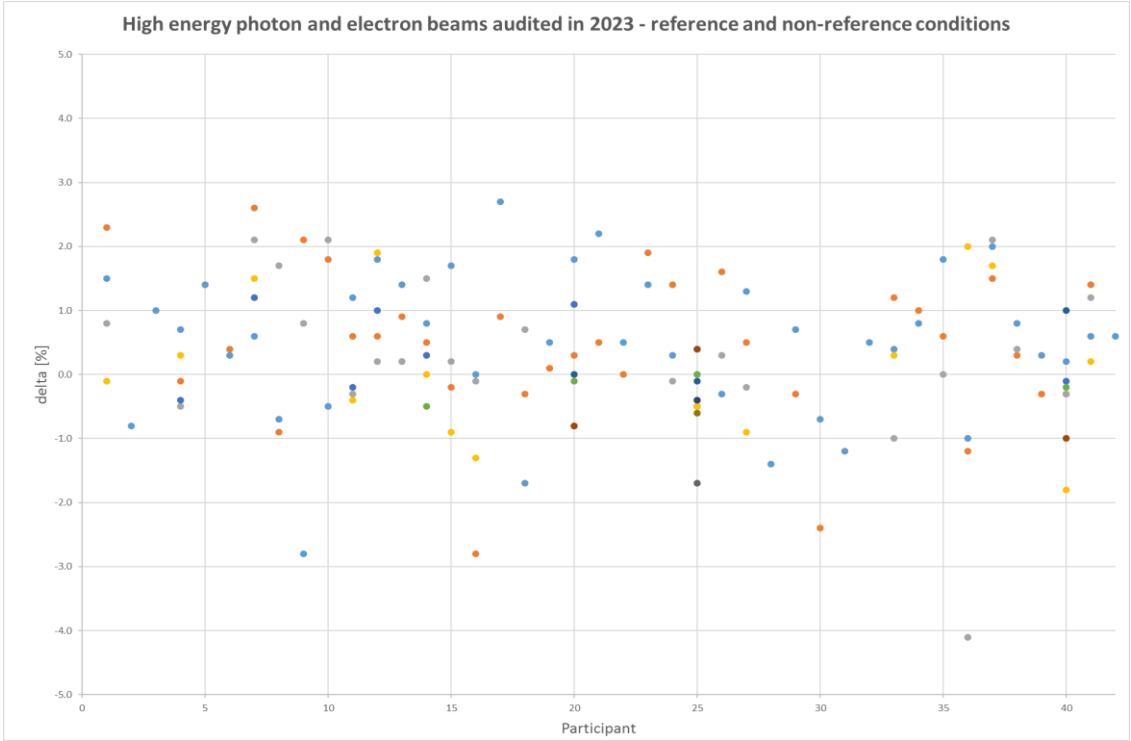
N [cGy/counts] – calibration coefficient of the TLD system;

f_{lin} – non-linearity dose response correction factor;

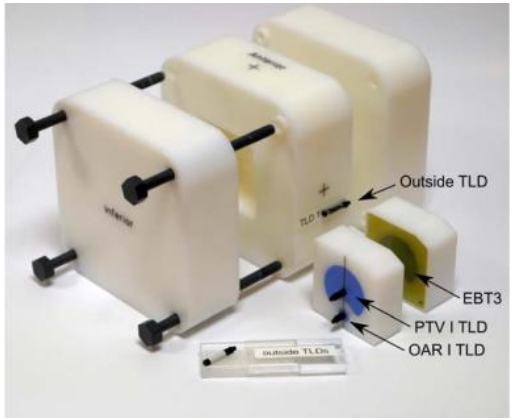
f_{en} – energy correction factor;

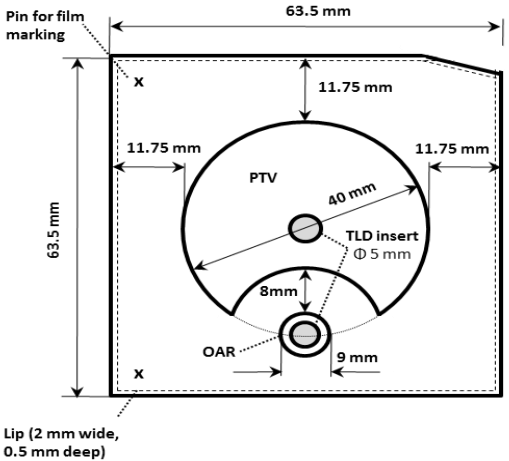
f_{fad} – fading correction factor;

f_{hol} – holder correction factor.



Level II of the audit is a comparison of the results of calculations made using the treatment planning system and measurements. Calculations and measurements are performed in a phantom designed specifically for the audit. TL detectors and film detectors are used to record the dose. Level II audits check: the accuracy of MLC leaf positioning, small-field performance, system calculations for different material densities. They are mostly carried out by mail order. In 2020, SSDL conducted this level II audit at 13 centres using a phantom containing defined PTV and OAR volumes.

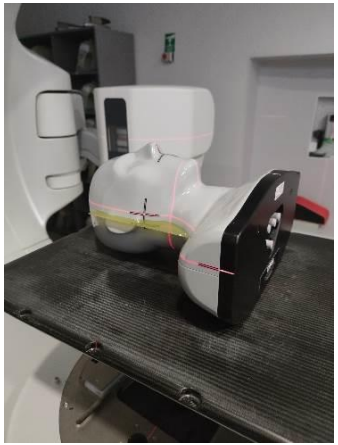




Results:

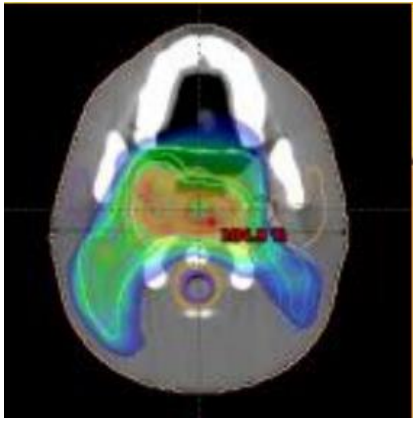
Hospital	Hospital #1				Hospital #2			
Passing rate (3%/3mm, 20% treshold) [%]	100	100			100	100		
TLD location	PTV_S	PTV_I	OAR_S	OAR_I	PTV_S	PTV_I	OAR_S	OAR_I
TLD Dose measured Dm [Gy]	4.137	4.213	1.056	0.991	3.765	3.888	1.851	1.734
Dose stated (from declared) Ds[Gy]	4.119	4.117	1.038	1.012	4.023	4.019	1.898	1.846
Deviation (Dm-Ds)/Ds [%]	**0.4%**	**2.3%**	**1.8%**	**-2.0%**	**-6.4%**	**-3.3%**	**-2.4%**	**-6.1%**
AVG deviation	1.4%		-0.1%		-4.8%		-4.3%	
Dm/Ds	1.004	1.023	1.018	0.980	0.936	0.967	0.976	0.939
Ds/Dp	0.990	0.990	1.016	0.991	1.005	1.004	1.034	1.006
Film dose location	PTV_ref	PTV_box	OAR_ref	OAR_box	PTV_ref	PTV_box	OAR_ref	OAR_box
Film Dose measured Dm [Gy]	4.100	4.070	1.031	1.039	3.919	3.924	1.837	1.844
Dose planned [Gy]	4.176	4.176	1.026	1.026	4.018	4.018	1.841	1.841
Dose stated (from plan) Dp [Gy]	4.159	4.159	1.022	1.022	4.004	4.004	1.835	1.835
Deviation (Dm-Ds)/Ds [%]	**-1.4%**	**-2.2%**	**0.9%**	**1.7%**	**-2.1%**	**-2.0%**	**0.1%**	**0.5%**
AVG deviation	-1.8%		1.3%		-2.1%		0.3%	
Dm/Ds	0.986	0.978	1.009	1.017	0.979	0.980	1.001	1.005
Dose TLD/Dose film	**1.009**	**1.035**	**1.025**	**0.954**	**0.961**	**0.991**	**1.008**	**0.940**

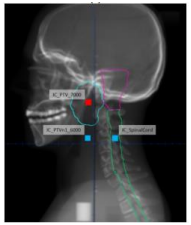
Level III audits include comprehensive dosimetry for advanced IMRT and stereotactic techniques and radiosurgery. These audits are performed using anthropomorphic phantoms and calculations performed in the treatment planning system. Thus, not only the operation and calibration of the therapeutic device is checked, but also the preparation of the treatment planning system for clinical applications. Level III audits are usually carried out on an exit basis. In 2021, SSDL conducted such an audit using the SHANE phantom provided by the IAEA. The audit was performed for 8 centres. It took place in two stages, in the first stage the audited centre had to perform several tasks, so that in the second stage the auditors would come to the audited centre and, together with local physicists, perform measurements in the hospital.

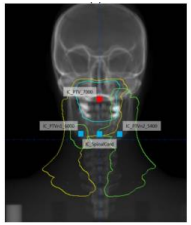


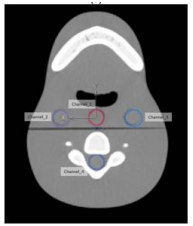
Results:

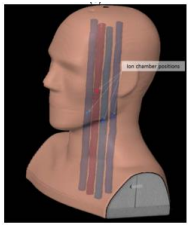
#	Relative output of the day	Dose difference [%]				Gamma
		IC_PTV_7000	IC_PTVn1_6000	IC_PTVn2_5400	IC_SpinalCord	global 3% 3mm
1	0.984	-3.6	-3.4	-4.5	-1.6	99.8
2	1.006	0.6	1.0	1.8	1.5	99.7
3	0.987	-1.9	-0.4	1.8	2.0	98.4
4	0.992	-4.5	-1.7	-2.4	-1.7	98.8
5	0.994	-2,3	-1.7	-1.4	-4.5	98.8
6	0.990	-3.5	-2.9	-1.1	-2.9	98.5
7	1.001	-2.1	-0.7	0.4	-5.3	91.5
8	0.998	-1.3	-2.0	-1.1	-2.1	96.3
AVG	**0.996**	**-2.1**	**-1.2**	**-0.3**	**-1.9**	**97.4**
SD	**0.7%**	**1.6**	**1.3**	**1.6**	**2.8**	**2.8**

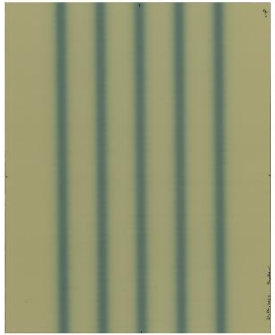




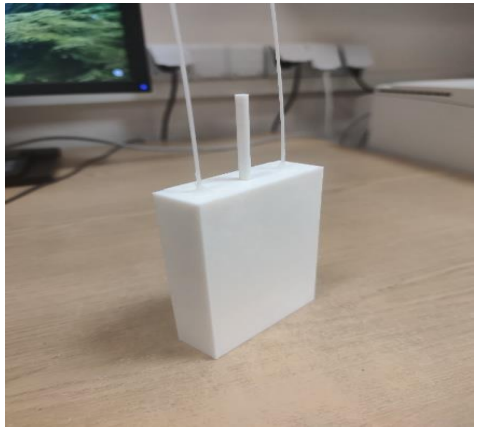


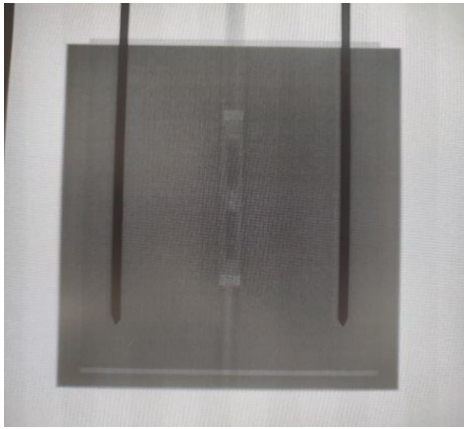


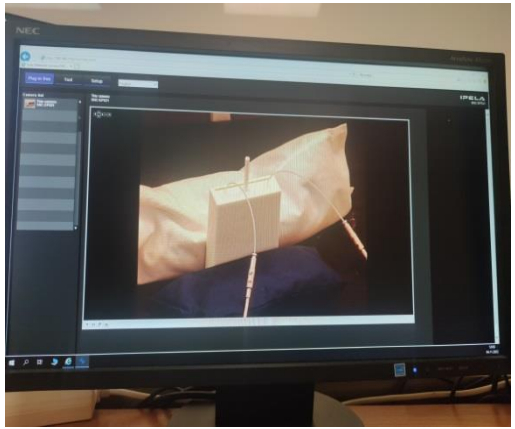




Regular dosimetry audits have contributed to raising the standards of radiotherapy in Poland. In order to meet expectations and the invariably dynamic development of treatment techniques in radiotherapy, SSDL is working on developing new types of customised audits, e.g. for brachytherapy, in addition to routine Level I audits.







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Thank you for attention.