



The external audit of therapy beams : Equal-Estro Experience

*Equal-Estro, a dosimetry laboratory keeping pace with
modernization in radiotherapy*

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Versailles, France
December 2 - 4, 2009

A brief history of Equal-Estro

Until 2004

- **EQUAL project was started during 1998**
 - dedicated to QC in external radiotherapy
 - launched by ESTRO and IGR-Paris
 - supported by the EC

Since 2004

- **EQUAL Laboratory become Equal-Estro sas in 2004**
- **Accredited by the AFSSAPS since 2004 (external radiotherapy)**
- **Accredited by the COFRAC since 2009 (TLD method)**
- **Equal-Estro laboratory currently propose dosimetry audits in :**
 - Conventional external radiotherapy
 - Brachytherapy
 - IMRT and Tomotherapy
 - Coming soon for Cyberknife, Micro-beams and protons

The Equal-Estro Laboratory

Current activity of the laboratory

Dosimetry audits in radiotherapy

- ❖ Mandatory controls (France)
- ❖ Volunteer checks
- ❖ Clinical trials



Location

- ❖ IGR – Villejuif, Paris

Laboratory Team

- ❖ 1 secretary
- ❖ 3 technicians
- ❖ 1 physicist



Quality Assurance

The accuracy requirements and the medical consequences need a dedicated QA programme

- **Internal QA** - by the staff in charge, working in the hospital
- **External audits** - with an independent dosimetry laboratory

**External audits have been performed by our laboratory
for more than 15 years for international clinical trials**

Measuring the dose for external audits - TLDs

TLD = Thermoluminescent dosimetry

- The TLD technique is one of the methods employed for dose measurements
- Equal-Estro use TLDs for the audit of the external beams as well for brachytherapy

Conventional radiotherapy



Linac under dose measurements



TLDs (tubes, powder, chips)



TLD reading system

- The method is similar to that employed by the IAEA

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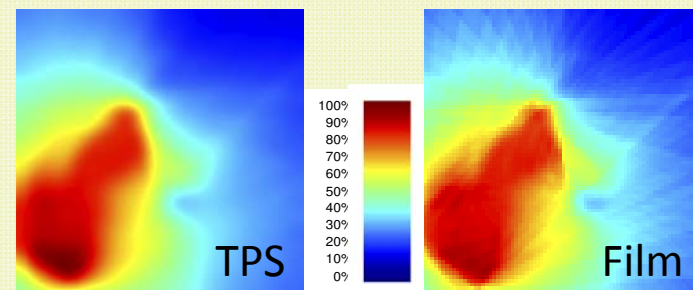
Measuring the dose for external audits

Modern techniques of radiotherapy

Available

- IMRT and Tomotherapy

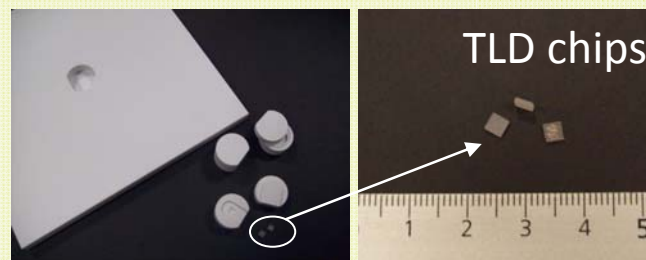
- Film dosimetry
- EasyCube phantom
- Compare TPS dose distribution with film dose distribution



In work

- Small beams (μ MLC)

- Small size, solid TLDs - chips
- EasyCube phantom

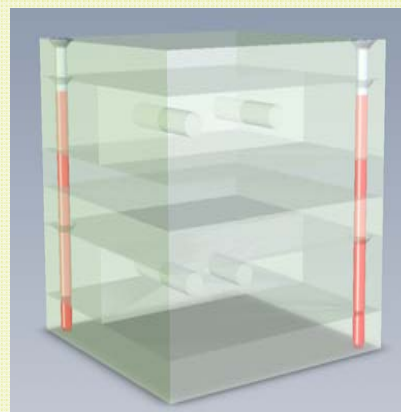


- Ciberknife

- Film dosimetry + TLD tubes

- Protons

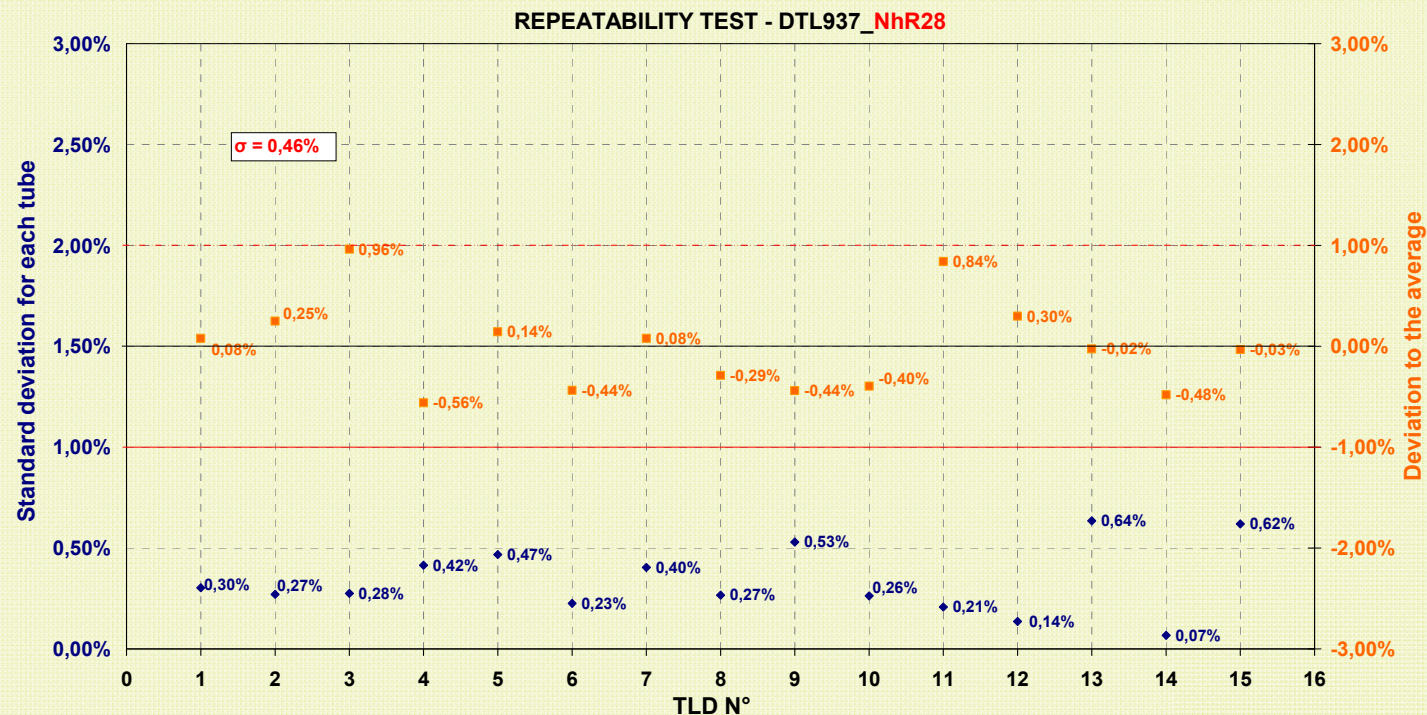
- Film dosimetry
- Orsay Proton Therapy Center



Metrology

Laboratory internal tests - repeatability

- A set of 15 TLDs are irradiated and read by Equal-Estro laboratory



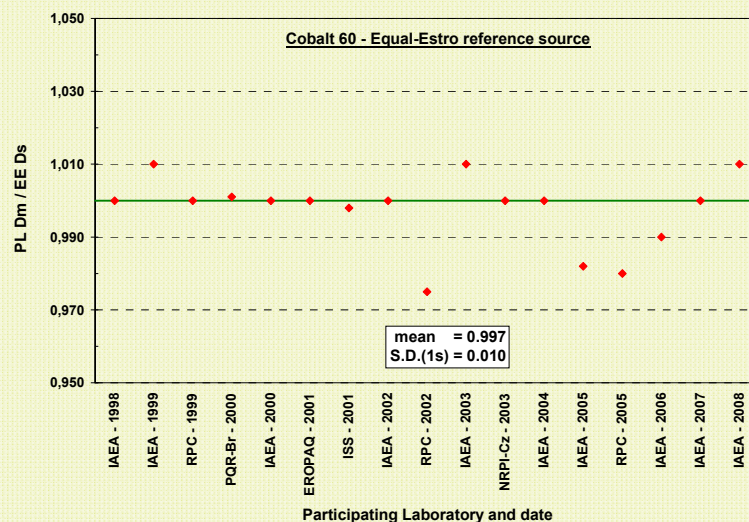
The most recent repeatability test, performed on September 2009, for the DTL-937 powder

- ❖ The result is considered as acceptable when Std.dev. is within 1 %
- ❖ The test is repeated periodically or as needed

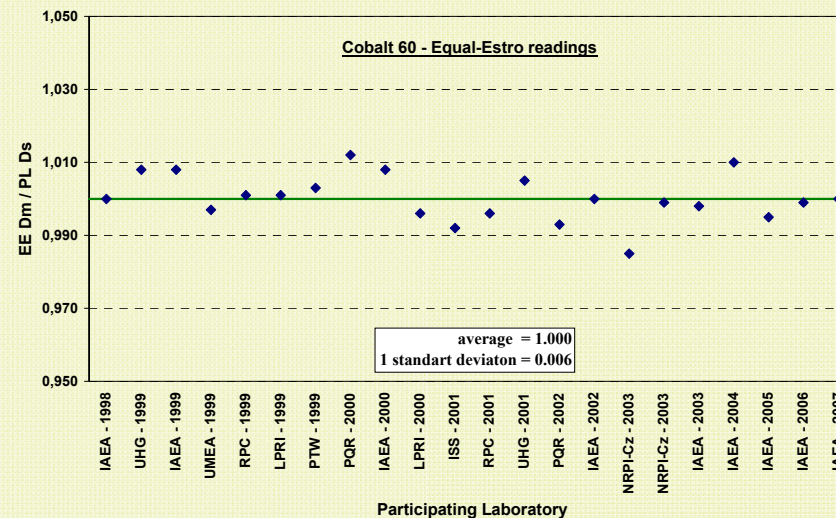
Laboratory external audits – intercomparisons

Co-60 gamma beams

Dosimeters irradiated in our laboratory
and read by other laboratories



Dosimeters irradiated in reference laboratories
and read in our laboratory



Our reference source is tested

Our TLD reading system is tested

- For the last ten years results of intercomparisons with reference centres show :
 - a standard uncertainty within $\pm 1\%$

External audit services

External radiotherapy

High Energy Photon Beams : example of checked parameters

- Reference Beam Output
- Depth Dose Data
- Beam Output Variation
- Wedge Transmission Factor

Brachytherapy systems

HDR and PDR systems using Ir-192 sources

- One point of check
- Irradiations using 3 symmetric positions of applicators

ACCEPTABILITY CRITERIA : measured dose / stated dose

High Energy Photon Beams

DEVIATION LEVELS on the D_m/D_s (δ)

$\delta \leq \pm 3 \%$	within OPTIMAL LEVEL	} → OK
$\delta > \pm 3 \%$ to $\leq \pm 5 \%$	within TOLERANCE LEVEL	
$\delta > \pm 5 \%$ to $\leq \pm 10 \%$	outside TOLERANCE LEVEL	→ Recheck
$\delta > \pm 10 \%$	EMERGENCY LEVEL	→ Stop + Recheck

HDR and PDR systems

$\delta \leq \pm 5 \%$	within OPTIMAL LEVEL	} → OK
$\delta > \pm 5 \%$ to $\leq \pm 7 \%$	within TOLERANCE LEVEL	
$\delta > \pm 7 \%$ to $\leq \pm 10 \%$	outside TOLERANCE LEVEL	→ Recheck
$\delta > \pm 10 \%$	EMERGENCY LEVEL	→ Stop + Recheck

Mandatory controls in France

- ❖ external dosimetry audits became mandatory in France since 2004
- ❖ external radiotherapy

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Décrets, arrêtés, circulaires

14 août 2007

JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE

Texte 34 sur 141

Décision

Décrets, arrêtés, circulaires

TEXTES GÉNÉRAUX

MINISTÈRE DE LA SANTÉ, DE LA JEUNESSE ET DES SPORTS

Décision du 27 juillet 2007 modifiant la décision du 2 mars 2004
fixant les modalités du contrôle de qualité externe des installations de radiothérapie externe

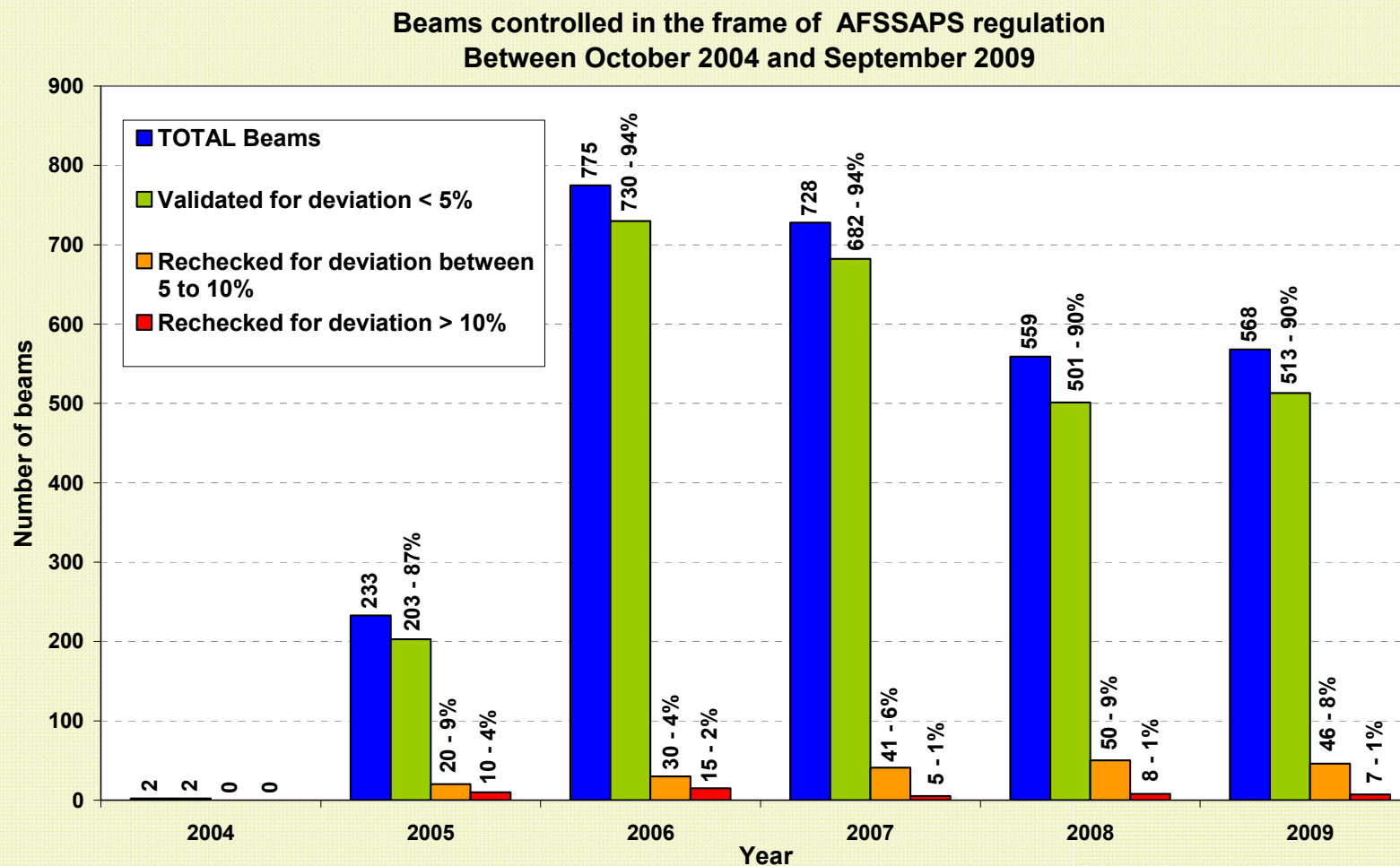
NOR : *SJSM0721861S*

- ❖ supervised by the AFSSAPS
(the French Health Products Safety Agency)

➤ **Our laboratory is in charge of such controls in France**

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Mandatory controls (in France)

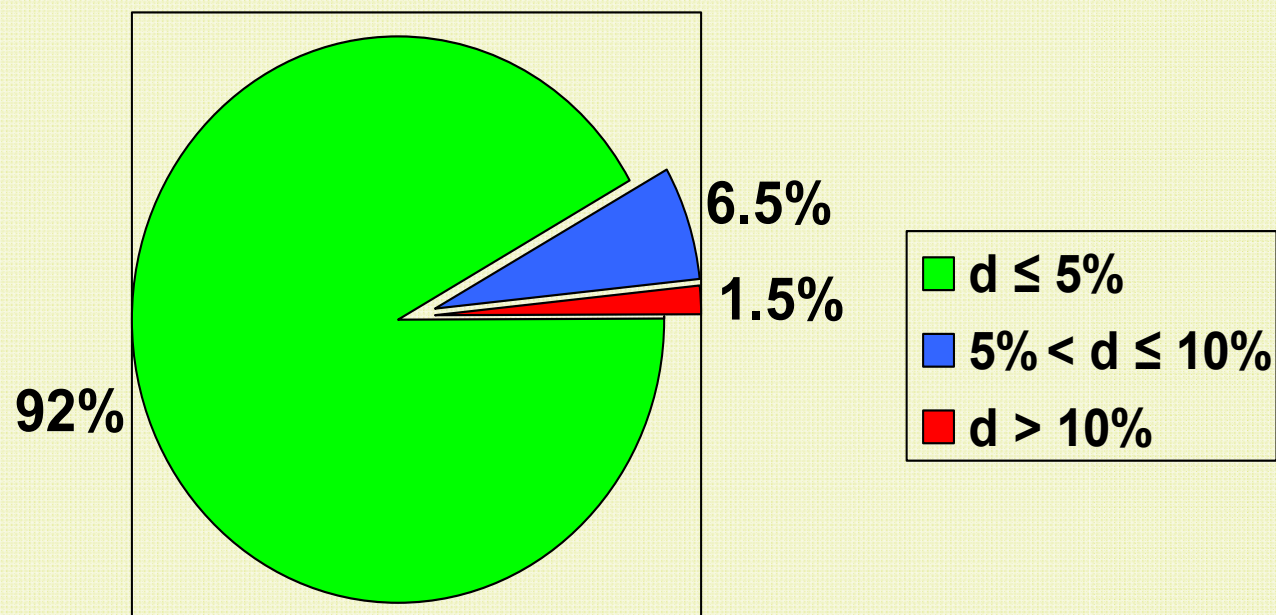


❖ since 2004, the serious deviations has diminuend

Results for mandatory controls

❖ **total number of beams, controlled since 2004 : 2863**

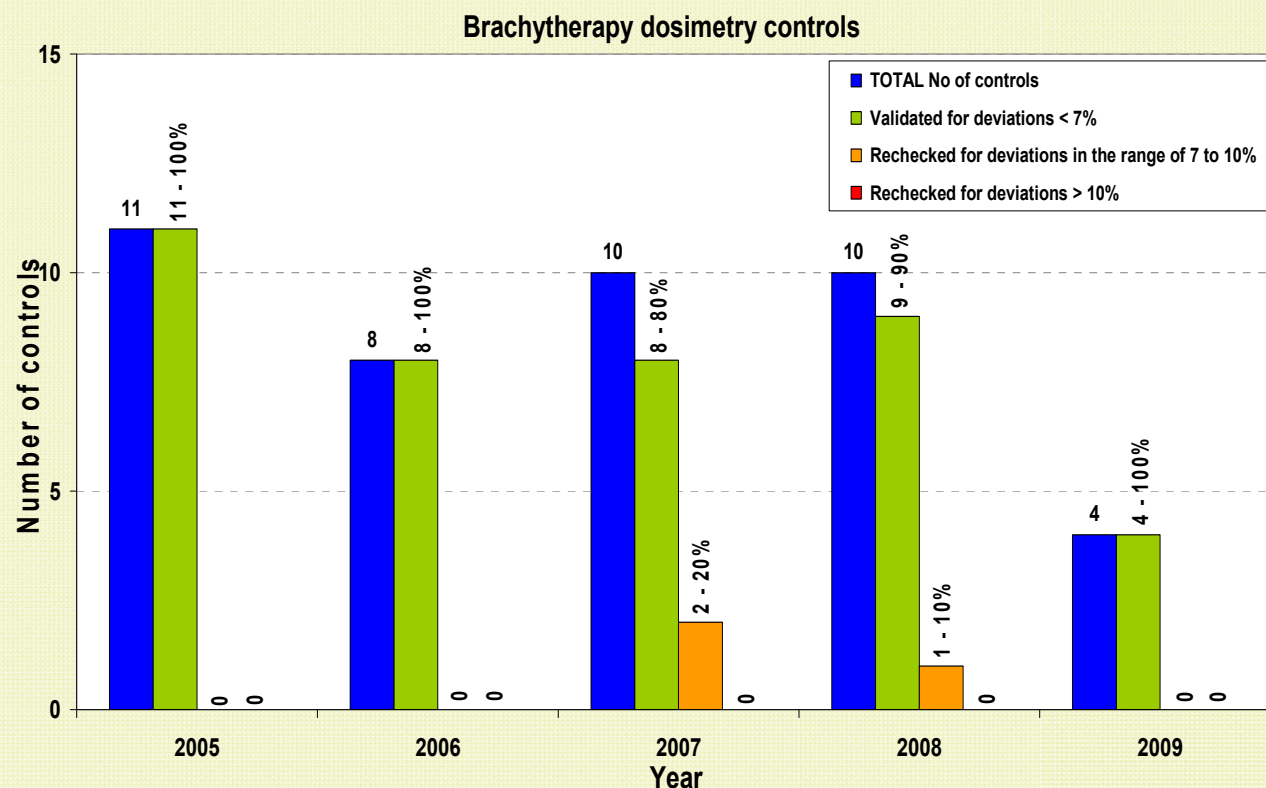
Deviation (δ)	$\delta \leq 5\%$	$5\% < \delta \leq 10\%$	$\delta > 10\%$
Nr. of beams	2631	187	45



❖ **More than 90 % of the checked beams fulfil the acceptability criteria after the first check**

Results of dosimetry audits in brachytherapy

- ❖ The controls were performed for European centres



- geometric reconstruction tests are additionally proposed

- ❑ Collaboration between the “BRAPHYQS” group and EQUAL Laboratory since January 2002

CONCLUSIONS

- *Equal-Estro* provide an independent and trustworthy verification of *dose delivery*
- The metrology is one of most important aspects of the activity in *Equal-Estro* laboratory
- The TLD method, as employed by our laboratory, has proved its suitability in practice
- Our laboratory is interested in developing new dose control techniques
- The external audits allows detecting *dosimetric* errors
- Major deviations for dose delivery are decreasing

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