Catalan Clinical Audit
Network for Quality Improvement
in Radiotherapy

Dosimetry audits:
QUATRO

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the European Union

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Learning objects

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Describe the scope of dosimetric measurements

– Understand which physical checks are included in QUATRO (e.g. reference and clinical dosimetry for photons/electrons).

Identify required equipment and preparations

– Know what the audit team brings (ion chambers, electrometer, etc.) and what the center must provide (e.g. water phantom, TPS access).

Physical measurements

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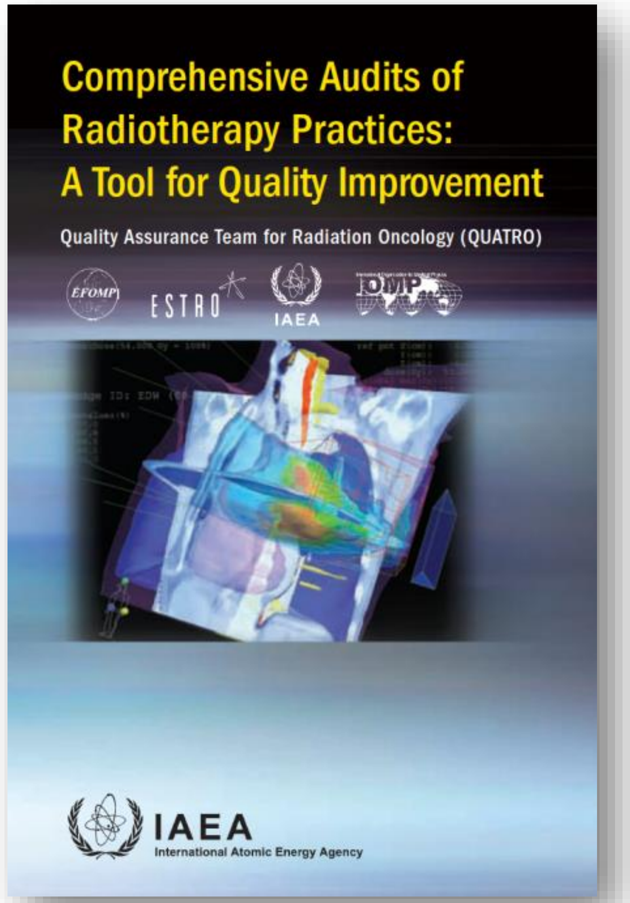
Physicist is required to perform physical measurements as part of the QUATRO audit



Audit preparation: before visit

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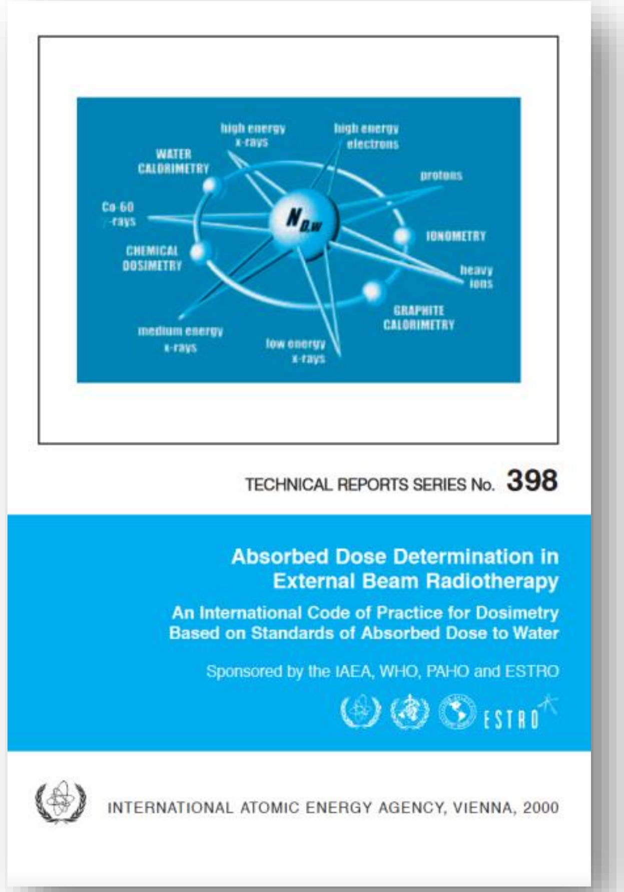
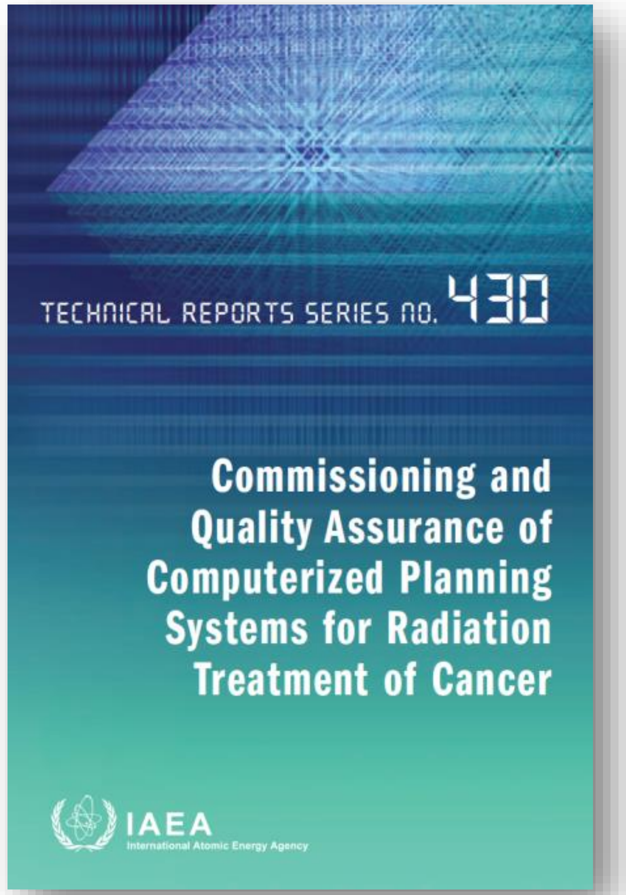
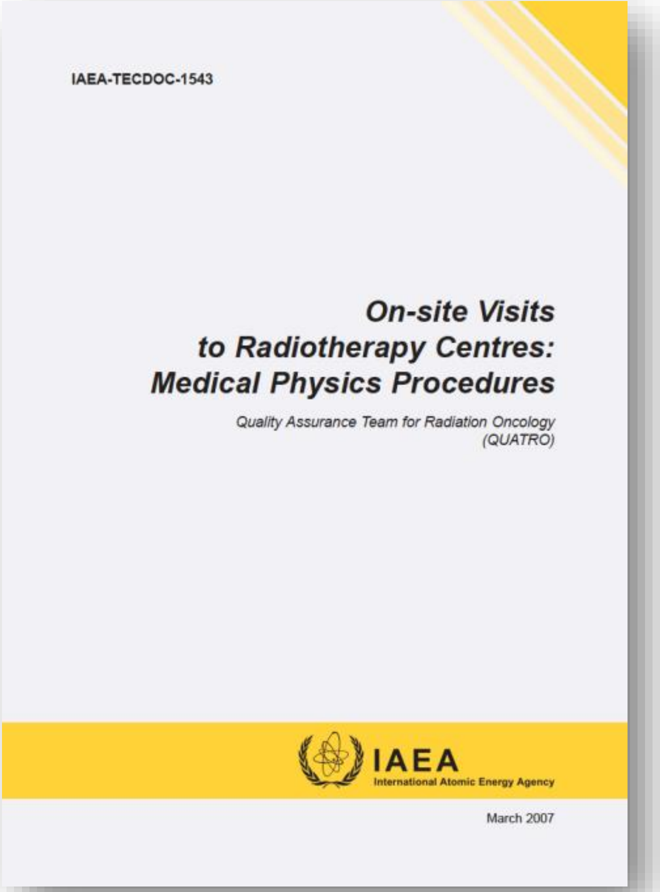
Mandatory reading: IAEA TRS 398, IAEA TRS 430 and IAEA TECDOC-1543







Audit preparation: before visit

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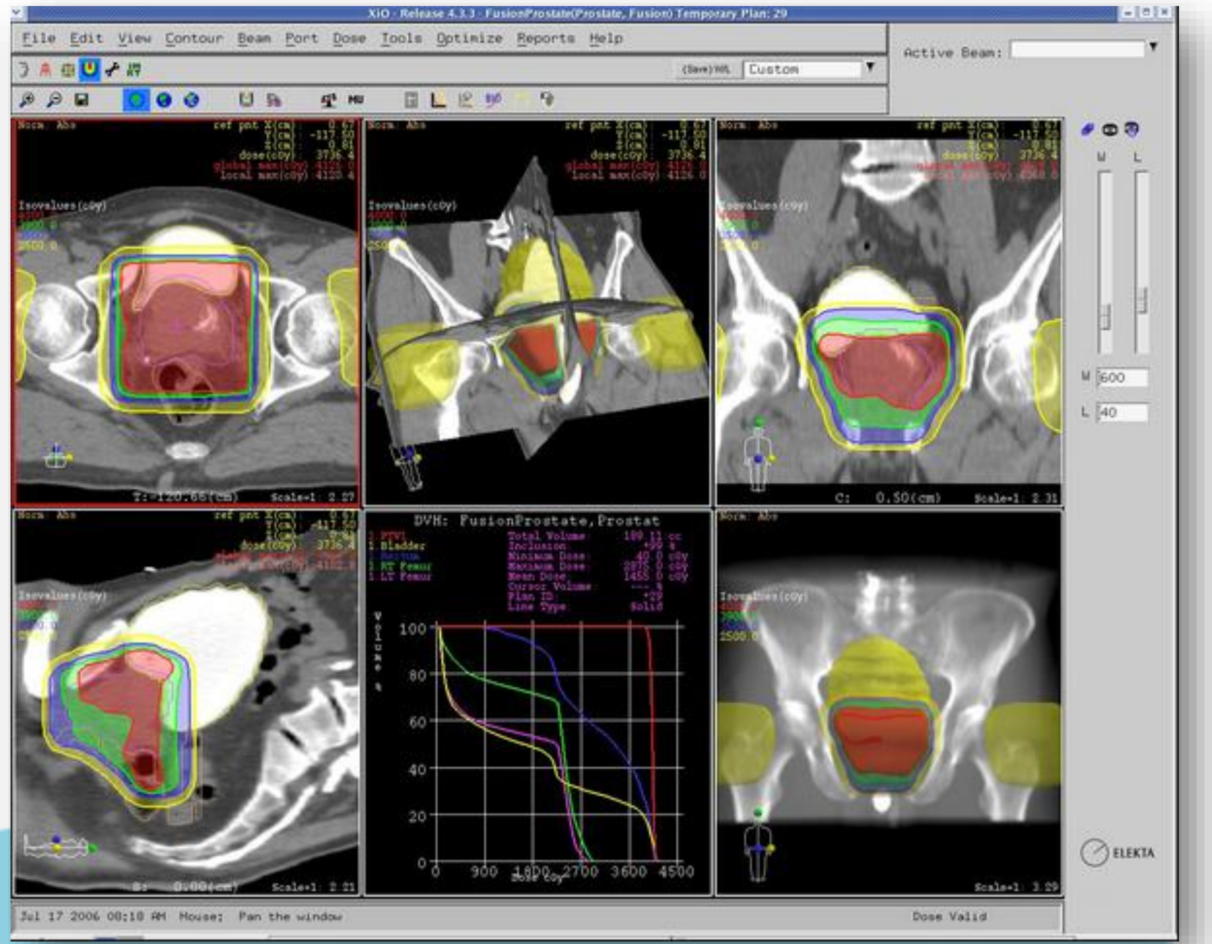
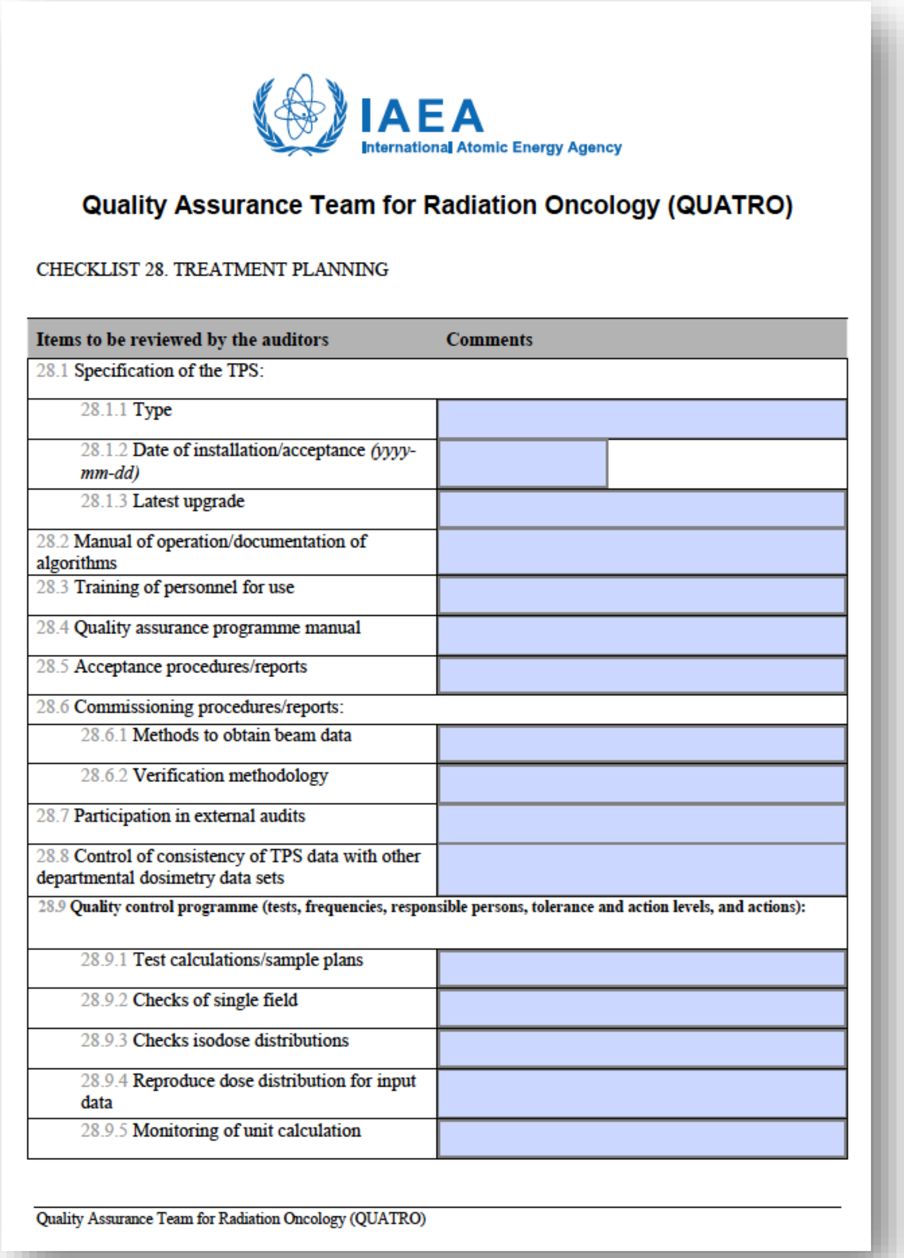
- Information on TPS
- Treatment delivery machines (beam types, energy, ...)
- Dosimetry equipment of the center
- Measurement protocols





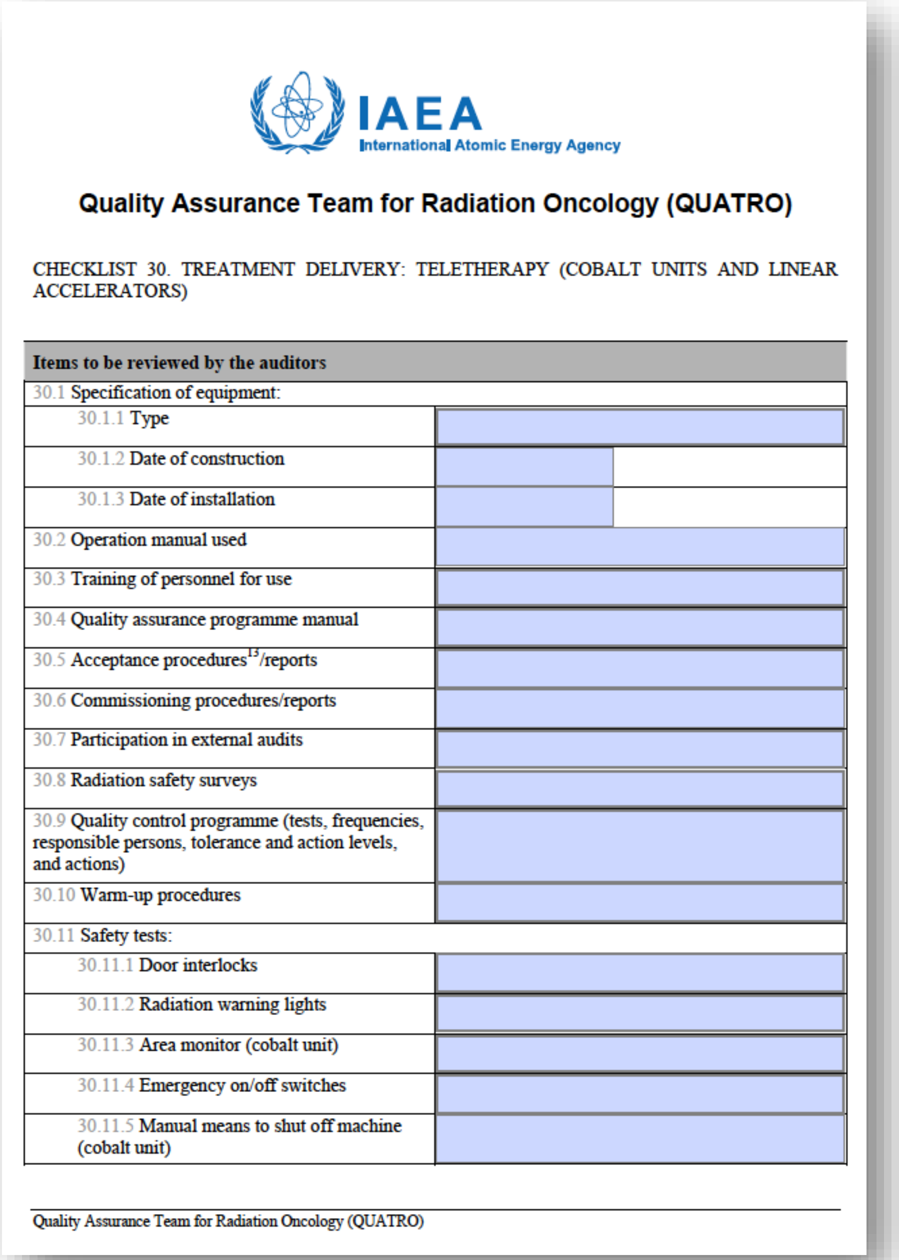
IAEA International Atomic Energy Agency

Quality Assurance Team for Radiation Oncology (QUATRO)

CHECKLIST 28. TREATMENT PLANNING

Items to be reviewed by the auditors	Comments
28.1 Specification of the TPS:	
28.1.1 Type	
28.1.2 Date of installation/acceptance (yyyy-mm-dd)	
28.1.3 Latest upgrade	
28.2 Manual of operation/documentation of algorithms	
28.3 Training of personnel for use	
28.4 Quality assurance programme manual	
28.5 Acceptance procedures/reports	
28.6 Commissioning procedures/reports:	
28.6.1 Methods to obtain beam data	
28.6.2 Verification methodology	
28.7 Participation in external audits	
28.8 Control of consistency of TPS data with other departmental dosimetry data sets	
28.9 Quality control programme (tests, frequencies, responsible persons, tolerance and action levels, and actions):	
28.9.1 Test calculations/sample plans	
28.9.2 Checks of single field	
28.9.3 Checks isodose distributions	
28.9.4 Reproduce dose distribution for input data	
28.9.5 Monitoring of unit calculation	

Quality Assurance Team for Radiation Oncology (QUATRO)



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CHECKLIST 30. TREATMENT DELIVERY: TELETHERAPY (COBALT UNITS AND LINEAR ACCELERATORS)

Items to be reviewed by the auditors	
30.1 Specification of equipment:	
30.1.1 Type	
30.1.2 Date of construction	
30.1.3 Date of installation	
30.2 Operation manual used	
30.3 Training of personnel for use	
30.4 Quality assurance programme manual	
30.5 Acceptance procedures[13]/reports	
30.6 Commissioning procedures/reports	
30.7 Participation in external audits	
30.8 Radiation safety surveys	
30.9 Quality control programme (tests, frequencies, responsible persons, tolerance and action levels, and actions)	
30.10 Warm-up procedures	
30.11 Safety tests:	
30.11.1 Door interlocks	
30.11.2 Radiation warning lights	
30.11.3 Area monitor (cobalt unit)	
30.11.4 Emergency on/off switches	
30.11.5 Manual means to shut off machine (cobalt unit)	

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QUATRO equipment test kit

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The kit provides:

- Electrometer
- Calibrated ionization chamber (cylindrical and plane-parallel)
- Water phantom
- Supplementary equipment (thermometer, barometer, rulers,....)
- TRS 398
- General documentation

What is included in the dosimetry audit

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PART II. ON-SITE DOSIMETRY VISITS TO RADIOTHERAPY HOSPITALS

Two evenings measuring

Logistics

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- **There is no need to suspend or reschedule patient treatments.**
  Measurements are performed after treatments are completed.
- **The experts bring all the necessary equipment for the measurements**
  (except the water phantom).
- **At least one member of the institution with knowledge of the TPS and the linear accelerator must be present**
  with the expert during measurements or TPS evaluations.
- **The TPS will be used during the expert's visit.**
- **Access to the CT may be required.**

The expert will be equipped with a standard instrumentation kit, which contains the following equipment:

(a) Electrometer;
(b) Two Farmer-type chambers and one plane-parallel ionization chamber along with calibration certificates;
(c) Triaxial cable;
(d) Digital barometer, thermometer (preferably 2 thermometers);
(e) Water phantom;
(f) Spirit level;
(g) Ruler;
(h) Calliper;
(i) Multimeter;
(j) Simple tools (screwdrivers), adaptor plug;
(k) Scotch tape;
(l) Seven verification films (pre-packed);
(m) Survey meter;
(n) Graph paper (millimetre scale);
(o) Spare batteries;
(p) Telescopic distance indicator for distance and isocentric checks;
(q) Stopwatch;
(r) Two TLD sets and a TLD holder along with the instruction and data sheets;
(s) If electrons are to be measured: a water phantom with provision for holding cylindrical and plane-parallel chambers and for varying the chamber position flexibly.

The dosimetry equipment is calibrated at the Dosimetry Laboratory of the IAEA and its calibration coefficients are traceable to BIPM. The Dosimetry Laboratory of the IAEA provides the quality assurance and maintenance of the expert's equipment. It is the expert's responsibility to complement this equipment with additional items which may be needed during the visit, such as a laptop and other items as appropriate.

Safety first

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11.1. SAFETY TESTS

Before conducting any tests on the treatment unit, the expert should conduct, as a minimum, the following safety tests to ensure the safety of working conditions:

(a) Door interlocking operation;
(b) Radiation light warning operation;
(c) Emergency on/off switches operation;
(d) Manual means to close the machine down;
(e) Exposure rate within the room when the treatment unit is in 'beam off' condition.

… It includes the security of QUATRO team

The expert must wear a personal radiation monitoring device and, if available, have a radiation survey meter with an active alarm option nearby.

MPE is the responsible of the radiation safety of all QUATRO team

Safety first

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Basic safety tests

- door interlock operational, ok
- radiation light warning operational, ok after repair
- exposure within the room with treatment unit in "beam off" condition.:
- max. 0.26μSv/h at 1m and 0.63μSv/h contact collimator

- Check the interlock and radiation light warning under all conditions
- In not functional, first repair before to proceed

Mechanical test as second

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Mechanical tests

– Lasers:. The congruence of the lateral lasers and the isocenter horizontal plane, 20 cm on either side of the isocenter, at the nominal treatment distance.

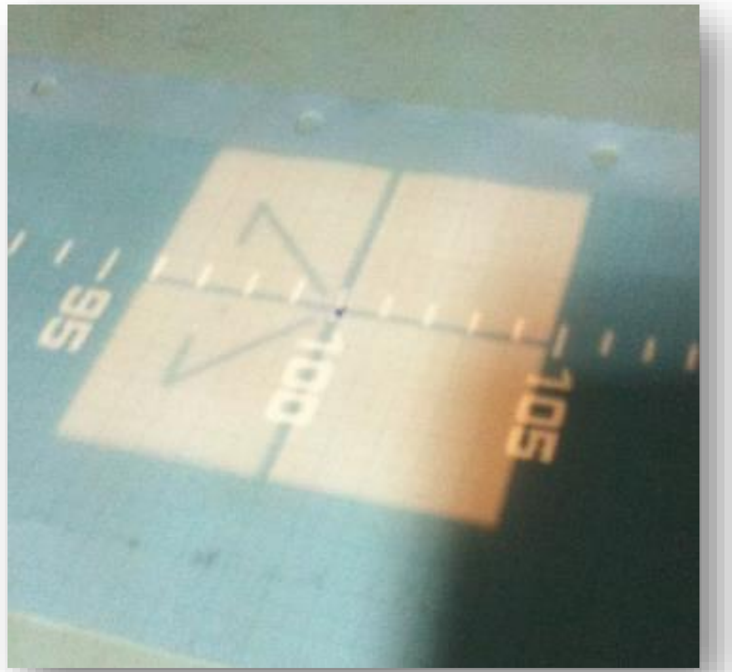
Better than 1mm

– Optical Distance Indicator (ODI):. The congruence of the ODI and the mechanical isocenter; the ODI at –10 cm, and +10 cm from the mechanical isocenter.

Less than 1mm difference at SSD 80 and 120, 0mm at SSD 100cm

– Field Size Indicator: The field size indicator compared to the light field at the nominal treatment distance for three field sizes (5 cm x 5 cm, 10 cm x10 cm, 20 cm x20 cm).

– All differences less than 1mm



- All mechanical parameters must be within tolerance before to proceed

Dosimetry equipment comparison

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Barometer, thermometer

Dosimetry calibrations and measurements

Basic dosimetry data

Barometer:

Local: local 1007.3 mBar

IAEA OPUS1: 1002.7 mBar

Thermometer, local: 24.0°C, IAEA: 23.9°C

Pictures of measurements

Barometer check

Dosimetry calibrations and measurements

Basic dosimetry data

Barometer:

Local: local 926.5 mBar

IAEA OPUS1: 922.3 mBar

Thermometer, local (electronical): 16.6°C, IAEA: 18.6°C: difference 2°C to be replaced

Pictures of measurements

Barometer & thermometer check

- If differences with the IAEA equipment are too large, replacement is to be recommended.
- Differences should be within 1% and 0.5°C for pressure and temperature respectively
- Be aware for digital thermometers, they can drift!

Dosimetry equipment comparison

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Before performing the beam output calibration, it is necessary for the expert to make the following comparisons:

(a) Comparison of the institution's and the expert's dosimetry systems;
(b) Comparison of the institution's and the expert's barometer and thermometer readings.

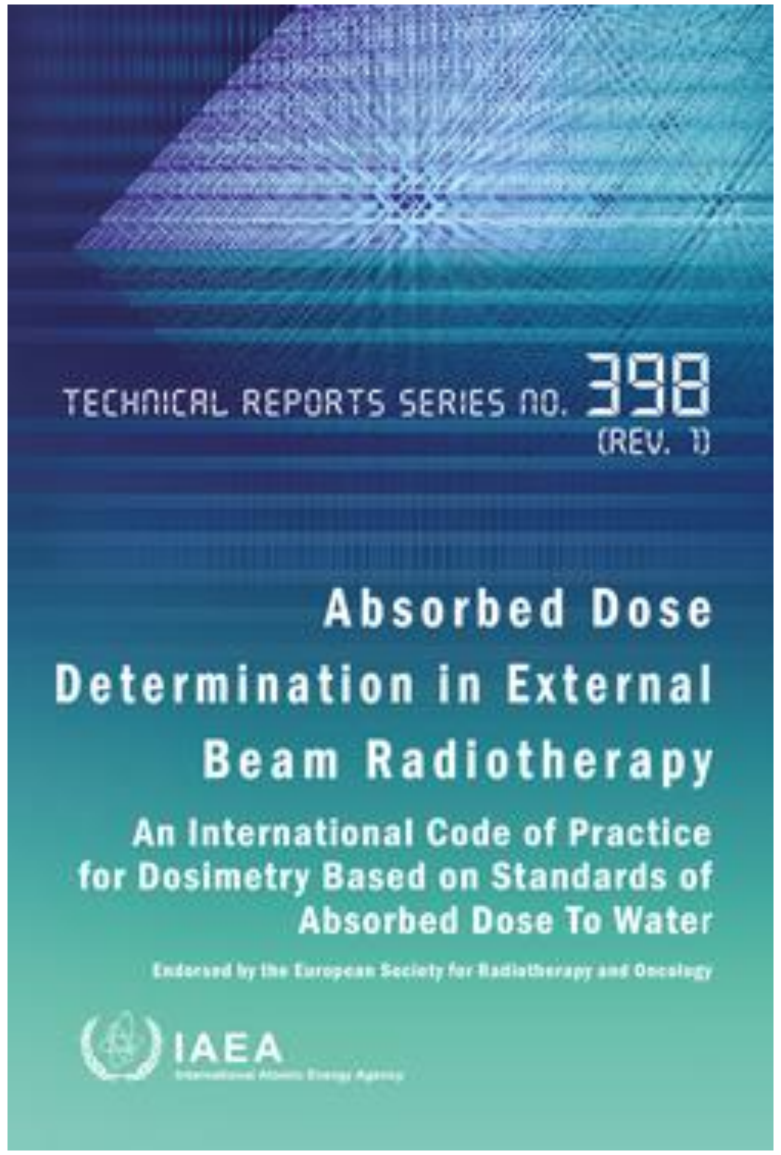
Ion chamber comparison

The standard method for comparison of the institution's ionization chamber and electrometer with the expert's dosimetry system is to position both chambers in a water phantom, preferably in a box phantom, and compare their readings in a ^{60}Co beam. If the institution has an ionization chamber that will not fit in the box phantom, then it may be necessary to undertake the comparison in air, with both chambers having the appropriate build-up material (build-up caps). If no cobalt unit is available at the institution, the comparison will be undertaken on the accelerator with the lowest megavoltage photon beam energy available.

For electron beams, the institution's ionization chamber and the expert's plane parallel chamber will be compared in the highest electron beam energy available, $R_{50} > 7\ g/cm^2$ ($\bar{E}_0 > 16$ MeV) is recommended according to TRS 398 [18]. If any questions arise, the comparison will be made with both a cylindrical and a plane-parallel chamber.

- The two readings will be converted to the same physical quantity, i.e. air-kerma or absorbed dose-to-water depending on the institution's dosimetry practice.
- The acceptance level of 2% is to be applied.
- Recalibration of their dosimetry system at the local SSDL, if there is one, or at the IAEA Dosimetry Laboratory is to be recommended.

IAEA (2000) Code of Practice in terms of $N_{D,w}$ (TRS-398)



IAEA (2000) Code of Practice in terms of $N_{D,w}$ (TRS-398)

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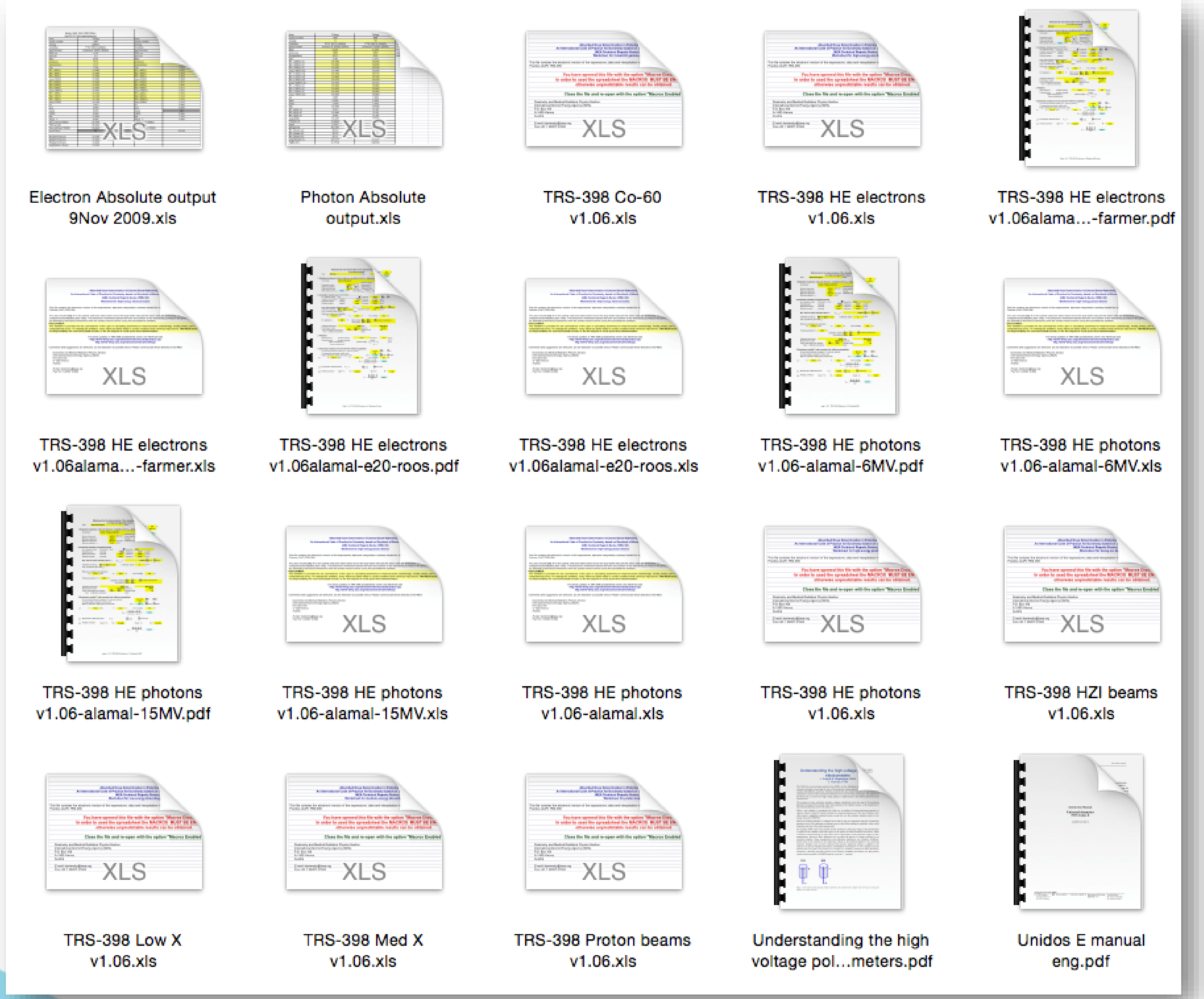
- Useful excel files exist for the application of TRS-398 in reference dosimetry.
- However, use of a spreadsheet does not replace understanding of the code and careful selection of appropriate equipment and data.



Basic and clinical dosimetry

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TECDOC 1543 is a useful resource

Provides examples

Provides a list of measurements to be performed by the medical physicist

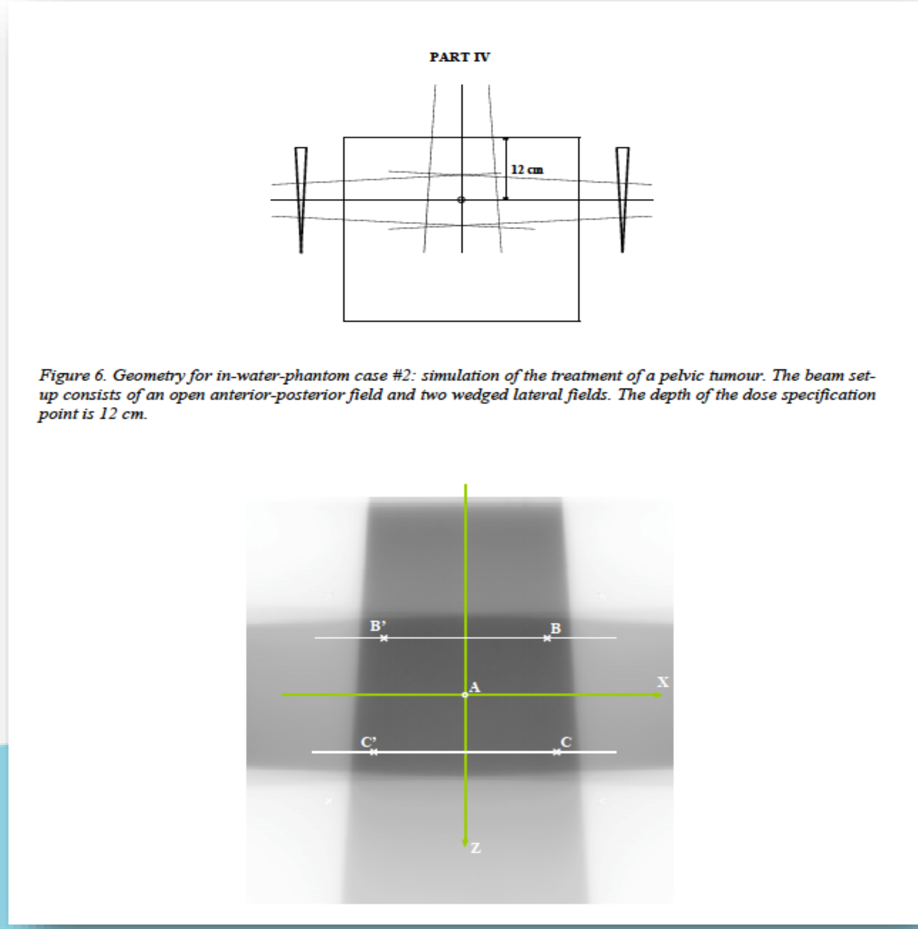
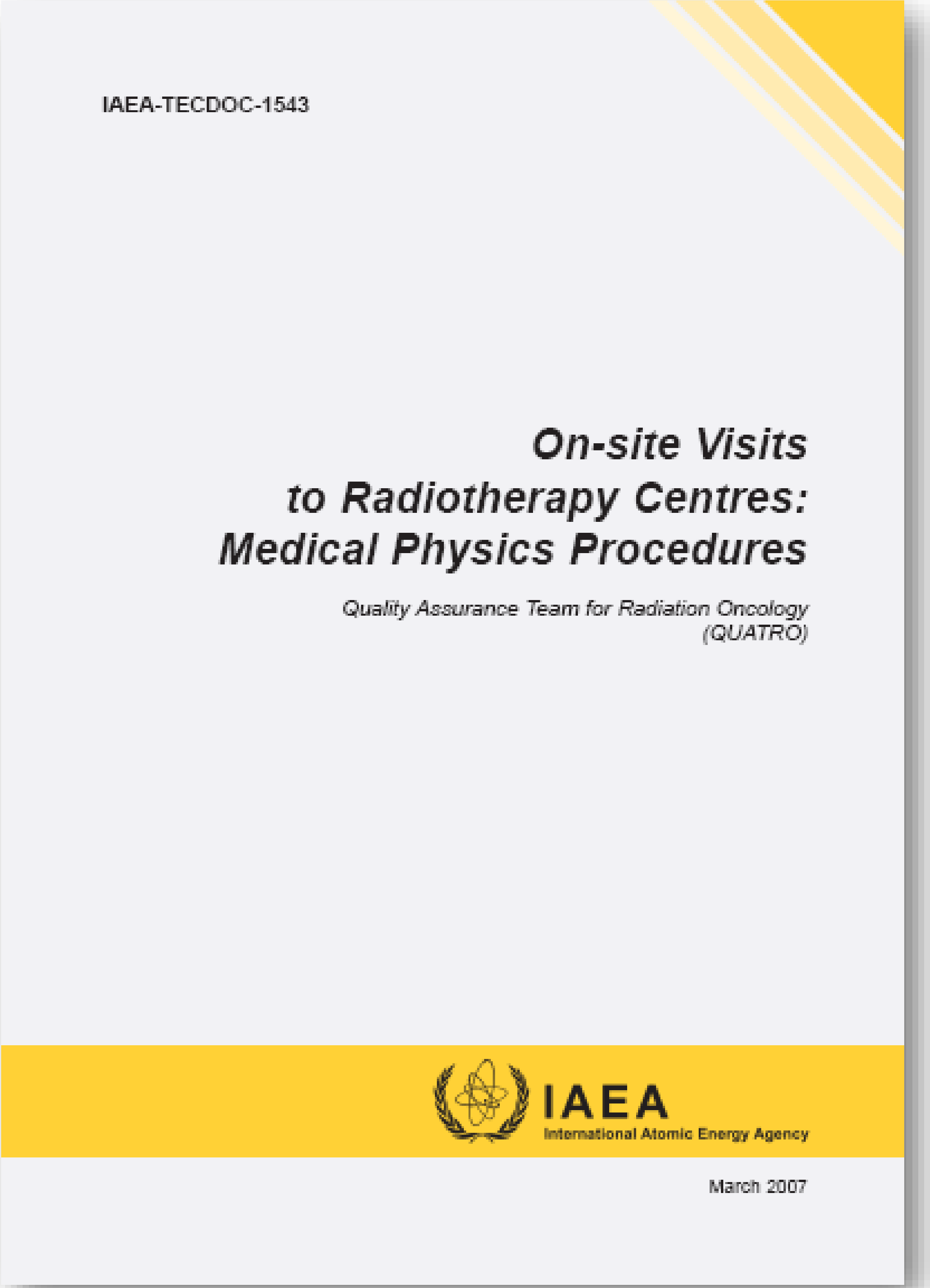

PART IV

Figure 6. Geometry for in-water-phantom case #2: simulation of the treatment of a pelvic tumour. The beam set-up consists of an open anterior-posterior field and two wedged lateral fields. The depth of the dose specification point is 12 cm.


IAEA-TECDOC-1543

On-site Visits to Radiotherapy Centres: Medical Physics Procedures

Quality Assurance Team for Radiation Oncology (QUATRO)

IAEA
International Atomic Energy Agency

March 2007

… from TECDOC 1543: measurement list for clinical dosimetry

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For photon beams, the clinical dosimetry tests will be done for a water phantom irradiated with a single field. The institution will calculate monitor units or time set to deliver 2 Gy for the beam geometries as follows:

(a) Field size 10 cm × 10 cm, depth 5 cm, with and without the most commonly used wedge;
(b) Field size 10 cm × 10 cm, depth 10 cm;
(c) Field size 7 cm × 15 cm, depth 5 cm, with and without the most commonly used wedge;
(d) Field size 7 cm × 15 cm, depth 10 cm.

If blocks are used at the institution, the expert and the local physicist will calculate monitor units or time set for a typical blocked field used at the institution.

For electron beams the clinical dosimetry tests will be done for a water phantom treated with a single field. The institution will calculate monitor units to deliver 2 Gy for the beam geometries as follows:

(a) Standard cone/field size (10 cm × 10 cm or 15 cm × 15 cm) at z_{90};
(b) Largest cone/field size available at z_{90}.

The ion chamber measurements of the basic electron and photon dosimetry parameters as described in section 13.2 will be used to verify the clinical dosimetry tests and calculations as outlined above. This procedure will be discussed with the institution's physicist.

Clinical dosimetry

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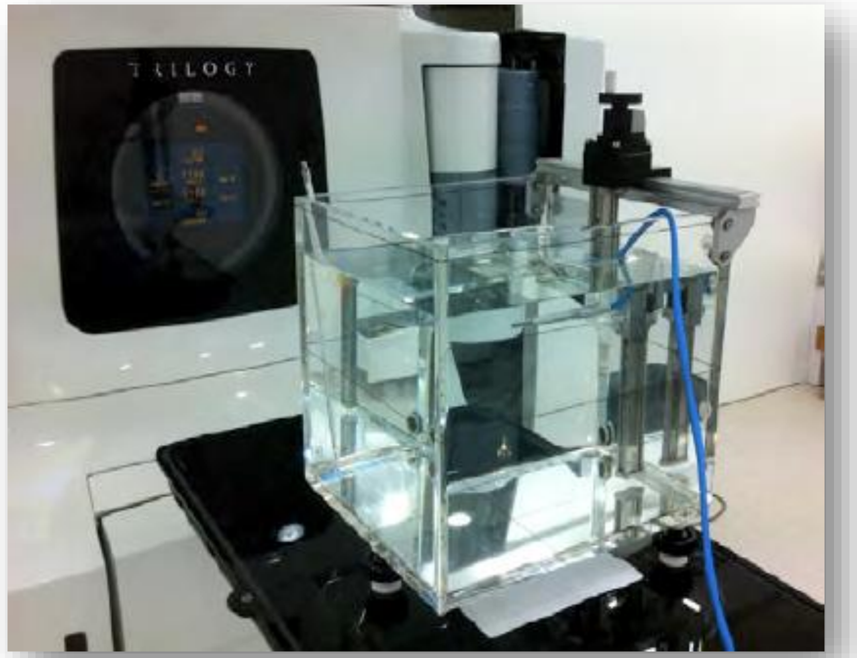
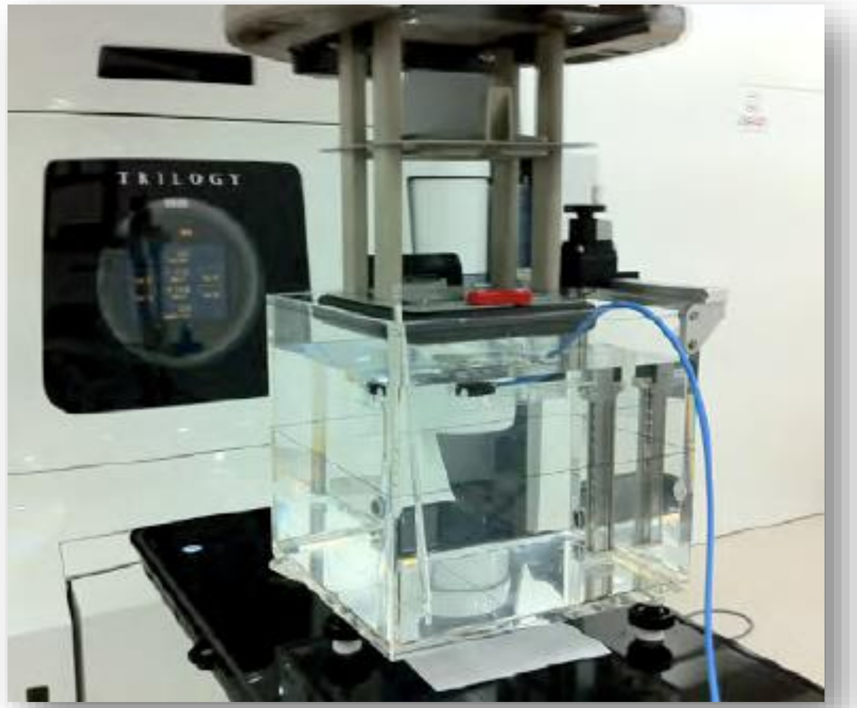
- Establish list of measurements to be performed
- Discuss the list with local physicist
- Ask for the TPS calculation of the same dose points
- Ask for the independent dose calculations of the same dose points

Photon reference dosimetry



Electron reference dosimetry



Clinical photon dosimetry: Measurements

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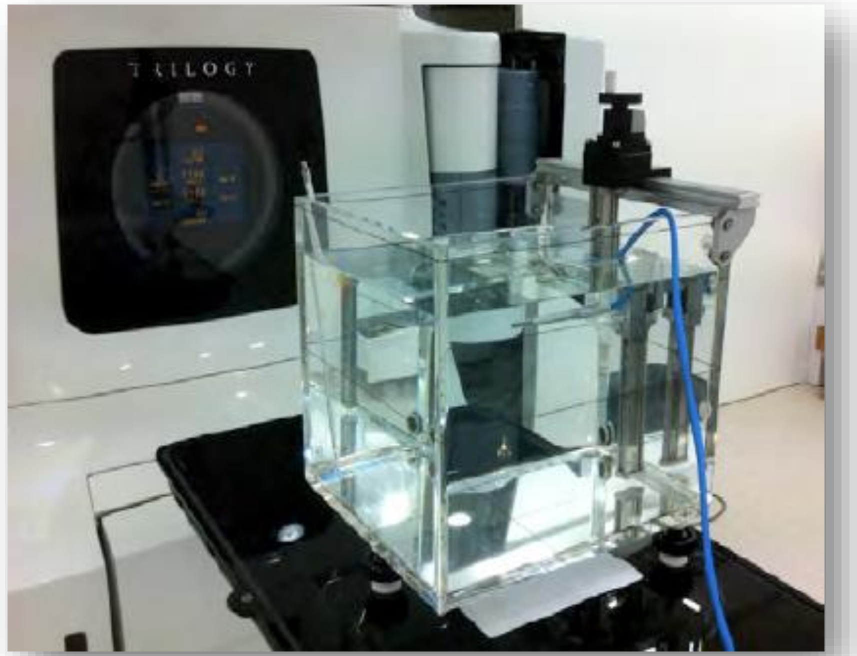
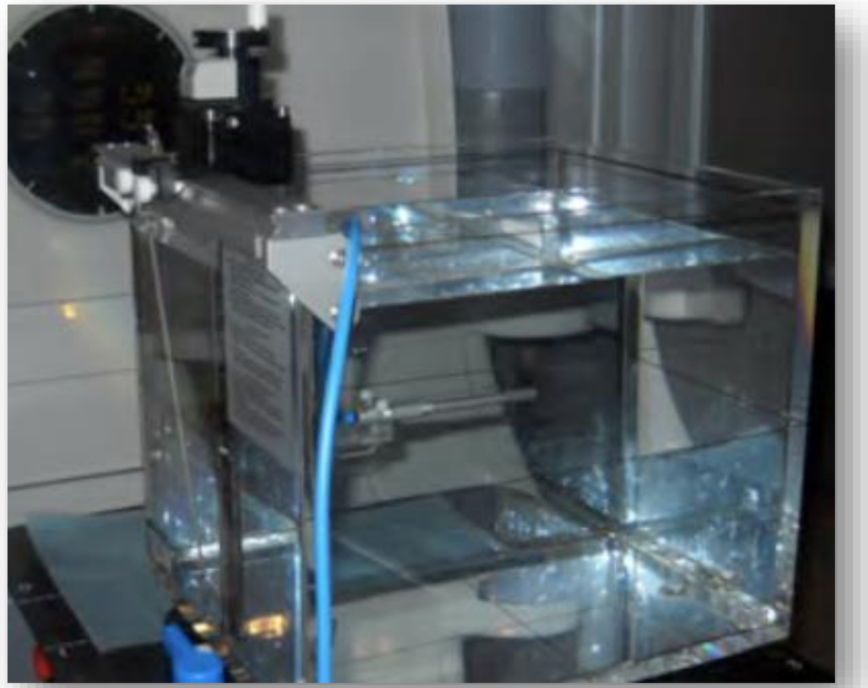
- Establish list of measurements to be performed
- Measurements are following TRS-398
- Use the Farmer type ionization chamber
- Use of the water phantom
- Use of the excel files for the calculations

- Ask for the center to perform their reference dosimetry or daily output check
- This is following the center methodology
- Check difference with the standard output in TPS

Photon reference dosimetry





Clinical photon dosimetry: Measurements

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- Ask for the center commissioning data and reference dosimetry data

Farmer PTW chamber calibration

Type/Series No. M 30013-1166
Measuring Volume 0.6cm³
PTW Electrometer definition: TW1
Calibration Factor N_w = 5.338E+07 Gy/C (Co-60)
Conditions 20 degrees C, 1013 mB (hPa), water phantom
Electrometer calibration k_{el} = 1.0045

$$D_w = k_Q \times k_D \times N_w \times \text{Reading}$$

	Trilogy		**Remarks**
	6MV	15MV	
$TPR_{20,10}$	0.67	0.76	**Beam Quality**
k_Q	**0.991**	**0.975**	**N_w*k_Q=Dose(Gy)**
TMR(10x10 , depth 5 cm)	0.923	0.984	
TMR(10x10 , depth 10 cm)	0.777	0.876	
$F^{dose}(5)$	**1.082**	**1.002**	Conversion of reading at 5 cm deprh in water to dose at Dmax
Kpol	1.001	1.001	
Krec	1.006	1.01	
Perspex Cube $PCF^{dose}(5)$	**1.094**	**1.013**	Conversion of reading at 5 cm depth in perspex to dose at Dmax
$F^{dose}(10)$	**1.284**	**1.125**	Conversion of reading at 10 cm depth in water to dose at Dmax

N_w defined in **TW1**
k_Q, $F^{dose}(5)$ or $F^{dose}(10)$ to be defined in $k_{1,2}$

Clinical photon dosimetry: Comparison

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Worksheet for the determination of the absorbed dose to water in a high-energy photon-beam

User: [redacted] Date: 02/05/2011

1. Radiation treatment unit and reference conditions for $D_{w,Q}$ determination

Accelerator: Varian Novalis TX nr5

Nominal Acc Potential: 6 MV

Nominal dose rate: 300.0 MU min^{-1} — Beam quality, Q ($TPR_{20,10}$): 0.667

Reference phantom: water — Set up: ☐ SSD ☑ SAD

Reference field size: 10 x 10 cm x cm — Reference distance: 95 cm

Reference depth z_{ref}: 5.0 g cm^{-2}

2. Ionization chamber and electrometer

Ion. chamber model: PTW 30006 / 30013 — Serial No.: 4264

Chamber wall material: PMMA thickness: 0.057 g cm^{-2}

Waterproof sleeve material: none thickness: 0.000 g cm^{-2}

Phantom window material: none thickness: 0.000 g cm^{-2}

Abs. dose-to-water calibration factor [a] N_{D,w,Q_0} = 0.0537 ☑ Gy/nC ☐ Gy/rdg

Calibration quality Q_0: ☑ Co-60 ☐ photon beam — Calibration depth: 5 g cm^{-2}

If Q_0 is photons, give $TPR_{20,10}$:

Reference conditions for calibration

P_0: 101.3 kPa — T_0: 20.0 °C — Rel. humidity: 50 %

Polarizing potential V_1: -400 V

Calibration polarity: ☑ +ve ☐ -ve ☑ corrected for polarity effect

User polarity: ☐ +ve ☑ -ve

Calibration laboratory: IAEA — Date: 27/11/2011

Electrometer model: Unidos E — Serial no.: 90466

Calib. separately from chamber: ☑ yes ☐ no — Range setting: nC

If yes Calibration laboratory: — Date:

3. Dosimetry reading [b] **and correction for influence quantities**

Uncorrected dosimeter reading at V_1 and user polarity: 17.25 ☑ nC ☐ rdg

Corresponding accelerator monitor units: 100 MU

Ratio of dosimeter reading and monitor units: M_1 = 0.1725 ☑ nC/MU ☐ rdg/MU

(i) P: 100.2 kPa — T: 21.3 °C — Rel. humidity: 50 %

$$k_{T,P} = \frac{(273.2+T)\,P_0}{(273.2+T_0)\,P} = 1.016$$

(ii) Electrometer calibration factor k_{elec}: 1.0000 ☐ nC/rdg ☑ dimensionless

(iii) Polarity correction [c] — rdg at $+V_1$: M_+ = 17.23 — rdg at $-V_1$: M_- = 17.25

$$k_{pol} = \frac{|M_+| + |M_-|}{2M} = 0.999$$

(iv) Recombination correction (two-voltage method)

Polarizing voltages: V_1 (normal) = 400 V — V_2 (reduced) = 100 V

Readings at each [e] V: M_1 = 17.25 — M_2 = 17.133

Beam type: ☑ pulsed ☐ pulsed-scanned

Voltage ratio V_1/V_2 = 4.0000 — Ratio of read. M_1/M_2 = 1.007

a_0 = 1.0220 — a_1 = -0.3632 — a_2 = 0.3413

$$k_s = a_0 + a_1\left(\frac{M_1}{M_2}\right) + a_2\left(\frac{M_1}{M_2}\right)^2 = 1.002$$ [f,g]

Corrected dosimeter reading at the voltage V_1:

$$M_Q = M_1\,k_{TP}\,k_{elec}\,k_{pol}\,k_s = 1.7548E-01$$ ☑ nC / MU ☐ rdg / MU

4. Absorbed dose rate to water at the reference depth, z_{ref}

Beam quality corr. factor for user quality Q: k_{Q,Q_0} = 0.9918

taken from ☑ Table 14 ☐ Other, specify:

$$D_{w,Q}(z_{ref}) = M_Q\,N_{D,w,Q_0}\,k_{Q,Q_0} = 9.3455E-03 \text{ Gy / MU}$$

5. Absorbed dose rate to water at the depth of dose maximum, z_{max}

Depth of dose maximum: z_{max} = 1.50 g cm^{-2}

(i) SSD set-up

Percentage depth-dose at z_{ref} for a 10 x 10 cm x cm field size

$PDD(z_{ref}$ = 5.0 g cm^{-2}) = %

Absorbed-dose rate at z_{max}:

$$D_{w,Q}(z_{max}) = 100\,D_{w,Q}(z_{ref}) / PDD(z_{ref}) = \text{ Gy / MU}$$

(ii) SAD set-up

TMR at z_{ref} for a 10 cm x 10 cm field size:

$TMR(z_{ref}$ = 5.0 g cm^{-2}) = 0.92

Absorbed-dose rate at z_{max}:

$$D_{w,Q}(z_{max}) = D_{w,Q}(z_{ref}) / TMR(z_{ref}) = 1.0112E-02 \text{ Gy / MU}$$

Notes: *D at max local: 1.0065 cGy/MU*

Clinical photon dosimetry: TPS calculations

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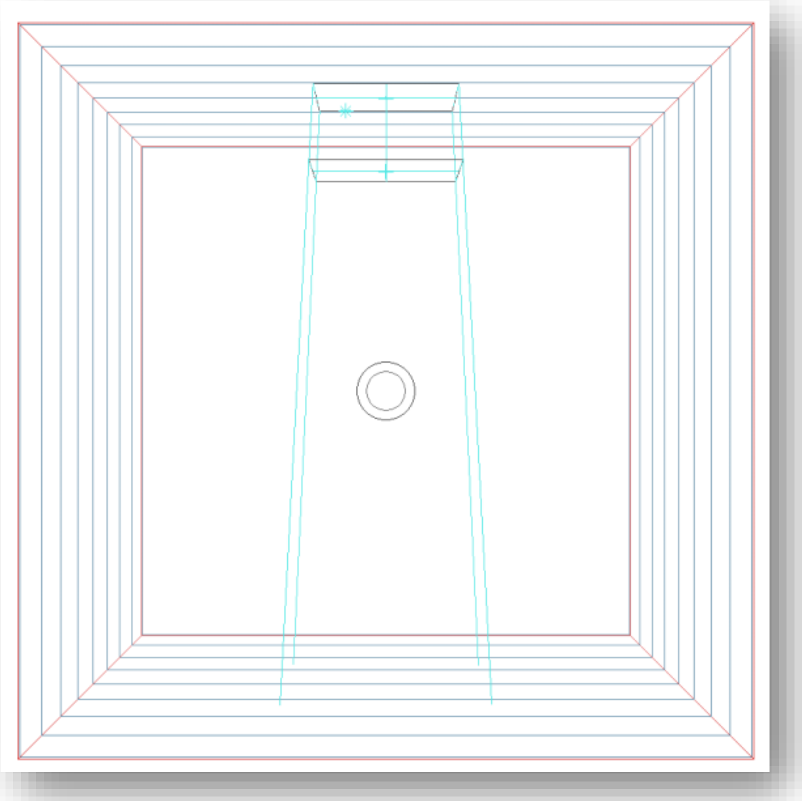
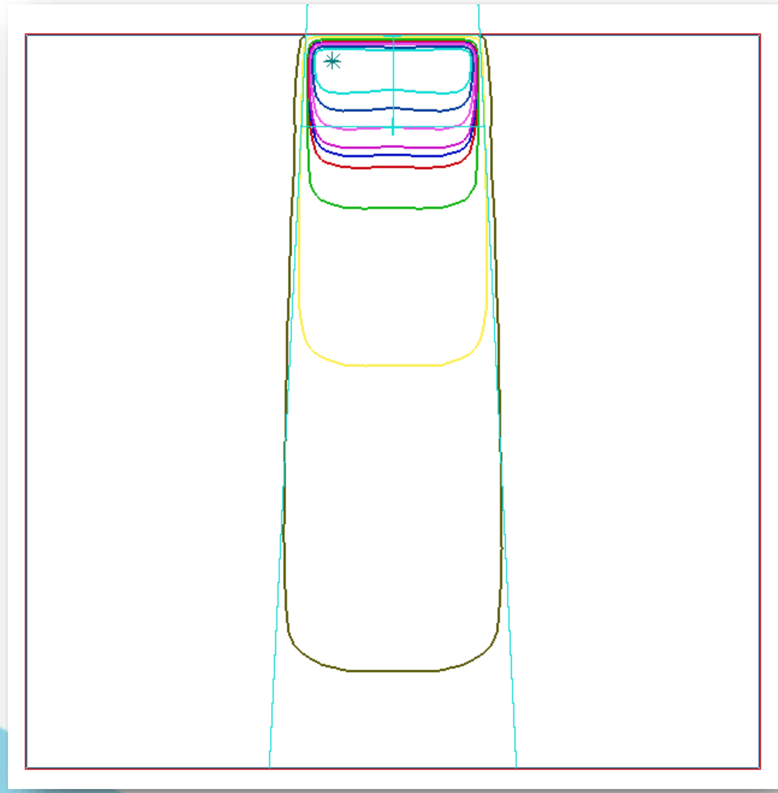
- Ask for the center to calculate the same dose points in the TPS
- Ask for the TPS algorithm
- Standard water phantom can be created in TPS





	Beam Number 1
Description	a
Machine ID	INFX6v500
Collimator	Asym
Setup/Dist (cm)	SAD/100.0
SSD/Wt fan SSD (cm)	95.0/95.0
Field Size at Isocenter	
Field Size (cm)	X1/X2 5.0/5.0
Field Size (cm)	Y2/Y1 5.0/5.0
Coll. Eq. Square (cm)	10.00
Blk. Eq. Square (cm)	9.87
Gantry/Coll angle (deg)	0.0/0.0
Couch (deg)	0.0
Isocenter/Beam entry	Iso
X, Y, Z(cm)	0.00/0.00/15.00
Port	MLC
Port/MLC normalization	blocked
Calc algorithm	Superposition
Weight (Gy)/No. fractions	1.000/1
X, Y, Z (cm)	0.00/0.00/15.00
Defined at	Def.depth fld.ctr.
Depth; skin (cm)	5.0
Effective; skin (cm)	5.0
Tray Factor(composite)	1.000
Min or MU(open/wdg)	104.63 (MU)
Integer MU(open/wdg)	105

Clinical photon dosimetry: Comparison

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Comparison TPS, manual calculation and measurement [redacted]

beam X6MV | **SSD=95cm** | **Varian Novalis TX**

field size	depth (cm)	WEDGE	dose for 200 MU TPS	dose for 200 MU manual	dose for 200 MU MEASUREMENT
10X10	5	no	184.40	184.60	186.91
10X10	5	45°	141.78	*	143.63
7x20	5	no	184.26	184.79	186.04
7x20	5	45°	155.24	*	156.75

field size	depth (cm)	WEDGE	TPS / measurement	manual / measurement	
10X10	5	no	-1.3%	-1.2%	difference daily check
10X10	5	45°	-1.3%		-0.50%
7x20	5	no	-1.0%	-0.7%	
7x20	5	45°	-1.0%		

beam X15MV | **SSD=95cm**

field size	depth (cm)	WEDGE	dose for 200 MU TPS	dose for 200 MU manual	dose for 200 MU MEASUREMENT
10X10	5	no	197.22	196.81	197.96
10X10	5	45°	160.21	*	160.71
7x20	5	no	194.95	194.44	196.93
7x20	5	45°	170.30	*	171.76

field size	depth (cm)	WEDGE	TPS / measurement	manual / measurement	
10X10	5	no	-0.4%	-0.6%	difference daily check
10X10	5	45°	-0.3%		0.50%
7x20	5	no	-1.0%	-1.3%	
7x20	5	45°	-0.9%		

Clinical electron dosimetry: Measurements

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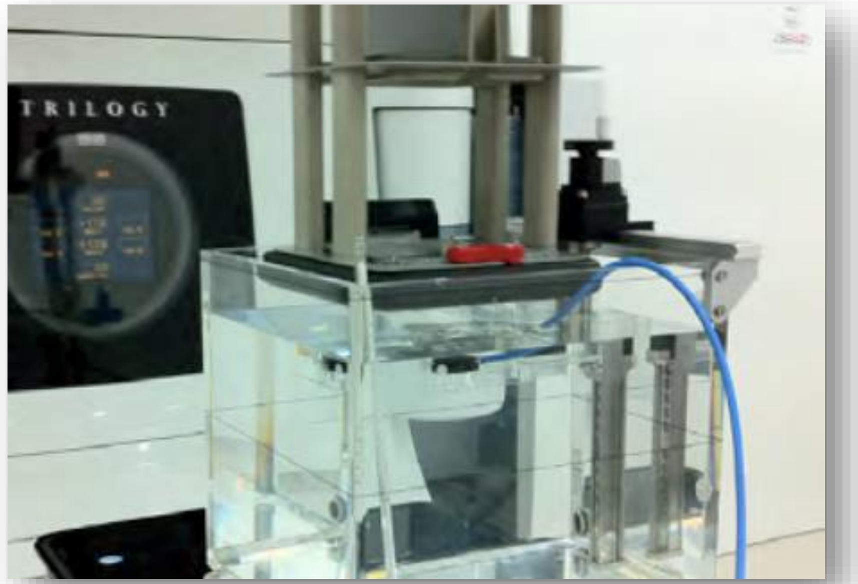
- Establish list of measurements to be performed
- Measurements are following TRS-398
- Use the Farmer type ionization chamber for high energies
- Use the plane-parallel (ROOS) type ionization chamber for lower energies
- Perform, if possible a cross-calibration between a Farmer and Roos ion chamber at high electron energy (for instance: 15 MeV)
- Use of the water phantom
- Use of the excel files for the calculations

- Ask for the center to perform their reference dosimetry or daily output check
- This is following the center methodology
- Check difference with the standard output in TPS

Electron reference dosimetry



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Recommendation	# Inst. Receiving rec.	% of Inst receiving rec	# Linacs receiving rec	% of Linacs receiving rec
QA	337	82.4	-	N/A
Small FS dependence	132	59.2	165	50.8
Wedge (FS or depth)	134	32.8	171	16.8
Off-axis factor	87	21.3	109	10.7
Electron calibration	83	20.3	105	10.3
Photon PDD	75	18.3	100	9.8
Update calibration	70	17.1	-	N/A
Electron PDD	47	11.5	57	5.6
Temp/press correction	44	10.8	-	N/A
IGRT coincidence	3	9.4	4	8.0
Beam symmetry	34	8.3	44	4.3

Measurements: TECDOC 1543

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- Set of tests
- Required equipment is described
- Acceptance criteria are provided

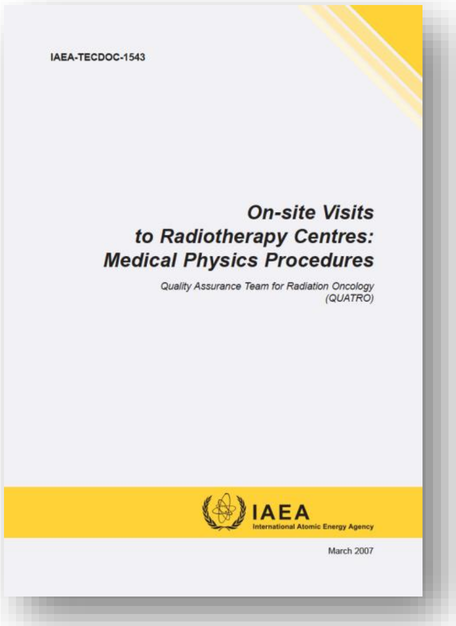

TABLE 2. PARAMETERS AND ACCEPTANCE CRITERIA FOR ON-SITE VISITS

Parameter	Criterion
Beam calibration	3%
Relative measurements (e.g. tray, wedge factors, %DD)	2%
Electron beam depth dose	3 mm
Brachytherapy source strength calibration	5%
Brachytherapy dose calculation	15%
Mechanical parameters	3 mm/2°

IAEA SUPPORTED NATIONAL "End-to-End" Audit system for Dose Delivery Using IMRT through On-Site-Visits to Radiation Therapy Institutions

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1. Share an antropomorphic phantom (SHANE TM CIRS) + set of contours (RT-structure)
2. Audit methodology proposal
3. Offer an excel book for evaluation of results

IAEA audit preferences

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Preference for “on site audit” to ease discussion with the auditors immediately after measurements

Preference for an “end to end” test to include all aspects from planning to delivery. Volume delineation not included.

Aim to let the phantom + methodology to national organizations who will run the audit nationally. Results shared with IAEA

Audit structure

IAEA

Local Audit Organisation

- Contacts IAEA for the phantom and the audit methodology
- Leeds the audit
- Organizes a Workshop:
  Explain the objectives of the audit
  Discuss the design of the audit

Local Radiotherapy institutions

- Request an audit

Audit structure

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Small field OF
Small field profiles

Shane irradiation
Point and 2D dose measurements

Patient data aquisition → Treatment planning → Delivery

CET to RED conversion curve

Volume calculation TPS

MLC QA test

Pre-treatment verification

Audit structure

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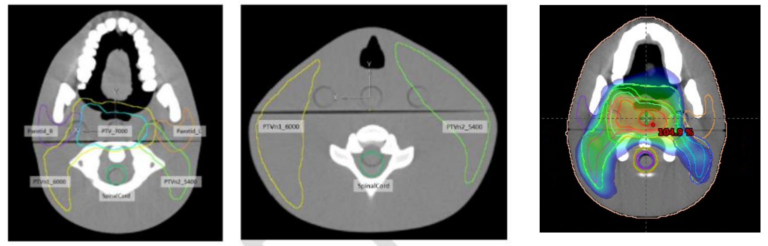
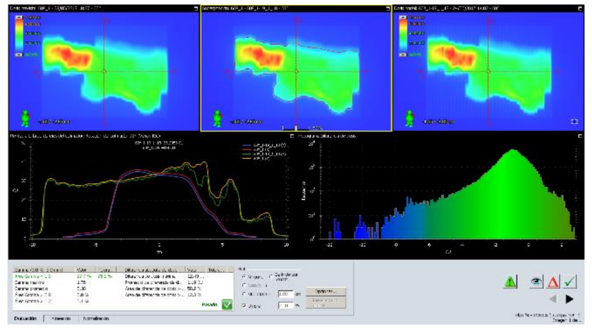
PRE-VISIT

Treatment plan



Verification



TPS output factors small fields

TPS beam profile field size 2x2cm^2 MLC

Picket fence TEST

SITE VISIT (1st day)

CT Shane (check of HU-RED curve)

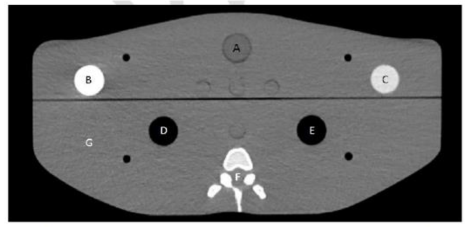


Figure 4. CT image of the shoulder region with electron density plugs: A – water, B - cortical bone, C - trabecular bone, D - lung exhale, E - lung inhale, F – spinal cord, G – soft tissue.

Register, re-calculation, re-optimization treatment plan

Pre-treatment verification

SITE VISIT (2nd day)

Beam output reference conditions

Shane Irradiation(i.c.+ radiochromic film)

Ouput factors measurement

Profiles(radiochromic film)

Important

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The computational activities should be performed using a clinically commissioned algorithm for H&N IMRT treatment planning with usual calculation settings (heterogeneity correction, calculation grid etc.).

The test on the machine should be performed on the treatment unit that will be used for the audit.

Recommended reading

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IAEA methodology for on-site end-to-end IMRT/ VMAT audits: an international pilot study

Pavel Kazantsev, Wolfgang Lechner, Eduard Gershkevitsh, Catharine H. Clark, Daniel Venencia, Jacob Van Dyk, Paulina Wesolowska, Victor Hernandez, Nuria Jornet, Milan Tomsej, Tomislav Bokulic & Joanna Izewska

To cite this article: Pavel Kazantsev, Wolfgang Lechner, Eduard Gershkevitsh, Catharine H. Clark, Daniel Venencia, Jacob Van Dyk, Paulina Wesolowska, Victor Hernandez, Nuria Jornet, Milan Tomsej, Tomislav Bokulic & Joanna Izewska (2020) IAEA methodology for on-site end-to-end IMRT/VMAT audits: an international pilot study, Acta Oncologica, 59:2, 141-148, DOI: 10.1080/0284186X.2019.1685128

To link to this article: https://doi.org/10.1080/0284186X.2019.1685128

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IMRT national audit in Portugal

Tania Santos • Maria do Carmo Lopes • Eduard Gershkevitsh • ... Sandra Brás • Rui Pirraco • Joanna Izewska • Show all authors

Published: August 23, 2019 • DOI: https://doi.org/10.1016/j.ejmp.2019.08.013 • Check for updates

Key messages

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- Dosimetry audits are performed on-site using independent, calibrated equipment to verify treatment beam accuracy.
- Physical measurements cover both reference and clinical conditions:
  - Photons: output, depth-dose, TPS vs. measured points
  - Electrons: cross-calibrations, use of ROOS and Farmer chambers
- TRS-398 and TECDOC-1543 are the basis for measurement procedures and acceptance thresholds.
- No patient treatments are interrupted: measurements are conducted after clinical hours.
- Institutions must provide local data and staff support: TPS details, measurement protocols, access to CT if needed.
- Common findings include:
  - Ion chamber mismatches
  - Output factor discrepancies
  - Barometer/thermometer calibration issues

Goal: Improve accuracy, not just assess compliance.