Package 4

INSTRUCTION SHEET, DATA SHEET AND RESULTS REPORTING FORM FOR THE STEP 2B AUDIT

This document contains the following forms:

Instruction Sheet for TLD postal dose quality audit for high energy electron beams for reference and non-reference conditions on-axis;

Data Sheet for TLD postal dose quality audit for high energy electron beams for reference and non-reference conditions on-axis;

Certificate for the step 2b audit.

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR HIGH ENERGY ELECTRON BEAMS

INSTRUCTION SHEET

Step 2b: Reference and non-reference conditions on-axis

Please irradiate the TLDs during the period:

_____

_____

and return them to the address given in the covering letter. Timely response will improve the accuracy of your results. Should the TLDs arrive late, please irradiate them as soon as possible but no later than one month after their receipt. If you are unable to carry out the irradiation, please **RETURN** the TLD set, marking it '**UNEXPOSED'**.

GENERAL INSTRUCTIONS

Five TLD capsules for one beam energy for this audit are provided in the box: four of them are to be irradiated, while the TLD with a white mark must not be irradiated; it is used to record environmental influences during transport and storage.

1. Irradiate the TLDs as instructed in the Technical Instruction (parts B and C) as if they were inside a patient. Ensure that the treatment unit is functioning properly and that is being used clinically or is ready for clinical use.
2. After the TLD irradiation, if possible, measure the dose delivered to the reference TLDs.
3. Fill in the Data Sheet.
4. Return the TLDs and the Data Sheet within ONE WEEK after the irradiation.

SPECIAL NOTE

Please protect the TLD capsules from accidental irradiation, heat (e.g. sunshine) and excessive humidity during storage.

CONFIDENTIALITY

The results of this TLD audit will be kept confidential by [DAN] and will not be disseminated without the written permission of the participating radiotherapy centre.

The TLD equipment sent to you represents a significant investment in cost, time and effort to the [DAN]. Failure to return the TLDs may be reported to your local authorities.

TECHNICAL INSTRUCTIONS for HOSPITAL STAFF
(physicists, oncologists, technicians)

A. Aim of the TLD audit

The purpose of this TLD audit is to check the dose delivered by the radiotherapy unit for high energy electron beams. This audit is to be carried out for two electron beams, a low energy (<10 MeV) and a high energy (⩾10 MeV). It will include measurements on the central (collimator) axis, at z_{max} depth in water, and at your usual source-to-surface (SSD). The measured fields are listed below.

- Reference field: 10 cm × 10 cm (to be carried out twice);
- Dose variation with field size: 6 cm × 6 cm;
- Dose variation with treatment distance:10 cm × 10 cm at SSD ≥ 105cm.

The checks will be performed by irradiating TLD capsules in a water phantom (using a standard IAEA TLD holder) to a specified dose.

B. Preparation of the TLD holder, water phantom and a therapy beam

1. Assemble and prepare the TLD holder (Fig. 1a). Use the provided rings of different thicknesses to adjust the irradiation depth to z_{max} corresponding to the beam energy in use. For example, if the centre of the TLD capsule is to be positioned at z_{max} = 3.3 cm depth, the upper surface of the plate should be positioned at 2.8 cm depth and the rings adding up to 1.8 cm should be placed in each column (Fig. 1b).
2. Place the holder in a water phantom with minimum dimensions of 30 cm length, width and height. Fill the phantom with water exactly to the level of the top end of the holder (Fig. 2).
3. Set your therapy unit for a vertical beam and insert the standard electron cone.
4. Place the water phantom below the head of your therapy unit and align the central axis of the holder (centre of the TLD capsule) with the central axis of the beam.
5. Adjust the table height so that the water surface is at your usual source to surface distance (SSD) (Fig. 2).
6. Calculate the monitor setting (number of monitor units, MU) to deliver a dose of 2 Gy in the irradiation conditions. The number of monitor units, for the specified dose, should be calculated according to the procedure used in clinical practice for the patients.

FIG. 1. Assembling of the IAEA electron standard holder for the TLD irradiation. (a) Holder in parts (b) Assembled holder, plate top at 2.8 cm depth

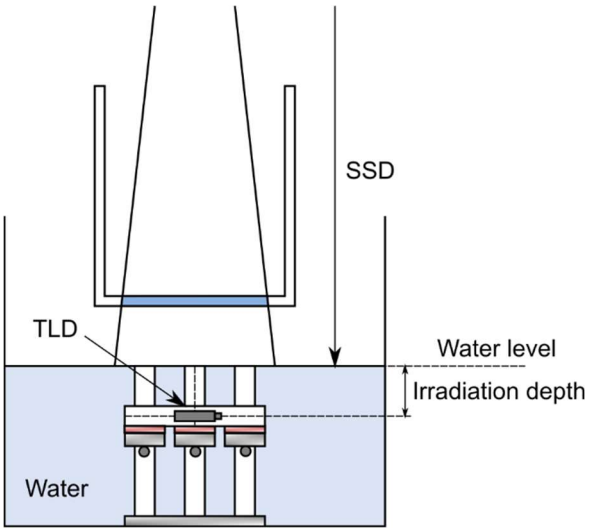

FIG. 2. Geometry set-up for the TLD irradiation

C. Irradiation of TLD capsules

NOTE: *The capsule with a white mark* ***must not be irradiated****; it is used to record environmental influences during transport and storage. Throughout all procedures, handle the capsules very carefully to prevent opening and loss of powder.*

1. Remove the circular holder plate from the stand, place one capsule in the plate. You can use the PMMA rod to push the TL-dosimeter. Make sure that the TLD is inserted in the correct orientation (Fig. 3).

NOTE: *If for any reasons you irradiated the TLDs under different conditions than specified above, please give the detailed explanation of what was done. Please include a description of your procedure and the dose calculation.*

2. Place the holder plate back in the stand.
3. Recheck the water level.
4. Adjust the alignment and the distance so that the surface of the water is at the required SSD.
5. Irradiate TLDs with the corresponding number of monitor units (MU) calculated as given in p. B6.
6. Remove the capsule from the holder plate by pushing the capsule with the PMMA rod. Dry the TLD capsule carefully with a tissue or towel. Place the irradiated capsule back into the corresponding plastic container.
7. Repeat the procedure with the next TLD capsule according to the recommended irradiation conditions.

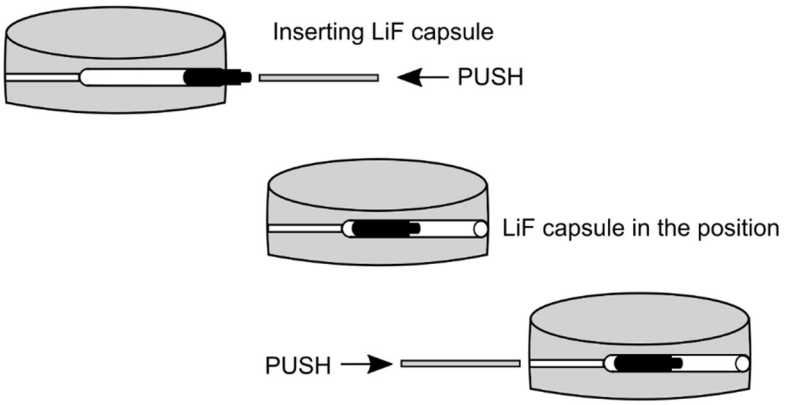

FIG. 3. Inserting, positioning and removing the TLD capsule

D. Absorbed dose measurements with an ionization chamber (additional request for medical physicists)

Determine experimentally the absorbed dose to water at the position of the TLD according to the dosimetry protocol you use. Complete the data sheet for the appropriate beam.

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR HIGH ENERGY ELECTRON BEAMS

DATA SHEET

Step 2b: Reference and non-reference conditions on-axis

It is of great importance for the TLD evaluation that the information requested below be completed. Please complete Part II if additional absorbed dose to water determination was made by ionization chamber measurements.

Individuals responsible

Radiation oncologist ..... *name* ..... *position*

Medical physicist ..... *name* ..... *position*

Name of institution .....

.....

Address .....

.....

Telephone number .....

Fax number .....:

E-mail .....

Form completed by

Name .....

Position ☐ Medical physicist ☐ Radiation oncologist ☐ Technician

Other: .....

On the day |__|__| |__|__| |__|__|__|__|
day *month* *year*

TLD irradiation performed by

Name .....

Position ☐ Medical physicist ☐ Radiation oncologist ☐ Technician

Other: .....

Previous participation in an external audit or inter-institution comparison for this beam

Has Step 1, TLD audit for photon beams in reference conditions been successfully completed before?

No ☐

Yes ☐ Date .....

Please also give information on participation in any other audit .....

FOR HOSPITAL STAFF (physicist, oncologist, technician)

A. Specifications of the treatment unit

The treatment unit used for this audit is of the type

.....

model *manufacturer* *serial number* *production year*

installed in the year .....

The characteristics of the beam are:

R_{50} =.....

z_{ref} = ... (..... cm × ..... cm at SSD = ... cm)

z_{max} = ...

and are obtained from: ☐ ionization curves ☐ dose curves.

B. Irradiation of the TLD capsules for the reference measurement

The TLD capsules were irradiated on the following date:

|__|__| |__|__| |__|__|__|__|

day *month* *year*

The TLD capsules were irradiated at ..... cm depth in water, ... ☐ z_{ref} ..... ☐ z_{max}
using a field ..... cm × ..... cm at a source skin distance (SSD) ..... cm

For the different TLD capsules, the irradiation time (in monitor units, MU) and the dose delivered[1] (in grays) were :

TLD 1: ..... MU D = ... Gy
TLD 2: ..... MU D = ... Gy

C. Calculation of MU setting for the reference measurement

Provide the data used for calculation of monitor unit (MU) setting for the TLD irradiation.

Please give a detailed explanation of your procedure for the above MU and dose calculation. Please provide all factors (beam output, any conversion or correction factors, etc.) you have used:

.....
.....
.....
.....
.....

Beam output [*units*] as stated for your clinical data :..... [.....]
on the date |__|__| |__|__| |__|__|__|__|
day *month* *year*

Please explain in detail the irradiation conditions for which this clinical beam output applies (e.g. in-air or depth in water, SAD, field size):

.....
.....
.....
.....
.....
.....

[1] Please adjust your irradiation time to get the absorbed dose to the TLD capsule as close as possible to 2 Gy (200 cGy).

D. Irradiation of the TLD capsules for non-reference on-axis measurements

The TLD capsules were irradiated on the following date:

|__|__| |__|__| |__|__|__|__|
day *month* *year*

The TLD capsules were irradiated at ..... cm depth in water, ☐ z_{ref} ☐ d_{max}
at a source skin distance distance (SSD) ..... cm.

For these TLD capsules the irradiation time is required to deliver 2 Gy to the capsule on the central (collimator) axis.

TLD 3:	6 × 6 cm²:	MU =.	D = ... Gy
TLD 4:	10 × 10 cm², SSD ≥ 105cm:	MU =.	D = ... Gy

E. Calculation of doses for the non-reference on-axis irradiations

Provide the data used for calculation of the MU setting and doses for the TLD irradiations.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, etc.), you have used in the manual calculation:

.....
.....
.....
.....
.....

ADDITIONAL REQUEST FOR MEDICAL PHYSICISTS

Determination of the absorbed dose to water by ionization chamber in the reference conditions

Measurements were performed by

.....

name *position*

on the following date: |__|__| |__|__| |__|__|__|__|
day *month* *year*

The absorbed dose rate to water in this beam was determined by using a dosimeter system composed of an ionization chamber.....
manufacturer *model*

and an electrometer .....

The Co-60 calibration factor of the dosimeter system (**ionization chamber TOGETHER with electrometer**) was:

..... R/scale unit (exposure calibration factor N_X)

or ..... Gy/scale unit (air kerma calibration factor N_K)

or ..... Gy/scale unit (absorbed dose to water calibration factor $N_{D,w}$).

The above stated calibration factor was determined by the following laboratory/manufacturer on the following date.....and refers to a temperature of.....°C
and a pressure [*units*] of..... [.....].

The absorbed dose to water in this beam was measured under the following conditions:

☐ water phantom ☐ plastic phantom – *please specify material* .....
field size: ..... cm × ..... cm
distance:
SSD = ……
SSD set-up

The depth of ☐ the geometrical centre **or** ☐ the P_{eff} of the ionization chamber in phantom was ……. cm.

Please give your reading results:

Average reading ..... [*scale units*]
Measurement performed during..... mu
Temperature.....°c
Pressure [*units*]..... [.....]
Electrometer scale.....
Electrometer voltage .....

The absorbed dose to water per MU in this beam was determined by the following code of practice (dosimetry protocol):

.....
.....
.....
.....
.....
.....

Please give detailed explanation of your procedure to determine the dose at the position of the centre of the TLD capsule based on the measurement described above. Please provide all factors you have used:

.....
.....
.....
.....
.....

STEP 2B AUDIT CERTIFICATE

[DAN letterhead]

RESTRICTED

[DAN] TLD POSTAL DOSE QUALITY AUDIT

Institution: *Institution name*
Address: *Institution address*

Country: *Country name*

TLD batch no: *xxx*
TLDs irradiated by: *Name*
Date of irradiation: *yyyy-mm-dd*
Evaluation: *yyyy-mm-dd*

STEP 2B: RESULTS OF TLD MEASUREMENTS FOR HIGH-ENERGY ELECTRON BEAMS

Radiation unit	Beam	Field [cm × cm]	TLD set #	User stated dose [Gy]	DAN (measured) dose [Gy]*	DAN mean dose [Gy]*	% deviation relative** to DAN mean dose	DAN mean dose / User stated dose
		10 × 10	*1*					
			2					
		6 × 6	*3*					
		10 × 10, SSD ≥ 105 cm	*4*					

* The uncertainty in the TLD measurement of the dose is *x.x*% (1 standard deviation); this does not include the uncertainty intrinsic to the dosimetry protocol (see IAEA TRS-398).
** % deviation relative to DAN measured dose = 100 × (User stated dose - DAN mean measured dose)/ DAN mean measured dose. A relative deviation with negative (positive) sign indicates that the user estimates lower (higher) dose than what is measured; a patient would therefore receive higher (lower) dose than what is intended by the factor given in the last column.
Agreement within ±*x*% between the user stated dose and the [DAN] measured dose is considered satisfactory.

Signature
……...
[TLD Officer] – [DAN]

Date:
yyyy-mm-dd

Signature
…….
Head – [DAN]

IMPORTANT NOTICE: This information is provided only as an independent verification of beam output and not as a machine calibration, nor as an alternative to frequent calibrations by a qualified physicist. **IT DOES NOT CONSTITUTE A STATEMENT WITH REGARD TO THE QUALITY OF RADIOTHERAPY TREATMENTS.**