APPLICATION NOTE

RTI Dose Probe

Various Scatter and Leakage Applications

This application note describes various use of the RTI Dose Probe for scatter and leakage applications in general x-ray environments.

Introduction

The Black Piranha used with the RTI dose Probe can be used for various scatter and leakage applications. The high sensitivity of the RTI Dose Probe together with the high sensitive electrometer of the Black Piranha can be used for measurement of dose rates as low as 1 nGy/s (3.6 µGy/h or 400 µR/h).
Measure these low levels requires a stable setup, and use of *Timed* or *Free run* mode with the Black Piranha.
Ocean QuickCheck comes with two pre-defined applications for scatter and leakage. These are using *Timed Mode* (10 seconds). One intended for use during exposures with exposure times less than 10 sec, and the other one intended for use on continuous radiation longer than 10 sec.

Demands on scatter and leakage meters

Various standards state various demands on the detector in use. Most common may be a demand that requires that the measurement is made so that it average the dose over a specific surface at a specific distance from the x-ray source.
E.g. as stated in IEC 60601-1-3:

> "10.1.206.3 LEAKAGE RADIATION in the LOADING STATE
> In the LOADING STATE, the AIR KERMA of LEAKAGE RADIATION from X-RAY TUBE ASSEMBLIES and X RAY SOURCE ASSEMBLIES, at 1 m from the FOCAL SPOT, averaged over any area of 100 cm^2 of which no principal linear dimension exceeds 20 cm, when operated at the NOMINAL X-RAY TUBE VOLTAGE under conditions of LOADING corresponding to the maximum specified energy input in one hour, shall not exceed the limits stated below, as applicable:
> - for X-RAY SOURCE ASSEMBLIES specified for use in X-RAY EQUIPMENT for dental radiography with intra-oral X-RAY IMAGE RECEPTORS, 0,25 mGy in one hour;
> - for all other X-RAY TUBE ASSEMBLIES and X-RAY SOURCE ASSEMBLIES, 1,0 mGy in one hour.
>
> 10.1.206.4 LEAKAGE RADIATION when not in the LOADING STATE
> When not in the LOADING STATE, the AIR KERMA of LEAKAGE RADIATION from X-RAY TUBE ASSEMBLIES and X-RAY SOURCE ASSEMBLIES, at 5 cm from any ACCESSIBLE SURFACE, averaged over any area of 10 cm^2 of which no principal linear dimension exceeds 5 cm, shall not exceed 20 µGy in one hour."

To fulfill these requirements one need two detectors, or multipple measurments has to be carried out with a smaller detector to average over the surface.

Or… Is the area of any great importance?

There are a number of other characteristics that is of importance for low dose measurements in the x-ray environment, such as sensitivity and response time.
For example; A traditional survey meter normally has a very good sensitivity and response to low doses. However, the large chamber volume and slow response time may lead to underestimation or even not detecting when making short x-ray exposures.
A stable set-up avoiding cable movements that may introduce noise (false readings) is also of importance.

RTI Dose Probe and Black Piranha for Scatter and Leakage measurements

RTI recommends the use of a dose probe holder when measure scatter and leakage. The image (right) shows the RTI Dose Probe and the RTI HVL stand.

Exposures (< 5 sec)

The example hereunder is bases on the Ocean Quick Check Application, *Scatter & Leakage (radiographic)*. The measuring mode of the Piranha is set to Timed using a 5 second measuring window.

1. Place the RTI Dose probe in the position where you shall measure the radiation. Make sure that the detectors sensitive area points in the direction where the radiation is expected to come from.

2. Select exposure parameters on the generator. E.g. 100 kVp, 10 mAs at a 200 ms exposure time.

3a. For scatter measurements - place a phantom or other scattering material in the patient position.
3b. For leakage measurements - close the collimators.

4. Press the start button in Ocean.

5. Make an exposure. Note that it is essential that the exposure is made (and finished) within the 5 sec window when the Piranha measures.

6. Now the dose has been measured, and the value can be used for further analysis and calculations.

Fluoro (> 10 sec)

The example hereunder is bases on the Ocean Quick Check Application, *Scatter & Leakage (fluoro)*. The measuring mode of the Piranha is set to Timed using a 10 second measuring window.

1. Place the RTI Dose probe in the position where you shall measure the radiation. Make sure that the detectors sensitive area points in the direction where the radiation is expected to come from.

2. Select exposure parameters on the generator. E.g. 100 kVp, 3 mA for a at a fluoroscopy exposure time of at least 15 sec.

3a. For scatter measurements - place a phantom or other scattering material in the patient position.
3b. For leakage measurements - close the collimators

4. Start the fluoroscopy exposure and wait for the radiation to stabilize.

5. Press the start button in Ocean. Note that it is essential that the exposure continues over the entire measuring window of 10 sec when the Piranha measures.

6. Now the dose rate has been measured, and the value can be used for further analysis.

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