WHITE PAPER   EPD TruDose

EPD TruDose for dosimetry in short pulsed X-ray fields using the example of industrial pulsed X-ray source XR-200

Introduction

Several X-Ray sources for mobile applications are available. The most compact, lightweight and robust models use a simple flash technique to produce the high voltages required for X-Ray generation. These X-Ray sources produce short X-Ray flashes with a duration of about 50ns. X-Ray energy can not be changed. X-Ray intensity is selected by selecting the number of flashes in a burst. For dosimetry with these generators pen dosimeters or not direct reading film or TLD dosimeters are recommended. Direct reading and warning electronic dosimeters typically use PIN diodes operated in counting mode. This class of instruments is considered not to be suited to measure short pulse duration X-Ray correctly.

However, the average pulse dose is correctly detected and accumulated by EPDs if the dose per X-Ray pulse is well below the registered dose per detector pulse of such a dosimeter. EPDs with more than one detector have furthermore the capability to detect an overrange condition and give an according warning.

The behavior of Thermo Scientific™ EPD TruDose™ in the radiation field of an XR-200 X-Ray Generator from Golden Engineering is described in the following sections in detail.

Electronical dosimeters EPD Trudose G and EPD Trudose BG have the capability to warn the user if he is exposed to an instrument overrange condition in direct beam and accumulate the dose correctly outside the direct beam area.

Overrange Alarm and EPD TruDose operating area
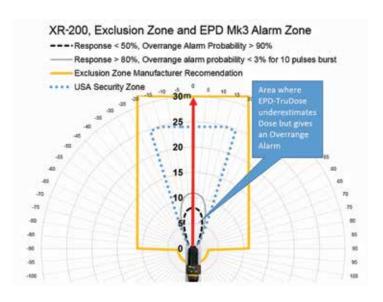
Zones around mobile X–Ray generator XR-200

 Figure 2-1: X-Ray Generator Zones

Inside the area shown by the black dashed line EPD TruDose will produce an overrange alarm. This enables the operator to immediately leave this area and be more cautious for the next exposure. This area extends up to 8 m (26 feet) from XR-200 in axis of main beam direction and only about 10 cm (4 inch) behind the instrument. See zoomed diagram Figure 2-3. In the area outside the grey continuous line EPD Trudose will correctly accumulate dose (response > 80%) and probability for an overrange alarm is low. This area starts less than 1 meter (40 inch) behind and to the side of the instrument and around 12 m (40 feet) in main beam direction. Figure 2-2 and Figure 2-3 Show the alarm zone in detail.

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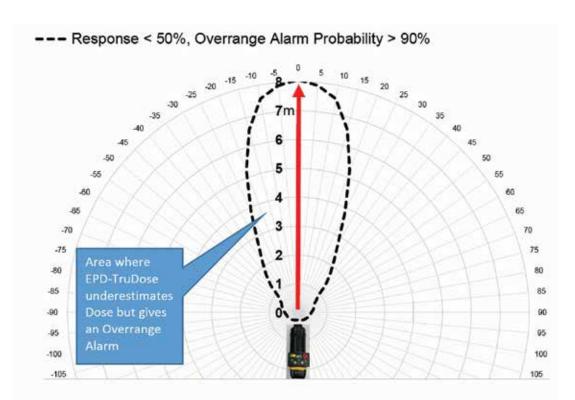--- Response < 50%, Overrange Alarm Probability > 90%

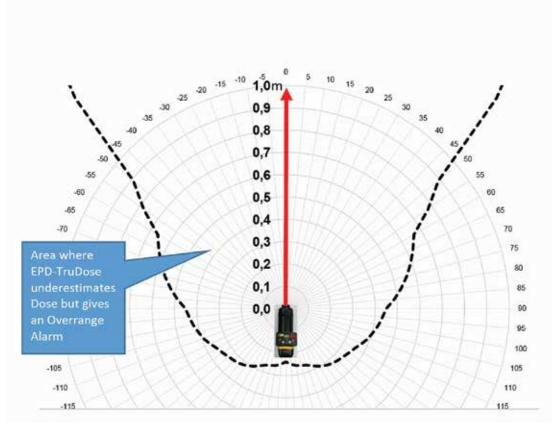Figure 2-2: Overrange Alarm Zone XR-200

Figure 2-3: Overrange Alarm Zone XR-200 rear Side Detail.

Figure 2-4 is specific for XR-200 X-Ray generators.

Figure 2-5 generally applies for short X-ray pulses with duration < 1µs and a repetition rate < 1000 pulses/Second.

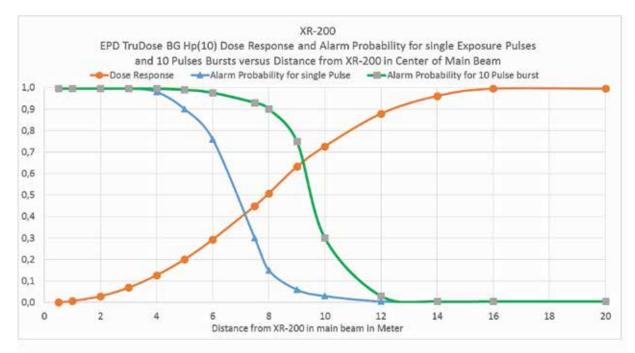Figure 2-5 is also valid for the other Golden Engineering Generators XRS-3 and XRS-4.

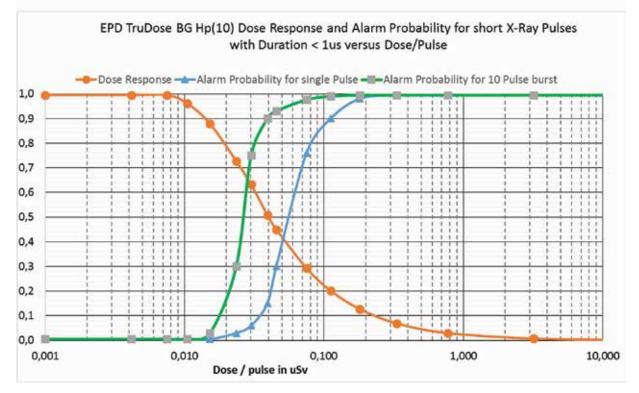**Figure 2-4: Alarm Probability and Dose Response versus distance in Beam Axis**

Figure 2-5: Dose Response and Overrange Alarm for short Pulses

Overrange alarms at continuous radiation

Overrange alarms at continuous radiation are given at a dose of 10 Sv or a dose rate of 10 Sv/h for both measurement quantities Hp(10) and Hp(0,07). The pulsed mode overrange alarm is independend of any other dose or rate or overrange alarm but triggers the same overrange alarm pattern.
To avoid nuisance alarms the pulsed overrange alarm is not triggered at dose rates of more than 1 mSv/h (Hp(10)). Normally XR-200 measurements are not done at high levels of continuous radiation from other sources. If so dose from these sources is of major concern versus dose from the pulsed X-ray source. Setting a dose rate limit of 1 mSv/h or less could help to avoid any alarm gaps.

Instrument configuration
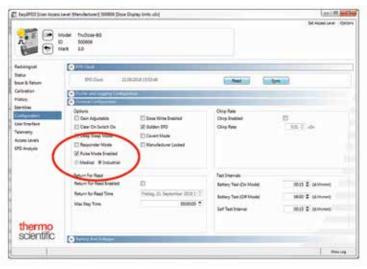
SetUp for Industrial Pulse Mode

Figure 4-1: Activation of Industrial Pulse Mode

EPD Trudose with activated pulsed mode show a pulse icon in EasyEPD. A pulse icon is also shown in the display of the Instrument.

Figure 4-2: Pulse Mode Display

Configuration of the instrument may not allow the normal user to alter Pulse Mode settings. This may be reserved to manufacturer or administrator access level.

As the alarm at a Pulse overrange event is given only for four seconds it is recommended to use the most strong alarm sound.

Figure 4-3: Suggested Alarm Pattern for Overrange Alarm

Find out more at **thermofisher.com/epdtrudose.**