

# RADIATION PROTECTION SERVICE

SAFETY ADVISORY SERVICES



UNIVERSITY OF LEEDS

## RPA GENERIC RISK ASSESSMENT NO 2: HAZARD IDENTIFICATION & RISK ASSESSMENT FOR THE USE OF BEDE MICROSOURCE TYPE A X-RAY DIFFRACTOMETERS

### DESCRIPTION

- 1) The Bede Microsource x-ray generator sits inside a purpose built cabinet. Access to the cabinet is via a door that is fully interlocked to the x-ray generator such that 'breaking' the circuit will terminate the production of x-rays. Other engineered safety features that are wired to the generator include a hazard warning beacon, flow / pressure detectors, and a collimator interlock. The system is under computer control; it is only possible to operate the x-ray tube via the computer console / software system, which monitors and is linked to the engineered safety devices.
- 2) The x-ray tube operates at 40 kV, 1.8 mA; the output from the tube is unknown, however, from data supplied in British Standards BS 4094 Part 2: 1971 it can be estimated that radiation dose rates directly in front of, or at a distance of 100 mm from the collimator, will be in the range 3 to 30 Sv h<sup>-1</sup>.

<u>Version</u>	<u>Author</u>	<u>Checked</u>	<u>Approved</u>	<u>Date of issue</u>
1.1	IKH	-	IKH	16 <sup>th</sup> April 2005

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## HAZARD &amp; RISK ASSESSMENT

Condition	Exposure pathway	Radiation exposure	Level of risk	Risk reduction measures
<b>Exposure to unshielded x-radiation</b>	<b>External irradiation</b>			
	(1) Damage to, or misalignment of the detector, which acts as the beam stop, may permit the leakage of radiation from the cabinet.	Penetrating x-rays; dose rate 0.3 Sv h <sup>-1</sup> .  If a person were exposed by standing adjacent to a leakage point, their exposure would exceed the University dose constraint (annual dose limit) of 1 mSv in ~12 seconds.	<b>Health – Low</b>  The likelihood of the detector being misaligned to the extent that it ceased to act as a beam stop is extremely low, and would require gross negligence on the part of the operator.  <b>Collateral – Low</b>  The unshielded dose rate exceeds internal guidelines and national dose rate limit for the designation of Controlled Areas, and thereby the potential for legislative infraction should there be a failure is very real. However, the likelihood of such a failure is low.  Critical failure of the equipment may be reportable to the Health and Safety Executive under RIDDOR.	The x-ray generator and the cabinet enclosure are manufactured to a high standard and are not expected to leak radiation.  The equipment has been subject to a 'Critical Examination' (CRIT 0503 IR SPEME), which found no failings with the system or its safety devices.  Failure of the x-ray tube or any of the safety features under normal operational conditions would cause the x-ray beam to terminate (this is not reportable).  If the equipment is moved vertically more than 1 m, or out of the laboratory, the Radiation Protection Adviser must carry out a Critical Examination before the x-ray tube is energised.

Condition	Exposure pathway	Radiation exposure	Level of risk	Risk reduction measures
	(2) Overriding the door interlocks and gaining access to the x-ray chamber whilst the x-ray tube is generating x-rays and the shutter is open.	<p>Penetrating x-rays; scatter dose rate <math>\sim 0.18 \text{ Sv h}^{-1}</math> at 300 mm from the x-ray tube.</p> <p>If a person were standing in front of the cabinet with the door open, their exposure would exceed the University dose constraint (annual dose limit) of 1 mSv in <math>\sim 20</math> seconds.</p> <p>Hand accessible dose rates are very high; national limits on extremity exposures would be exceeded in <math>\sim 20</math> seconds. The University dose constraint would be exceeded instantaneously.</p>	<p><b>Health – Low</b></p> <p>It is not possible for a user to easily / inadvertently override the safety features; consequently the risk of exposure through accident or negligence is low.</p> <p><b>Collateral – Medium</b></p> <p>The unshielded dose rate exceeds the dose rate limit for the designation of Controlled Areas, and thereby the potential for legislative infraction, should a person deliberately bypass the safety systems, is very real.</p>	<p>Users must be trained in the operation of the equipment and must follow appropriate protocols.</p> <p>No one should attempt to bypass any of the safety features.</p> <p>Alignment must only be carried out with the knowledge and written approval (by e-mail or letter) of the RPS.</p>
<b>Damage / fire</b>				
	Damage to the equipment by impact or fire.	<p>Penetrating x-rays; dose rate <math>0.3 \text{ mSv h}^{-1}</math>.</p> <p>If the equipment was damaged but still operable, and a person was exposed by standing adjacent to a leakage point, their exposure would exceed the University dose constraint (annual dose limit) of 1 mSv in <math>\sim 12</math></p>	<p><b>Health - Low</b></p> <p>If the equipment were subject to high-energy impact there is the low possible that misalignment might occur.</p> <p>It is unlikely that the equipment would remain operable after sustaining fire</p>	<p>If the equipment has received a significant knock, has been close to a fire, or has been damaged in any other way the user should (1) switch off and isolate the power, then (2) inform the RPS, the RPA and the manufacturer to seek advice before using the equipment.</p>

Condition	Exposure pathway	Radiation exposure	Level of risk	Risk reduction measures
		seconds.	damage.	
<b>Unauthorised maintenance / servicing</b>				
	Access to an unguarded x-ray beam.	Penetrating x-rays; dose rate 3 to 30 Sv h <sup>-1</sup> .  Hand accessible dose rates are very high; national limits on extremity exposures would be exceeded in ~20 seconds. The University dose constraint would be exceeded instantaneously.	<b>Health – High</b>  Removal of the cabinet covers could give access to areas where there is a high dose rate.  <b>Collateral – Medium</b>  Dose rate exceeds internal guidelines and national dose rate limit for the designation of Controlled Areas; potential for legislative infraction.	All repairs and modifications to the equipment must only be carried out by the manufacturer or by a qualified service engineer approved by the RPS.  If the equipment is serviced on site the service engineer must have sole use of the laboratory.