RADIATION PROTECTION SERVICE

DEPARTMENT OF WELLBEING, SAFETY & HEALTH

UNIVERSITY OF LEEDS

RPA GENERIC RISK ASSESSMENT NO 5: HAZARD IDENTIFICATION & RISK ASSESSMENT FOR THE USE OF CABINET / ENCLOSURE X-RAY DIFFRACTION EQUIPMENT

DESCRIPTION

1) The column x-ray generator sits inside a purpose built cabinet. Access to the cabinet is via door(s) that are interlocked to the x-ray generator such that 'breaking' the circuit will terminate the production of x-rays. Other engineered safety features wired to the generator include a hazard warning beacon, and flow / pressure detectors. 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) **Under normal operational conditions, with the safety features working correctly, there is no risk of exposure to radiation**.

3) The x-ray tubes typically operate at 40 kV, 30 mA. The output from the tubes 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^{-1}.

Version	Author	Date of issue	Date of review	Risk Rating
1.3	Ian Haslam	7th October 2014	14th October 2015	Low

HAZARD & RISK ASSESSMENT

Condition	Exposure pathway	Radiation exposure	Level of risk	Risk reduction measures
Exposure to unshielded x-radiation	***External irradiation***			
	(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^{-1}. 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.	**Health – Low** 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. **Collateral – Low** 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.	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' 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 Service 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.	Penetrating x-rays; scatter dose rate ~0.18 Sv h^{-1} at 300 mm from the x-ray tube. 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 ~20 seconds. 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.	**Health – Low** 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. **Collateral – Medium** 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 by-pass the safety systems, is very real.	Users must be trained in the operation of the equipment and must follow appropriate protocols. No one should attempt to bypass any of the safety features. Alignment must only be carried out with the knowledge and written approval (by e-mail or letter) of the Radiation Safety Coordinator or the Radiation Protection Service.

Condition	Exposure pathway	Radiation exposure	Level of risk	Risk reduction measures
Damage / fire				
	Damage to the equipment by impact or fire.	Penetrating x-rays; dose rate 0.3 mSv h^{-1}. 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 ~12 seconds.	**Health - Low** If the equipment were subject to high-energy impact there is the low possible that misalignment might occur. It is unlikely that the equipment would remain operable after sustaining fire damage.	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 Radiation Safety Coordinator, the Radiation Protection Service and the manufacturer to seek advice before using the equipment.
Unauthorised maintenance / servicing				
	Access to an unguarded x-ray beam.	Penetrating x-rays; dose rate 3 to 30 Sv h^{-1}. 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.	**Health – High** Removal of the cabinet covers could give access to areas where there is a high dose rate. **Collateral – Medium** 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 Radiation Safety Coordinator or the Radiation Protection Service. If the equipment is serviced on site the service engineer must have sole use of the laboratory.