RADIATION PROTECTION SERVICE

SAFETY ADVISORY SERVICES

UNIVERSITY OF LEEDS

RPA GENERIC RISK ASSESSMENT NO 22:
HAZARD IDENTIFICATION & RISK ASSESSMENT FOR A GE LUNAR IDXA BONE DENSITOMETER

INTRODUCTION

1) This is an assessment of the risks from radiation exposure for work involving a GE Lunar iDXA. This assessment does not assess the risks from planned medical exposures to patients or volunteers undergoing scans and this is subject to a separate dose and risk assessment (see IRMER procedures).

2) The GE Lunar iDXA Bone Densitometer is an x-ray scanner used to measure bone density and body composition. It consists of an x-ray head mounted underneath a scanner table with the x-ray beam directed upwards to a detector arm above the patient.

3) The x-ray tube operates at 100kV with a maximum 2.5mA current and a filter splits the x-ray output into high and low energy components at 70keV and 38keV. The resulting x-rays are output as a fan beam (4.5º) oriented parallel to the table axis whilst the x-ray head/beam and detector arm are moved to traverse the scan area required.

DOSE ASSESSMENT

4) Manufacturers (GE) data give estimated patient skin entrance doses ranging from <10µGy for hand, forearm or total body scans to 329µGy for spine or femur scans. Calculations of the effective dose to the patient based on phantom measurements (ref 1) are 1-10µSv per scan.

5) Isodose plots of the scatter dose as measured by the manufacturer with a 25x25x15 cm water phantom at 100kV, 2.5mA are appended to this assessment (ref 2). The estimated scatter dose at 2m from the centre of the scanner table is 2µGy/h and this was confirmed by measurement (ref CRIT 1501 XRID41 FBS)

6) The projected maximum usage of the scanner is estimated at 20 scans a week and the longest scan time used (for a standard total body scan) is 436 seconds giving a maximum exposure time estimate of 8720seconds / week = 2.4 hours / week = 125 hours / year.

7) Maximum radiation dose per year to an operator at an operator position 2m from the scanner is therefore 2µSv/h x 125hours = 0.25mSv / year.

HAZARD & RISK ASSESSMENT

Condition	Persons exposed	Radiation exposure	Level of risk	Risk reduction measures
Exposure to x-rays				
Exposure to scatter radiation within the scanner room during normal operation: **outside controlled area**.	Operators	x-rays; scatter dose rate <2µSv h^{-1}. Estimated dose (see 7 above) <0.25mSv/y.	**Health – negligible** The estimated dose is less than 0.1 of the annual UK natural background level. **Collateral – negligible** Dose rate is below the university's dose constraint of 1mSv for radiation workers.	Operator training. Demarcation of controlled area within 2m of scanner. Access restrictions for scanner room. Local rules include instructions for operator to keep out of controlled area whilst scan in progress. Daily QA procedures. Critical Examination before the x-ray tube is first used; if repaired, altered or moved; and annually. Dose levels confirmed by environmental dose monitoring.
Exposure to scatter radiation within the scanner room during normal operation**: inside controlled area**.	Operators	Penetrating x-rays; scatter dose rate up to 50µSv/h at edge of scanner table. Estimated dose 6.25mSv/y.	**Health – Low** The estimated dose is 2-3 times the annual UK natural background level and >3/10 the UK legal dose limit for workers of 20mSv. This estimate assumes the operator is	Operator training. Demarcation of controlled area within 2m of scanner. Local rules include instructions for operator to keep out of controlled area

Condition	Persons exposed	Radiation exposure	Level of risk	Risk reduction measures
			close to the scanner table for all scans. **Collateral – medium** Estimated dose exceeds dose constraint and dose limit for non-classified radiation workers (6mSv).	whilst scan in progress.
Damage to equipment				
Damage to the equipment by impact or fire.	All persons entering the scanner room.	Penetrating x-rays; potential dose rate – several Sv h^{-1}.	**Health - Low** If the equipment were subject to damage it is possible that the x-ray shielding might be compromised although this is unlikely. If the equipment was damaged but still operable radiation exposure could exceed the University annual dose constraint of 1mSv in seconds. **Collateral – Low** Dose rate could exceed dose constraint and legal dose limits; potential for legislative infraction.	If the equipment has been damaged in any way the user should: - switch the power off and - inform the RPS and seek advice before using the equipment.
Maintenance / servicing				
Removal of panels / shielding giving access to unguarded x-ray beam	All persons entering the scanner room.	Penetrating x-rays; potential dose rate – several Sv h^{-1}.	**Health – High** Removal of panels or shielding could give access to areas where there is a high dose rate. Radiation exposure could exceed the University annual dose	There must be a service and maintenance contract for the equipment and all repairs and modifications to the equipment must only be

Condition	Persons exposed	Radiation exposure	Level of risk	Risk reduction measures
			constraint of 1mSv in seconds. **Collateral – High** Dose rate could exceed dose constraint and legal dose limits; potential for legislative infraction.	carried out by a qualified service engineer. The service engineer must have sole use of the room if servicing requires the removal of shielding or over-riding of safety features.

REFERENCES:

Ref 1: Fundamentals of Bone Densitometry, National Osteoporosis Society, https://www.nos.org.uk/document.doc?id=657

Ref 2: Lunar enCORE-based X-ray Bone Densitometer, Safety and Technical Specification Manual, GE Healthcare, rev 5, Sept 2010.