

Risk Assessment, Regulation 7 of the Ionising Radiations Regulations 1999

Work Registration Form J Radiological Risk Assessment

Please complete all sections:

Work Reg. ID / RIP No: (RPA/RPO Use Only.)	RADWR-073266	Applicants Own Unique Ref No.	XrayReg2010_1
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J1 RPA / RPO Comments

RPA / RPO Comments
<p>This risk assessment ONLY considers the radiological aspects of this work and further assessment will be needed to cover the other hazards present (e.g. biological and COSHH).</p> <p>Heads of Department, Principle Investigators, Radiation Protection Supervisors (RPS) and users must comply with College Policy and Guidance relating to work with ionising radiations. Policy & Guidance for work involving ionising radiations can be found on the Safety Department Web Pages at:</p> <ul style="list-style-type: none"> • Ionising Radiations Policy - http://www3.imperial.ac.uk/safety/policies/individualpolicies/pc14ionising • Ionising Radiations Guidance - http://www3.imperial.ac.uk/safety/guidanceandadvice

J2 RPA / RPO Inspection

RPA or RPO inspection Required (Y/N):	Yes	Date:	06.02.2010
Inspection Findings			
<p>The single diffraction x-ray set is located in laboratory 5.20 of the 5th Floor in the Flowers Building. This x-ray set is used to conduct experiments on protein crystals where images are taken of these crystals and recorded in 0.5 to 1 degree increments using a phosphorescent image plate detector. Using the method it is possible to calculate the electron density of the crystal to measure the molecular structure. The x-ray set consists of a rotating anode x-ray generator, interlocks, Perspex shielded cabinet, an emergency stop button, audio warning and lights.</p> <p>The X-ray set is housed in an enclosure and all the access panels are interlocked. The Optics is also interlocked near the x-ray generation port aperture. The Critical examinations carried out from the 26th March to the 23rd July 2009 Rigaku Europe (the manufacturer) demonstrates that the interlocks are checked during the annual service and the safety system is designed to 'fail-safe', when a lights are not working correctly, if any part of the optics are removed or the shutters to the x-ray generating anode are jammed open. These events result in disabling the production of x-rays but not the power supply.</p> <p>The power supply can be cut to the system when the emergency stop is activated, which is located on the operating panel of the x-ray machine. This action will cut x-ray generation completely, whilst a triggered interlock will only close the shutter to the x-ray generator which blocks the escape of any x-rays even though the anode is still rotating. To re-set the system, a manual coded command must be sent via the control software for the x-ray machine.</p> <p>The door interlock system around the panelled Perspex shielding enclosure can be overridden by the use of a key which only the Laboratory Manager/ Radiation Protection Supervisor (RPS) has access to and keep in their office. The Perspex enclosure provides x-ray shielding from scattered x-rays although a small section of the enclosure has now been removed at the rear away from the main beam path to give better access to cables and connection cup links. 20 personnel are registered to use the x-ray machine and are given card access on the approval of the Laboratory Manager/RPS via College Card Security. These persons must have attended the College's Radiation Principles Training course and been given localised training by the Laboratory Manager/RPS before they can be approved to use the x-ray machine. The x-ray set is operated every day and on average 168 hours per week for experiment. Beam alignments are only carried out by the Laboratory Manager/RPS for the facility as this process gives the highest risk of exposure to a person's extremities. A dose assessment has been produced by the RPO</p>			

using the findings of the Critical Examination and it is recommended that a Standard Operating Procedure (SOP) and separate risk assessment for beam alignments is produced by the Laboratory Manager/RPS.

J3 Dose Assessment

Annual Radiation Dose Assessment			
External Dose Assessment		Internal Dose Assessment	
> 1mSv expected (Y/N)	No	>1mSv expected (Y/N)	N/A
<p>Basis for assessment</p>	<p>According to the Critical Examination Report on the 24th July 2009, the x-ray set was tested at its highest operating setting of 40 kV voltage and 30 mA current to generate x-ray photons. A couple of different radiation monitoring instruments were used to carry out the x-ray leakage measurements at various points on the equipment, Autonnic 100 type x-ray monitor used on the 15th April 2009 and a Thermo Mini 900 D H*(10) used on the 28th April, 13th and 23rd May 2009.</p> <p>The findings of the measurement results in the report state that there is a risk of being exposed to the primary beam of x-rays, which when measured with a Mini 900 D H*(10) (cap off or not cap off) indicates a dose rate of at least 1mSv/h or Full Scale Deflection (FSD) on the instrument at a distance of 1.1 metres. Remedial action was taken by the manufacturer and improvements made to backstop and beam stop. The additional shield backstop reduced the x-ray scatter exposure from the primary beam to a reported dose equivalent rate of 1µSv/h. In addition to this a larger backstop was installed after an RPO dose rate inspection reported dose rate from scattered x-ray exposures of 2µSv/h at the operating position for the user. With this additional backstop added to the Perspex enclosure the monitored dose equivalent rate was reported to be <0.1µSv/h (Cap off and on) with the Mini 900 DH*(10) monitor.</p> <p>The report findings also indicate that at a distance of 1cm from the collimator tip there is an estimated dose rate of at least 3mSv/h which demonstrates that beam alignments are the greatest risk of exposure from the 200µm x 200µm collimated beam of high dose rate x-ray photons (low energy x-rays). (See RPO Beam alignment Dose assessment attached).</p> <p>The external exposures through shielding or any gaps in the Lead Perspex cabinet are monitored by the Laboratory Manager/RPS using a Mini 900 X and these findings are recorded and the records kept for a minimum of 2 years. Currently there is negligible count rate being detected through or near any gaps in the shielding when the MM007HFM x-ray machine is generating x-rays. So the exposure is deemed very low from this equipment with all the shielding in place.</p> <p>The resulting actions from the RPO inspection are listed below;</p> <ul style="list-style-type: none"> • The issue of finger TLD's on a monthly basis is recommended for the Laboratory Manager/RPS or by those persons authorised to conduct beam alignments unless there is a more suitable process for carrying out beam alignments adopted which removes the user from any potential exposure to the collimated beam. • A review of the instrumentation used by the user for area monitoring needs to be conducted, if the effective energy 8 keV from the copper Kα X-radiation is to be detected through any gaps in the enclosure. • Annual inspection by the College RPO needs to be conducted for College accountancy compliance. • The emergency e-stops and any audible alarms must be tested by activating them before any service or maintenance to the system is carried out by the manufacturer, this event should be supervised by the Laboratory Manager/RPS (This event can cause damage to the x-ray generator). • Lab Manager/RPS must go on a full RPS course to obtain their competence as an RPS for this area since being appointed in January 2010. 		

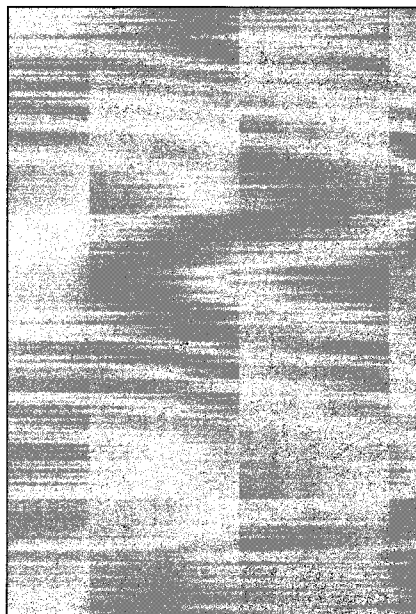
	<ul style="list-style-type: none"> Any near miss, dangerous occurrences, possible over exposure and noticeable physical damage to the x-ray set needs to be reported to the Laboratory Manager/RPS, HoD and College RPO/RPA without delay. All users need to be suitably trained and instructed by attending at least the College's Radiation Principles Course and localised training given by the Laboratory Manager RPS and signed off by the RPS. Any changes to working practice or relocation of equipment must be notified to be College RPO/RPA before the event occurs. Local Rules must be complied with and displayed correctly. Radiation Monitoring Records need to be kept for 2 years minimum for inspection. Permits to work must be issued or direct supervision by the Laboratory Manager/RPS be conducted for any servicing or maintenance by the manufacturer. Review of this assessment must be carried out every 12 months.
Applicable Generic Risk Assessment No.	Risk assessment conducted by Jeremy Moore dated 28 th October 2008.

J4 Designation of Work Areas

Designation of Areas					
Supervised Area Required (Y/N)	Yes	Is proposed work area suitable (Y/N)	Yes	Comments	Local Rules, Signage and restricted access is needed especially when beam alignments or servicing and maintenance is being carried out.
Controlled Area Required (Y/N)	No	Is proposed work area suitable (Y/N)	No	Comments	N/A

J5 Dosimetry

Dosimetry Required					
TLD (or suitable alternative) Quarterly	TLD (or suitable alternative) Monthly	Neutron Quarterly	Thyroid	Extremity Monthly	Other
Body				2 x Finger Rings	
RPA/RPO Comments		Currently there is no issue of finger ring TLD for this working practice, even though the Critical Examination clearly states this recommendation for any close work by the user near the collimated x-ray generator (especially when conducting beam alignments). See attached RPO Report.			
Radiation Monitoring Programme (Recommended)		Routine Area monitoring conducted by the Laboratory Manager/RPS is required every month. 1) All monthly monitoring must be recorded to prove that the area is being constantly reviewed and all exposures from the x-ray set are being kept as low as reasonably			



- practicable (ALARP).
- 2) Use Mini 900 X serial number 5997 for monitoring near the collimated beam when carrying out beam alignments.
 - 3) The use of a Mini 900 44B (able to detect down to 6 keV photons) is recommended to monitor the Perspex enclosure external surfaces and any gaps in any part of the cabinet, cable ports, access points and joins in panels, (when the set is running at 40 kV 30mA) to detect x-ray leakage from effective copper x-rays of 8 keV.
 - 4) If any count rates above background are found, the College RPO/RPA must be notified and a dose assessment conducted using a passive dose meter for personal dose equivalent measurements to skin Hp (0, 07).
 - 5) Any area where raised count rate above background is found must be restricted and the risk assessment reviewed by the College RPO/RPA and all users notified of the findings.

J6 Quality Assurance

Work Registration number	Date of Review
RADWR-073266	24.03.2011

J7 RPA / RPO Endorsement

It is recommended that this work can proceed. This endorsement is on the condition that all the provided information is correct and the RPA / RPO recommendations are complied with

RPA / RPO	Name	Signature	Date
RPO	Ross Morgan	<i>R Morgan</i>	26.03.2010
RPA	Brian Robertson	<i>BR</i>	12/4/2010
Relevant RPS / DSO	Name	Signature	Date

Action	Date
This copy returned to Department RPS	
Copy sent / retained by Site RPO	
Copy sent / retained by RPA	