Risk Management Guidelines - Radiation

Introduction

These guidelines are designed to assist users to identify hazards, assess the risks and determine the controls to reduce the risk associated with radiation hazards and must be read in conjunction with the OHS Risk Management Procedure.

All risk assessments must be documented using the online system - SARAH.

The occupational health and safety risks must be identified and eliminated where possible or otherwise minimized. When the hazard cannot be eliminated, a combination of primary and secondary controls provides the safest option for reducing the risk of exposure to a hazard. Reduction of risk is best done following the Hierarchy of Controls.

Primary controls are those which make the environment safer by controlling or restricting the impact of the hazard on those associated with the work activity. Primary controls are described in the top section of the hierarchy and include Substitution, Isolation and Engineering.

Secondary controls assist the worker to be safer, in the case of Administrative controls or act as the last layer of protection to those exposed to the hazard in the case of Personal Protective Equipment. These are less reliable than primary controls, but still improve safety.

There are mandatory controls required by legislation and standards for research with Ionising Radiation. These controls are provided for your convenience.

The primary aim of the risk assessment process is to ensure the safety of all tasks in the workplace. The end result of a risk assessment is the implementation and maintenance of appropriate risk controls.

When to do a risk radiation assessment at Monash

A risk assessment must be undertaken for all activities that involve Radiation hazards.

How to complete a risk assessment

Tutorial videos on how to use SARAH to complete risk assessments, are available on the Risk Management and Safe Work Instructions page.

If the activity being assessed is common at Monash University, there may be an existing risk assessment available in SARAH, which could be adopted using the cloning function.

To complete a Risk Assessment, this step by step process should be followed:

1. 1. Follow the OHS Risk Assessment Guide to complete the risk assessment in SARAH.
2. Describe the activity that is being assessed. Refer to any existing Standard Operating Procedures (SOPs) or protocols relevant to the activity.

3. Determine who are the people that know about the process and the hazards associated with the activity (e.g. Supervisors, Safety Officers, Subject Matter Experts, OHS Consultant/Advisor).
4. Identify what hazards are associated with the process, considering hazards associated with:
    a. Installation;
    b. Operation;
    c. Waste generation;
    d. Associated equipment, tasks or activities that may need to occur as part of the process; and
    e. Decommissioning.
5. Consult with your risk assessment team on the hazards identified.
6. Further resources are available from the Monash OH&S website, Australian Standards, WorkSafe Victoria and Safe Work Australia.

Radiation Internal Risk

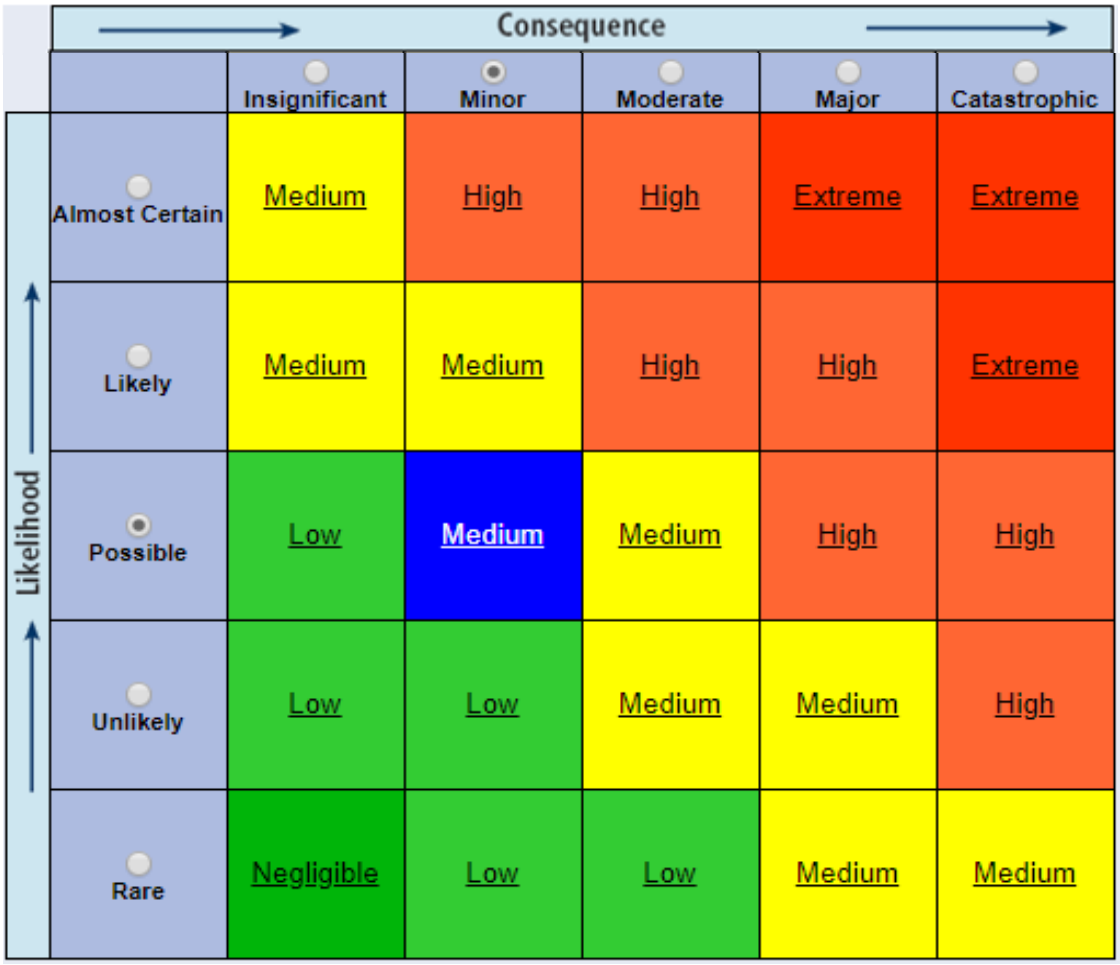
7. Identify and describe existing controls currently in place.
8. Determine consequences of radiation internal risk from the isotope with consideration given to existing controls.

		Th-nat, U-nat	Cr-51, Cu-64, F-18, Ga-68, Tc-99m, Zn-62	C-14 H-3 (when used as labelled organic or biological compound)	Ca-45 Lu-177	I-125, P-32, P-33, S-35
Activity up to	200GBq	Major	Catastrophic		Catastrophic	
	20GBq(	Moderate	Catastrophic		Catastrophic	
	2GBq	Minor	Major		Catastrophic	
	200MBq	Insignificant	Moderate		Major	
	20MBq	Insignificant	Minor		Moderate	
	2MBq	Insignificant	Insignificant		Minor	
	200kBq	Insignificant	Insignificant		Insignificant	
	20kBq	Insignificant	Insignificant		Insignificant	

9. Determine the likelihood of exposure to the isotope from the operation with consideration given to existing controls.

		Likelihood of Exposure
Operation	**Complex dry operations or work with radioactive gases**	**Almost Certain**
	Simple dry operations (manipulation of powders) **Work with volatile radioactive compounds**	**Likely**
	Complex wet operations e.g. multiple operations, or operations with complex glass apparatus	**Possible**
	Normal chemical operations e.g. analysis of simple chemical preparations	**Unlikely**
	Very simple wet operations e.g. using aliquots of stock solution)	**Rare**

10. Assess the level of risk using the risk matrix. The risk rating will be assigned automatically once the Likelihood and the Consequence are selected.



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MONASH University

Radiation Hazards – Hierarchy of Controls		
All		
• Isotope used must be listed on Monash's unsealed sources license. • Radiation workers must have undertaken the OHS multimedia radiation training, and passed the associated exams, in addition to training in local departmental and laboratory procedures • No food and drink is consumed or stored in the laboratory • Good housekeeping at all times • Storage of isotopes conforms with the requirements outlined in *Using Ionising Radiation* • Contamination monitoring using an appropriate hand-held radiation monitor (or by wipe testing for H-3, C-14 or S-35) is carried out and area decontaminated if necessary, regularly to a schedule set in consultation with the RSO, and before area is used for non-isotope work. Monitoring results must be logged and kept in the laboratory.		
Low	**Medium**	**High**
Engineering controls		
Primary and secondary containment is used (e.g. work in spill trays)	Primary and secondary containment is used (e.g. work in spill trays) A fume hood must be used for any work with volatiles or powders	Primary and secondary containment is used (e.g. work in spill trays) A fume hood must be used for any work with volatiles or powders
Administrative and procedural controls		
• Work must be undertaken in an area chosen in consultation with the RSO, and delineated in some manner from general laboratory space. • Non-radiation workers in the same laboratory must receive a briefing on radiation hazards. • Access to this area is restricted to laboratory workers. If other persons need to enter, they must be accompanied at all times. • Personal dosimeter must be worn by radiation workers if any isotope other than 3H, 14C, 33P, 35S is used. • Waste must be stored in clearly labelled containers, shielded if necessary, and disposed of in accordance with university guidelines.	• Work must be undertaken in a dedicated radiation laboratory • Access to this area is restricted to radiation workers. If other persons need to enter, they must be accompanied at all times. • Personal dosimeter must be worn by all laboratory users if any isotopes other than 3H, 14C, 33P, 35S are used anywhere in the laboratory. • Waste must be stored in clearly labelled containers, shielded if necessary, and disposed of in accordance with university guidelines. • Workers using volatile iodine must regularly undergo thyroid testing as per *Using Ionising Radiation at Monash University*	• Work must be undertaken in a dedicated radiation laboratory which complies with the Australian Standards for a medium-level radioisotope laboratory. • Access to the area is limited to a list of radiation workers authorised by the RSO. List is to be clearly displayed at the entrance. If other persons need to enter, they must be accompanied at all times. • Personal dosimeter must be worn to enter the room. • Waste must be stored in clearly labelled containers, shielded if necessary, and disposed of in accordance with university guidelines. • Workers using volatile iodine must regularly undergo thyroid testing as per *Using Ionising Radiation at Monash University*.
Personal Protective Equipment (PPE)		
• Lab coat and appropriate gloving (as indicated by chemical risk assessment)	• Lab coat and appropriate gloving (as indicated by chemical risk assessment)	• Wrap-over type lab coat and double gloving (appropriate glove type as

• Safety glasses • Fully enclosed footwear • Long hair tied back	• Safety glasses • Fully enclosed footwear • Long hair tied back	indicated by chemical risk assessment) • Safety glasses • Fully enclosed footwear • Long hair tied back

12. List the proposed controls.
13. Nominate a person to implement each control.
14. Estimate the reduction in likelihood and consequences provided by the additional controls. The risk rating will be assigned automatically once the Likelihood and the Consequence are selected.

Radiation External Risk

15. Determine consequences of radiation external risk from the isotope and the amount used. Use the following formula that combines the amount of radioactive material with the external hazard per quantity.

Consequences = ΓA

Where Γ = gamma dose rate.

A = Activity of source.

Isotope	Γ (GBq)	Γ (MBq)	Γ (mCi)
Na-22	362	0.362	13.39
Na-24	523	0.523	19.35
Mn-54	138	0.138	5.11
Co-57	41	0.041	1.52
Co-60	370	0.37	13.7
Zn-65	89	0.089	3.29
Ge-68	16	0.016	0.592
In-111	140	0.140	5.18
I-125	74	0.074	2.74
Ba-133	123	0.123	4.55
Cs-137	103	0.103	3.81
Eu-152	201	0.201	7.44
Eu-155	18	0.018	0.666

Pb-210	0.43	0.00043	0.0159
Ra226	223	0.223	8.25
Am-241	85	0.085	3.14

Γ x Activity				
<0.5	**0.5-2**	**2-10**	**10-100**	**>100**
Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**

16. Determine the likelihood of exposure to the isotope from the distance to the source.

Distance	Likelihood
10 cm	Almost Certain
50 cm	Likely
1 m	Possible
2 m	Unlikely
5m	Rare

17. Determine what controls are currently in place. Reduce the consequences and likelihood in line with existing controls. Assess the risk using the risk matrix.

				Consequences				
				Γ x Activity				
				<0.5	0.5-2	2-10	10-100	>100
				Controls				
	Distance			Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	10 cm	Controls	Almost Certain	Medium	High	High	Extreme	Extreme
	50 cm		Likely	Medium	Medium	High	High	Extreme
	1 m		Possible	Low	Medium	Medium	High	High
	2 m		Unlikely	Low	Low	Medium	Medium	High
	5 m		Rare	Negligible	Low	Low	Medium	Medium

For x-rays or where reliable dose rate measurements can be made, then use the following table.

Dose rate <0.5µSv/h above background	Dose rate between 0.5 and 25µSv/h	Dose rate >25µSv/h
Low	Medium	High

18. Use the following suggested controls to reduce the dose rate to acceptable levels. The left-hand side of the table lists strategies for reducing the dose to workers. The right-hand side lists the amount of lead (in millimetres) required to reduce the amount of radiation by half for a specific isotope. These values should be used as a guide only, confirmation with radiation monitoring should be done to radiation levels are safe.

Controls				
Make area of high dose rate inaccessible, or shield to reduce the does to as low as reasonably achievable. **Reduce:** Reduce the activity of the source, or the amount of material in-use. **Distance:** Use tongs or remote handling. Store sources far away from users. **Time:** Limit the amount of time spent at the task (practice routine operations before isotope use to improve dexterity and speed). **Shield:** Place source in lead container or behind lead screen. Personal lead screens for use during work. Lead apron.	**Shielding**			
	Isotope	**Half Value Layer (mm of Lead)**	**Peak Voltage (kVp)**	**Half Value Layer (mm of Lead**
	Na-22	6.5	50	0.06
	Na-24	20	100	0.27
	Mn-54	11	150	0.30
	Co-57	<1	200	0.52
	Co-60	10	250	0.88
	Zn-65	14	300	1.47
	Ge-68	4.2	400	2.5
	In-111	<1	1000	7.9
	I-125	.1		
	Ba-133	1.6		
	Cs-137	6.5		
	Eu-152	6.6		
	Eu-155	0.4		
	Pb-210	<1		
	Ra*-226	12		
	Am-241	<1		

* Including decay products.

19. List the proposed controls.
20. Nominate a person to implement each control.

21. Estimate the reduction in likelihood and consequences provided by the controls, and record the value (high, medium or low).

				Consequences				
				Γ x Activity				
				<0.5	0.5-2	2-10	10-100	>100
				Controls				
	Distance			Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	10 cm	Controls	Almost Certain	Medium	High	High	Extreme	Extreme
	50 cm		Likely	Medium	Medium	High	High	Extreme
	1 m		Possible	Low	Medium	Medium	High	High
	2 m		Unlikely	Low	Low	Medium	Medium	High
	5 m		Rare	Negligible	Low	Low	Medium	Medium

For x-rays or where reliable dose rate measurements can be made, then use the following table.

Dose rate <0.5µSv/h above background	Dose rate between 0.5 and 25µSv/h	Dose rate >25µSv/h
Low	Medium	High

The Hierarchy of Control

Radiation Hazards – Hierarchy of Controls	
Primary Controls	
Elimination	Regulations supporting the *OHS Act* require the elimination of risks as the first step in risk control.
Substitution	Substitution of a less hazardous alternative.
Isolation	Enclosing or isolating the hazard from the people.
Engineering Controls	Changing processes, equipment or tools e.g.: • Machinery guards • Ventilation • Mechanical aids
If risk remains above acceptable levels, then administrative controls should be applied. If these are still not adequate, then personal protective clothing and equipment should be worn. Secondary control should be used in conjunction with primary controls, and should not be relied upon.	
Secondary Controls	
Administrative Controls	Information, training and procedures e.g.: • Job rotation • Limiting access • Permit systems • Safe operating procedures • Training • Signage
Personal Protective Equipment	Laboratory coat, safety glasses, closed shoes/steel capped boots, hearing protection.