MONASH University

Occupational Health and Safety
AS/NZS 4801
OHSAS 18001
OHS20309
SAI Global

Risk Management Radiation Hazard Edition March 2015

Introduction

Monash University's Victorian campuses are all governed by the Victorian OHS Act 2004 and its subordinate regulations and codes of compliance. An inherent part of all OHS legislation is the requirement for workplaces to control the hazards its activities may pose to the health and safety of staff, visitors, contractors and students.

This version of the Risk Management Program is designed to assist users identify hazards, assess the risks and determine the controls to reduce the risk associated with chemical hazards. For general risk assessments, please see the Risk Management Program.

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 do a risk assessment at Monash

If the risk you are assessing is a common risk at Monash University there may be a pre-existing risk assessment available to use as guidance.

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

1. Establish what process is being assessed. If there is a Standard Operating Procedure for the task, make it available.
2. Involve people that know about the process and the hazards associated with it.
3. Print out or open an electronic copy of the Risk Assessment Worksheet.
4. Fill in the details of at the top of the worksheet, and enter the names of the people involved as the Risk Assessment Team.
5. Identify what hazards are associated with the process. There are many hazards listed on the worksheet, but there may be additional hazards. Take into account 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.

    Enter the hazard in column 1 of the second page of the Risk Assessment Worksheet and the identified hazards in column 2. More rows can be added as required.
6. Seek information on the hazards identified. Some examples of places to look are your Risk Assessment Team, Supervisor, Safety Officer, knowledgeable colleagues, Monash OH&S website, OHS Consultant/Advisor, other organisations with similar operations, Victorian WorkCover Authority, Safe Work Australia, Australian Standards, and the internet.

Radiation Internal Risk

7. Determine consequences of radiation internal risk from the isotope.

		Isotope			
		H-3, C-14, bound S-35, Cr-51	P-33, unbound S-35	P-32, Zn-65	I- 125
Activity	200GBq	Major	Catastrophic	Catastrophic	Catastrophic
	20GBq	Moderate	Catastrophic	Catastrophic	Catastrophic
	2GBq	Minor	Major	Catastrophic	Catastrophic
	200MBq	Insignificant	Moderate	Major	Catastrophic
	20MBq	Insignificant	Minor	Moderate	Major
	2MBq	Insignificant	Insignificant	Minor	Moderate
	200kBq	Insignificant	Insignificant	Insignificant	Minor
	20kBq	Insignificant	Insignificant	Insignificant	Insignificant

8. Determine the likelihood of exposure to the isotope from the operation.

		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

9. Determine what controls are currently in place, record these in column 2. Reduce the consequences and likelihood in line with existing controls and record the value for the likelihood in column 3 and the consequences in column 4.

10. Assess the risk using the risk matrix. Enter this value in column 5.

		Consequences				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Medium	Medium

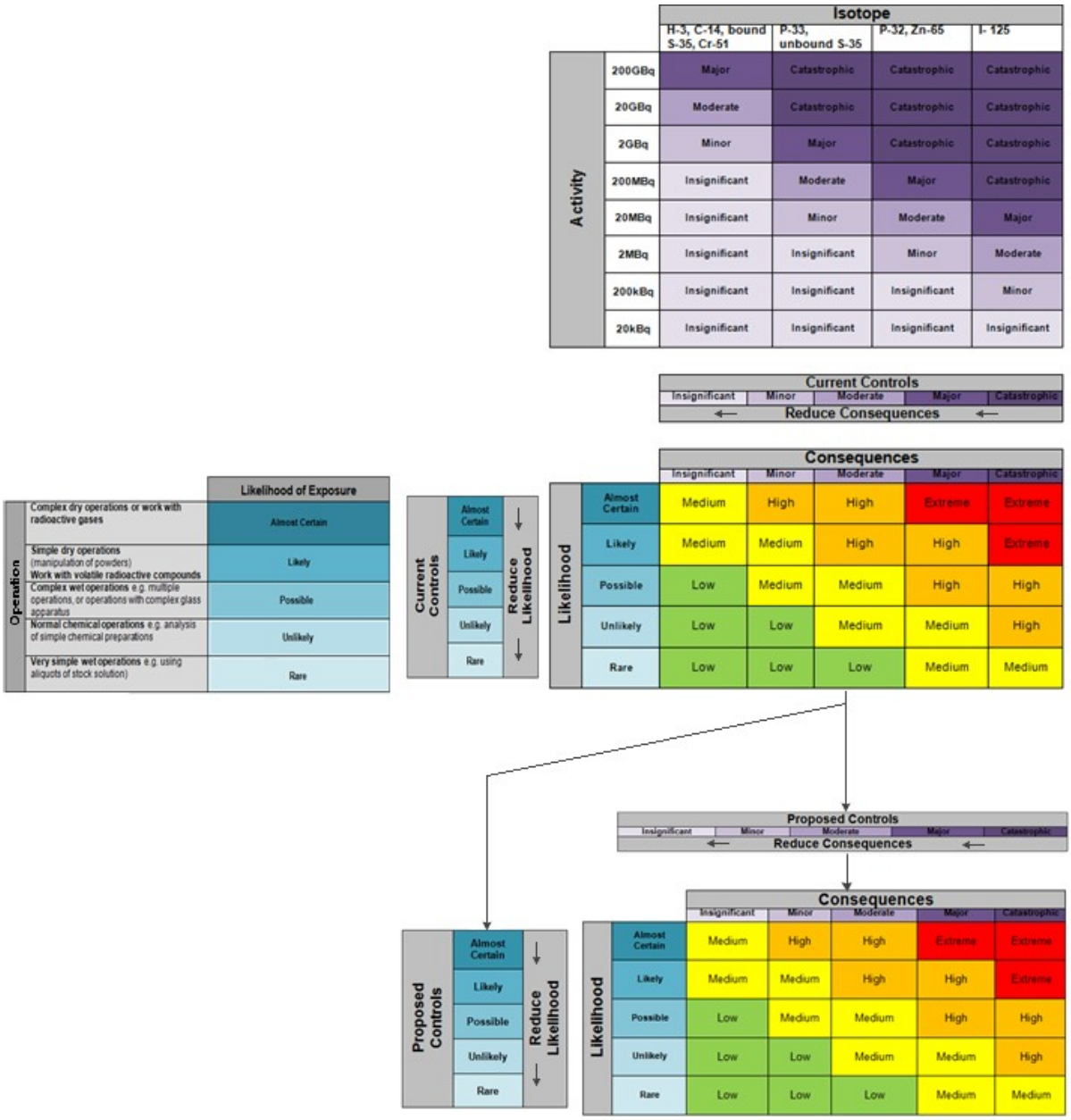
11. The risk determines what controls are required. Refer to the controls on the following table.

All		
• Isotope used must be listed on Monash's unsealed sources licence. • 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) • Safety glasses • Fully enclosed footwear • Long hair tied back	• Lab coat and appropriate gloving (as indicated by chemical risk assessment) • Safety glasses • Fully enclosed footwear • Long hair tied back	• Wrap-over type lab coat and double gloving (appropriate glove type as indicated by chemical risk assessment) • Safety glasses • Fully enclosed footwear • Long hair tied back

12. List the proposed controls on column 6 of the risk assessment worksheet.
13. Nominate a person to implement each control. Enter the responsible person in column 7.
14. Estimate the reduction in likelihood (record on column 8) and consequences (record on column 9) provided by the controls, and record the value (high, medium or low) on column 10.

		Consequences				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Medium	Medium

Summary


Isotope
H-3, C-14, bound S-35, Cr-51
P-33, unbound S-35
P-32, Zn-65
I- 125
Activity
200GBq
Major
Catastrophic
Catastrophic
Catastrophic
20GBq
Moderate
Catastrophic
Catastrophic
Catastrophic
2GBq
Minor
Major
Catastrophic
Catastrophic
200MBq
Insignificant
Moderate
Major
Catastrophic
20MBq
Insignificant
Minor
Moderate
Major
2MBq
Insignificant
Insignificant
Minor
Moderate
200kBq
Insignificant
Insignificant
Insignificant
Minor
20kBq
Insignificant
Insignificant
Insignificant
Insignificant
Current Controls
Insignificant
Minor
Moderate
Major
Catastrophic
Reduce Consequences
Consequences
Likelihood
Almost Certain
Likely
Possible
Unlikely
Rare
Medium
High
Extreme
Low
Operation
Likelihood of Exposure
Complex dry operations or work with radioactive gases
Simple dry operations (manipulation of powders) Work with volatile radioactive compounds
Complex wet operations e.g. multiple operations, or operations with complex glass apparatus
Normal chemical operations e.g. analysis of simple chemical preparations
Very simple wet operations e.g. using aliquots of stock solution)
Current Controls
Reduce Likelihood
Proposed Controls
Reduce Likelihood

Radiation External Risk

7. 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**

8. 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

9. Determine what controls are currently in place, record these in column 2. Reduce the consequences and likelihood in line with existing controls and record the value for the likelihood in column 3 and in column 4 respectively.
10. Assess the risk using the risk matrix. Enter this value in column 5.

				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	Low	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

11. 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.

12. List the proposed controls on column 6 of the risk assessment worksheet.
13. Nominate a person to implement each control. Enter the responsible person in column 7.

14. Estimate the reduction in likelihood (record on column 8) and consequences (record on column 9) provided by the controls, and record the value (high, medium or low) on column 10.

				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	Low	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

15. Once the risk assessment worksheet is completed, you can give it to your supervisor, Health and Safety Representative or Safety Officer for review.
16. After taking their comments into consideration give it to your supervisor for authorisation.
17. All OHS controls and the method for maintaining the controls must be included in the documentation for the process being assessed.

Summary

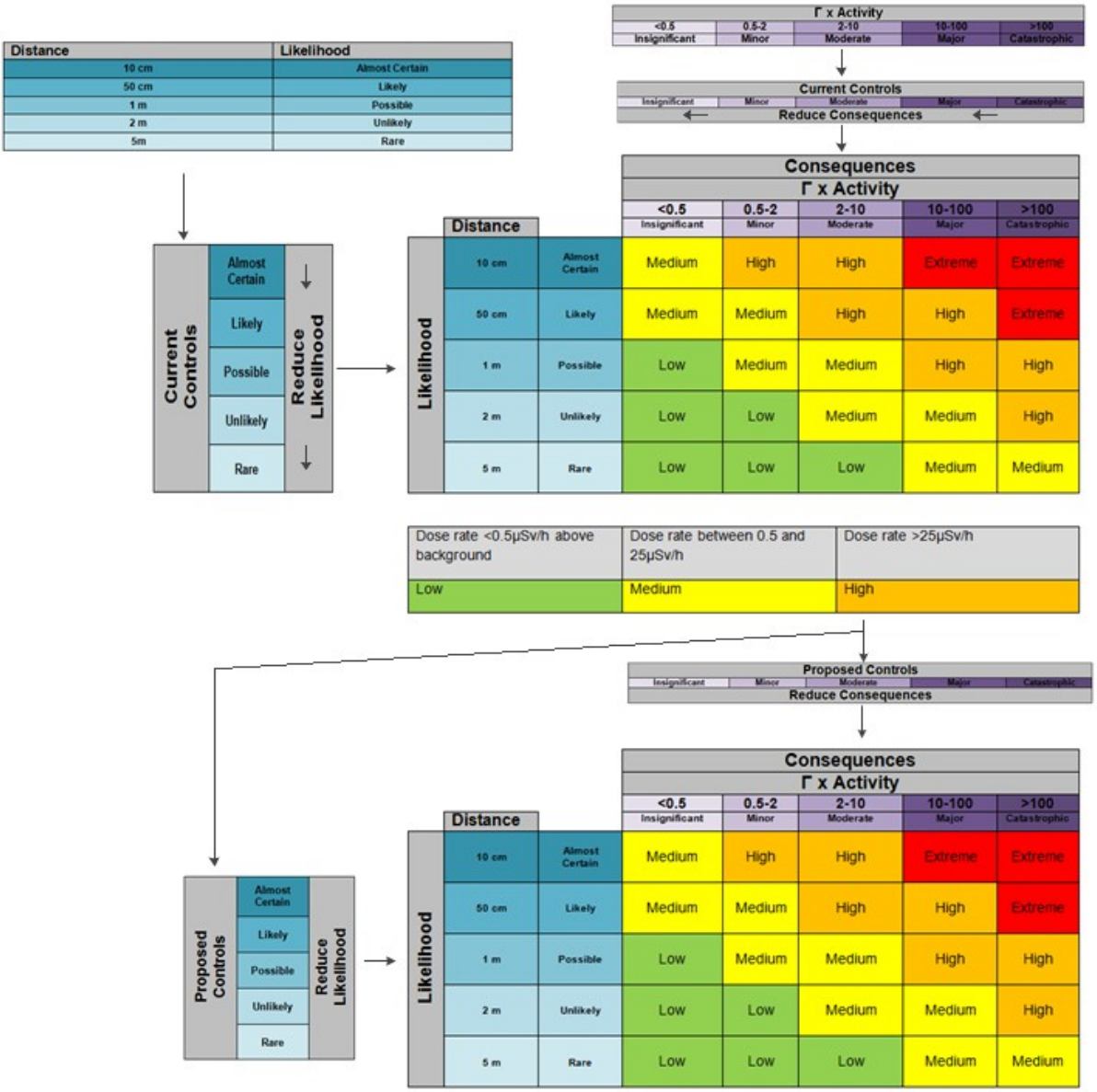

Distance
Likelihood
10 cm
Almost Certain
50 cm
Likely
1 m
Possible
2 m
Unlikely
5m
Rare
Γ x Activity
<0.5
Insignificant
0.5-2
Minor
2-10
Moderate
10-100
Major
>100
Catastrophic
Current Controls
Reduce Consequences
Consequences
Γ x Activity
Distance
Likelihood
Medium High High Extreme Extreme
Medium Medium High High Extreme
Low Medium Medium High High
Low Low Medium Medium High
Low Low Low Medium Medium
Current Controls
Reduce Likelihood
Dose rate <0.5µSv/h above background
Dose rate between 0.5 and 25µSv/h
Dose rate >25µSv/h
Low
Medium
High
Proposed Controls
Reduce Consequences
Consequences
Γ x Activity
Distance
Likelihood
Medium High High Extreme Extreme
Medium Medium High High Extreme
Low Medium Medium High High
Low Low Medium Medium High
Low Low Low Medium Medium
Proposed Controls
Reduce Likelihood

Table 3

The Hierarchy of Control

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.

MONASH University

OHS System
Occupational Health and Safety
AS/NZS 4801
OHSAS 18001
OHS20309
SAI Global

RISK ASSESSMENT WORKSHEET

Risk Assessment Title:					
Details of Process:					
Risk Register:			**Risk Assessment Number:**		
Campus		**Faculty/Division**		**School/Department/Centre**	
Building		**Room No.**		**Assessment Date**	

Risk Assessment Team						
Name	**Signature**	**Date**		**Name**	**Signature**	**Date**

Hazard Categories applicable to this Risk Assessment

Animal/Insect/Vegetation ☐	Equipment/Machinery/Vehicles ☐	Manual Handling/Ergonomics ☐
Biological ☐	Outdoor Hazards ☐	Psychological/Social ☐
Chemical ☐	Water/Gases/Liquids ☐	Physical Hazards ☐
Hazardous Areas ☐	Radiation ☐	Other ☐

Approval

Supervisor

Name:
Signed: Date:

INSERT PHOTO or DIAGRAM

AS APPROPRIATE

Hazard	Current Controls	Likelihood	Consequences	Current Risk	Proposed Controls	Responsible Person	Likelihood	Consequences	Residual Risk
1	2	3	4	5	6	7	8	9	10